A PYRAMIDAL MODEL OF SEX STEREOTYPING: EXAMINING PATTERNS OF ASSOCIATIONS IN THE CONTEXT OF WOMEN IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS FIELDS

by

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DEDICATION

To my family and friends, for their unrelenting love and support

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ABSTRACT

Science fields have a dearth of female participants. Previous research has provided evidence that many factors contribute to this phenomenon, including negative stereotypes of women's abilities in STEM and women's lowered identification with STEM fields. This dissertation aimed to demonstrate how stereotyping and identity are part of a pattern of cognitive associations. In particular, the research considers the role of gendered traits (i.e., agentic and communal traits). The goal of Study 1 was to identify how gendered traits correspond to traits necessary in science fields. Results demonstrated that agentic traits are viewed as more necessary for success in science fields. Next, Study 2 aimed to demonstrate that the agency-science association is related to gender-science stereotyping and women's identification with science by experimentally manipulating the agency-science association. Results revealed that male and female students who are exposed to the agentic-science association have a stronger relationship between their gender-science stereotyping and science identity than those exposed to a communal-science association. Study 3 took an individual-differences perspective to test whether a meaningful pattern of associations involving the self, sex, traits (agentic & communal), and science emerges. This model is referred to as the pyramidal model of sex stereotyping, and it delineates a pattern of associations that may contribute to the underrepresentation of women in science. Results revealed that people do hold cognitively consistent patterns, particularly

those who are in stereotypical fields for their gender (e.g., men in STEM and women in humanities), and that these patterns predict behavioral choices and career intentions. Finally, Study 4 tested an intervention based on the pyramidal model by experimentally manipulating the association between gendered traits and science fields, revealing that increasing communal-science associations increases the degree to which women in STEM form cognitively consistent patterns of associations. Together, these four studies provide evidence for the role of gendered traits in the underrepresentation of women in STEM fields, while offering a theoretical contribution by emphasizing the importance of examining *patterns* of associations rather than isolated stereotypes. Future research should consider these patterns when designing interventions to increase women's participation in science fields.

CHAPTER 1

Introduction

Despite significant progress in the last few decades, women remain underrepresented in science[1], technology, engineering, and math (STEM) fields. Women earn only 38.2% of the bachelor's degrees in the hard sciences and engineering (National Science Foundation, 2011), even though women earn more bachelor's degrees overall than men (Bureau of Labor Statistics, 2011). Furthermore, only 23.2% of jobs in STEM fields are held by women, even though women form 46.3% of the total workforce (National Science Foundation, 2011). This discrepancy has serious consequences for women, since individuals with degrees in STEM fields tend to be higher earning than those with degrees in humanities or social sciences (Carnevale, Strohl, & Melton, 2011), and the lack of women in these fields may inhibit other women from pursuing these careers (Cohen & Swim, 1995; Sekquaptewa & Thompson, 2003; Young, Cady, & Foxon, 2006), thus creating a cyclical problem. The gender discrepancy in STEM fields also creates a problem for the fields themselves, given that some researchers have suggested that diversity aids innovation (Bantel & Jackson, 1989; Hong & Page, 2004) and that science can be limited by gendered assumptions (Martin, 1991). The present research explores reasons why women may be underrepresented in STEM fields and tests an intervention that could lead to increases in women's participation in STEM fields.

Many factors could contribute to the underrepresentation of women in STEM fields. Historically, many of the explanations have centered on ability, positing that men have a superior disposition for STEM-related abilities (e.g., Ackerman, 2006; Baron-Cohen, 2003; Nuttall, Casey, & Pezaris, 2005). However, a recent meta-analysis showed that gender differences in math achievement in the United States have been eliminated (Hyde, Lindberg, Linn, Ellis, & Williams, 2008), and achievement gaps around the world are related to other measures of gender equity (e.g., gender equity in school enrollment, women's parliamentary representation, etc.; Else-Quest, Hyde, & Linn, 2010), suggesting that sociocultural factors play a larger role than innate ability. Others (e.g., Ceci, Williams, & Barnett, 2009) focus on family obligations as an explanation since women often have more family obligations than men do (Maume, 2006) and, on average, desire a home-centered lifestyle more than men (Hakim, 2006). Although this may be one contributing factor, this explanation is lacking because it is not specific to STEM fields, and thus does not explain why there is an underrepresentation of women in STEM fields but not others, such as law or psychology. Similarly, there may be discrimination against hiring and promoting women in STEM fields, but discrimination occurs in many fields (Cohn, 2000), so this explanation is not wholly satisfying either. While factors such as these are certainly important contributors to the phenomenon, a large body of research has pointed to the effects of negative stereotypes regarding women's abilities in math and science as a contributing factor (e.g., Nosek et al., 2009; Quinn & Spencer, 2001; Schmader, Johns, & Barquissau, 2004; Sekaquaptewa & Thompson, 2003; Shih, Pittinsky, & Ambady, 1999; Spencer, Steele, & Quinn, 1999).

One major body of literature focuses on the experience of stereotype threat, which occurs when people who are stereotyped as lacking ability in a given domain perceive that giving a poor performance would be seen as stereotype confirming (Steele, 1997). Concern about this possibility uses cognitive resources and paradoxically leads to underperformance (Schmader & Johns, 2003; Steele, 1997; Steele, Spencer, & Aronson, 2002). For example, women perform worse on a math test when the math-gender stereotype is made salient just prior to the test (Spencer, Steele, & Quinn, 1999). When a manipulation is introduced that reduces the salience or relevance of the stereotype to the testing situation, women perform the same as men on the test. A recent meta-analysis of stereotype threat has shown that stereotyped students underperform when under threat to such a degree that under neutral testing conditions (i.e., when the salience of the stereotype is reduced) they actually outperform the non-stereotyped students (Walton & Spencer, 2009).

Research has uncovered many factors that contribute to the stereotype threat effect, demonstrating that performance is particularly vulnerable when the test is difficult (Keller, 2007; O'Brien & Crandall, 2003; Spencer et al., 1999), when doing well in the domain is important to the individual (Aronson, Lustina, Good, Keough, Steele, & Brown, 1999; Hess, Auman, Colcombe, & Rahhal, 2003; Keller, 2007), and when the individual is strongly identified with the stereotyped identity (Schmader, 2002). Notably, personal endorsement of the stereotype has been linked to increased vulnerability to stereotype threat (Kiefer & Sekaquaptewa, 2007b; Schmader et al., 2004).

This underperformance can lead to women's underrepresentation in STEM fields in several ways. Perhaps most obviously, academic performance is one of the most important criteria for getting into graduate schools and careers in STEM. Furthermore, others may be less encouraging of women's continuation in STEM fields if they are not performing well. Also, women may become frustrated due to their underperformance, as well as the anxiety and discomfort they may feel while under stereotype threat (Murphy, Steele, & Gross, 2007). These are just a few examples of how stereotype threat can result in fewer women in STEM fields.

Given this convincing literature, it seems that one way to increase women's participation in STEM fields is to reduce the gender-STEM stereotype. One instigator of the present research is to consider a new method of stereotype reduction. This research takes a social cognitive approach, which defines stereotypes as an association between two concepts in memory (Greenwald & Banaji, 1995). This association is considered strong when thinking of one concept easily activates thoughts of the other concept. The sex-STEM stereotype, then, is a strong association between males and STEM coupled by a weak association between women and STEM.

There has been a long history of research focusing on reducing stereotypes (for reviews, see Blair, 2002; Hilton & von Hippel, 1996). Much of this research has focused on presenting counterstereotypic examples. While some of this work has successfully reduced stereotypic associations (e.g., Dasgupta & Asgari, 2004), other researchers have found that counterstereotypic examples are ineffective, since individuals often respond by making situational attributions for behavior (Sekaquaptewa & Espinoza, 2004) or add to their stereotypes by creating subtypes (Hewstone, 1994) rather than actually eliminating their stereotypes. Note that this method of stereotype reduction focuses exclusively on the stereotype that is being targeted, without any consideration of other stereotypes or beliefs that may be supporting the targeted stereotype. In other words, no attention is paid to *why* someone may hold that stereotype or how they might justify it. For example, a person who endorses the sex-STEM stereotype (i.e., associates men but not women with STEM fields) may believe that men are better suited for STEM fields because they believe men possess certain qualities and that those qualities are necessary for success in STEM. Presenting a counterstereotypic example (i.e., a woman in STEM) may not be the strongest stereotype reduction method because it does not address the pattern of associations and beliefs that may contribute to one's endorsement of the sex-STEM stereotype. Instead, it only focuses on the concepts of sex and STEM, which are just two of many concepts, all of which are cognitively connected by a web of associations. A central argument of the present line of research is that effective stereotype reduction should consider the *pattern* of associated beliefs that contribute to the stereotype, rather than focusing on the stereotype in isolation. In the case of the sex-STEM stereotype, it may be important to consider other stereotypes and beliefs that are cognitively supporting the sex-STEM stereotype, such as the personal traits that people associate with success in STEM fields, and how those traits are gendered.

In addition to a focus on stereotypes, there has been an emphasis on women's choices and preferences as an explanation for the underrepresentation of women in STEM fields (e.g., Ceci & Williams, 2010, 2011; Ceci et al., 2009; Lippa, 1998; Su, Rounds, & Armstrong, 2009). The argument made is that women are equally capable of success in STEM careers as men, but they are simply less interested in those fields and willingly opt out of them. Criticisms of this kind of explanation focus on the distinction between "opting out" and being "pushed out" (Williams, Manvell, & Bornstein, 2006), arguing that the mass media tend to favor the former phrase while women themselves tend to use the latter phrase while describing their experiences. Furthermore, while some may see the "opt out" explanation as an ending point in the discussion of why women are underrepresented in STEM fields, it instead could be seen as a starting point, given that preferences and choices are not made in a vacuum but rather in the presence of a complex web of constraints.

In essence, the question becomes *why* women may have lowered interest in STEM fields. One way to address this question is to examine science identity as a variable, given that students' engagement and interest with STEM fields has been connected to having a science identity (Archer, Dewitt, Osborne, Dillon, Willis, & Wong, 2010; Carlone & Johnson, 2007; Hazari, Sonnert, Sadler, & Shanahan, 2010). Similar to work on stereotype reduction in this area, interventions designed to affect women's science identity often emphasize female exemplars who are successful or knowledgeable in science fields, although research is mixed as to how effective female role models actually are in increasing women's science identity (Gilmartin, Denson, Li, Bryant, & Aschbacher, 2007; Hazari et al., 2010; Stout, Dasgupta, Hunsinger, & McManus, 2011). The present work examines the connections between stereotyping and identity associations, positing that they are part of the same network of associations that could predict participation in STEM fields, and thus an understanding of their relationship could lead to the development of interventions that are effective for altering both sex-STEM stereotyping and STEM identity.

Thus, the present research aims to 1) examine the cognitive organization of the sex-STEM stereotype and STEM identity, and 2) use that cognitive organization to derive an intervention to reduce the sex-STEM stereotype and increase women's STEM identity. Two theories, unified theory and social role theory, frame this research.

Unified Theory

Unified theory (Greenwald, Banaji, Rudman, Farnham, Nosek, & Mellott, 2002), which incorporates balance theory (Heider, 1958), congruity theory (Osgood & Tannenbaum, 1955), and dissonance theory (Festinger, 1957), proposes that associations involving concepts of the self, social groups, and attributes form in predictable, triangular patterns. For example, there are three associations involved in the pattern of the self, the social group women, and the attribute of excelling in STEM fields: self-women, self-STEM, and women-STEM (see Figure 1). Further, unified theory predicts that these triangular associations are "balanced," such that the strength of each association is a product of the other two associations in the triangle. Using the women in STEM example, if a woman has a strong association between herself and the social group women and a strong association between herself and excellence in STEM, then she will have a strong association between women and STEM (e.g., "I am a woman. I excel in STEM fields. Thus, women excel in STEM fields."). On the other hand, if she has a strong association between herself and the social group women, and a *weak* association between herself and excellence in STEM, then she will have a weak association between women and STEM (e.g., "I am a woman. I do not excel in STEM fields. Thus, women do not excel in STEM fields."). Any one of the associations in the triangle may be conceptualized as being dependent upon the other two.

Previous research has provided empirical support for unified theory in the context of women in STEM. For example, Kiefer and Sekaquaptewa (2007a) found that women's gender identity moderated the relationship between their math-gender stereotyping and math-related outcomes. Women who were low in gender identity and low in math-gender stereotyping performed the best on a math test, while women who were high in both gender identity and stereotyping expressed the least amount of interest pursuing a math-related career. Through the lens of unified theory, these findings suggest that women who strongly associate themselves with being a woman and associate math with men do not associate themselves with math. Nosek, Banaji, & Greenwald (2002) tested these connections directly in a sample of women and found that associating the self with female and math with male led to more negative attitudes toward and lower identification with math.

In summary, unified theory proposes that the associations between the self, an attribute, and a social group are connected in a predictable way. Greenwald et al. (2002) suggest testing these relationships using regression analyses where any one of the associations is considered the criterion variable and the other two associations and their interaction are treated as predictor variables. To find support for unified theory, the interaction of any two sides of the triad should predict the third (Blanton & Jaccard, 2006), which would exhibit the interdependence of the three associations. Further details on these analyses will be presented with Studies 3 and 4.

Social Role Theory

Gaining a better understanding of these patterns of associations, rather than isolated stereotypes, may lend insight into how sex-STEM stereotypes operate to affect men and women in STEM fields. Although framed in different terms, Alice Eagly (1987) suggested a pattern of associations as an explanation for sex[2] differences. In her social role theory, Eagly proposes that sex differences result from differing expectations of appropriate conduct for men and women, which are mediated through gendered traits. In other words, a person is expected to possess gendered traits based solely on their sex, and gendered traits correspond to certain roles and behaviors. Thus, an association is formed between sex and certain roles and behaviors. In the language of unified theory (Greenwald et al., 2002), social role theory describes a triangle of three associations: sex-gendered traits, gender traits-roles/behaviors, and sex-roles/behaviors.

In the context of the sex-STEM stereotype, men are expected to possess masculine traits and masculine traits may be associated with excelling in STEM fields, leading to a strong association between men and STEM. Alternatively, women are expected to possess feminine traits and feminine traits may *not* be associated with excelling in STEM fields, leading to a weak association between women and STEM. In order to examine this application of social role theory to the sex-STEM stereotype, it is necessary to define what traits are deemed masculine and feminine and compare these traits to those associated with excelling in STEM fields.

Gender theorists have often conceptualized masculine traits as agentic and feminine traits as communal (Bem, 1974; Conway, Pizzamiglio, & Mount, 1996; Deaux & Lewis, 1984; Eagly, 1987; Eagly & Mladinic, 1989; Rudman & Glick, 2001; Spence & Helmreich, 1978). *Agency* refers to a set of personal attributes pertaining to self-assertion and independence, including traits such as independence, competitiveness, ambition, decisiveness, and individualism. *Communality* refers to a set of personal attributes pertaining to concern for others and interpersonal sensitivity, including traits such as helpfulness, kindness, nurturance, empathy, and inclusiveness. If the sex-STEM stereotype is mediated by gendered traits, as social role theory (Eagly, 1987) would predict, then agentic (or masculine) traits must be *strongly* associated with success in STEM since males are stereotyped as better suited for STEM fields. Communal (or feminine) traits, on the other hand, must be *weakly* associated with success in STEM since females are stereotyped as being poorly suited for STEM fields.

Previous research suggests that STEM fields may not be perceived as communal and that this could relate to the gendered patterns of STEM participation. For example, Diekman, Brown, Johnston, and Clark (2010) found that STEM careers are seen as incompatible with communal goals and that women's interest in communal goals negatively predicts interest in STEM careers. Hazari et al. (2010) found that physics identity is negatively related to a desire to work with others, which seems reminiscent of a lack of communality. This lack of an association between communality and science could lead students to assume that communal people are unlikely to be scientists. Since perceived similarity to the people in the field is an important predictor of interest in academic fields (Cheryan & Plaut, 2010), believing that communal scientists are rare could influence communal individuals to avoid science careers. Finally, Weisgram and Bigler (2006) reported that middle school girls who participated in an intervention program that emphasized the altruistic aspects of science showed increased interest in science compared to girls attending a comparable program that did not mention altruism, which suggests that interventions designed to alter perceptions of science have promise for increasing women's participation in STEM fields.

Across four studies, the present research will test hypotheses regarding the role of trait (communal versus agentic) perceptions of science in the cognitive organization of the sex-STEM stereotype and STEM identity. More specifically, Study 1 aims to identify the traits associated with success in science, testing the hypothesis that more agentic than communal traits are deemed important for success in science. Study 2 tests whether an intervention designed to emphasize the communal aspects of science affects sex-science stereotyping and women's science identity. Study 3 measures six associations that are hypothesized to form a cognitively consistent pattern of associations (dubbed the pyramidal model of sex stereotyping) that predicts participation in STEM fields. Finally, Study 4 explores the effect of the communal-science intervention on this pattern of associations.

Footnotes

1. While "science" obviously includes social sciences such as psychology, women are not underrepresented in the social sciences, so this work focuses on the "harder" sciences (e.g., physics, chemistry, etc.). Therefore, the term "science" in this paper excludes social sciences.
2. While colloquially the terms "sex" and "gender" are used interchangeably, I follow the conventions of research in the psychology of women by using "sex" to refer to a biological categorization (e.g., "male" and "female") and "gender" to refer to a related categorization based on social construction (e.g., "feminine" and "masculine").

CHAPTER 2

Study 1: Gendered Traits in Perceptions of Science

In order to assess whether gendered traits are associated with science fields, students and faculty in STEM fields were asked to identify traits that are necessary for success in science fields. The key question was presented as either a closed- or open-ended question because research in survey methodology (e.g., Schuman & Presser, 1979) suggests that responses to open-ended questions consist of whatever is immediately brought to mind by the question, whereas the response options in closed-ended responses can remind participants of responses that they might not have considered otherwise. Study 1 aims to assess traits that are popularly associated with science fields (i.e., responses to open-ended version) as well as traits that are necessary for success in science but are not commonly associated with science (i.e., responses to close-ended version). In other words, responses to the open-ended version of the question in the present study are expected to represent stereotypes of science fields, whereas responses in the closed-ended version are expected to encompass a wider variety of responses.

Hypotheses

Agentic traits are expected to be viewed as more essential to success in science fields than communal traits. To that end, participants are expected to list more agentic than communal traits in response to an open-ended question about the traits needed for success in science. However, because communal traits may indeed be necessary for success in science, participants are expected to rate communal traits as being at least somewhat necessary for success in science when those traits are presented in a close-ended survey question.

Furthermore, responses from students and faculty will be compared. Because faculty members may be in a better position than students to know what traits are important for success in science, it is possible that faculty members will associate communal traits with science more than students. On the other hand, since the association between agentic (and not communal) traits is potentially based on stereotypes of the field and faculty have been in the field longer than students and thus have been exposed to those stereotypes and beliefs more than students, they may be less likely to associate communal traits with science than students.

Method

Participants. Students and faculty in STEM fields were solicited to participate via emails to their university departments. All schools contacted were in the Big Ten conference. Participants were asked to complete a 10-minute online survey. In appreciation for the participants' time, one out of every twenty-five participants won a $25 gift card to an online retailer.

A total of 115 faculty and 122 undergraduate students responded to the survey. Seventy-eight of the faculty sample identified as men, 36 as women, and 1 as other; the mean age of the faculty sample was 43.48 (SD = 11.61). Most of the faculty sample was White (83.5%) and either middle (40.9%) or upper middle class (49.6%). The student sample consisted of 78 women and 43 men (one person did not identify their gender), with a mean age of 21.26 (*SD* = 4.64). The majority of the student sample identified as White (70.5%) and either middle (42.6%) or upper middle class (36.9%).

Design & measures.

Traits-science association. Participants were randomly assigned to either the open-ended condition or the close-ended condition. In both conditions, the participants responded to the question: "What personal traits and/or characteristics do you think contribute to success in a **science career?**" In the close-ended condition, participants were instructed to rate each of 18 traits listed on a 7-point scale from "not at all important" to "extremely important." Importantly, this list consisted of both agentic (i.e., confident, hardworking, assertive, independent, self-sufficient, individualistic, ambitious, dominant, competitive) and communal (e.g., helpful, selfless, communal, supportive, sociable, interdependent, considerate, connected, family-oriented) traits, which were selected from previous research on communal versus agentic traits (Bem, 1974; Conway et al., 1996; Deaux & Lewis, 1984; Eagly, 1987; Spence & Helmreich, 1978). The survey software randomized the order of the items for each participant.

In the open-ended condition, participants responded to the same question, but were given these additional instructions: "Please list below as many traits and characteristics as you can. Limit your responses to single words or short phrases, and please rate each item you list on a scale from 1 to 7, where 1 indicates that it is not at all important for success in a science career and 7 indicates that it is extremely important for success in a science career." Participants were given 18 spaces to list traits.

The open-ended responses were coded as either *agentic*, *communal*, or *neither* by three research assistants who were blind to the hypothesis and the question asked. At least two out of the three coders agreed on how to categorize 95.5% of the traits; traits were designated as *communal*, *agentic*, or *neither* if at least two out of three coders agreed on the coding. If at least two coders did not agree on the coding, the trait was coded as *neither*.

Self-trait associations. All participants also answered the question "To what extent do you feel **you** possess the following personal traits and/or characteristics?" All participants rated the traits listed on a 7-point scale, ranging from "Definitely does NOT describe me" to "Definitely DOES describe me." The traits rated were identical to the items used in the closed-ended version of the traits-science association question described above. This question was counterbalanced with the traits-science association question.

Measures of success & attitudes toward one's field. Both students and faculty responded to several items regarding how successful they felt in their major/field (3 items; $\alpha = .80$), how satisfied they were with their major/field (5 items; $\alpha = .85$), how accepted they felt in their major/field (2 items; $\alpha = .88$), and how motivated they were to continue in their major/field (1 item). These items were counterbalanced with questions designed to measure student and faculty member's success in STEM fields. Specifically, students indicated how likely they felt their career would be in the same field as their major. Faculty indicated how many manuscripts they had published, how many books they had published, how many grants they had applied for, and how many grants they had received; these items were summed to create a summary score representing the faculty members' productivity (4 items; $\alpha = .73$).

Demographics. The questionnaires concluded with demographic questions, including age, sex, race/ethnicity, level of education, occupation, and length of time in the field.

Results

Traits viewed as important for success in science. In the close-ended responses, agentic words (M = 5.59, SD = .62) were rated as more important for success in science than communal words (M = 4.29, SD = .92), $t(159) = -16.33$, $p < .001$. There was no difference between faculty and undergraduate student responses.

In the open-ended responses, participants listed an average of 6.42 traits (SD = 4.13). Overall, more agentic traits (M = 2.36, SD = 1.84) were listed than communal traits (M = 1.54, SD = 1.56), $t(167) = 5.13$, $p < .001$. Furthermore, the agentic traits listed were rated as more important to success in science (M = 5.78, SD = 1.06) than the communal traits listed (M = 5.42, SD = 1.23), $t(113) = 2.64$, $p = .01$. There were no differences between faculty and undergraduate student responses.

Comparing open- and closed-ended conditions. The ratings for the open-ended and close-ended responses were compared with a 2 (communal v. agentic traits, within-subjects) x 2 (open- v. closed-ended responses, between-subjects) x 2 (faculty v. undergraduate students, between-subjects) mixed ANOVA[1]. Means and standard errors for this analysis are presented in Figure 2. As predicted, there was a main effect of trait type, $F(1, 201) = 74.77$, $p < .001$, such that agentic traits were rated as more important for success in science than communal traits. There was also a main effect of open- v. closed-ended condition, $F(1, 201) = 28.39$, $p < .001$, such that traits in the open-ended version were rated as more important than those in the close-ended version. There was no main effect of participant type, $F(1, 201) = 1.70$, $p = .19$, indicating that faculty and students rated traits roughly the same overall.

These main effects were qualified by some two-way interactions. Trait type (agentic v. communal) interacted significantly with participant type (faculty v. student), $F(1, 201) = 5.26$, $p = .02$. Simple effects analyses revealed that students rated the communal traits more important than the faculty did, $F(1, 201) = 4.23$, $p = .04$, although students and faculty rated the agentic traits equally important, $F(1, 201) = .55$, $p = .46$. However, both faculty, $F(1, 201) = 60.69$, $p < .001$, and students, $F(1, 201) = 19.91$, $p < .001$, rated agentic traits more important than communal traits.

Trait type (agentic v. communal) also interacted with condition (open- v. closed-ended), $F(1, 201) = 24.16$, $p < .001$. Simple effects analyses revealed that communal traits listed in the open-ended condition were rated as more important than communal traits listed in the closed-ended condition, $F(1, 201) = 33.04$, $p < .001$, while agentic traits were not rated differently in the closed- v. open-ended conditions, $F(1, 201) = 2.01$, $p = .16$. In both the closed, $F(1, 201) = 104.12$, $p < .001$, and open-ended conditions, $F(1, 201) = 7.37$, $p = .007$, agentic traits were rated as more important than communal traits.

Participant type (faculty v. student) did not significantly interact with condition (open- v. closed-ended), $F(1, 201) = .17$, $p = .68$, nor was there a significant three-way interaction between participant type (faculty v. student), trait type (agentic v. communal), and condition (open- v. closed-ended), $F(1, 201) = .64$, $p = 43$.

Self-ratings of communality and agency. Participants also rated how much the communal and agentic traits applied to themselves. A 2 (trait type) by 2 (participant type) by 2 (sex) ANOVA revealed a main effect of trait type, $F(1, 231) = 19.85$, $p < .001$, such that participants rated themselves as more agentic (*M* = 5.34, *SE* = .06) than communal (*M* = 5.04, *SE* = .06). This main effect was qualified by an interaction with sex, $F(1, 231) = 7.35$, $p = .007$, such that men viewed themselves as significantly more agentic (*M* = 5.36, *SE* = .08) than communal (*M* = 4.88, *SE* = .08), $F(1, 231) = 27.29$, $p < .001$, whereas women viewed themselves as equally agentic (*M* = 5.32, *SE* = .09) and communal (*M* = 5.20, *SE* = .08), $F(1, 231) = 1.44$, $p = .23$. There was no main effect or interactions with participant type.

As might be expected since all of the participants are in STEM fields, self-ratings of agency and communality correlated with ratings of what traits were perceived as important for success in science fields. Participants who perceived themselves as agentic were more likely to rate agentic traits as necessary for success in science, $r = .25$, $p < .001$, and participants who perceived themselves as communal were more likely to rate communal traits as necessary for success in science, $r = .24$, $p < .001$. These correlations were not significantly different for faculty versus students.

Outcome variables. The next set of analyses examined how the ratings of communal and agentic traits related to various outcome variables, such as the participants' ratings of their productivity and satisfaction in STEM fields. Means and standard deviations for these measures are in Table 1. Notably, female faculty members felt less successful, satisfied, accepted, and motivated to continue than male faculty members, *F*s > 4.66, *p*s < .03, although there was no significant difference between male and female faculty members' productivity, $F(1, 110) = 2.51$, $p = .12$. Male and female undergraduate students did not differ significantly regarding their feelings of productivity, satisfaction, acceptance, motivation to continue, or the likelihood that their career would be in the same field as their major, *F*s < .99, *p*s > .52.

Bivariate correlations between these measures and ratings of communal and agentic traits are shown in Table 2. Of interest, people who viewed themselves as agentic were significantly more likely to view themselves as successful, satisfied, and accepted, and they were marginally significantly more motivated to continue in their field and more productive (for faculty). Communal self-ratings were positively correlated with feelings of productivity and acceptance in one's field, but not any of the other outcome variables. Ratings of communal traits as being necessary for success in science were positively correlated with feelings of success, satisfaction, acceptance, and the likelihood that students' careers will be in the same field as their major, whereas ratings of agentic traits as being necessary for success in science did not significantly correlate with any of the outcome variables.

Finally, regression analyses were conducted to examine how the trait ratings and the interaction of self-ratings and science-ratings could predict various outcomes. More specifically, a series of regressions was run where self-ratings of communality, science-ratings of communality, and their interaction were entered as predictors of feelings of productivity, satisfaction, acceptance, motivation to continue in one's field, likelihood that one's career will be in the same field as one's major (students only), and productivity (as measured by the number of publications, grants, etc.; faculty only). A second series of regression analyses was run that was identical but examined agentic self- and science -ratings. Sex (male or female) and time in the field were included as covariates in all of these analyses. Results for these regressions can be found in Table 3. Across the regressions with agentic trait ratings, self-ratings seem to be predictive of more positive outcomes, such that the more participants see themselves as agentic the more successful, satisfied, and accepted they feel in their field. Agentic science-ratings tended to not be consistently predictive of the outcome variables, nor were the interaction terms (although for faculty productivity, there was a marginally significant interaction, indicating that the most productive faculty are those who view themselves as agentic *and* rate agentic traits as important for success in science). Across the regressions for communal trait ratings, self-ratings were not consistently predictive of positive outcomes, but viewing communal traits as necessary for success in science was consistently predictive of positive outcomes, such that the more people rated communal traits as necessary for success in science the more successful, satisfied, accepted, and motivated to continue in their field they were. The interactions terms were not statistically significant.

Discussion

In both the closed- and open-ended conditions, both faculty and undergraduate students rated the agentic traits as more necessary for success in science than the communal traits. Additionally, in the open-ended condition, participants listed more agentic traits than communal traits as being important for success in science. These results support the hypothesis that communal traits are not associated with success in science fields. Because communal traits are gendered, in that they are associated more with women than men, this finding provides evidence that there are gendered associations made with academic disciplines beyond the gender-science stereotype (i.e., that men are more suited for science fields than women). One limitation of this finding is that, since no comparison field was included in this study (e.g., humanities), it may be the case that agentic traits (more than communal traits) are associated with success in any field, not just science. Studies 3 and 4 include humanities as a comparison group to address this possibility. Regardless of whether there is a connection between agentic traits and success in other fields, this study clearly shows that this association exists for science fields.

Hypotheses predicted that communal traits would be rated as more important in the close-ended version compared to the open-ended version, where participants may not even consider communal traits. In fact, these data show the reverse pattern; communal traits were rated higher in the open- than close-ended version. This is likely due to the fact that participants were prodded in the open-ended version to list traits that were important to success in science; traits that they found unimportant may have been less likely to be listed, and without being listed they could not be rated for the degree of their importance. The fact that the agentic traits were rated as equally important in the closed- and open-ended conditions speaks to the strong connection between agentic traits and success in science.

This study also compared responses from faculty and undergraduate students. While faculty and students viewed agentic traits similarly, communal traits were rated as more important by students than faculty. Again, these findings speak to the agentic (but not communal) associations made with science fields. Faculty members, as opposed to students, have spent more time in their academic disciplines, and so perhaps they are more familiar with the expectations held for people in those fields. Students, who have spent less time in the field, may have not been exposed as much to the agentic-science association, and thus are more likely to view communal traits as important for success in science, perhaps because these traits are generally positive. Alternatively, since there is a cohort difference between students and faculty, it may be that students are more likely to view agentic and communal traits as complementary, while faculty are more likely to view agentic and communal traits as conflicting. Regardless, this finding is promising; since students view science fields as more communal than faculty do, students may be more susceptible to a manipulation that attempts to strengthen associations between communal traits and science fields. Such a manipulation is tested in Studies 2 and 4.

Results also revealed connections between how participants view themselves and what traits they deem important for success in science. For both students and faculty, the more importance they placed on agentic (or communal) traits for success in science, the more likely they were to view themselves as agentic (or communal). These correlations point to the interconnectedness of beliefs about oneself and one's field. However, beliefs about oneself and beliefs about science differentially predict outcomes (i.e., feelings of success, satisfaction, acceptance, motivation to continue, likelihood career will be in same field as major, and productivity). Perceiving oneself as agentic was related to more positive outcomes, whereas perceiving oneself as communal was not. This may reflect the emphasis on possessing agentic, but not necessarily communal, traits in science fields. On the other hand, perceiving communal traits as important for success in science was related to more positive outcomes, whereas perceiving agentic traits as important for success in science was not. This finding offers some tentative evidence that viewing science fields as communal could have some important benefits.

Notably, female faculty members reported lower feelings of success, satisfaction, acceptance, and motivation to continue in their field compared to male faculty members.

This would presumably leave them vulnerable to disengagement with their field, so understanding why these women have these feelings is paramount to research in this field. In addition to examining the pattern of beliefs regarding themselves and what is important for success in science, it may be important to examine the sex-science stereotype as well (i.e., the belief that men are better suited for science fields than women). Study 2 begins to examine these connections. The weakness of a communal-science association, combined with the association between communal traits and women, may inhibit a science-female association. Conversely, the strong agentic-science association, coupled with the strong agentic-male association, can lead to associating men with science fields. Furthermore, associations with the self may be relevant; if people generally see science fields as requiring agentic traits but they do not see themselves as having agentic traits, then they may be less likely to identify with science fields. These patterns of associations, explored further in Study 2 and even more in-depth in Studies 3 and 4, can provide insight into the underrepresentation of women in science fields.

Footnote

1. Participants in the open-ended condition who did not list any agentic or communal traits (n = 30) were excluded from these analyses.

CHAPTER 3

Study 2: Altering Perceptions to Alter Stereotypes

Study 1 has illuminated a critical association between agentic traits and science fields and a *lack* of an association between communal traits and science fields. Study 2 aims to demonstrate that the association of agentic but not communal traits with science is related to gender-science stereotyping and women's identification with science fields. Specifically, an experimental manipulation designed to increase communal-science and decrease agency-science associations is predicted to increase female-science associations (i.e., reduce stereotyping) and women's science identification.

While women have increased in agency since the 1970s, men's communality has not changed much since the 1970s (Twenge, 1997), resulting in a substantial sex difference for communal traits (e.g., Twenge, 2009). This difference is seen in self-report of communal traits (e.g., Vogt & Colvin, 2003), perceptions of communal traits by friends and family (e.g., Vogt & Colvin, 2003), and the stereotyping of unknown targets (e.g., Bosak, Sczensy, & Eagly, 2008; Swann, Kwan, Polzer, & Milton, 2003). For example, one study found that recommendation letters written for women applying for academic positions were more likely to mention communal traits than letters written for men (Madera, Hebl, & Martin, 2009). Interestingly, women are actually punished for exhibiting agentic traits (Rudman, 1998; Rudman & Glick, 1999, 2001), particularly if it is not accompanied by assurance that they also possess more communal qualities (Eagly & Karau, 2002; Heilman & Okimoto, 2007).

This association between communality and women, combined with the association between agency and science, may preclude an association between women and science. Agentic and communal traits are often viewed as opposites (Abele, Uchronski, Suitner, & Wojciszke, 2008; Suitner & Maass, 2008), so if women are associated with communal traits then they may not be viewed as agentic, which in turn may make them seem less suitable for science fields. Similarly, if someone believes that men are more agentic than women, and they believe that agentic traits are important for success in STEM fields, then they may logically conclude that men are better suited for STEM fields than women, regardless of how agentic women actually are. Thus, the stereotype that men are better suited for careers in science (i.e., the sex-science stereotype) could partly be caused by the association of agency with science fields.

Similarly, women's associations between communal traits and themselves may have an impact on their career choices. For example, women have been shown to place a higher value on communal aspects of their lives compared to men (Ferriman, Lubinski, & Benbow, 2009). If communal traits are not readily associated with science fields, then women may be less interested in them. In other words, because women often associate communality with themselves more than agency (e.g., Vogt & Colvin, 2003), the agency-science association may lead them to distance themselves from those fields, coming to believe that they may be better suited for careers that are associated with communal traits (e.g., "I am communal. Science fields are not communal. Therefore, I am not suited for a science field.”). Therefore, the agency-science association could lead to lowered self-science associations for women.

Hypotheses

Participants in the experimental condition (i.e., those who receive the manipulation designed to increase communal-science associations) will show decreased endorsement of the sex-science stereotype compared to those in the control condition. Furthermore, women in the experimental condition will exhibit increased self-science associations compared to those in the control condition.

Method

Participants. Participants (*N* = 156) were recruited via the UM Introductory Psychology Subject Pool. There were 100 men and 56 women in the sample. Participants ranged in age from 17 to 29 years old (*M* = 18.57, *SD* = 1.18) and were predominantly first-year students (72.4%). The majority of the sample identified as White (59.0%), but 21.8% identified as Asian/Asian-American, 8.3% as Black/African American, 6.4% as Latino/a, and 4.5% identified as another race or chose not to identify. There was a diversity of majors represented in the sample, although many of the participants classified their major as a natural science (31.4%) or social science (29.5%); only 9.0% were humanities majors, 5.8% were engineering majors, 3.8% were fine arts majors, and 20.5% were “other” majors.

Manipulation. Participants were randomly assigned to either the communal-science condition or the agentic-science condition. The manipulation had two parts. First, participants in both conditions were given information about what it takes to be successful in science fields. Participants in the communal-science condition read a paragraph that emphasized how collaborative science fields are and thus how communal traits are necessary for science fields. They also saw a graph that communicated that the majority of articles in the top ten science journals are written by 5 or more authors. Participants in the agentic-science condition read a paragraph that emphasized how independent science fields are and thus how agentic traits are necessary for science fields. They also saw a graph that communicated that the majority of articles in the top ten science journals are written by single authors. See Appendix A for a copy of this part of the manipulation. This part of the manipulation was pretested on a sample of 55 students from the UM Psychology Subject Pool. Participants who were shown the agentic-science version did not implicitly associate science with agentic (rather than communal) traits ($M = .11$, $SD = .35$) more than those that read the communal-science version ($M = .05$, $SD = .27$), as measured by a Single-Category Implicit Association Test (which measured whether participants are faster categorizing words when *communal* and *science* share a response key versus when *agentic* and *science* share a response key; Karpinski & Steinem, 2006), $t(53) = .63$, $p = .53$. However, participants who were shown the agentic-science version did explicitly associate science with agentic (rather than communal) traits ($M = 1.92$, $SD = 1.34$) more than those that read the communal-science version ($M = .31$, $SD = 1.07$), as measured by questionnaire items, $t(53) = -4.95$, $p < .001$.

Since the first part of the manipulation seemed to affect explicit associations but not implicit associations, a second part was added that could affect implicit associations. This part of the manipulation was modeled after a manipulation developed by Karpinski and Hilton (2001) to change other kinds of implicit associations. Participants were instructed to memorize pairs of words that appeared one at a time on a computer screen.

In total, there were 200 word pairs, divided into four blocks of fifty word pairs each. The word pairs were presented in a random order, and many of them repeated. Importantly, participants were randomly assigned to one of two conditions in the memory task. The counterstereotypic condition paired communal words with the word "science" and agentic words with the word "humanities," while the stereotypic condition paired agentic words with "science" and communal words with "humanities."

Dependent variables.

Sex-science stereotyping and science identification. The primary dependent variables were sex-science stereotyping and science identification. They were measured explicitly through questionnaire measures (see Appendix B) and implicitly through the Single Category Implicit Association Test (SC-IAT; Karpinski & Steinman, 2006), which is a modified version of the Implicit Association Test (IAT; Greenwald, McGhee, & Schwarz, 1998) that only requires one (as opposed to two) sets of opposing categories. For the sex-science (i.e., stereotyping) SC-IAT, participants categorized words into the categories *male*, *female*, or *science*. Importantly, response times to these categorizations were compared when the *science* category shares a response key with the *male* category to when it shares a response key with the *female* category. If a person responded more quickly when *male* and *science* share a response key, it is inferred that they implicitly associate men and science. The self-science (i.e., science identification) SC-IAT was identical except that the *male* and *female* categories were replaced with *self* and *other*. If a person responded more quickly when *self* and *science* share a response key, it is inferred that they implicitly associate themselves with science fields.

Results

It was hypothesized that participants in the communal-science (compared to agentic-science) condition would show less endorsement of the gender-science stereotype. Furthermore, women (but not men) in the communal-science (compared to agentic-science) condition were predicted to show increased identification with science fields and increased persistence on the science-related task.

Manipulation check. In response to the question "Did it seem that the description on the handout portrayed science as a field that required agentic traits, or did the description portray science as a field that required communal traits?", 60.26% of the participants in the agentic condition responded "agentic" and 17.9% responded "communal," whereas 73.08% of the participants in the communal condition responded "communal" and 6.41% responded "agentic." The rest of the participants responded "neither."

At the end of the study, participants responded to four questions that tested their memory of the manipulation presented at the beginning of the study. None of the participants incorrectly answered all four questions, but 2.6% missed three questions, and 12.8% missed two questions. These participants were removed from the analyses, which left 84.6% (n=132) for the analyses.

There were no significant differences between conditions as to whether the participants found the manipulation (i.e., the description of scientists) realistic (M_{agentic} = 4.88, SD_{agentic} = 1.22, M_{communal} = 5.11, SD_{communal} = 1.13, $t(129) = -1.12$, $p = .26$). However, participants in the communal condition did find the manipulation easier to understand and thought that it portrayed science more positively than the participants in the agentic condition (understand: $M_{agentic}$ = 5.93, $SD_{agentic}$ = .68, $M_{communal}$ = 6.24, $SD_{communal}$ = .74, $t(130) = -2.46$, $p = .02$; valence: $M_{agentic}$ = 4.06, $SD_{agentic}$ = 1.24, $M_{communal}$ = 5.24, $SD_{communal}$ = 1.05, $t(130) = -5.90$, $p < .001$). Note that including these variables as control variables in the main analyses did not alter the pattern of results.

The effect of condition on stereotyping. Two *t*-tests were performed to test the hypothesis that participants in the agentic condition would stereotype more than participants in the communal condition. Participants in the agentic condition ($M = .17$, $SD = .25$) did not show significantly more implicit stereotyping than those in the communal condition ($M = .11$, $SD = .29$), $t(130) = .24$, $p = .81$. Similarly, participants in the agentic condition ($M = 3.67$, $SD = .76$) did not report significantly more explicit stereotyping than those in the communal condition ($M = 3.62$, $SD = .73$), $t(130) = .38$, $p = .71$.

The effect of condition on science identity. ANOVA analyses were used to test whether women (but not men) in the communal condition showed increased science identity compared to those in the agentic condition. For implicit science identity, there were no main effects of condition, $F(1, 128) = .12$, $p =.73$, or gender, $F(1, 128) = .28$, $p = .60$. Furthermore, gender did not interact with condition to predict implicit science identity, $F(1, 128) = .52$, $p = .47$. For explicit science identity, there was a main effect of condition, $F(1, 128) = 5.57$, $p = .02$, such that participants in the agentic condition ($M = 3.90$, $SE = .13$) reported higher explicit science identity than those in the communal condition ($M = 3.46$, $SE = .14$). There was no main effect of gender, $F(1, 128) = .03$, $p = .87$, nor did condition and gender significantly interact, $F(1, 128) = .21$, $p = .64$.

Regression analyses. Regression analyses were used to test whether the manipulation interacted with stereotyping and gender to predict science identity. For implicit science identity, there were no main effects or two-way interactions, but there was a marginally significant three-way interaction, $\beta = -.16$, $p = .10$ (for the full results of this regression, see Table 4; for a graphical representation, see Figure 3). In order to probe this interaction, I examined the simple slopes and simple interactions for both the agentic and the communal conditions.

For the agentic condition, the simple interaction of gender and implicit gender-science stereotyping is marginally significant, $\beta = .25$, $p = .07$. Furthermore, the simple slope of implicit gender-science stereotyping predicting implicit science identity for women in the agentic condition is significant, $\beta = -.37$, $p = .04$, indicating that the more these women (who have been given information regarding how scientists are agentic) implicitly associate science with men, the less they implicitly identify with science. The simple slope of implicit gender-science stereotyping predicting implicit science identity for men in the agentic condition was not significant, $\beta = .14$, $p = .51$.

For the communal condition, the simple interaction of gender and implicit gender-science stereotyping was not significant, $\beta = -.06$, $p = .66$. The simple slope of implicit gender-science stereotyping predicting implicit science identity for women in the communal condition was not significant, $\beta = -.01$, $p = .93$. Likewise, the simple slope of implicit gender-science stereotyping predicting implicit science identity for men in the communal condition was not significant, $\beta = -.13$, $p = .56$.

Similar analyses were run using condition, gender, explicit gender-science stereotyping, and their interactions to predict explicit science identity. There was a marginally significant main effect of condition, $\beta = -.19$, $p = .06$, such that participants in the agentic condition reported higher explicit science identity than participants in the communal condition. None of the other main effect or interaction terms in the regression approached significance, $\beta \leq .12$, $p \geq .17$ (for the full results of this regression, see Table 4).

Discussion

Study 2 provides evidence that the agentic-science association is causally related to the relationship between sex-science stereotyping and science identification. By increasing communal-science associations, this relationship was attenuated, such that it was no longer statistically significant. These findings point to the interconnected nature of these associations. Note that these findings could be strengthened through the consideration of additional associations that are merely assumed here, such as the degree to which people associate themselves with their sex and the degree to which people see themselves as having agentic or communal traits. The goal of Study 3 is to examine a fuller pattern of associations.

Note that this could be interpreted as a rather insidious form of sexism; while it is often recognized as inappropriate and sexist to make claims about women being unfit for certain positions (Swim & Cohen, 1997), it seems more acceptable to claim that individuals in science fields need to have certain traits, and then conveniently conclude that the people who have those traits just happen to be men. If that is the case, then increasing the association between communality and science would not just keep women interested in science fields, it could also reduce sexist hiring and promotion practices in science fields.

CHAPTER 4

Study 3: Developing a Pyramidal Model of Sex Stereotyping

While Study 1 showed evidence for an association between agentic (but not communal) traits and science fields, Study 2 provided evidence that the traits-science association can influence sex-science associations. Using an individual differences framework, the goal of Study 3 is to show how these two associations exist within a pattern of associations that involve the self, sex, gendered traits, and science fields.

In the context of sex stereotyping, or associations made with male and female social groups, it is helpful to combine gender role theory (Eagly, 1987) and unified theory (Greenwald, et al., 2002) into a single model. As described in Chapter 1, gender role theory proposes that expectations about roles and behaviors are mediated through gendered traits. Put in the language of unified theory, strong associations exist between the attributes of gendered traits and the social groups of males and females. Because these traits are more or less important for various roles and behaviors, these sex-traits associations then create expectations of an individual's behavior based on their sex. Thus, a sex stereotype is the product of the sex-traits and traits-behaviors associations.

Unified theory (Greenwald et al., 2002) then incorporates the self by predicting a "balanced" identity, represented by triangles of associations between the self, a social group, and an attribute. Incorporating the self becomes essential in explaining sex differences, such as the underrepresentation of women in STEM fields. Joining unified theory and social role theory (Eagly, 1987), a pyramidal model of sex stereotyping that includes associations between the self, gendered traits, sex, and roles & behaviors emerges (see Figure 4). Essentially, the model combines four triangular patterns of associations to form a larger, pyramidal pattern of associations.

As explicated above, gender role theory predicts that the association between sex and roles & behaviors (Association D in Figure 4) is mediated by associations between sex and gendered traits (E) and gendered traits and roles & behaviors (C). Thus, gender role theory predicts ΔECD. Unified theory predicts a "balanced" identity involving the self, attributes, and group membership; in other words, unified theory predicts ΔFEA (i.e., the self-traits-sex triangle) and ΔABC (i.e., the self-traits-roles/behaviors triangle).

Sex stereotyping occurs through the association of sex with gendered traits (i.e., association E) and behaviors & roles (i.e., association D). For example, one stereotype is that women are communal, which is an association between sex and gendered traits (i.e., association E). Another stereotype is that men are more suited for STEM fields than women, which is an association between sex and roles & behaviors (i.e., association D). However, the model exhibits how these associations are a product of the other associations in the model. Further, the self is especially implicated when persons are high in gender identity (i.e., association F is strong), leading to patterns of sex differences.

The goal of Study 3 is to test whether this proposed model holds in the context of the sex-science stereotype and the association between agentic traits and science fields. Thus, the "roles & behaviors" concept in the model would be participation in science, and the “gendered traits” would be communality and agency. All six associations will be measured, both implicitly and explicitly. The guiding hypothesis for the study is that individuals’ will exhibit pyramidal patterns of associations, where the strength of any association is dependent on the strength of the other two associations in its triangles.

Additionally, various outcomes were measured, such as intended career and a choice between a science- or humanities-related activity, to gauge how these associations may affect individuals in STEM and non-STEM fields. The hypothesis is that individuals whose sex-science stereotype and science identity are cognitively supported by other associations (i.e., those who exhibit a cognitively consistent pattern of associations) are more likely to select an activity and pursue a career that is consistent with their major.

Method

Participants. Undergraduate students (*N* = 151) were recruited through the UM Introductory Psychology subject pool, as well as through flyers around campus. In exchange for their participation, participants received $10, except for those from the subject pool who received credit for a course requirement. In order to ensure variability among the strengths of various associations, efforts were made to recruit both male and female participants at all stages in their undergraduate career (i.e., first-years through seniors) who are majoring in both STEM and humanities fields. The sample included 75 women and 74 men (2 people chose not identify their gender).

Procedure. After giving informed consent, participants completed implicit measures via computerized tasks and explicit measures via questionnaire in a laboratory setting. The order of these tasks was counterbalanced, as was the order of associations being measured within each task. Finally, participants completed several demographic questions and selected whether they would like to complete a genetics or word puzzle, which served as a behavioral measure of preference for science v. humanities fields.

Measures. All six associations were measured implicitly using a series of Implicit Association Tests (IATs; Greenwald, McGhee, & Schwartz, 1998). IATs measure implicit associations by comparing the response times in various categorization tasks. For example, if a participant is faster categorizing words when the concepts "male" and "science" share a response key than they are when the concepts "female" and "science" share a response key, the participant has a stronger male-STEM implicit association than a female-STEM association. The IAT differs from the SC-IAT (used in Study 2) because it involves two pairs of categories, which allows us to use humanities as a comparison group to science. Six IATs were administered to measure the six associations in the pyramidal model (see Table 5 for categories and words).

All six associations were also measured explicitly using questionnaire items modeled after the IAT items (Rudman, Greenwald, & McGhee, 2001). For example, to measure the self-gendered traits association, participants rated the accuracy of each of the items from the Gendered Traits concept (see Table 5) as a description of *self* and *others*. Similar to the scoring of an IAT, a difference score was computed, so as to determine whether communality or agency is associated more with the self or others. Each of the six associations was measured using similar items.

Additionally, various outcome measures were collected in order to gauge the effect of these patterns of associations on their intent to continue in the field. Participants were asked directly if they intend to continue in their chosen academic field and what graduate school and/or career they plan to pursue after graduation.

Demographic questions included sex, race/ethnicity, socioeconomic status, age, major(s), minor(s), year in school, parents' occupation, and parents' level of education.

Results

Descriptive statistics for all six associations are presented in Table 6. Of note, all of the stereotypic associations (i.e., traits-discipline, sex-discipline, and sex-traits associations) are significantly different than zero, showing that, on average, the sample endorsed the stereotypes both implicitly and explicitly. Furthermore, men (*M* = .38, *SD* = .35) had a stronger male/self implicit association than women (*M* = -.53, *SD* = .39), *t*(147) = -15.03, *p* < .001, STEM majors (*M* = .28, *SD* = .36) had a stronger science/self implicit association than humanities majors (*M* = -.26, *SD* = .46), *t*(118) = 7.04, *p* < .001, and men (*M* = .12, *SD* = .41) had a stronger agency/self implicit association than women (*M* = -.16, *SD* = .40), *t* (147) = -4.26, *p* < .001.

Tests of unified theory. Greenwald et al. (2002) proposed an analysis plan for tests of unified theory that involves a two-step hierarchical regression. One of the three associations should be arbitrarily designated as the criterion variable, while the other two should be the predictor variables; note that these are arbitrary distinctions because the hypotheses being tested are that these three associations are dependent on one another, not that they are causally related. To be comprehensive, three analyses are presented here for each triangle of associations, so that each association has a turn at being the criterion variable. Greenwald et al. (2002) suggest using the interaction term, calculated by multiplying the two predictor variables, as the sole predictor in the first step of the regression, and then adding the two main effects in the second step. In this analysis, the significance of the first step provides evidence for the predicted multiplicative model (i.e., that the two predictor variables interact to predict the criterion variable). Furthermore, the increment in *R* for the second step would suggest whether the model was purely multiplicative (if the increment is not statistically significant) or whether the individual predictor variables explained some variance in the criterion variable (if the increment is statistically significant). Note that the interpretation of this analysis depends on the scaling assumption that the numeric zero for the association variables actually represents having no association between the concepts (Blanton & Jaccard, 2006; Greenwald et al., 2002; Greenwald, Rudman, Nosek & Zayas, 2006). In the case of the measures employed here, a numeric zero is theoretically analogous to the participant having no association between the concepts.

The purpose of these analyses is to determine whether each triangle of associations is cohesive in the sense that the strength of one association depends on the other two associations. The results of these analyses can be found Table 7. In general, the regression analyses show support for the balance of the triangles of implicit associations, but mixed support for the balance of the triangles of explicit associations (i.e., self-traits-sex and sex-traits-discipline are balanced explicitly, but self-sex-discipline and self-traits-discipline are not). For some of the associations there was a limited range of responses, which could have affected these analyses.

Testing the full pyramidal model. To test whether the six associations in the model generally formed a cognitively consistent pattern, within-subjects contrast analyses, as described by Furr and Rosenthal (2003), were employed. These analyses operate by identifying sets of contrast weights that correspond to possible patterns in the data, producing scores (known as L_P scores) for each participant by multiplying their association scores by the contrast weights and then summing them together. These L_P scores represent the degree to which an individual's data fits a predicted pattern, such that positive scores indicate the predicted pattern, scores of 0 indicate no correspondence to the predicted pattern, and negative scores indicate the opposite of the predicted pattern. L_P scores are then compared across groups to test whether certain participants fit particular patterns more than other participants.

Note that in order for the L_P scores to be interpreted this way, the contrast weights used to compute the L_P scores have to sum to zero (Furr & Rosenthal, 2003). Because the association scores are scored such that men in science fields would be predicted to have all positive scores, some of the association scores had to be reverse-scored to produce contrast weights that summed to zero. The contrast weights were kept consistent across all four patterns, while the direction of particular associations changed such that all of the L_P scores represent "consistent" associations for a particular group (STEM women, STEM men, humanities women, and humanities men), so that the resulting L_P scores could be collapsed later for the outcome analyses (described below). Table 8 contains the contrast weights and reverse-scoring information for each pattern tested.

Patterns of implicit associations. The first pattern tested produced $L_{\text{STEM men implicit}}$ scores that correspond to the predicted pattern for men majoring in STEM fields. Specifically, men in STEM fields were expected to implicitly associate men with science, themselves with men, themselves with science, themselves with agentic traits, agentic traits with science, and men with agentic traits. A contrast analysis revealed that men majoring in STEM fields (*M* = 1.17, *SD* = .65) do indeed exhibit this pattern of implicit associations more than men in humanities majors (*M* = .78, *SD* = .42), women in STEM majors (M = .38, SD = .50), and women in humanities majors (M = .30, SD = .40), $F(1, 116) = 43.5$, $p < .001$.

The second pattern tested produced $L_{\text{Humanities men implicit}}$ scores that correspond to the predicted pattern for men majoring in humanities fields. Specifically, this pattern represents implicit associations with men and humanities, men and the self, the self and humanities, the self and agentic traits, agentic traits and humanities, and men and agentic traits. A contrast analysis revealed that men majoring in humanities fields (M = .29, SD = .56) do indeed exhibit this pattern of implicit associations more than men in STEM majors (M = -.18, SD = .41), women in STEM majors (M = -.67, SD = .38), and women in humanities majors (M = -.67, SD = .38), $F(1, 116) = 41.26$, $p < .001$.

The third pattern tested produced $L_{\text{STEM women implicit}}$ scores that correspond to the predicted pattern for women majoring in STEM fields. Specifically, this pattern represents implicit associations with women and science, women and the self, the self and science, the self and communal traits, communal traits and science, and women and communal traits. A contrast analysis revealed that women majoring in STEM fields (M = .30, SD = .24) do indeed exhibit this pattern of implicit associations more than men in STEM majors (M = -.35, SD = .44), men in humanities majors (M = -.31, SD = .32), and women in humanities majors (M = -.17, SD = .24), $F(1, 116) = 47.44$, $p < .001$.

The final pattern tested produced $L_{\text{Humanities women implicit}}$ scores that correspond to the predicted pattern for women majoring in humanities fields. Specifically, this pattern represents implicit associations with women and humanities, women and the self, the self and humanities, the self and communal traits, communal traits and humanities, and women and communal traits. A contrast analysis revealed that women majoring in humanities fields (*M* = 1.48, *SD* = .73) do indeed exhibit this pattern of implicit associations more than men in STEM majors (*M* = .33, *SD* = .38), men in humanities majors (*M* = .44, *SD* = .44), and women in STEM majors (*M* = .79, *SD* = .42), $F(1, 116) = 69.76$, $p < .001$.

In order to test whether the sample as a whole demonstrated the predicted pattern of associations, I created a variable that consisted of the L_P score for the pattern that was predicted for that kind of participant, depending on whether they were male or female and whether they were majoring in STEM fields or humanities (i.e., $L_{\text{STEM men implicit}}$ scores for men majoring in a STEM field, $L_{\text{Humanities men implicit}}$ scores for men majoring in a humanities field, etc.). The new variable will be referred to as $L_{\text{consistent implicit}}$ scores. A one-sample *t*-test on the $L_{\text{consistent implicit}}$ scores revealed that the sample as a whole demonstrated the predicted cognitively consistent pattern of associations (*M* = .87, *SD* = .77), $t(119) = 12.33$, $p < .001$. A 2 (sex: male or female) by 2 (major: STEM or humanities) ANOVA tested whether some groups of participants demonstrated their predicted pattern more than others. There was no main effect of sex, $F(1, 116) = 1.67$, $p = .20$, or main effect of major, $F(1, 116) = 1.53$, $p = .22$, sex and major interacted to significantly predict $L_{\text{consistent implicit}}$ scores, $F(1, 116) = 71.25$, $p < .001$. Men in STEM (*M* = 1.17, *SD* = .65) and women in humanities (*M* = 1.48, *SD* = .73) had higher $L_{\text{consistent implicit}}$ scores than women in STEM (*M* = .30, *SD* = .44) or men in humanities (*M* = .29, *SD* = .56).

Patterns of explicit associations. Corresponding L_P scores were calculated for the explicit associations. A contrast analysis revealed that men majoring in STEM fields (*M* = 2.28, *SD* = 1.73) do indeed exhibit their expected pattern of explicit associations (as represented by $L_{\text{STEM men explicit}}$) more than men in humanities majors (*M* = 1.98, *SD* = 1.11), women in STEM majors (*M* = .44, *SD* = 1.27), and women in humanities majors (*M* = -.19, *SD* = 1.36), $F(1, 116) = 29.51$, $p < .001$. Another contrast analysis revealed that men majoring in humanities fields (*M* = .98, *SD* = 1.00) do indeed exhibit their expected pattern of explicit associations (as represented by $L_{\text{Humanities men explicit}}$) more than men in STEM majors (*M* = .43, *SD* = 1.08), women in STEM majors (*M* = -1.29, *SD* = 1.23), and women in humanities majors (*M* = -.87, *SD* = 1.16), $F(1, 116) = 22.42$, $p < .001$. A third contrast analysis revealed that women majoring in STEM fields (*M* = .37, *SD* = 1.19) do indeed exhibit their expected pattern of explicit associations (as represented by $L_{\text{STEM women explicit}}$) more than men in STEM majors (*M* = -1.46, *SD* = 1.00), men in humanities majors (*M* = -1.57, *SD* = 1.47), and women in humanities majors (*M* = .33, *SD* = 1.09), $F(1, 116) = 28.56$, $p < .001$. A final contrast analysis revealed that women majoring in humanities fields (*M* = 2.01, *SD* = 1.79) do indeed exhibit their expected pattern of explicit associations (as represented by $L_{\text{Humanities women explicit}}$) more than men in STEM majors (*M* = .30, *SD* = 1.41), men in humanities majors (*M* = .26, *SD* = 1.23), and women in STEM majors (*M* = -1.78, *SD* = 1.15), $F(1, 116) = 13.57$, $p < .001$.

In order to test whether the sample as a whole demonstrated the predicted pattern of associations, I created $L_{\text{consistent explicit}}$ scores in the same manner as the $L_{\text{consistent implicit}}$ scores. $L_{\text{consistent explicit}}$ scores represent the degree to which participants' explicit associations fit the predicted pattern of cognitive consistency. A one-sample *t*-test on the $L_{\text{consistent explicit}}$ scores revealed that the sample as a whole demonstrated the predicted cognitively consistent pattern of explicit associations (*M* = 1.52, *SD* = 1.73), $t(119)$ =

9.61, $p < .001$. A 2 (sex: male or female) by 2 (major: STEM or humanities) ANOVA tested whether some groups of participants demonstrated their predicted pattern more than others. There was no main effect of sex, $F(1, 116) = 1.99$, $p = .16$, or main effect of major, $F(1, 116) = .30$, $p = .59$, but sex and major interacted to significantly predict $L_{\text{consistent explicit}}$ scores, $F(1, 116) = 22.54$, $p < .001$. Men in STEM ($M = 2.28$, $SD = 1.73$) and women in humanities ($M = 2.01$, $SD = 1.79$) had higher $L_{\text{consistent explicit}}$ scores than women in STEM ($M = .37$, $SD = 1.19$) or men in humanities ($M = .98$, $SD = 1.00$).

Outcome variables. The last set of analyses employs the $L_{\text{consistent}}$ scores to predict outcome variables, including their desire to pursue a career in a field consistent with their major, and their choice to complete a science-related versus word-related puzzle at the end of the study. The hypothesis tested here is that people with cognitively consistent patterns of associations (i.e., higher $L_{\text{consistent}}$ scores) are more likely to desire a career consistent with one's major and more likely to choose a puzzle consistent with one's major. These hypotheses were tested using independent-sample *t*-tests.

Of the 105 participants who were majoring in STEM or humanities fields and indicated their intended career during the study, 75 (71.4%) indicated that they intended on pursuing a career in the same field as their major, whereas 30 (28.6%) indicated careers that were not consistent with their major. People who indicated their intended career was consistent with their major ($M = 1.00$, $SD = .80$) had higher $L_{\text{consistent implicit}}$ scores than those whose major was inconsistent with their intended career ($M = .53$, $SD = .64$), $t\ (103) = -2.88$, $p = .005$. However, there were no significant differences in the $L_{\text{consistent explicit}}$ scores between people who indicated their intended career was consistent with their major ($M = 1.66$, $SD = 1.65$) and those whose major was inconsistent with their intended career (*M* = 1.20, *SD* = 1.73), *t* (103) = -1.27, *p* = .21. Logistic regressions predicting whether one's career was consistent with one's major produced the same pattern of results, even when controlling for sex and major; also, there were no significant interactions between sex, major, and $L_{\text{consistent}}$ scores.

Of the 117 participants who were majoring in STEM or humanities fields and selected a puzzle to complete at the end of the study, 47 (40.17%) participants chose the genetics puzzle and 70 (59.83%) participants chose the word puzzle. Furthermore, 78 chose a puzzle that is consistent with their major (i.e., humanities majors choosing the word puzzle and STEM majors choosing the genetics puzzle) while 39 chose a puzzle that is inconsistent with their major (i.e., humanities majors choosing the genetics puzzle and STEM majors choosing the word puzzle). People who chose the puzzle that was consistent with their major (*M* = 1.00, *SD* = .75) had higher $L_{\text{consistent implicit}}$ scores than those who chose the puzzle that was inconsistent with their major (*M* = .58, *SD* = .76), *t* (115) = -2.85, *p* = .005. However, there was only a marginally significant difference in the $L_{\text{consistent explicit}}$ scores between people who selected the puzzle consistent with their major (*M* = 1.69, *SD* = 1.75) and those that did not (*M* = 1.09, *SD* = 1.59), *t* (115) = -1.80, *p* = .08. Logistic regressions predicting whether one's career was consistent with one's major produced the same pattern of results, even when controlling for sex and major; also, there were no significant interactions between sex, major, and $L_{\text{consistent}}$ scores.

Discussion

Results from Study 3 revealed general support for the hypothesis that people form cognitively consistent patterns of associations between the self, sex, traits, and discipline. The analyses that examined individual triangle of associations demonstrated that the strength of the associations in the pyramidal model tend to depend on each other. All of the triangles of implicit associations showed at least some evidence that the strength of any given association in the triangle depended on the other two associations. However, while the explicit sex-traits-self and discipline-traits-sex triangles also followed this pattern, the explicit sex-discipline-self triangle and the discipline-traits-self triangle did not. Both of the explicit triangles that did not show the pattern involve the discipline-self association, which could suggest that there is something specific to that association that interferes with the hypothesized triangle of associations; future research may investigate this possibility.

The analyses that examined the full pyramid show even more convincing evidence that the participants' associations formed cognitively consistent patterns. All of the subsamples of participants (men majoring in STEM fields, men majoring in humanities fields, women majoring in STEM fields, and women majoring in humanities fields) seemed to exhibit their predicted pattern of cognitively consistent associations, for both implicit and explicit associations. Interestingly, people who are in traditional fields for their sex (i.e., men in STEM fields and women in humanities fields) exhibited a stronger adherence to their predicted pattern of associations than people who are in non-traditional fields (i.e., women in STEM fields and men in humanities fields). If it is the case that having a cognitively consistent pattern of associations is more stable, as is suggested by previous theories of cognitive consistency (e.g., Festinger, 1957; Greenwald et al., 2002; Heider, 1958), then it may be the case that people who are in non-traditional fields for their sex are more vulnerable to fluctuating associations. Future research could test this through longitudinal research that tracks associations over time, as well as the consequences of stable versus fluctuating associations.

Study 3 also provided evidence that having a cognitively consistent pattern of associations is related to meaningful outcomes. Specifically, the degree to which students displayed cognitively consistent patterns of implicit associations was related to choosing a major-consistent activity in the moment (i.e., the puzzle) as well as desiring a career in a major-consistent field. Because this research was instigated by an examination of the problem of the underrepresentation of women in STEM fields, this suggests that encouraging a cognitively consistent pattern of associations that supports women's participation in STEM could lead women to persist in STEM fields. Study 4 attempts to increase the likelihood that women in STEM will demonstrate a cognitively consistent pattern by encouraging an association between science and communal traits.

It is worth noting the caveats in interpreting these results. This study used Implicit Association Tests (IATs) to measure implicit associations. IATs have been used in a wide variety of research since their introduction in the mid-1990s, but they do have a drawback in that a single IAT score actually contains four different sub-associations. For example, the sex-discipline IAT is a composite of participants' response times to the combinations of male/science, female/humanities, male/humanities, and female/science. When examining the resulting IAT score, it is difficult to discern if one of these sub-associations is influencing the score more than the others. In interpreting the relationship between IAT scores, it becomes even harder to identify if some sub-associations are driving a relationship compared to others. This information may be important if interventions are aiming to alter associations; knowing that one part of an association is primarily responsible for positive or negative outcomes would better assist intervention development. To address this issue, future research should replicate the findings from this study using other measures of implicit associations (such as the Single-Category IAT that was used in Study 2) that do not rely on a composite of four sub-associations.

A conceptually similar problem arises with the use of L_P scores. Furr and Rosenthal (2003) note that while L_P scores do serve as an index of how much each participant's data fits a predicted pattern, the L_P scores do not allow researchers to identify *how* the data fit the pattern. Therefore, it may be the case that participants fit certain associations more than others or that certain associations are driving the relationship between the L_P scores and the outcome variables. Future research may be able to develop even more sophisticated statistical techniques that can address this issue.

CHAPTER 5

Study 4: An Intervention to Alter Patterns of Associations

As exhibited in Study 3, people generally form cognitively consistent patterns between the concepts of the self, sex, traits, and discipline. One way of thinking about this is that the strength of each association in the pyramidal model is a product of the strength of the other two associations in its respective triangle. Because each association is part of two triangles, the strength of every association in the model may affect, either directly or through other associations, the strength of any other association in the model. For example, suppose the relationship between the self and gendered traits (Association A in Figure 4) is driven by the strength of the associations between sex and the self (F) and sex and gendered traits (E). In this example, a woman may strongly associate herself with the social group "women" (F) and strongly associate women with communal traits (E); the strength of these two associations then contribute to the strength of her association between herself and communal traits (A). This self-gendered traits association, however, could also be conceived as dependent on the associations between the self and behaviors & roles (B) and gendered traits and behaviors & roles (C). In other words, the self-gendered traits association is part of two triangles of associations, ΔAEF and ΔABC. Consequently, the strength of association E and/or F can affect the strength of associations B and/or C because they are all related to association A.

Thus, the "balanced" nature of the associations in the pyramidal model of sex stereotyping implies that altering any association in the model has the potential to affect stereotyping and identity. This tenet of the pyramidal model lends itself easily to a wide variety of interventions based on altering different associations. Because certain associations (namely, the sex-STEM stereotype) have been shown to impact men and women in STEM fields, altering other associations may affect the sex-STEM stereotype and indirectly affect academic performance and persistence in STEM fields.

Most previous attempts at increasing women's participation in STEM fields, such as exposure to female scientists, may be conceptualized as attempting to affect the sex-self, self-behaviors/roles, and sex-behavior/roles associations (ΔBDF) by altering the sex-behaviors/roles association (D). The intent is to expose students to female scientists in order to strengthen their female-STEM association (D), which may then lead female students, who are presumed to have a strong self-female association (F), to strengthen their self-STEM association (B) and subsequently show more interest and performing better in STEM fields. However, previous intervention research does not tend to measure all of the associations presumed to be affected by intervention, instead just focusing on the association that was intended to be changed (usually the sex-STEM stereotype). Therefore, this process has not been documented by previous research.

Furthermore, little research has considered the role of gendered traits in altering sex stereotypes, especially the sex-STEM stereotype. According to the pyramidal model, gendered traits play a direct role in the self-traits (A), sex-traits (E), and traits-behaviors/roles (C) associations. Study 4 will attempt to manipulate the traits-behaviors/roles association (C), rather than the self-traits or sex-traits associations, for three reasons. First, because the other associations involving gendered traits (i.e., self-traits and sex-traits associations) may form more directly and earlier in the lifespan, these associations may be difficult to manipulate in a laboratory setting. Second, Study 2 manipulated the traits-behavior/roles association, so this study is an opportunity to replicate those findings. Since Study 2 did not incorporate all of the associations in the pyramidal model, the results for Study 4 are expected to be even stronger. Finally, previous research has shown that an intervention that emphasized the altruistic aspects of science increased girls' interest in science (Weisgram & Bigler, 2006), which is conceptually similar to focusing on increasing the association between communal traits and science. In sum, the primary aim of Study 4 is to manipulate the association between gendered traits and STEM and test the implications for the five other associations in the model.

Hypotheses

As a replication of Study 3, the six associations are expected to depend on each other in a "balanced" manner, as predicted by the pyramidal model, and participants are expected to demonstrate a cognitively consistent pattern of associations. Furthermore, because the participants in the counterstereotypic condition are expected to have stronger communal-science associations than those in the stereotypic condition, they are also expected to have stronger female-science associations, especially for those participants who have strong female-communal associations. Similarly, participants in the counterstereotypic condition who have strong self-communal associations are expected to associate themselves more with science than those participants in the stereotypic group.

Method

Participants. Undergraduate students (*N* = 268) were recruited through the UM Introductory Psychology subject pool, as well as through flyers around campus. In exchange for their participation, participants received $10, except for those from the subject pool who received credit for a course requirement. The sample included 148 women and 110 men (10 people chose not identify their gender). Seventy-one humanities majors and 147 STEM majors were in the sample.

Procedure. In a between-subjects design, participants first completed a memory task aimed at manipulating the traits-discipline association. The manipulation is the same as the one used in Study 2, but it only includes the memory task that was modeled after the manipulation developed by Karpinski and Hilton (2001), as opposed to the memory task *and* the article. Using only one part of the manipulation could provide insight to which part of the manipulation may have been most effective in Study 2. Following the exact same procedure as in Study 2, the memory task consisted of participants memorizing 200 word pairs that were either communal words paired with "science" and agentic words paired with "humanities" (for the counterstereotypic condition) or agentic words paired with "science" and communal words paired with "humanities" (for the stereotypic condition). This manipulation was pretested with an independent sample of 32 participants from the UM Psychology Subject Pool. Results of the pretest revealed that participants in the stereotypic condition (M = .89, SD = .28) had a significantly stronger implicit science-agency/humanities-communality association compared to those in the counterstereotypic condition (M = .51, SD = .37), as measured by an IAT, $t(30)$ = 3.24, p = .003. Furthermore, participants in the stereotypic condition (M = 1.38, SD =

1.37) had a marginally significantly stronger explicit science-agency/humanities-communality association compare to those in the counterstereotypic condition (*M* = .76, *SD* = .68), as measured through questionnaire items, $t(30) = 1.68$, $p = .10$.

After the manipulation, all participants completed the implicit and explicit measures for all six associations that were used in Study 3. Finally, participants completed several demographic questions, including their intended career, and chose between a STEM-related and humanities-related puzzle, just as in Study 3.

Results

The means and standard deviations for each of the implicit and explicit associations can be found in Table 9. Note that the discipline-traits association serves as a manipulation check; indeed, those in the stereotypical condition associated science with agency and humanities with communality more than those in the counterstereotypical condition.

Replicating findings from Study 3.

Tests of unified theory. See Table 10 for analyses analogous to Study 3. In other words, these analyses ignore the manipulation; instead, they include the traits-discipline association, since the manipulation is expected to affect the other associations in the model only to the extent that it affected the traits-discipline association. Overall, these analyses reveal at least some support for the connections between the associations in the various triangles, both implicitly and explicitly. Specifically, the implicit sex-discipline-self and discipline-traits-self triangles and the explicit sex-discipline-self triangle met all of the criteria established by Greenwald et al. (2002) to declare the associations balanced, and the rest of the implicit and explicit triangles met several of the criteria.

Testing the full pyramidal model. L_P scores were calculated in the identical manner as Study 3. These are the results for the predicted pattern of implicit associations. A contrast analysis revealed that men majoring in STEM fields (M = 1.09, SD = .57) do indeed exhibit their expected pattern of implicit associations (as represented by $L_{\text{STEM men implicit}}$) more than men in humanities majors (M = .66, SD = .47), women in STEM majors (M = .30, SD = .51), and women in humanities majors (M = .21, SD = .45), $F(1, 206) = 79.20$, $p < .001$. Another contrast analysis revealed that men majoring in humanities fields (M = .05, SD = .47) do indeed exhibit their expected pattern of implicit associations (as represented by $L_{\text{Humanities men implicit}}$) more than men in STEM majors (M = -.12, SD = .39), women in STEM majors (M = -.49, SD = .47), and women in humanities majors (M = -.48, SD = .40), $F(1, 206) = 20.18$, $p < .001$. A third contrast analysis revealed that women majoring in STEM fields (M = .20, SD = .49) do indeed exhibit their expected pattern of implicit associations (as represented by $L_{\text{STEM women implicit}}$) more than men in STEM majors (M = -.32, SD = .47), men in humanities majors (M = -.33, SD = .39), and women in humanities majors (M = -.05, SD = .51), $F(1, 206) = 41.96$, $p < .001$. A final contrast analysis revealed that women majoring in humanities fields (M = 1.18, SD = .67) do indeed exhibit their expected pattern of implicit associations (as represented by $L_{\text{Humanities women implicit}}$) more than men in STEM majors (M = .25, SD = .42), men in humanities majors (M = .48, SD = .40), and women in STEM majors (M = .64, SD = .56), $F(1, 206) = 61.57$, $p < .001$.

Next, I tested whether the sample as a whole demonstrated the predicted pattern of implicit associations using $L_{\text{consistent implicit}}$ scores, as in Study 3. A one-sample t-test on the $L_{\text{consistent implicit}}$ scores revealed that the sample as a whole demonstrated the predicted cognitively consistent pattern of implicit associations (*M* = .67, *SD* = .73), *t*(209) = 13.22, *p* < .001. A 2 (sex: male or female) by 2 (major: STEM or humanities) ANOVA tested whether some groups of participants demonstrated their predicted pattern more than others. There was no main effect of sex, *F*(1, 206) = 2.04, *p* = .16, or main effect of major, *F*(1, 206) = .15, *p* = .70, but sex and major interacted to significantly predict $L_{\text{consistent implicit}}$ scores, *F*(1, 206) = 144.86, *p* < .001. Men in STEM (*M* = 1.09, *SD* = .57) and women in humanities (*M* = 1.18, *SD* = .67) had higher $L_{\text{consistent implicit}}$ scores than women in STEM (*M* = .20, *SD* = .49) or men in humanities (*M* = .05, *SD* = .46).

Next are identical analyses for patterns of explicit associations. A contrast analysis revealed that men majoring in STEM fields (*M* = 4.67, *SD* = 2.66) do indeed exhibit their expected pattern of explicit associations (as represented by $L_{\text{STEM men explicit}}$) more than men in humanities majors (*M* = 1.59, *SD* = 1.41), women in STEM majors (*M* = .94, *SD* = 1.86), and women in humanities majors (*M* = -1.53, *SD* = 1.69), *F*(1, 211) = 188.70, *p* < .001. Another contrast analysis revealed that men majoring in humanities fields (*M* = 1.79, *SD* = 1.47) do indeed exhibit their expected pattern of explicit associations (as represented by $L_{\text{Humanities men explicit}}$) more than men in STEM majors (*M* = .13, *SD* = 1.15), women in STEM majors (*M* = --3.09, *SD* = 1.60), and women in humanities majors (*M* = -1.06, *SD* = 1.26), *F*(1, 211) = 112.69, *p* < .001. A third contrast analysis revealed that women majoring in STEM fields (*M* = 2.54, *SD* = 1.49) do indeed exhibit their expected pattern of explicit associations (as represented by $L_{\text{STEM women explicit}}$) more than men in STEM majors (*M* = -.97, *SD* = 1.08), men in humanities majors (*M* = -2.15, *SD* = 1.40), and women in humanities majors (*M* = .60, *SD* = 1.42), *F*(1, 211) = 291.80, *p* < .001. A final contrast analysis revealed that women majoring in humanities fields (M = 3.94, SD = 2.04) do indeed exhibit their expected pattern of explicit associations (as represented by $L_{\text{Humanities women explicit}}$) more than men in STEM majors (M = -1.27, SD = 1.34), men in humanities majors (M = .37, SD = 1.32), and women in STEM majors (M = 1.43, SD = 1.64), $F(1, 211) = 183.02$, $p < .001$.

$L_{\text{consistent explicit}}$ scores were computed to represent the degree to which participants' explicit associations fit the predicted pattern of cognitive consistency. A one-sample *t*-test on the $L_{\text{consistent explicit}}$ scores revealed that the sample as a whole demonstrated the predicted cognitively consistent pattern of explicit associations (M = 3.42, SD = 2.29), $t(214) = 21.89$, $p < .001$. A 2 (sex: male or female) by 2 (major: STEM or humanities) ANOVA tested whether some groups of participants demonstrated their predicted pattern more than others. There was no main effect of sex, $F(1, 211) = .001$, $p = .97$, but there was a main effect of major, $F(1, 211) = 5.78$, $p = .02$, and sex and major interacted to significantly predict $L_{\text{consistent explicit}}$ scores, $F(1, 211) = 48.85$, $p < .001$. Men in STEM (M = 4.67, SD = 2.66) and women in humanities (M = 3.42, SD = 2.04) had higher $L_{\text{consistent explicit}}$ scores than women in STEM (M = 2.54, SD = 1.49) or men in humanities (M = 1.79, SD = 1.47).

Outcomes. The last set of analyses that replicate the findings from Study 3 employ the $L_{\text{consistent}}$ scores to predict outcome variables, including their desire to pursue a career in a field consistent with their major and their choice to complete a science-related versus word-related puzzle at the end of the study.

Of the 216 participants who were majoring in STEM or humanities fields and indicated their intended career during the study, 136 (63.0%) indicated that they intended on pursuing a career in the same field as their major, whereas 80 (37.0%) indicated careers that were not consistent with their major. For patterns of implicit associations, there was no significant difference between people who indicated their intended career was consistent with their major (M = .71, SD = .73) compared to those whose intended career was inconsistent with their major (M = .61, SD = .73), t (207) = -.92, p = .36. For patterns of explicit associations, there were also no significant differences between people who indicated their intended career was consistent with their major (M = 3.63, SD = 2.24) and those whose major was inconsistent with their intended career (M = 3.16, SD = 2.31), t (211) = -1.44, p = .15. Logistic regressions predicting whether one's career was consistent with one's major produced the same pattern of results, even when controlling for sex and major; also, there were no significant interactions between sex, major, and $L_{\text{consistent}}$ scores.

Of the 194 participants who were majoring in STEM or humanities fields and selected a puzzle to complete at the end of the study, 68 (35.1%) participants chose the genetics puzzle and 126 (64.9%) participants chose the word puzzle. Furthermore, 110 chose a puzzle that is consistent with their major (i.e., humanities majors choosing the word puzzle and STEM majors choosing the genetics puzzle) while 84 chose a puzzle that is inconsistent with their major (i.e., humanities majors choosing the genetics puzzle and STEM majors choosing the word puzzle). People who chose the puzzle that was consistent with their major (M = .87, SD = .75) had higher $L_{\text{consistent implicit}}$ scores than those who chose the puzzle that was inconsistent with their major (M = .45, SD = .63), t (190) = -4.08, $p < .001$. There was also a significant difference in the $L_{\text{consistent explicit}}$ scores between people who selected the puzzle consistent with their major (M = 3.87, SD = 2.27) and those that did not (M = 2.69, SD = 1.86), t (195) = -3.96, $p < .001$. Logistic regressions predicting whether one's career was consistent with one's major produced the same pattern of results, even when controlling for sex and major; also, there were no significant interactions between sex, major, and $L_{consistent}$ scores.

Effect of the manipulation on the associations. Regression analyses were employed to test whether the manipulation had an effect on the triangles of associations. Since the manipulation affected the traits-discipline association, the goal of these analyses is to examine whether the manipulation affected other associations that were part of a triangle with the traits-discipline association. The prediction would be that the manipulation moderated the relationship between the other two associations in the triangle. In other words, these analyses are analogous to the triangle analyses in Study 3, except that the manipulation takes the place of the traits-discipline association.

Sex-traits-discipline triangle. Using a regression analysis, I tested whether the traits-discipline manipulation moderated the relationship between the sex-traits implicit association and the sex-discipline implicit association. The criterion variable was the sex-traits implicit association, and the predictor variables were the manipulation condition, the sex-discipline implicit association, and their interaction. The sex-discipline implicit association significantly predicted the sex-traits implicit association, $\beta = .25$, $p < .001$. There was no main effect of the manipulation on the sex-traits implicit association, $\beta = .02$, $p = .71$, but the manipulation significantly moderated the relationship between the sex-discipline implicit association and the sex-traits implicit association, $\beta = -.12$, $p = .04$. In other words, there was a positive relationship between the sex-traits and sex-discipline implicit associations, such that the more someone implicitly associated men with science and women with humanities, the more likely they were to implicitly associate men with agency and women with communality, but this relationship was weaker for participants in the counterstereotypical condition compared to those in the stereotypical condition.

An analogous regression analysis was run using the explicit sex-traits and sex-discipline associations. While the sex-discipline explicit association was a significant predictor of the sex-trait explicit association, $\beta = .57$, $p < .001$, the traits-discipline manipulation ($\beta = -.05$, $p = .35$) and the interaction of the manipulation and the sex-discipline explicit association ($\beta = -.07$, $p = .19$) were not significant predictors.

Self-traits-discipline triangle. Using a regression analysis, I tested whether the traits-discipline manipulation moderated the relationship between the self-discipline implicit association and the self-traits implicit association. The criterion variable was the self-traits implicit association, and the predictor variables were the manipulation condition, the self-discipline implicit association, and their interaction. While the self-discipline implicit association was a significant predictor of the self-traits association, $\beta = .19$, $p = .003$, the traits-discipline manipulation ($\beta = -.03$, $p = .64$) and the interaction term were not ($\beta = -.05$, $p = .46$).

An analogous regression analysis was run using the explicit self-traits and self-discipline associations. The self-discipline explicit association was a significant predictor of the self-trait association, $\beta = .27$, $p < .001$. The traits-discipline manipulation was not a significant predictor of the self-trait association, $\beta = -.05$, $p = .44$, but it did interact significantly with the self-discipline explicit association, $\beta = -.16$, $p = .02$. Simple slope analyses revealed that, for those in the stereotypical condition, there was a positive association between the self-discipline and self-trait explicit associations, $\beta = .41$, $p <$

.001, whereas participants in the counterstereotypical condition did not have a significant relationship between the self-discipline and self-trait associations, $\beta = .12$, $p = .17$.

The effect of the manipulation on the patterns of associations. To test whether the manipulation affected the degree to which participants' adopted their predicted pattern of associations, a 2 (condition: stereotyping or counterstereotypical) x 2 (sex: male or female) x 2 (major: STEM or humanities) ANOVA was conducted on $L_{consistent}$ scores. Means are presented in Figure 5. Results revealed no significant main effects and only one significant two-way interaction (sex by major, $F(1, 202) = 137.33$, $p < .001$), but there was a significant three-way interaction, $F(1, 202) = 392$, $p = .05$. Of note, women majoring in STEM fields had a significantly more cognitively consistent pattern of implicit associations when they received the counterstereotypical manipulation compared to the stereotypical manipulation, $F(1, 202) = 3.91$, $p = .05$.

An identical ANOVA was run predicting the degree to which participants' adopted their predicted pattern of explicit associations. Means are presented in Figure 6. Results revealed a main effect of major, $F(1, 207) = 7.79$, $p = .01$, a two-way interaction of sex and major, $F(1, 207) = 53.45$, $p < .001$, and a three-way interaction, $F(1, 207) = 4.16$, $p = .04$. Men in STEM were the only group that significantly differed between the stereotypical and counterstereotypical conditions, $F(1, 207) = 12.96$, $p < .001$.

Discussion

Study 4 replicated the results of Study 3 in large part, providing further evidence that people tend to hold cognitively consistent patterns of associations between the concepts of the self, sex, traits, and disciplines. Study 4 also tested the effect of a manipulation designed to alter the traits-discipline association on the pattern of associations. The results reveal that the memory test was a successful manipulation of the traits-discipline association, since those in the stereotypic condition showed a stronger STEM/agentic and humanities/communal association pattern than those in the counterstereotypic condition. However, note that the manipulation did not reverse the association; in other words, participants in the counterstereotypic condition still associated STEM with agency and humanities with communality, but it was to a lesser extent than those in the stereotypic condition. Had the manipulation been successful in reversing the discipline-traits association, it may have had even stronger effects.

The manipulation did show some effects on other associations in the model. As predicted, the manipulation interacted with the sex-discipline implicit association to predict the sex-traits implicit association. Participants who associated men with STEM and women with humanities tended to associate men with agency and women with communality, but this association was stronger for participants in the stereotypical condition compared to those in the counterstereotypical condition. The manipulation did not have an effect on the relationship between the explicit sex-traits and sex-discipline associations.

On the other hand, the manipulation interacted with the self-discipline explicit association to predict the self-traits explicit association. In the stereotypic condition, people who associated themselves with STEM tended to associate themselves with agency. However, in the counterstereotypic condition, there was no significant relationship between the self-discipline and self-traits explicit associations. In other words, the manipulation successfully disrupted the explicit self-discipline-traits triangle of association. However, the manipulation did not have an effect on the relationship between the implicit self-discipline and self-traits associations.

Why did the manipulation affect the *implicit* sex-traits-discipline triangle but the *explicit* self-traits-discipline triangle? One explanation is that the sex-traits-discipline triangle of associations involves more stereotypes, which are subject to social desirability effects. Indeed, one rationale for measuring implicit associations is to avoid the social desirability associated with explicit stereotyping measures (Greenwald & Banaji, 1995). Because participants presumably have more control over their responses to the explicit measures, they may have consciously tried to refrain from using stereotypes when responding to the sex-traits and sex-discipline explicit association items, which may have disrupted the effect of the manipulation on these associations, leading to changes in the implicit but not explicit associations. On the other hand, since the self-traits-discipline triangle of associations does not involve stereotypes, social desirability may have been less of a concern, thus allowing for the manipulation to affect those explicit associations. However, it is unclear why the manipulation did not affect the implicit self-traits-discipline triangle. Future research may attempt to further explore these patterns to better understand the effects (and boundary conditions) of this manipulation.

Perhaps most promisingly, the manipulation did increase the degree to which women in STEM majors formed a cognitively consistent pattern of implicit associations. This finding is of particular interest since the underrepresentation of women in STEM fields is what sparked this research. To the extent that having a cognitively consistent pattern of implicit associations is related to positive outcomes, this finding suggests that manipulations aimed at increasing associations between communal traits and science fields could have positive implications for women in STEM.

CHAPTER 6

General Discussion

Across four studies, this dissertation has provided empirical support for the proposed pyramidal model of sex stereotyping. Furthermore, it has illuminated the importance of considering gendered traits when addressing the underrepresentation of women in STEM fields. Study 1 demonstrated that people consider agentic traits to be more important for success in science than communal traits. Study 2 provided evidence that it is important to examine the relationship between various associations rather than isolated associations, and it also demonstrated that the relationships between various associations can be altered with an experimental manipulation. Study 3 showed that people do hold a cognitively consistent pattern of associations, which predicts what kinds of activities people are interested in right now as well as whether their desired career is consistent with their current field of study. In addition to generally replicating the findings of Study 3, Study 4 showed that increasing the association between communal traits and science can affect related associations and, importantly, can produce a more cognitively consistent pattern of implicit associations for women in STEM fields.

There are several advantages to examining associations via the pyramidal model of sex stereotyping. First, it is a meaningful model of sex stereotyping that lends insight and practicality into the patterns of associations underlying stereotyping. Second, it may be applied to both men and women and a multitude of sex stereotypes. Future research should test patterns of associations in a context other than studying women in STEM fields to see if they can conceptually replicate these findings. Third, this model demonstrates the importance of examining patterns of associations, rather than isolated associations. Future research could test even more directly whether single associations or patterns of associations are better predictors of success and participation in STEM fields. Finally, this research bridges two theories that had not previously been merged, unified theory (Greenwald et al., 2002) and gender role theory (Eagly, 1989).

This research has applied implications because it focuses on an actual social problem: the underrepresentation of women in STEM fields. This research shows how STEM fields are gendered in a way that steers women away from them, either through stereotyping or through women's disidentification with STEM. Importantly, this gendering may be unfounded; it is quite possible that communal traits are actually important to have in STEM fields, particularly in light of the predominance of collaboration across STEM fields. Future research should test whether communal traits contribute to success in STEM fields in order to support the adoption of interventions aimed at increasing the association between communal traits and science fields. Such a misperception could have great consequences, since the desire to pursue communal goals (Diekman et al., 2010) and work with other people (Hazari et al., 2010) are negatively related to interest in STEM fields. This kind of misperception could affect women more than men, since women are more likely than men to view themselves as possessing communal traits (as shown in the present research) and desire careers consistent with communal goals (Diekman et al., 2010). Furthermore, this misperception could contribute to the presence of the sex-STEM stereotype, which contributes to further barriers keeping women from STEM fields. Examining the validity of the perception that communal traits are not compatible or not necessary for STEM fields is a key area of future research on this topic.

Note that interventions that increase communal-STEM associations should actually increase the participation of *communal* people, both men and women, in STEM fields. The present research is not intended to reinforce stereotypes that all women possess communal traits. The framing of communal-STEM interventions as addressing the problem of underrepresentation of women in STEM fields is grounded in research showing that women, *on average*, do see themselves as more communal than men (as shown in the present work, as well as Twenge, 2009; Vogt & Colvin, 2003) and that others project communal traits onto women more than men (Bosak et al., 2008; Swann et al., 2003; Vogt & Colvin, 2003). However, it is also clear from this research that there is substantial variability in the degree to which both men and women view themselves as possessing communal traits. Therefore, a communal-science intervention could increase the diversity of people in STEM fields by targeting communal people, not just women. Relatedly, note that when testing the relationships between associations, it is important to *actually measure* associations like the self-traits association and sex-self association, as in the present work, rather than assume the strength of these associations based on demographics information.

Since the pyramidal model of sex stereotyping posits that each association in the model is dependent on the others, interventions need not be limited to the traits-discipline association. The traits-discipline association was strategically targeted in the present research based on related previous work (e.g., Diekman et al., 2010; Weisgram & Bigler, 2006), the novelty of examining gendered traits in this context, and the intuition that the traits-discipline association may be more susceptible to change than others. However, other associations in the model could be targeted as well. For example, priming people to think about agentic traits they may possess should increase their STEM identity, to the extent that they associate agentic traits with STEM fields. Similarly, encouraging people to recognize that men can and do possess communal traits and women can and do possess agentic traits should affect their sex-STEM stereotyping to the extent that they associate agentic versus communal traits with STEM fields. Since social role theory (Eagly, 1989) suggests that expecting men to be agentic and women to be communal underlies a wide variety of sex differences, a manipulation that targets the sex-traits association could be effective in reducing a host of sex stereotypes.

Furthermore, targeting multiple associations may be even more effective than an intervention targeting a single association. One idea put forth in this work is that it is important to consider the *patterns* of associations rather than individual associations isolated from one another. The same idea could be applied to interventions. For example, in addition to increasing communal-science associations, women could be primed to think about the communal aspects of themselves (e.g., an intervention to increase the self-communal association). Targeting both of these associations could have a stronger impact on science identity, depending on the strength of the other associations in the model. A bevy of hypotheses could be tested exploring various combinations of the interventions targeting different associations in the model.

One advantage of the pyramidal model of sex stereotypes is that it is easily adapted. For example, the traits concept could focus on traits other than communal and agentic traits, or the roles/behaviors concept could focus on something other than academic disciplines. Future research should test the pyramidal model of sex stereotypes in a variety of contexts. It would be particularly interesting if having a cognitively consistent pattern of associations was more important for some domains compared to others.

Another strategy for pursuing future research in this field is to examine these associations longitudinally. The use of the experimental method to test interventions in Studies 2 and 4 allows one to conclude that the traits-discipline association *can* cause changes in the pattern of associations, but it would be interesting to see how these associations might be naturally causally related over time. The present work does not really speak to questions of which associations cause changes in the others, but instead posits that it is possible that changing any association in the model could affect others. Developmentally, however, it might be the case that some associations form earlier than others and tend to cause other associations to form. For example, it could be that children see only examples of male scientists and thus form the male-science association. The agentic-science association could form later after learning that men should be agentic and women should be communal (i.e., the sex-traits association). In other words, the agentic-science association could form because the other two associations already exist. On the other hand, it could be that children are taught science in such a way that they come to believe that agentic traits are actually more important for success in science, and since men are supposed to have more agentic traits, the logical conclusion is that men are better at science (i.e., the male-science association forms because the agentic-science and agentic-male associations already exist). Understanding the timeline of the formation of these associations could provide valuable information as to which associations could be more susceptible to interventions, as well as what interventions might be introduced to children that could not only affect a targeted association but also prohibit the formation of other associations.

Other longitudinal work could test ideas about the importance of having a cognitively consistent pattern of associations. Several theorists suggest (e.g., Greenwald et al., 2002; Heider, 1958) that having an imbalanced (i.e., inconsistent) pattern of associations is unstable, such that associations will eventually change to form a more balanced pattern. Longitudinal studies could actually test this hypothesis and provide evidence that those with more consistent patterns of associations are less likely to change, which could have meaningful implications for who is likely to drop out of particular fields. Understanding patterns of consistency over time could also help discern when certain kinds of interventions may be more effective than others.

In summary, this work offers a theoretical contribution by demonstrating the importance of examining patterns of associations, as well as a practical contribution by introducing and testing an intervention that could increase women's participation in STEM fields. Hopefully this research will serve as a firm starting point for future work further examining these patterns of associations and related interventions.

FIGURES

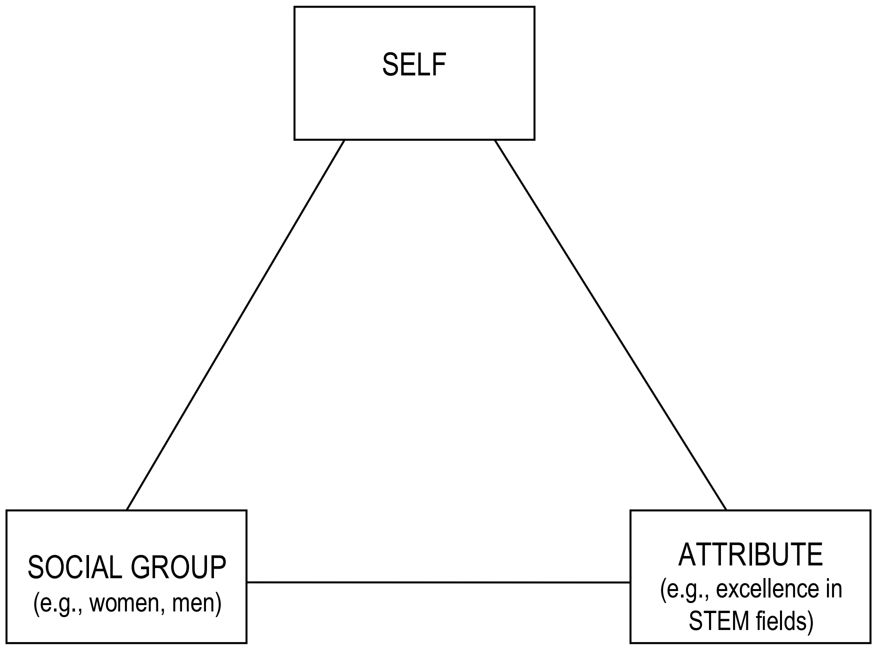

Figure 1. Graphical representation of unified theory (Greenwald, et al., 2002). Boxes represent concepts and lines represent associations.

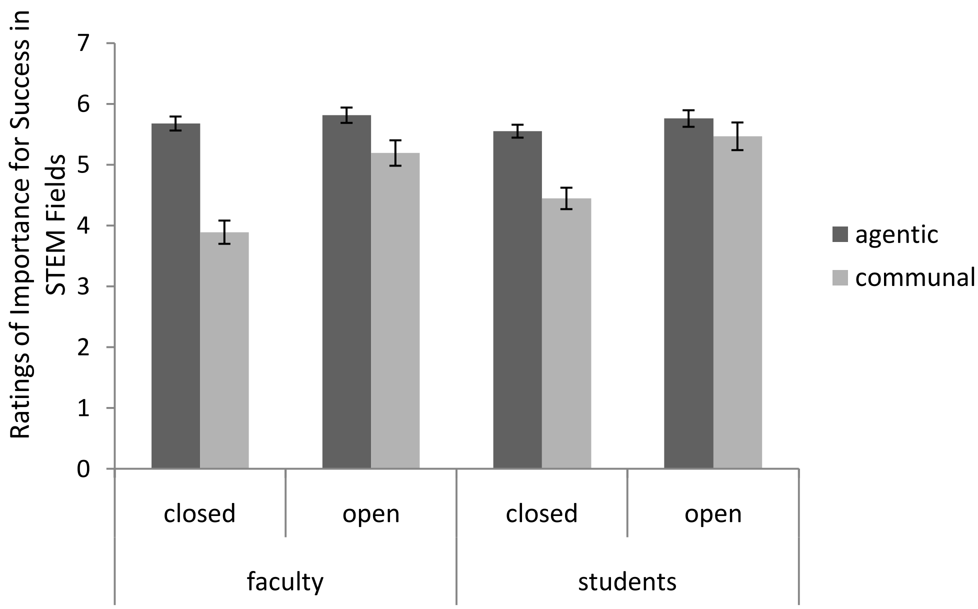

Figure 2. Ratings of the importance of agentic versus communal traits for success in science fields (Study 1).

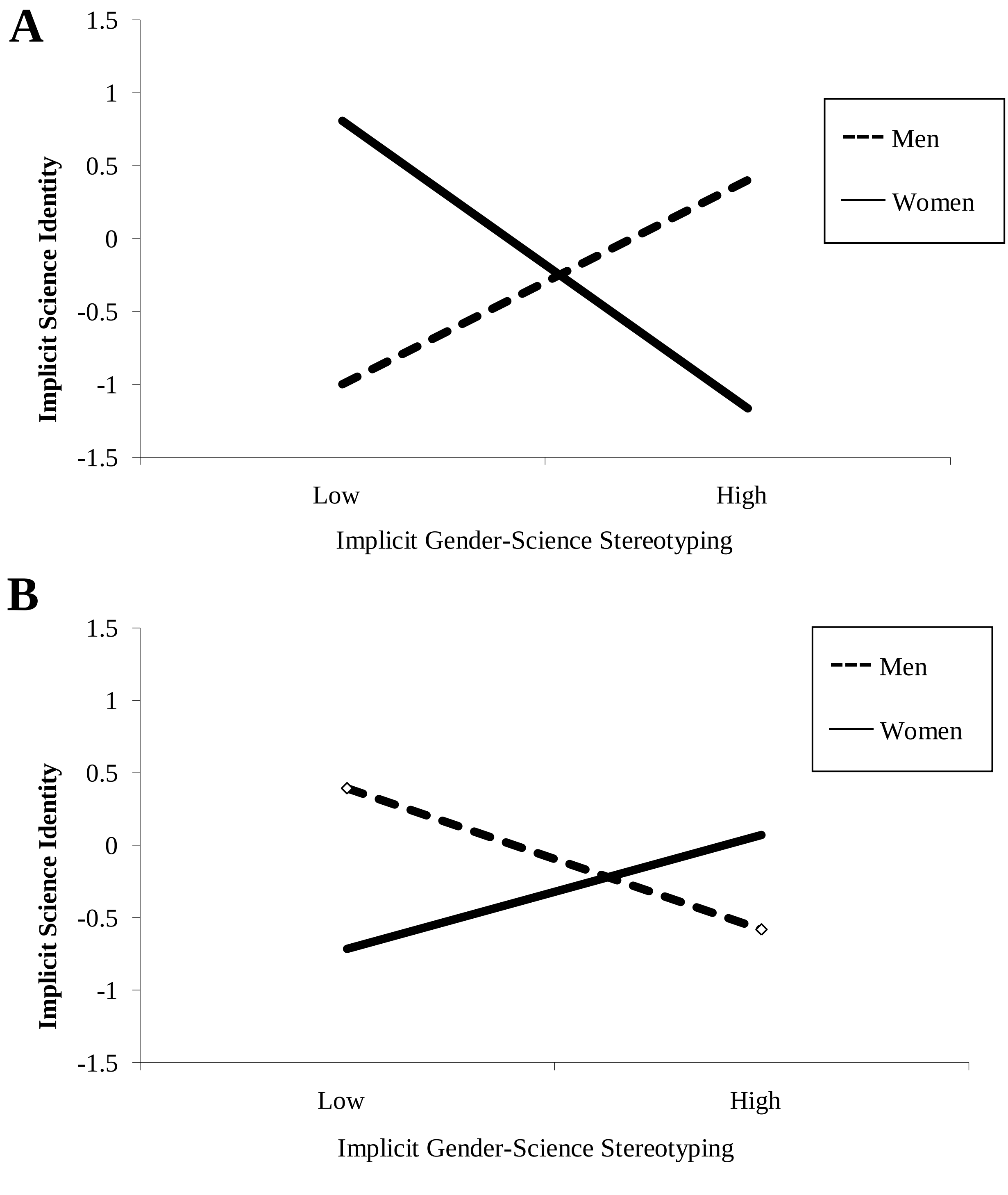

Figure 3. The relationship between implicit gender-science stereotyping and implicit science identity for men and women in the agentic versus communal conditions. These graphs depict the regression analysis reported in Table 3. Figure 3A depicts the slopes for the agentic condition and Figure 3B depicts the slopes for the communal condition.

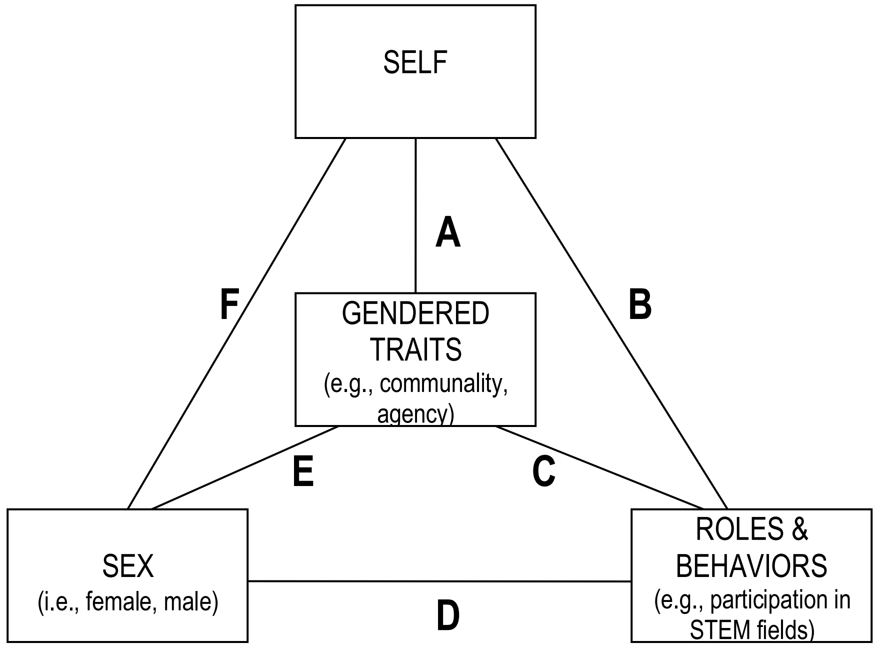

Figure 4. Graphical representation of the pyramidal model of sex stereotyping, which combines the social role and unified theories. Boxes represent concepts and lines represent associations.

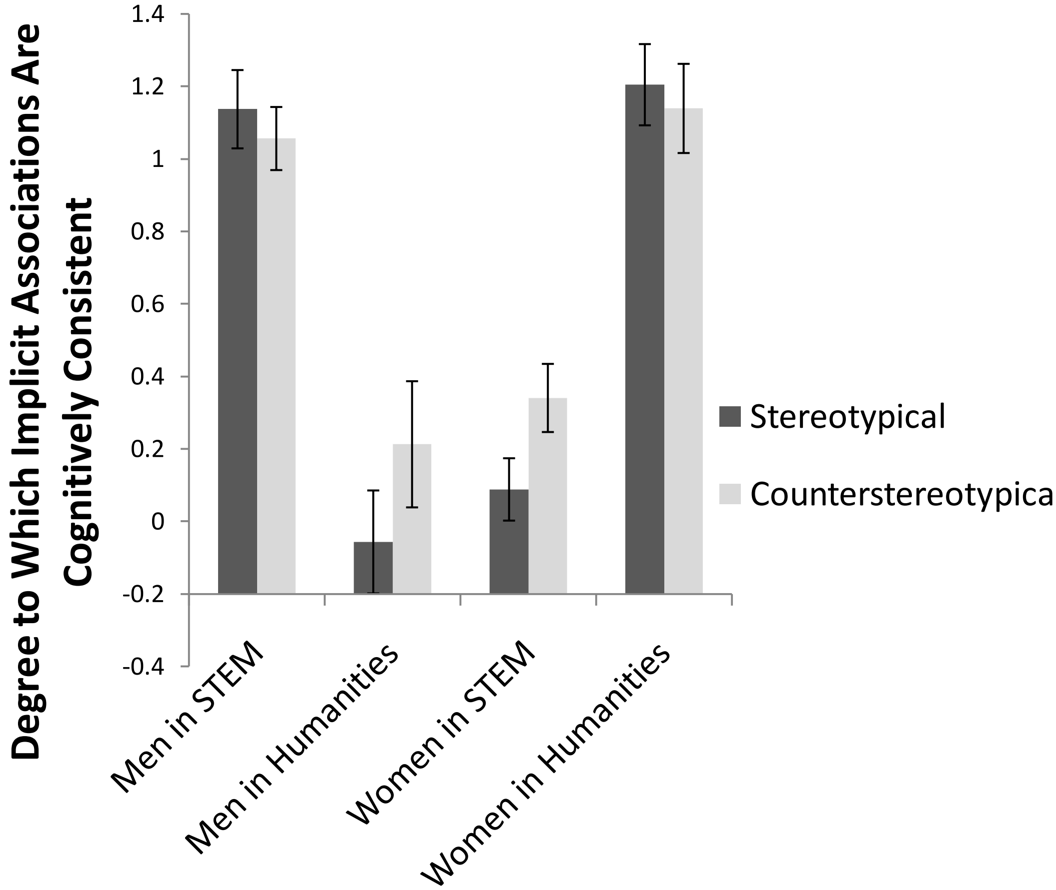

Figure 5. Means of $L_{\text{consistent implicit}}$ scores across all groups (Study 4).

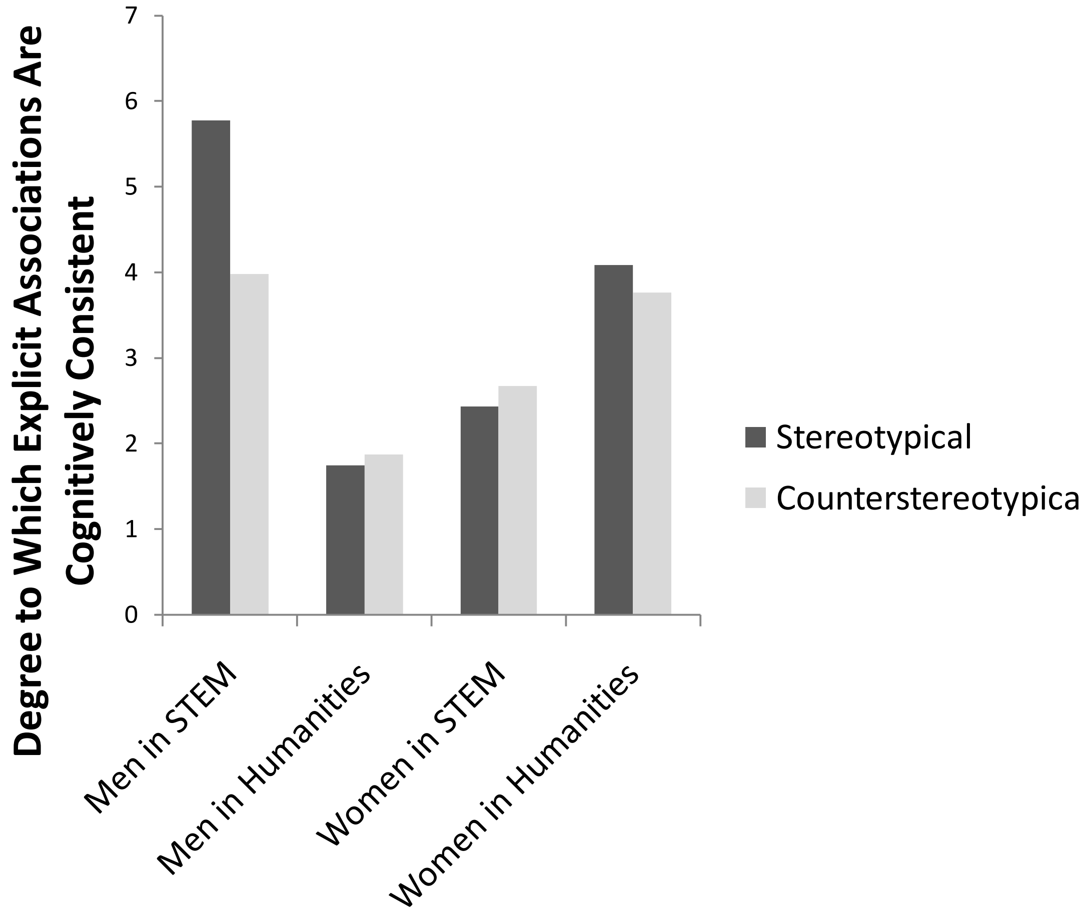

Figure 6. Means of $L_{\text{consistent explicit}}$ scores across all groups (Study 4).

TABLES

Table 1

Means & Standard Deviations of Outcome Variables (Study 1)

	Faculty		Students	
	Men	Women	Men	Women
Feelings of Success	5.03 (1.20)	4.47 (1.15)	5.13 (.98)	5.13 (1.12)
Satisfaction	5.63 (1.06)	5.07 (.99)	5.62 (.97)	5.57 (1.26)
Acceptance	5.25 (1.16)	4.50 (1.24)	5.15 (1.40)	5.08 (1.45)
Motivation to Continue	5.99 (1.13)	5.44 (1.56)	6.23 (.89)	6.07 (1.35)
Career in Same Field as Major	N/A	N/A	6.15 (1.17)	6.04 (1.51)
Productivity	36.16 (57.01)	20.49 (49.27)	N/A	N/A

Table 2

Correlations between Trait Ratings & Outcome Variables (Study 1)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Feelings of Success	-									
2. Satisfaction	.59***	-								
3. Acceptance	.60***	.45***	-							
4. Motivation to Continue	.28***	.60***	.39***	-						
5. Likelihood Career in Same Field as Major (Students Only)	.26**	.46***	.19*	.37***	-					
6. Productivity (Faculty Only)	.26**	.22*	.25**	.13	-	-				
7. Self-Ratings of Communality	.23***	.10	.15*	-.02	-.12	-.07	-			
8. Self-Ratings of Agency	.26***	.22***	.28***	.12†	.06	.16†	.30***	-		
9. Science-Ratings of Communality	.23***	.19**	.21**	.09	.21*	.02	.26***	.01	-	
10. Science-Ratings of Agency	-.05	.00	-.08	.13†	-.10	.09	.08	.24***	.17*	-

†$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$

Table 3

Standardized Beta Coefficients for Regressions where Traits Variables Predicted Outcome Variables (Study 1)

	Outcome Variables					
	Successful	Satisfied	Accepted	Motivated to Continue	Career in Same Field as Major (Students Only)	Productivity (Faculty Only)
Regression with Agentic Variables						
Sex (Covariate)	-.09	-.14†	-.14*	-.14*	-.01	-.10
Time in the Field (Covariate)	-.18**	-.14*	-.12†	-.21**	-.16	.07
Self-Rating	.27***	.21**	.30**	.08	.07	.08
Science-Rating	-.10	-.04	-.15*	.13†	-.14	.08
Interaction of Self- & Science-Ratings	-.08	.03	-.06	.07	.00	.19†
Total R^2	.10***	.07**	.12***	.08**	.04	.09
Regression with Communal Variables						
Sex (Covariate)	-.16*	-.18*	-.20**	-.15*	-.05	-.13
Time in the Field (Covariate)	-.16*	-.10	-.07	-.20**	-.14	.07
Self-Rating	.20**	.06	.14†	-.06	-.19†	-.03
Science-Rating	.18**	.20**	.19**	.12†	.26**	.03
Interaction of Self- & Science-Ratings	.05	.11	-.04	-.02	.12	.03
Total R^2	.12***	.08**	.09**	.06*	.12*	.03

†$p \leq .10$, *$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

Note. For the sex variable, men were coded as -.5 and women were coded as .5. For the successful, satisfied, accepted, and motivated to continue outcome variables, the time in the field covariate was a dichotomous variable wherein students were coded as -.5 and faculty were coded as .5. For the career in same field as major outcome variable, which included only students, Year in School was used for this covariate. For the productivity outcome variable, which included only faculty, time in field was coded such that 1 indicated receiving one's degree less than 10 years ago, 2 indicated receiving one's degree in the last 10-20 years, and 3 indicated receiving one's degree more than 20 years ago.

Table 4

Unstandardized Partial Coefficients (B's), Standard Errors, and Standardized Partial Coefficients (β's) for Regressions Predicting Implicit and Explicit Science Identity (Study 2)

	Implicit Science Identity			Explicit Science Identity		
	B	SE(*B*)	β	*B*	SE(*B*)	β
Condition (contrast coded)	.016	.052	.029	-.383	.198	-.185†
Gender (contrast coded)	.027	.052	.047	.095	.198	.044
Gender-Science Stereotyping (centered)	-.095	.097	-.092	-.184	.134	-.131
Condition*Gender	.087	.103	.077	-.220	.395	-.053
Condition*Gender-Science Stereotyping	.048	.194	.023	.132	.267	.047
Gender*Gender-Science Stereotyping	.202	.194	.098	.351	.267	.120
Condition*Gender*Gender-Science Stereotyping	-.641	.387	-.155†	-.522	.534	-.093

Note. The implicit gender-science stereotyping measure was used in the regression predicting implicit science identity, and the explicit gender-science stereotyping measure was used in the regression predicting explicit science identity. For both implicit and explicit gender-science stereotyping, higher scores indicate associating men with science more than women. $^{\dagger}p \leq .10$, $^{*}p \leq .05$.

Table 5

Items for the Implicit Association Tests in Studies 3 & 4

CONCEPT	**Person**		**Sex**	
CATEGORIES	SELF	OTHER	MALE	FEMALE
ITEMS	Me I [Participant's First Name] [Participant's Last Name] [Participant's Hometown]	They Them [Other First Name] [Other Last Name] [Other Hometown]	Man Boy Son Sir Male	Woman Girl Daughter Lady Female
CONCEPT	**Gendered Traits**		**Discipline**	
CATEGORIES	AGENTIC	COMMUNAL	SCIENCE	HUMANITIES
ITEMS	Individual Decisive Independent Autonomous Competitive	Connected Supportive Interdependent Considerate Helpful	Chemistry Physics Mathematics Engineering Technology	Literature Language History Music Art

Table 6

Means & Standard Deviations (Study 3)

Association	**Positive scores indicate association between…**	**Women**	**Men**	**STEM Majors**	**Humanities Majors**	**Overall**
Sex-Self						
Implicit	female/other & male/self	-.53(.39)	.38(.35)	.03(.59)	-.28(.52)	-.08 (.58)
Explicit		-1.70(.94)	1.92(1.01)	.39(2.03)	-.28(1.95)	.09 (2.06)
Sex-Discipline						
Implicit	male/science & female/humanities	.29(.38)	.33(.39)	.30(.38)	.33(.44)	.31 (.39)
Explicit		.69(1.30)	1.04(1.26)	.92(1.32)	.74(1.43)	.86 (1.30)
Sex-Traits						
Implicit	female/communality & male/agency	.46(.36)	.50(.35)	.47(.33)	.52(.36)	.48 (.35)
Explicit		.65(.75)	.82(.79)	.72(.76)	.71(.80)	.74 (.73)
Discipline-Traits						
Implicit	science/agency & humanities/communality	.67(.32)	.60(.32)	.59(.32)	.71(.35)	.63 (.33)
Explicit		.72(.69)	.74(.77)	.79(.71)	.53(.61)	.72 (.73)
Discipline-Self						
Implicit	self/science & other/humanities	-.05(.46)	.21(.44)	.28(.36)	-.26(.46)	.07 (.47)
Explicit		-.08(1.02)	-.07(1.12)	.09(.97)	-.47(1.27)	-.07 (1.06)
Traits-Self						
Implicit	self/agency & other/communality	-.16(.40)	.12(.41)	.00(.43)	-.06(.43)	-.03 (.42)
Explicit		.05(.59)	.12(.64)	.10(.63)	.03(.59)	.09 (.61)

Table 7

Tests of Unified Theory (Study 3)

Criterion	Step 1	*β*	Step 1 R^2	Step 2	*β*	Step 2 R^2	R^2 Change
Sex-Discipline-Self Triangle (ΔBDF): Implicit							
Self-Discipline	Interaction of Sex-Discipline & Sex-Self	.63**	.390**	Interaction of Sex-Discipline & Sex-Self	.80**	.425**	.04*
				Sex-Discipline	.02		
				Sex-Self	-.26**		
Sex-Discipline	Interaction of Self-Discipline & Sex-Self	.59**	.35**	Interaction of Self-Discipline & Sex-Self	.59**	.35**	.00
				Self-Discipline	.04		
				Sex-Self	.01		
Sex-Self	Interaction of Sex-Discipline & Self-Discipline	.55**	.31**	Interaction of Sex-Discipline & Self-Discipline	.72**	.34**	.03*
				Sex-Discipline	.08		
				Self-Discipline	-.24*		
Sex-Discipline-Self Triangle (ΔBDF): Explicit							
Self-Discipline	Interaction of Sex-Discipline & Sex-Self	.02	.00	Interaction of Sex-Discipline & Sex-Self	.04	.00	.00
				Sex-Discipline	.05		
				Sex-Self	-.05		
Sex-Discipline	Interaction of Self-Discipline & Sex-Self	.02	.00	Interaction of Self-Discipline & Sex-Self	.03	.02	.02
				Self-Discipline	.04		
				Sex-Self	.13		
Sex-Self	Interaction of Sex-Discipline & Self-Discipline	.01	.00	Interaction of Sex-Discipline & Self-Discipline	.05	.02	.02
				Sex-Discipline	.13		
				Self-Discipline	-.06		

Criterion	Step 1	β	Step 1 R^2	Step 2	β	Step 2 R^2	R^2 Change
Sex-Traits-Self Triangle (ΔAEF): Implicit							
Sex-Self	Interaction of Self-Traits & Sex-Traits	.31**	.10**	Interaction of Self-Traits & Sex-Traits	.09	.12**	.03
				Self-Traits	.26†		
				Sex-Traits	.05		
Self-Traits	Interaction of Sex-Self & Sex-Traits	.31**	.10**	Interaction of Sex-Self & Sex-Traits	.12	.12**	.02
				Sex-Self	.24†		
				Sex-Traits	.03		
Sex-Traits	Interaction of Sex-Self & Self-Traits	.08	.01	Interaction of Sex-Self & Self-Traits	.08	.01	.01
				Sex-Self	.05		
				Self-Traits	.03		
Sex-Traits-Self Triangle (ΔAEF): Explicit							
Sex-Self	Interaction of Self-Traits & Sex-Traits	.28**	.08**	Interaction of Self-Traits & Sex-Traits	.43**	.10**	.02
				Self-Traits	-.18		
				Sex-Traits	.08		
Self-Traits	Interaction of Sex-Self & Sex-Traits	.33**	.11**	Interaction of Sex-Self & Sex-Traits	.50**	.14**	.03†
				Sex-Self	-.22†		
				Sex-Traits	-.09		
Sex-Traits	Interaction of Sex-Self & Self-Traits	.33**	.11**	Interaction of Sex-Self & Self-Traits	.34**	.12**	.01
				Sex-Self	.02		
				Self-Traits	-.10		

Criterion | Step 1 | β | Step 1 R^2 | Step 2 | β | Step 2 R^2 | R^2 Change

Discipline-Traits-Self Triangle (ΔABC): Implicit							
Self-Discipline	Interaction of Self-Traits & Discipline-Traits	.46**	.21**	Interaction of Self-Traits & Discipline-Traits	.62**	.23**	.02
				Self-Traits	-.20		
				Discipline-Traits	-.09		
Self-Traits	Interaction of Self-Discipline & Traits-Discipline	.42**	.18**	Interaction of Self-Discipline & Traits-Discipline	.65**	.19**	.02
				Self-Discipline	-.24		
				Traits-Discipline	.07		
Discipline-Traits	Interaction of Self-Discipline & Self-Traits	.33**	.11**	Interaction of Self-Discipline & Self-Traits	.31**	.13**	.02
				Self-Discipline	-.16†		
				Self-Traits	.06		
Discipline-Traits-Self Triangle (ΔABC): Explicit							
Self-Discipline	Interaction of Self-Traits & Discipline-Traits	.11	.01	Interaction of Self-Traits & Discipline-Traits	.06	.02	.01
				Self-Traits	.05		
				Discipline-Traits	.09		
Self-Traits	Interaction of Self-Discipline & Traits-Discipline	.13	.02	Interaction of Self-Discipline & Traits-Discipline	.12	.03	.01
				Self-Discipline	.01		
				Traits-Discipline	-.12		
Discipline-Traits	Interaction of Self-Discipline & Self-Traits	.07	.01	Interaction of Self-Discipline & Self-Traits	.06	.03	.02
				Self-Discipline	.10		
				Self-Traits	-.11		

Criterion	Step 1	*β*	Step 1 R^2	Step 2	*β*	Step 2 R^2	R^2 Change
Discipline-Traits-Sex Triangle (ΔCDE): Implicit							
Sex-Discipline	Interaction of Sex-Traits & Discipline-Traits	.19*	.03*	Interaction of Sex-Traits & Discipline-Traits	.13	.04	.00

				Sex-Traits	.03		
				Discipline-Traits	.05		
Discipline-Traits	Interaction of Sex-Discipline & Sex-Traits	.17*	.03*	Interaction of Sex-Discipline & Sex-Traits	.13	.04	.01
				Sex-Discipline	.00		
				Sex-Traits	.10		
Sex-Traits	Interaction of Sex-Discipline & Discipline-Traits	.19*	.04*	Interaction of Self-Discipline & Self-Traits	.07	04†	.01
				Self-Discipline	.09		
				Self-Traits	.12		
Discipline-Traits-Sex Triangle (ΔAEF): Explicit							
Sex-Discipline	Interaction of Sex-Traits & Discipline-Traits	.46**	.21**	Interaction of Sex-Traits & Discipline-Traits	-.23†	.37**	.17**
				Sex-Traits	.49**		
				Discipline-Traits	.39**		
Discipline-Traits	Interaction of Sex-Discipline & Sex-Traits	.63**	.40**	Interaction of Sex-Discipline & Sex-Traits	.27*	.46**	.08**
				Sex-Discipline	.18*		
				Sex-Traits	.33**		
Sex-Traits	Interaction of Sex-Discipline & Discipline-Traits	.58**	.33**	Interaction of Self-Discipline & Self-Traits	.05	.43**	.09**
				Self-Discipline	.25**		
				Self-Traits	.43**		

† $p < .10$, * $p < .05$, ** $p < .01$

Note. β refers to the standardized regression coefficients associated with each term in each step of the models presented.

Table 8

Contrast Weights & Scoring of Associations for Patterns Tested in Studies 3 & 4

	Associations											
	Sex-Discipline		Sex-Self		Self-Discipline		Self-Traits		Traits-Discipline		Sex-Traits	
Original Scoring	male/science & female/ humanities		female/other & male/self		self/science & other/humanities		self/agency & other/ communality		science/agency & humanities/ communality		female/ communality & male/agency	
Reverse Scoring	female/science & male/humanities		male/other & female/self		other/science & self/humanities		other/agency & self/communality		humanities/agency & science/ communality		male/ communality & female/agency	
Pattern	Weight	Scoring	Weight	Scoring	Weight	Scoring	Weight	Scoring	Weight	Scoring	Weight	Scoring
$L_{\text{STEM men}}$	-.5	Reverse	-.5	Reverse	-.5	Reverse	.5	Original	.5	Original	.5	Original
$L_{\text{Humanities men}}$	-.5	Original	-.5	Reverse	-.5	Original	.5	Original	.5	Reverse	.5	Original
$L_{\text{STEM women}}$	-.5	Original	-.5	Original	-.5	Reverse	.5	Reverse	.5	Reverse	.5	Original
$L_{\text{Humanities women}}$	-.5	Reverse	-.5	Original	-.5	Original	.5	Reverse	.5	Original	.5	Original

Note. The top half of the table indicates what positive scores represent for each association for each direction of scoring. The bottom half of the table indicate the contrast weights and direction of scoring used for each association for each predicted pattern. Essentially, if the contrast weight is positive, then the association should be scored such that positive scores are predicted for that group, but if the contrast weight is negative, then the association should be scored such that negative scores are predicted for that group (i.e., the opposite association of the positive scores). To form the L_P scores used in Studies 3 and 4, these weights were multiplied by the association scores (either scored in the original direction or reverse-scored, as indicated) and then summed (Furr & Rosenthal, 2003).

Table 9

Means & Standard Deviations for Associations across Conditions (Study 4)

Association	**Positive scores indicate association between…**	**Stereotypical Condition**	**Counterstereotypical Condition**	***t*-test comparing conditions**
Sex-Self				
Implicit	female/other & male/self	-.15 (.55)**	-.09 (.55)*	-.89
Explicit		-.90 (3.37)**	-.31 (3.44)	-1.40
Sex-Discipline				
Implicit	male/science & female/humanities	.25 (.41)**	.20 (.39)**	1.08
Explicit		.74 (1.44)**	.67 (1.27)**	.39
Sex-Traits				
Implicit	female/communality & male/agency	.41 (.34)**	.41 (.29)**	-.05
Explicit		1.06 (1.14)**	.93 (.96)**	.99
Discipline-Traits				
Implicit	science/agency & humanities/communality	.65 (.32)**	.47 (.39)**	4.25**
Explicit		1.04 (1.04)**	.65 (.92)**	3.26**
Discipline-Self				
Implicit	self/science & other/humanities	.06 (.44)†	.10 (.46)*	-.63
Explicit		.85 (2.63)**	1.09 (2.48)**	-.74
Traits-Self				
Implicit	self/agency & other/communality	.04 (.42)	.01 (.41)	.52
Explicit		.25 (1.10)**	.08 (.82)	1.46

† $p < .10$, * $p < .05$, ** $p < .01$

Note. Analyses presented include one-sample t-tests comparing each mean to zero (which would represent no association) and independent-sample t-tests comparing the stereotypical and counterstereotypical conditions.

Table 10

Tests of Unified Theory (Study 4)

Criterion	Step 1	*β*	Step 1 R^2	Step 2	*β*	Step 2 R^2	R^2 Change
Sex-Discipline-Self Triangle (ΔBDF): Implicit							
Self-Discipline	Interaction of Sex-Discipline & Sex-Self	.41**	.17**	Interaction of Sex-Discipline & Sex-Self	.38**	.17**	.002
				Sex-Discipline	-.03		
				Sex-Self	.04		
Sex-Discipline	Interaction of Self-Discipline & Sex-Self	.34**	.12**	Interaction of Self-Discipline & Sex-Self	.31**	.12**	.004
				Self-Discipline	-.06		
				Sex-Self	.05		
Sex-Self	Interaction of Sex-Discipline & Self-Discipline	.37**	.14**	Interaction of Sex-Discipline & Self-Discipline	.33**	.14**	.004
				Sex-Discipline	.05		
				Self-Discipline	.07		
Sex-Discipline-Self Triangle (ΔBDF): Explicit							
Self-Discipline	Interaction of Sex-Discipline & Sex-Self	.30**	.09**	Interaction of Sex-Discipline & Sex-Self	.35**	.10**	.01
				Sex-Discipline	.09		
				Sex-Self	-.10		
Sex-Discipline	Interaction of Self-Discipline & Sex-Self	.32**	.10**	Interaction of Self-Discipline & Sex-Self	.34**	.13**	.03*
				Self-Discipline	.15*		
				Sex-Self	.06		
Sex-Self	Interaction of Sex-Discipline & Self-Discipline	.31**	.10**	Interaction of Sex-Discipline & Self-Discipline	.31**	.11**	.01
				Sex-Discipline	.09		

				Self-Discipline	-.07		

Criterion	Step 1	*β*	Step 1 R^2	Step 2	*β*	Step 2 R^2	R^2 Change
Sex-Traits-Self Triangle (ΔAEF): Implicit							
Sex-Self	Interaction of Self-Traits & Sex-Traits	.24**	.06**	Interaction of Self-Traits & Sex-Traits	.16	.09**	.03*
				Self-Traits	.08		
				Sex-Traits	.17**		
Self-Traits	Interaction of Sex-Self & Sex-Traits	.24**	.06**	Interaction of Sex-Self & Sex-Traits	.20†	.06**	.001
				Sex-Self	.05		
				Sex-Traits	-.01		
Sex-Traits	Interaction of Sex-Self & Self-Traits	.14*	.02*	Interaction of Sex-Self & Self-Traits	.12†	.05**	.03*
				Sex-Self	.17**		
				Self-Traits	-.02		
Sex-Traits-Self Triangle (ΔAEF): Explicit							
Sex-Self	Interaction of Self-Traits & Sex-Traits	.26**	.07**	Interaction of Self-Traits & Sex-Traits	.27**	.08**	.01
				Self-Traits	-.08		
				Sex-Traits	.08		
Self-Traits	Interaction of Sex-Self & Sex-Traits	.29**	.08**	Interaction of Sex-Self & Sex-Traits	.46**	.11**	.03**
				Sex-Self	-.25**		
				Sex-Traits	.10†		
Sex-Traits	Interaction of Sex-Self & Self-Traits	.32**	.10**	Interaction of Sex-Self & Self-Traits	.32**	.13**	.03**
				Sex-Self	.11†		
				Self-Traits	.13*		

Criterion	Step 1	β	Step 1 R^2	Step 2	β	Step 2 R^2	R^2 Change
Discipline-Traits-Self Triangle (ΔABC): Implicit							
Self-Discipline	Interaction of Self-Traits & Discipline-Traits	.25**	.06**	Interaction of Self-Traits & Discipline-Traits	.34**	.07**	.005
				Self-Traits	-.11		
				Discipline-Traits	-.04		
Self-Traits	Interaction of Self-Discipline & Traits-Discipline	.26**	.07**	Interaction of Self-Discipline & Traits-Discipline	.34**	.07**	.004
				Self-Discipline	-.10		
				Traits-Discipline	-.05		
Discipline-Traits	Interaction of Self-Discipline & Self-Traits	.20**	.04**	Interaction of Self-Discipline & Self-Traits	.20**	.04**	.004
				Self-Discipline	-.05		
				Self-Traits	-.02		
Discipline-Traits-Self Triangle (ΔABC): Explicit							
Self-Discipline	Interaction of Self-Traits & Discipline-Traits	.29**	.08**	Interaction of Self-Traits & Discipline-Traits	.13	.11**	.03**
				Self-Traits	.15†		
				Discipline-Traits	.16**		
Self-Traits	Interaction of Self-Discipline & Traits-Discipline	.35**	.12**	Interaction of Self-Discipline & Traits-Discipline	.30**	.13**	.002
				Self-Discipline	.06		
				Traits-Discipline	.03		
Discipline-Traits	Interaction of Self-Discipline & Self-Traits	.30**	.08**	Interaction of Self-Discipline & Self-Traits	.26**	.12**	.04**
				Self-Discipline	.20**		
				Self-Traits	.03		

Criterion	Step 1	β	Step 1 R^2	Step 2	β	Step 2 R^2	R^2 Change
Discipline-Traits-Sex Triangle (ΔAEF): Implicit							

Sex-Discipline	Interaction of Sex-Traits & Discipline-Traits	.30**	.09**	Interaction of Sex-Traits & Discipline-Traits	.15	.10**	.006
				Sex-Traits	.14		
				Discipline-Traits	.09		
Discipline-Traits	Interaction of Sex-Discipline & Sex-Traits	.19**	.04**	Interaction of Sex-Discipline & Sex-Traits	.12	.04*	.004
				Sex-Discipline	.10		
				Sex-Traits	.001		
Sex-Traits	Interaction of Sex-Discipline & Discipline-Traits	.25**	.06**	Interaction of Self-Discipline & Self-Traits	.09	07**	.008
				Self-Discipline	.17		
				Self-Traits	.02		
Discipline-Traits-Sex Triangle (ΔAEF): Explicit							
Sex-Discipline	Interaction of Sex-Traits & Discipline-Traits	.53**	.28**	Interaction of Sex-Traits & Discipline-Traits	.28*	.36**	.08**
				Sex-Traits	.43**		
				Discipline-Traits	-.13		
Discipline-Traits	Interaction of Sex-Discipline & Sex-Traits	.53**	.28**	Interaction of Sex-Discipline & Sex-Traits	.39**	.38**	.10**
				Sex-Discipline	-.21**		
				Sex-Traits	.43**		
Sex-Traits	Interaction of Sex-Discipline & Discipline-Traits	.62**	.38**	Interaction of Sex-Discipline & Discipline-Traits	.11	.51**	.12**
				Sex-Discipline	.38**		
				Discipline-Traits	.38**		

† $p < .10$, * $p < .05$, ** $p < .01$

Note. β refers to the standardized regression coefficients associated with each term in each step of the models presented.

APPENDICES

Appendix A

Experimental Manipulation for Study 2

This information was shown to participants prior to completing the dependent measures. They are modified from information found at The Princeton Review website, which describes what various careers are like (http://www.princetonreview.com/Careers.aspx?page=1&cid=34).

Manipulation for the Agentic-Science:

What Does It Take to Be a Research Scientist?

The Princeton Review conducted a large-scale survey assessing what different careers are like. Below is a summary of the results of their survey regarding what it is like to be a scientist.

Research scientists "are paid to be creative, careful, and productive" said one of our survey respondents, and the rest agreed. Scientists analyze how the world works. Scientists spend over 60 percent of their time in the lab or in front of their computers analyzing data. Most work is done independently, and more than one respondent pointed out that being autonomous is "essential" to success in this field. Research scientists compete with each other to gain access to information and to make cutting-edge discoveries. This requires good self-motivating skills and an ability to always keep end goals in mind. "You don't spend a lot of time hanging out with other scientists, but you do spend a lot of time reading about them." Scientists are challenged, excited, and satisfied with the profession in which the majority spend their entire careers.

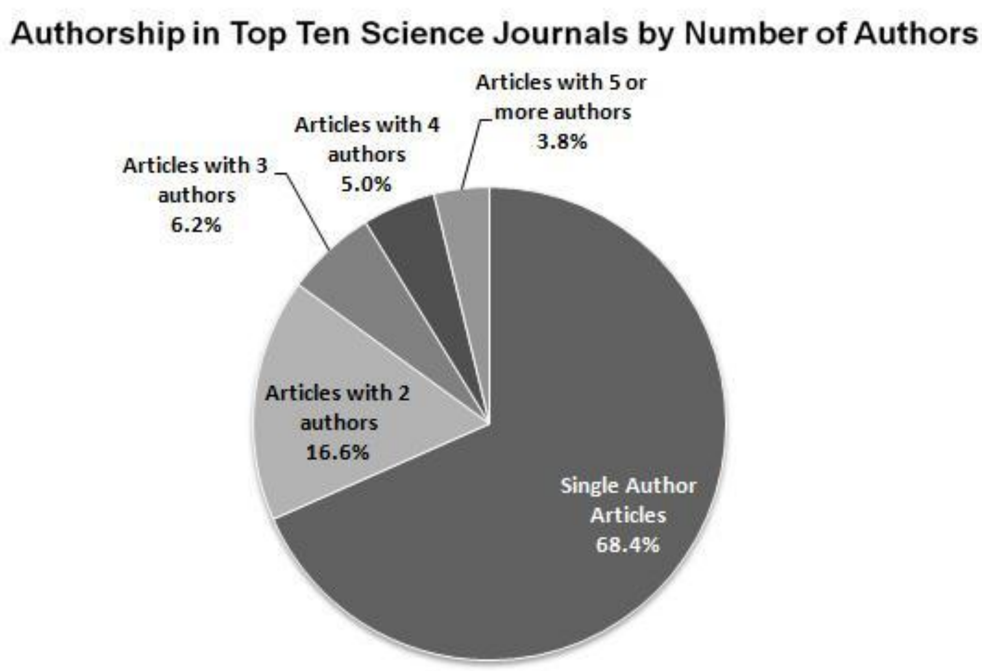

Figure 1. Scientists tend to work independently, leading to single author research publications.

Manipulation for the Communal-Science Association:

What Does It Take to Be a Research Scientist?

The Princeton Review conducted a large-scale survey assessing what different careers are like. Below is a summary of the results of their survey regarding what it is like to be a scientist.

Research scientists "are paid to be creative, careful, and productive" said one of our survey respondents, and the rest agreed. Scientists analyze how the world works. Scientists spend over 60 percent of their time in the lab or in front of their computers analyzing data. Most work is done in teams (and published in teams as well, see Figure 1 below), and more than one respondent pointed out that teamwork skills are "essential" to success in this field. Research scientists work closely with each other, share information and collaborate to make cutting-edge discoveries. This requires good interpersonal skills and an ability to always keep end goals in mind. "You don't spend a lot of time by yourself in the lab, but you do spend a lot of time working with other scientists." Scientists are challenged, excited, and satisfied with the profession in which the majority spend their entire careers.

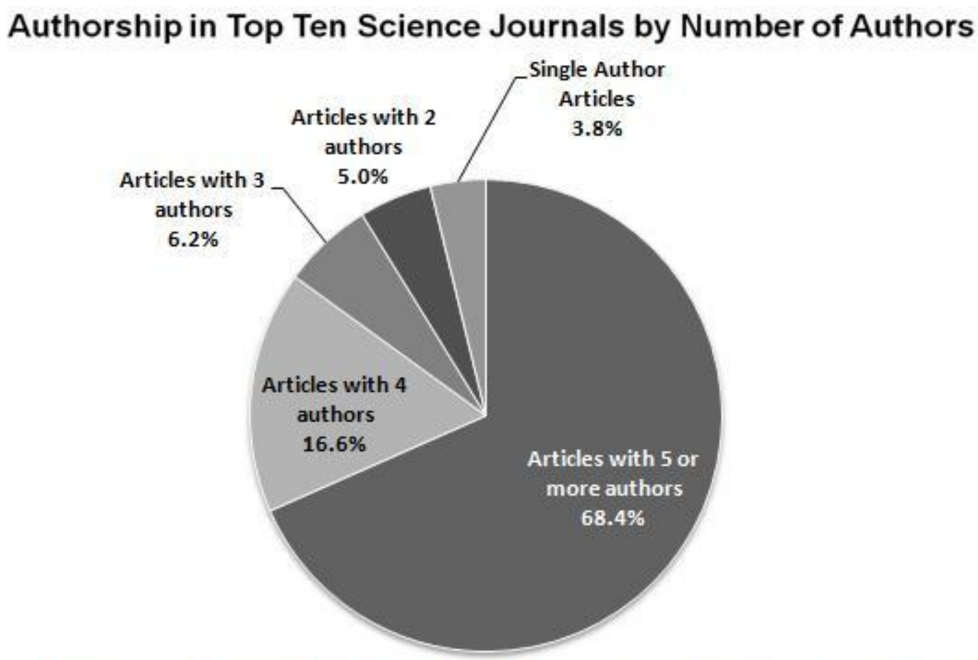

Figure 1. Scientists tend to work in groups, leading to research publications by multiple authors.

Appendix B

Explicit Measures of Sex-Science Stereotyping and Science Identification Used in Studies 2, 3, and 4

Note: These items will be randomized when given to the participants, but are arranged according to the association they are designed to test for your ease.

Sex-Science Stereotyping Items

Please rate the following words using this scale:

1	2	3	4	5	6	7
completely disagree						completely agree

____ It is possible that men have more science ability than do women.
____ In general, women may be better than men at science disciplines.
____ I don't think that there are any real gender differences in science ability.
____ Generally, men are better suited for careers in the sciences than women.
____ The word **male** is characteristic of **people in the sciences.**
____ The word **female** is characteristic of **people in the sciences.**
____ The word **man** is characteristic of **people in the sciences.**
____ The word **woman** is characteristic of **people in the sciences.**

Science Identification Items

Please rate the following words using this scale:

1	2	3	4	5	6	7
completely disagree						completely agree

____ Participating in science disciplines is an important part of my self-image.
____ Participating in science disciplines is *unimportant* to my sense of what kind of person I am.
____ Participating in science disciplines has very little to do with how I feel about myself.
____ I am a science person.
____ I would feel incomplete as a person if I did not participate in science.
____ I associate myself with science disciplines.
___ I do not associate myself with science disciplines.

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