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Adolescents' and Emerging Adults' Implicit Attitudes about STEM Careers: "Science is Not Creative"

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ABSTRACT: Although interest in science and math is often high in the elementary grades, interest in choosing science and math careers drops off beginning in junior high school for both genders, but especially for girls. By high school, a shift towards increased rigor is often accompanied by a lack of creativity in the way that scientific disciplines are taught. The Implicit Association Test (IAT) was administered to male and female high school students to test their implicit associations of science with creativity. In a follow-up study, the IAT was administered to male and female college students in order to measure implicit associations of science with creativity, and associations of science with self. Results showed that the association of science with lack of creativity was present for young women in high school as well as college, but for young men the science-uncreative association was evident only among the college population. Only college-aged women showed a significant association of science with others (not self). Interest in science careers for women, but not for men, was predicted by a science-creative implicit association. These findings underscore the importance of implicit beliefs about the nature of scientific practice for understanding adolescents' and emerging adults' interest in science careers.

KEY WORDS: STEM, Science education, Creativity, Sex differences, Implicit attitudes.

INTRODUCTION

Educators have struggled for years to increase young people's interest in choosing careers in scientific, technological, engineering and mathematical (STEM) fields (Bevins, Byrne, Brodie, & Price, 2011; Elster, 2014; Osborne, Simon, & Collins, 2003). Although interest in science and math is often high in the elementary grades, interest in choosing science and math careers drops off beginning in junior high school for both genders, but especially for girls (Eccles et al.,1993; George, 2006; Quinn & Lyons, 2011; Simkins, Davis-Kean, & Eccles 2005). Science literacy and math

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skill are promoted in the elementary years by parental support, including visiting science museums, providing science toys, and other resources, and in later years by parental support for high academics more generally (Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001). This support can lead to increased efficacy in science and math, and increased likelihood of science career choice. Alternatively, a lack of support, coupled with the increased rigor of science courses starting in junior high can be associated with increased difficulty and decreased interest in the years when career choices are being made (Simpkins, Davis-Kean, & Eccles, 2006).

By high school, a shift towards increased rigor is often accompanied by a lack of creativity in the way that scientific disciplines are taught (Osborne, et al., 2003). Students perceive that their science classes focus on established facts rather than the excitement of scientific discovery; they are thus unchallenged by the material and consider the topic boring. However, when challenging creative approaches are used, they value science more (Osborne & Collins, 2001). Thus, students often come to believe that the day-to-day practice of science is both uncreative and socially isolated, and students who like science are often negatively stereotyped in this way (Hannover & Kessels, 2004). Furthermore, a gender difference in interest in math and science has been reported repeatedly, with girls choosing science career paths less frequently than boys even though they may be just as competent in these subjects (Dick & Rallis, 1991).

Even when girls do choose science related careers, they are less likely to choose a pure research path (e.g., Grunert & Bodner, 2011), choosing instead more socially relevant science careers such as psychology, health science or veterinary medicine (National Science Board, 2008; Farmer, Waldrop, Anderson & Reisinger 1995). In fact, it is widely believed that STEM careers do not promote communal goals of altruism and affiliation, career goals that are particularly valued among women (Diekman, Brown, Johnston, & Clark, 2010). There is evidence that girls enjoy science less in relation to other high school subjects, and are more likely to underestimate their science competence compared to boys (Quinn & Lyons, 2011).

The perception still persists that hard sciences such as chemistry, physics and engineering are uncreative professions practiced in socially isolated laboratories, contrary to the beliefs of most practicing scientists. Our earlier research has confirmed these anti-scientific attitudes (Masnick, Valenti, Cox, & Osman, 2010). When high school and college students are asked to rate the similarity of common professions, multidimensional scaling (MDS) analysis revealed that science professions are clustered on an axis at the opposite end of professions in the arts that are generally considered to be highly creative (e.g., painter, writer, musician). On a second dimension, scientific professions are situated far away from professions of similar status that require social interaction (e.g., lawyer, teacher, psychotherapist). Each of these findings was confirmed by regressing the MDS dimensions on participants' explicit ratings of various professions. Participants consciously rated scientific professions as lower on creativity and sociality than other professions of similar prestige, and these rating provided a good fit for the MDS structure. There were no age differences between high school and college ratings or MDS solutions; the data for both boys and girls suggests that these negative perceptions of science are already set by adolescence.

Three significant questions remain, to be addressed in this paper:

1. Does the attitude that science is uncreative persist at the level of implicit, fast, and automatic processing?
2. Do high school and college subjects identify with or reject science at an implicit level?
3. Are there gender differences in these implicit attitudes?

BACKGROUND

Implicit Attitudes about Science

The Implicit Association Test (IAT) was developed to detect the possible non-conscious presence of socially disapproved attitudes. For example, participants may understandably have reservations towards expressing negative racial beliefs on explicit measures of attitudes, or they may not even be aware that they have such attitudes. The IAT is a reaction-time task, constructed on the assumption that participants will respond faster when making familiar associations gained in extensive past experience than in making unfamiliar associations. In a classic study, Greenwald, McGhee, & Schwartz (1998) asked participants to press a computer key with the right hand as fast as possible if a briefly presented word was either a negative adjective or a typically African-American name (e.g., Latonya). They were to press a key with the other hand if typically, Anglo-American names or positive adjectives were presented; appropriate counterbalancing of hands and stimulus words was applied. It was found that participants responded faster when typical African-American names were paired with negative adjectives than when they were associated with positive adjectives. The reverse was true for white names: i.e., participants were faster to associate white names with positive adjectives than with negative ones. This effect has been replicated several times, and has been found to occur even when the participants are themselves African-Americans (Baron & Banaji, 2006; Nosek, Banaji, & Greenwald, 2002).

The IAT effect has been replicated in a host of different studies in social psychology on many different subjects. Rudman, Greenwald, & McGhee (2001) found that women associated warmth with female words, whereas men associated power with masculinity. Combined with other experiments, IAT effects suggest that people tend to associate positive attributes with themselves and their own gender (Greenwald & Farnham, 2000).

Indeed, when self-associated terms are used as stimuli in IAT studies, the effects typically become stronger. For example, the IAT effect is stronger for self-generated descriptors than for others, and the self-generated descriptors are quickly associated with positive attributes (Perkins & Forehand, 2006). Conversely, if the experimental method deemphasizes identification, IAT effects are reduced (Popa-Roch & Delmas, 2010).

Of particular interest in the current study is work related to gender differences in IAT effects for STEM subjects. A host of studies of both implicit and explicit attitudes have found that math and science are associated with males, and arts and language subjects are commonly associated with females. This gender stereotype runs deep, has cross-cultural validity, and is associated with math and science performance. For example, a massive sample of IAT results from up to 34 countries, with a total of a half million subjects, suggests that male is associated with science terms, and female with artistic terms. Furthermore, the larger the gender association, the larger the difference in 8th grade math and science scores cross-culturally on two separate test administrations (1999 and 2003), even when controlled for such covariates as starting level of cultural gender bias and country of origin GPD (Nosek et al., 2009). More importantly, the gender stereotype is implicated in whether or not men or women identify with studying science and math, or indicate an interest in becoming scientists (Kessels, Rau, & Hannover, 2006).

Dominant attitudes and science careers

To explain the ubiquitous finding that women are less likely to choose science careers, one would need to examine dominant attitudes (science is evaluated negatively), gender (science is considered more negatively by women), and self-identification with careers (science is not associated with the self-concepts of most women). For example, Nosek et al. (2002) used IAT methods to examine in detail the relationships among implicit attitudes towards math, gender, and self-concept. In this study, four separate IATs were administered, consisting of

a. math vs. language terms associated with pleasant vs. unpleasant words,
b. math vs. arts terms associated with pleasant vs. unpleasant words,
c. science vs. arts terms associated with pleasant vs. unpleasant terms, and
d. self vs. other terms associated with math vs. art terms.

All of the predicted implicit associations among domains were obtained. For example, all participants were faster to associate the arts with pleasant adjectives and faster to associate math and science terms with unpleasant adjectives. They were also faster to associate self-words with art terms than with math terms. But in nearly every case, the magnitude of this effect was greater for women. Furthermore, the magnitudes of IAT effects for women were correlated with both school performance and with explicit attitudes about math and science. Both men and women demonstrated equally strong associations of math with male and arts with female. For women, implicit associations of math with male were correlated with lower SAT mathematics scores. For men, implicit identification with math was associated with higher confidence and performance on mathematics SAT. Explicit ratings in these experiments usually correlated highly with the implicit results, but the implicit results explained an additional portion of variance compared to the explicit results alone.

A further link between implicit attitudes towards science and career choice would be if implicit beliefs were related to both self-concept and one's college major. Perugini, O'Gorman, and Prestwich (2007) asked young adults in a variety of college majors to circle self-related terms (yielding "self-activation"), or neutral terms in a proofreading task. Both groups of participants were then administered an IAT which paired positive or negative terms (e.g. good, pleasure, friend vs. evil, pain, ugly) with discipline names (e.g. history, literature vs. biochemistry, mathematics). IAT results significantly predicted whether the participant was in an arts or science major, and self-activation significantly improved predictions. A similar effect was not found for explicit attitudes.

The Current Study

In summary, socialization processes in American society tend to turn children against science and math at least as early as age 13. This outcome is exacerbated both by increasing rigor and uninspired teaching in the subjects. Gender stereotypes and self-identification with those stereotypes increase the likelihood that girls will self-identify less with STEM career paths than boys. Without countervailing support from parents and teachers, these forces become increasingly implicit, internalized, and difficult to reverse, even for young women who are just as competent in these subjects as men.

The current study examines implicit attitudes against science among adolescents (ages 14-17) and college students, and examines an aspect as yet unstudied, but recognized as important by educators: the belief that science is not creative. Regrettably, we predict that students as young as 14 might already have come to the implicit conclusion that science consists of established findings about the world, rather than a creative process of investigation. Moreover, all previous findings in this area suggest that the size of the implicit association of science with low creativity will be greater for women than for men. We predicted that these effects would be confirmed in explicit measures as well, but the IAT effects would add to the explanatory power of explicit attitude measures.

STUDY 1

Implicit attitudes regarding creativity in science and art were investigated first with the IAT in a sample of male and female high school students.

METHODOLOGY

Participants

Fifty-one high school student volunteers (22 females and 29 males, ages 16-18) were tested individually. These students attended a public high school in New York State, USA, with a population that is 89% European-American, 5% Asian-American, and 4% Hispanic. Our sample approximated the ethnic proportions of the school from which they were drawn. Informed consent was obtained from the parent or guardian for each student. Students were recruited from science courses at the high school.

Procedure: The IAT

The IAT measures the relative strength of association between a target concept (e.g., occupation: scientist and artist) and an attribute concept (e.g., creativity and lack of creativity). To measure strength of association, participants are required to pair concepts as quickly as possible with one hand or the other. For example, participants were told in one block of trials to respond with the left hand as quickly as possible, if they see either a title of a science occupation (e.g., chemist), or a word that denotes creativity (e.g., inventive), and to respond with the right hand if they see a title of an artistic occupation (e.g., sculptor), or a word denoting lack of creativity (e.g., unoriginal). In a second block of trials, the pairing of the target concept and attribute concepts were switched by requiring one hand to respond to science occupations or words denoting lack of creativity, and to respond with the other hand to artistic occupations or words denoting creativity. If the association of art with creativity is stronger than the association of science with creativity, then reactions times should be faster when art and creativity are paired.

Each student was administered the IAT using E-Prime software (Psychology Software Tools, Inc.) on a notebook computer. To perform the task, participants were instructed to place a left-hand finger on the “e” key and a right-hand finger on the “i” key. For both the practice trials and test trials, five words represented each of the four categories:

- science (biologist, chemist, meteorologist, geologist, physicist);
- art (sculptor, novelist, portrait painter, landscaper, interior designer);
- creative (creative, imaginative, inventive, ingenious, inspired); and
- uncreative (routine, common, unoriginal, unchanging, repetitive).

For one block of 60 trials (20 practice trials and 40 test trials), participants were instructed to press one key (e or i) each time a word representing the categories “science” and “creative” appeared in the centre of the screen, and to press the other key each time a word representing the categories “art” and “uncreative” appeared on the screen. Stimulus words appeared on the screen for 5 seconds, and the next word was displayed 5 seconds after the response. Reaction times from the stimulus presentation to the key press were recorded for each trial. In the second block of 60 trials (20 practice and 40 test), the associations were switched, so that now the participant needed to press one key if the categories “science” and “uncreative” appeared, and to press the other key if the categories “art” and “creative” appeared. Across participants, counterbalancing was used to ensure that the “e” and “i” key were used to respond equally to the 4 categories, and the pairing of “science” and “creative” categories occurred equally often in the first and second trial blocks.

RESULTS AND DISCUSSION

The response latencies were analysed using the standard protocol for the improved scoring algorithm recommended by Greenwald, Nosek, and Banaji (2003). For each participant, we calculated D (analogous to Cohen’s d) by taking the mean difference in reaction times for “science-uncreative/art-creative” trials and “science-creative/art-uncreative” trials, and dividing the mean by the pooled standard deviation of the reaction times. A score of “0” indicates that the mean reaction time was equal in the “science-creative, art-uncreative” and the “science-uncreative, art-creative”, hence indicating no differential association of science and art with creativity. Positive scores indicate a stronger association of science with creativity, whereas negative scores indicate a stronger association of science with lack of creativity.

An independent-samples t-test revealed a significant gender effect, $t(49) = 2.78$, $p = .008$. As seen in Figure 1, the mean IAT effect in women (0.54) is almost five times as large as the effect for men (0.11), indicating a much stronger association of science with lack of creativity among women. Furthermore, only the female high school students showed a reliable implicit association of science with lack of creativity as evidenced by a significant one-sample t-test comparing the mean IAT effect to 0; $t(21) = 5.478$, $p < .001$. These findings suggest that by high school age, a striking gender difference in perceptions of science is already in place, and likely to influence college major choices and career plans.

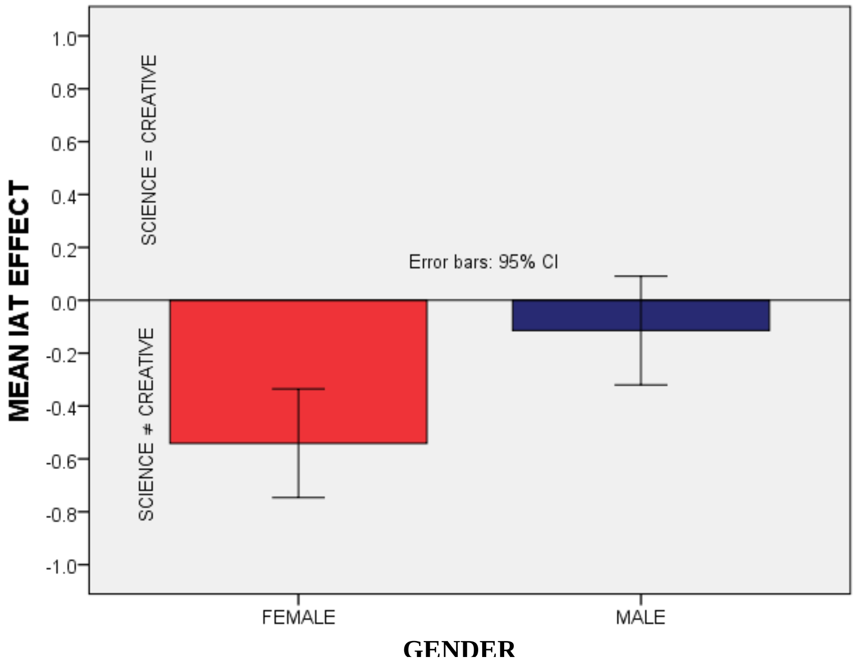

Figure 1 Mean IAT effect by gender.

A negative effect indicates a stronger association of science with non-creative words than with creative words.

STUDY 2

Our goal in Study 2 was to extend our research on the association of science and creativity to a college-aged population. As in Study 1, we measured science-creativity associations for men and women using the IAT. To this we added an IAT for measuring science-self associations, as well as an explicit measure of attitudes about science, the Test of Science Related Attitudes (TOSRA; Fraser, 1981).

METHODOLOGY

Participants

Sixty-seven college student volunteers (22 females and 27 males, ages 18-22) were tested individually. The college students attended a suburban university in New York with a higher level of diversity compared to the high school population (e.g., 64% White/European ancestry).

Instruments

The IAT: Science and Creativity. We tested the implicit associations of occupations (science/art) with the attribute concept of creativity. The same stimulus words and testing procedure from Study 1 were used. The four word categories were

- science (biologist, chemist, meteorologist, geologist, and physicist),
- art (sculptor, novelist, portrait painter, landscaper, interior designer),
- creative (creative, imaginative, inventive, ingenious, inspired) and
- uncreative (routine, common, unoriginal, unchanging, repetitive).

The IAT: Science and Self. In addition, the college sample was given an implicit identity task to examine the strength of association between the target concept of occupation (science/art) and the target concept of self (I/they). The science and art occupations from Study 1 were also used in this IAT, along with the target attribute words for self (I, mine, me, myself) and other (them, theirs, they, their). These are the same target words from the identity implicit task used by Nosek et al. (2002).

The Test of Science-Related Attitudes (TOSRA). The Test of Science-Related attitudes (TOSRA) is a 70-item questionnaire that measures seven attitudes on a 5-point scale:

- social implications of science,
- normality of scientists,
- attitude to scientific inquiry,
- adoption of scientific attitudes,
- enjoyment of science lessons,
- leisure interest in science, and
- career interest in science.

The scale was originally developed for secondary-school students (Fraser, 1978), but its content is appropriate for college students as well. Estimates of Internal consistency reliability for the TOSRA subscales ranged from 0.66 to 0.93 in a large sample of secondary school students in the Sydney metropolitan area (Fraser, 1981).

Procedure

Each participant was tested individually after giving informed consent. The procedure for the implicit measures was identical to that used in Study 1. The IATs, in counterbalanced order, were administered first, followed by the explicit measure of science-related attitudes (TOSRA).

RESULTS AND DISCUSSION

Implicit measures of science attitudes

As in Study 1, the response latencies from the IAT trials were analysed using the improved scoring algorithm recommended by Greenwald, et al. (2003). For each participant, the measure D was calculated. Positive scores indicated an association of science with the concepts "creative" or "self".

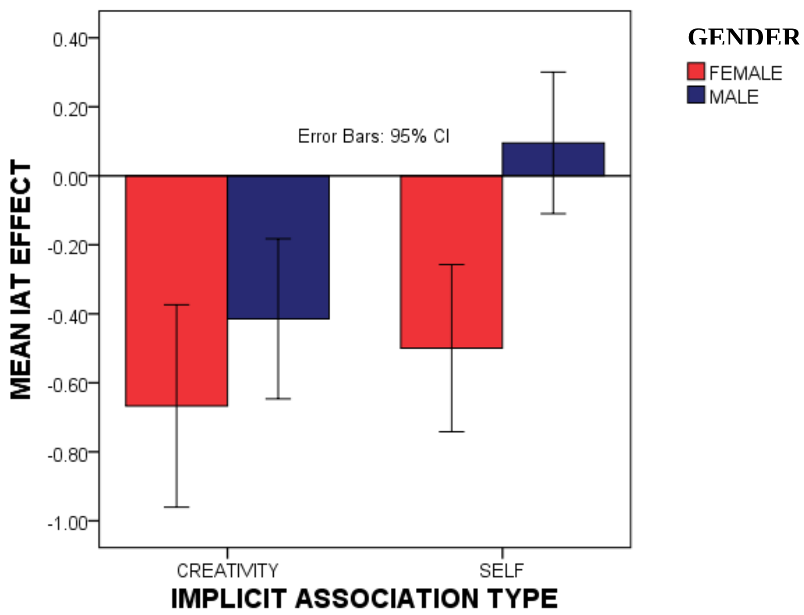

Figure 2 **Mean IAT effect by association type (science-creativity; science-self) and gender.**

All participants associated science with less creativity than art, but only the women associated science with others more than with themselves.

Figure 2 displays the mean IAT D scores as a function of type of IAT (creative; self) and gender. A mixed ANOVA (IAT type x gender) revealed a marginally significant interaction, $F(1, 47) = 3.095$, $p = 0.085$. The mean IAT scores for male and female students are substantially less than 0 for the science-creative association, hence indicating that science is not associated with creativity, but only the female science-self association is less than 0, indicating a science-other association (single-sample t-tests; each $p < .001$). Unlike the result in Study 1, where only high school female students showed a science-uncreative association, the college sample revealed no gender effect for the science-uncreative association. On the other hand, there was a significant gender difference favouring women for the science-other association ($t(47) = 3.896$, $p < .001$). Overall, these data suggest that college women and men hold the implicit attitude that science is not creative, but only women hold the attitude that science is associated with others and not with the self.

Explicit measures of science attitudes: TOSRA Subscales

Mean scores for male and female students on the seven TOSRA subscales are displayed in Figure 3.

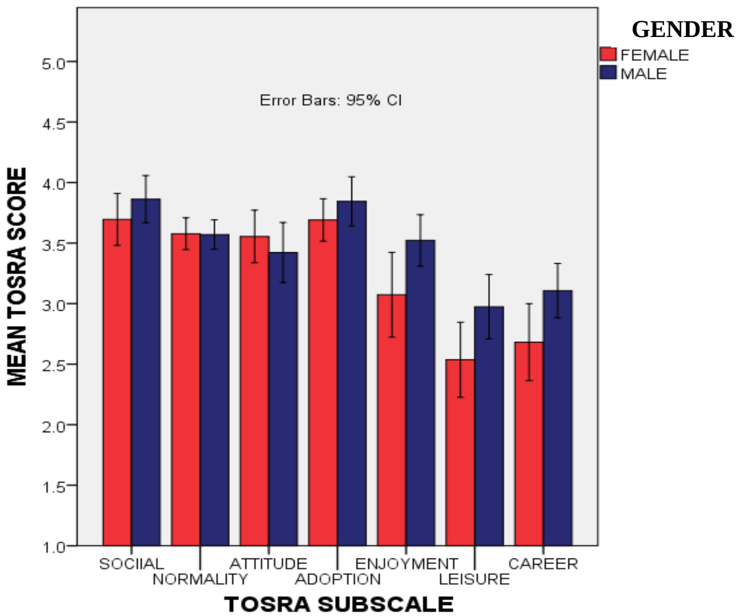

Figure 3 Mean TOSRA subscale scores as a function of gender.

The attitudes of men appear to be higher on most if not all of the subscales. That is, men expressed more positive explicit attitudes toward science than women. MANOVA revealed a significant effect of gender

(F(6, 42) = 37.601, p < .001) and a marginally significant effect of the gender x subscale interaction (F(6, 42) = 6.000, p = 0.080). Post-hoc t-tests revealed more positive attitudes about science for men on the following subscales: enjoyment of science lessons, leisure interest in science, and career interest in science (all p values < .05). We note that there was no gender difference in the average number of college science courses taken by this sample (M = 0.86), or in the percentage of STEM majors (7%).

We compared the college students' implicit and explicit attitudes about science by correlating the IATs (science-creative and science-self) with the 7 subscales of the TOSRA for men, women, and for the combined sample. The correlation coefficients are presented in Table 1. A positive correlation indicates that the science-creative or science-self implicit association is significantly related to positive explicit attitudes about science. Women with a higher implicit association of science and creativity also adopted explicit positive scientific attitudes (r = 0.48) and expressed career interest in science (r = 0.55). There were no significant correlations between women's implicit identification with science and any of the TOSRA subscales.

Table 1 Correlation coefficients for mean TOSRA subscale score with IAT effect for the two IATs.

	Female students (n=22)		**Male students (n=27)**		**All students (N=49)**	
TOSRA subscale	Sci. is creative	Science Identity	Sci.is creative	Science Identity	Sci.is creative	Science Identity
Social implications	0.40	-0.04	-0.28	0.10	-0.06	0.16
Normality of scientists	-0.20	-0.19	-0.17	0.13	-0.19	-0.03
Attitude to scientific inquiry	-0.07	-0.24	-0.21	0.31	-0.16	0.05
Adoption of scientific attitudes	0.48*	0.21	-0.52**	0.13	-0.03	0.27
Enjoyment of science lessons	0.39	0.32	-0.33	0.49**	0.16	0.49**
Leisure int. in science	0.38	0.16	-0.46*	0.47*	0.25	0.44**
Career int. in science	0.55**	0.14	-0.50**	0.40*	0.10	0.36**

*p < .05, **p < .01

However, the pattern for men was distinctly different, and unexpected. When men's implicit association of science and creativity was stronger, they were less likely to adopt a scientific attitude (r = -0.52) and less likely to show career interest in science (r = -0.53). Figure 4 illustrates the interaction of gender and science-creative association for predicting career interest in science as superimposed scatterplots for male and female college students.

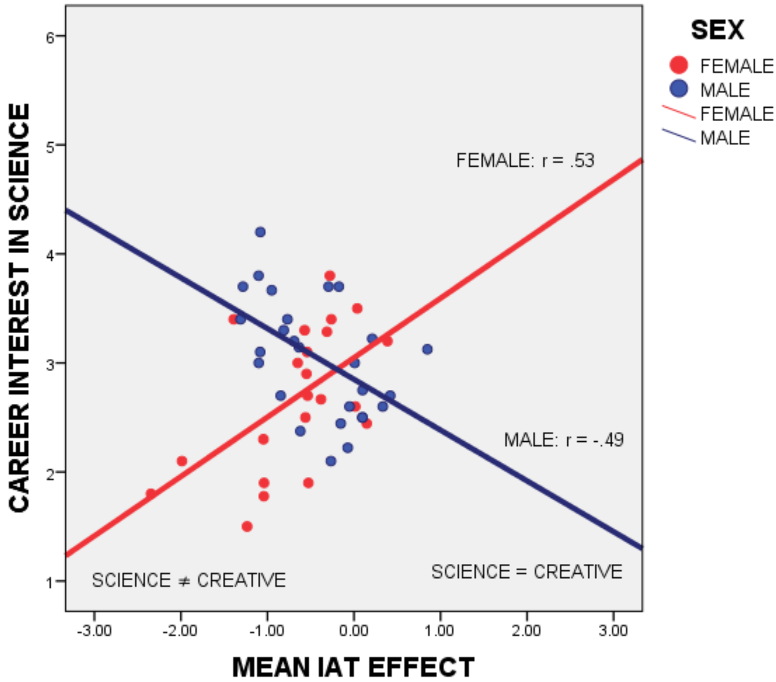

Figure 4 **Association of science-creative IAT effect and explicit career interest in science, by gender.**

This counterintuitive finding suggests to us that either

a. male students have less favourable attitudes about creativity, or
b. their understanding of the term "creativity" is different compared to that of female students.

CONCLUSION

Our aim in this research was to examine implicit and explicit attitudes about science careers in high school and college students. Our review of past studies and our own published work suggested that adolescents and emerging adults would hold negative attitudes about science, specifically, the belief that science was an uncreative enterprise and the belief that science was “not for me.” Evidence that students believe science was not creative was obtained for female high school students, and for both male and female college students. Responses in the IAT task for these groups were significantly delayed when words denoting “creativity” and “science careers” were associated. In other words, male students’ negative attitude that “science was not creative” appeared to increase from high school to college, but female students’ attitude about the lack of creativity in science was established in high school and possibly earlier. These findings complemented the work of Eccles and others on modelling the cognitive, social and cultural antecedents of career choice (e.g., Eccles, 2011; Quinn & Lyons, 2011; Wang, Eccles, & Kenny, 2013). In particular, the current study added to our understanding of students’ early conceptualizations of scientific professions.

As expected, we observed a gender difference on most of our explicit measures of attitudes about science. More positive attitudes were expressed by college-age men for the TOSRA subscales, measuring enjoyment of science lessons, leisure interest in science, and career interest in science. The observed gender difference in attitudes about science was consistent with previous studies demonstrating that young women were less likely to value careers in basic science and mathematics (e.g., Diekman et al., 2010; Grunert & Bodner, 2011; Osborne et al., 2003).

We also found an unexpected gender difference among college students in the association of creativity and career interest. Women who linked science with creativity tended to be more positive about science and more interested in a science career. Surprisingly, men who linked science with creativity tended to be less positive about science, and less interested in a science career. It was possible that men and women tended to value creativity differently in a career, with more women enthusiastic about careers they perceived as creative, and men less so. Alternatively, it might be that men and women were interpreting creativity differently. Although our data did not directly address this issue, there have been published studies in this area. When assessed on perceptions of domain-specific creativity, women tended to rate themselves more creative in art, while men tended to rate themselves as more creative in math and science (Kaufman, 2006; Kaufman et al., 2009). Thus, it might be that men and women in our study were thinking more about artistic creativity and that this particular interpretation led to differential associations with science depending on the gender of the participant.

Beliefs about creativity are important to understand because they play an important role in self-evaluation in school and in the workplace. Creative self-efficacy is an important predictor in determining middle and secondary school children’s beliefs about their own competence in science (Beghetto, 2007). Consistent with findings for younger students, a survey of Turkish university engineering students concludes that “creativity and independence in the jobs are important elements that Turkish students think about when considering their careers for the future” (Cavas, Cakiroglu, Cavas, & Ertepinar, 2011, p. 280). Other recent work suggests that once in the workforce, people who believe their jobs require creativity rise to the challenge and generate more creative solutions to real-world problems (Robinson-Morral, Reiter-Palmon, & Kaufman, 2013). Thus, it is important to understand the expectation and value for creativity in a career of any kind.

This is the first operationalization of scientific creativity for use with the IAT, and we recognize the need for methodological improvements. Of some concern is the fact that many of the antonyms of creativity are inherently negative. Our list (routine, common, unoriginal, unchanging, repetitive) does not invalidate our results, because the general IAT effect of associating these negative words with science is still an important finding. However, activities may be no creative yet still valuable. For some, science may be considered a solid, diligent investigation into reality itself, as contrasted with artistic imagination and invention. Thus, a list of IAT terms that taps the valued aspects of scientific activity may provide insight into our seemingly anomalous findings.

Analogous to previous observations that women have a stronger tendency not to associate math with the self (Nosek et al, 2002), our research has demonstrated that women also are less likely to associate science with self. This suggests that the triadic association of science, self, and creativity may vary by gender. If both men and women do not associate science with creativity, but women have a stronger tendency not to associate science with self, then we also would predict that women have stronger self-associations with creativity. Our finding of high science career interest, only in women who associate science with creativity, provides indirect support for the idea that women value creativity more than men. In the light of our findings, more research on the triadic associations of creativity, self and science across gender is needed. It is important to know if creativity—an underappreciated feature of science-- is perceived as a female attribute. If such results are found, of course, it becomes an unfortunate recognition of the obstinate nature of sexism related to STEM fields in our society.

Finally, our study highlighted the more general problem of bias that was largely unconscious and could lead even well-meaning scientists to perpetuate real discrimination. In a recent study, 127 Physics professors, presented with vitae from prospective employees with an undergraduate physics degree applying for a lab manager position, who differed only on gender, the professors believed they were evaluating a real person. Both male and female professors judged the woman as less competent and hireable. They also offered to pay the woman an average of almost $4000 less. In addition, the faculty were administered the Modern Sexism Scale, a measure of subtle gender bias. The greater the professors' subtle bias against women, the less competent and "hireable" the woman was perceived, and the less mentoring she was offered. The female applicant was rated as more "likable". Nonetheless, "…liking the female student more than the male student did not translate into positive perceptions of her composite competence, or material outcomes in the form of a job offer, an equitable salary, or valuable career mentoring" (Moss-Racusin, Dovidio, Brescoll, Graham & Handelsman, 2012, p. 16477). Even though the percentage of women in physics and astronomy faculty has increased to 14% overall by 2010, and represents 26% of newly hired faculty (Ivie, White, Garrett, & Anderson, 2013), the percentage of women undergraduate physics graduates has remained flat for a decade at approximately 20% (Mulvey & Nicholson, 2012). Without a change in the largely implicit attitudes of those already in positions of influence, the progress of women to the top ranks of the profession is expected to be slow.

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