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Not Feeling Good in STEM:

Effects of Stereotype Activation and Anticipated Affect on Women's Career Aspirations

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Abstract

Despite great efforts to increase women's participation in science, technology, engineering, and math (STEM), relatively few women choose careers in these fields. We argue that women might expect to feel less good in contexts where unfavorable gender stereotypes are activated in their minds (e.g., by strong underrepresentation) and, consequently, are less likely to aspire to STEM careers. In two pilot studies (*N*s = 28/61), we confirmed that undergraduate women expect more negative and less positive affect (i.e., generally (un)pleasant emotions) and a heightened sense of threat in a stereotype-activating, compared to a not stereotype-activating, test scenario. In Study 1 (*N* = 102), the scenario indirectly lowered college women's STEM career aspiration (adjusted for preliminary domain identification) due to lower anticipated positive affect, but not to higher negative affect, in the stereotype-activating scenario. The scenario had no detrimental effect on college men's anticipated affect or their career aspirations. In Study 2, 91 high school students reported anticipated affect and self-efficacy in different university majors and their intentions to choose the subject as a major. The more stereotypically male (in terms of gender distribution) the subject, the more negative and the less positive was young women's, but not young men's, anticipated affect. Only lower positive, but not higher negative, affect predicted low study intentions over and above self-efficacy. To increase women's aspirations, their expected feelings in STEM deserve attention. One approach to foster positive affect might be to create less stereotypical STEM contexts.

Keywords: occupational aspiration, motivation, sex roles, emotional responses, anticipated affect, stereotype threat, gender, STEM, self-efficacy, human sex differences, gender distribution

Not Feeling Good in STEM:
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Being one of few women in a field that is stereotypically male (e.g., in science, technology, engineering, or mathematics; STEM) can make gender stereotypes salient (Inzlicht and Ben-Zeev 2000). Negative competence-related stereotypes in particular (i.e., that women are less capable in a specific domain) can elicit a sense of threat and thus can reduce the motivation to engage in the respective domain and lead to its abandonment (Davies et al. 2002; Davies et al. 2005; Kronberger and Horwath 2013; Murphy et al. 2007; Woodcock et al. 2012). Women's avoidance and opting out of stereotypically male domains is a socially and economically costly phenomenon because these areas lose talent and women reduce their chances for high status jobs. Understanding underlying motivational processes is therefore highly relevant because it may aid in increasing women's interest, motivation, and persistence in stereotypically male careers.

The salience of negative stereotypes seems to be a powerful deterrent contributing substantially to women's underrepresentation in stereotypically male domains. In the present work, we argue that this is at least partially due to women's anticipation of how they would feel in a stereotype-activating context, such as a math course with very few other women. We base our argument on research showing that the affective consequences people expect from certain actions determine which actions they choose (Baumeister et al. 2007; Mellers and McGraw 2001). Specifically, we expect that the more women imagine a career-relevant context as stereotypically male, the less positive and the more negative affect they will anticipate experiencing in this context. We further argue that anticipated positive and negative affect—the total of expected pleasant and unpleasant emotional experiences—will predict women's career aspirations. Stereotype-activating conditions thus would have an indirect effect on career

aspirations by altering women's anticipated affective experiences (i.e., by increasing negative and decreasing positive anticipated affect). We tested these predictions in an experimental and a correlational study by specifically focusing on college and high school women's career aspirations in STEM fields. These are traditionally male domains where negative stereotypes about women's abilities are still widespread (Shapiro and Williams 2012).

Women's Career-Related Choices

Previous research has shown how performing under the pressure of negative stereotypes can influence women's math-related attitudes and aspirations. Many studies (see Nguyen and Ryan's, 2008, meta-analysis) have demonstrated, for example, that contextual cues can impair performance of individuals who belong to a negatively stereotyped group (the so-called *stereotype threat* effect on performance). For women in math-related fields, subtle sexism (Dardenne et al. 2007), reminders of gender roles (Davies et al. 2002), or diagnostic math tests (Schuster et al. 2015; Spencer et al. 1999) can activate stereotypes and thereby reduce performance. An especially powerful stereotype-activating cue is the underrepresentation of one's group (Sekaquaptewa and Thompson 2003). Its effects seem to gradually increase with the extent of underrepresentation (Inzlicht and Ben-Zeev 2000). Single incidents of exposure to stereotype-activating cues can also have immediate effects on career-related intentions (Davies et al. 2002; Murphy et al. 2007; Smith et al. 2013). Specifically, television commercials depicting traditional gender roles (Davies et al. 2002), videos of a scientific conference attended predominantly by men (Murphy et al. 2007), or a brochure about a university department with photos of predominantly male students (Smith et al. 2013) have all been shown to undermine women's aspirations of engaging in career fields that are stereotypically male.

The processes by which contextual cues affect career aspirations are not yet conclusively clear. It has been argued that contextual cues can diminish expectancies for one's performance (Cadinu et al. 2003), elicit a sense of competence-related threat (Steele et al. 2002), suggest that one has to work harder than others (Smith et al. 2013), and reduce the sense of social belonging (Cheryan et al. 2009; Murphy et al. 2007). The most important reason to dismiss stereotypically male career options might differ across women and across domains. However, there seems to be a general tendency for women to expect these careers to be unsatisfactory and unpleasant, and this expectation becomes even stronger when contextual cues trigger negative gender-related stereotypes.

Mediation by Anticipated Affect

We therefore propose a mediator researchers have not yet explicitly examined in the context of gendered career aspirations: anticipated affect. When we refer to *anticipated affect*, we mean the extent to which a person expects to feel good and/or bad in a potential future situation that results from his or her behavioral choices (Richard et al. 1996a). Several motivation and decision theorists have pointed out that affective reactions provide feedback about the success of past actions and regulate future actions by implying they will be pleasant or unpleasant (Baumeister et al. 2007; Carver and Scheier 1990; Mellers and McGraw 2001). Thus, anticipated affect could be considered as the subjectively experienced value of a hypothetical future. There is evidence that anticipated affect predicts behavioral choices over and above attitudes towards the target behavior (Richard et al. 1996). Previous research has shown that anticipated affect, or specific anticipated emotions, can predict a diverse range of behaviors, such as dividing resources fairly (Van Der Schalk et al. 2012) and adopting the goal to perform well on a test (Stephens and Pekrun 2011). Thus, anticipated affect seems to be an important factor

for motivated choice in general that might also be involved in women's career aspirations and career-related choices.

Specifically, we argue that (imagined or present) stereotype-activating cues can alter the affective reaction stereotyped group members expect to feel in a relevant context. More precisely, women will anticipate less pleasant affect in a context where they are reminded of negative gender-related stereotypes, which in turn will reduce their motivation to pursue a career in the domain where the stereotypes apply. Stereotype threat research has shown that activation of stereotypes in performance situations elicits negative emotions like anxiety (Johns et al. 2008; Osborne 2001) and dejection (Keller and Dauenheimer 2003), negative thoughts (Cadinu et al. 2005), and self-doubts (Steele and Aronson 1995), and it reduces performance expectations (Cadinu et al. 2003; Stangor et al. 1998). It is thus clearly an unpleasant experience to perform in the context of salient negative stereotypes about one's group.

In addition, women have been shown to feel a lower sense of belonging in math or science-related contexts where they are outnumbered by men (Murphy et al. 2007; Good and Dweck, 2012). Good et al. (2012) showed that women's lower sense of belonging to the math community predicted their lower enrollment in male-dominated math classes. This work points to the relevance of affect because the authors' measure of belonging is for the most part an affective one (e.g., "I feel content"; "I feel valued", "I enjoy being an active participant"; Good et al., 2012; p. 717). However, the authors did not specifically investigate affect or anticipated affect, and they did not report the respective influence of anticipated positive and negative affect on course enrollment.

Baumeister and colleagues (2007) argue that specific or generalized affective memories, which are often based on previous experiences, influence a person's choices and actions by

signaling that future experiences will be similarly pleasant or unpleasant. Because many stereotype-activating cues are likely to be encountered during women's childhood and adolescence (e.g., diagnostic tests, sexism, stereotype-confirming peers, underrepresentation of women in male domains), women have sufficient experience on which to predict their affective reactions. Thus, when a woman reflects on how she would feel pursuing a math-related career, such previous unpleasant experiences might color her anticipated affect. Based on these findings, in the present work, we aim at extending earlier research by investigating the effect of stereotype-activating cues on women's career aspirations in STEM and the mediating role of anticipated positive and negative affect.

The Present Studies

In the present work we present two studies testing the hypothesis that women's anticipated affect in a stereotypically male domain predicts their career aspirations. We further hypothesize that women anticipate more negative and less positive affect when they imagine stereotype-activating settings compared to more neutral settings. In Study1, we experimentally manipulated stereotype activation in an imagined test scenario by describing the scenario in a way that has been used to induce stereotype threat in past research (Inzlicht and Ben-Zeev 2000; Nguyen and Ryan 2008). We measured undergraduate women's and men's anticipated affect in these scenarios and later asked them to report their career aspirations in math-related fields. We hypothesized that stereotype-activating cues in a performance scenario will lead women, but not men, to expect more negative and less positive affect (Hypothesis 1). We further hypothesized that by influencing anticipated affect, the stereotypic scenario will lead indirectly to lower career aspirations of women, but not of men, in math-related domains (Hypothesis 2).

In Study 2, to test the role of anticipated affect found in an experimental setting in a more realistic setting, we asked female and male high school students about their actual expectations about majoring in different departments at university. We then examined the relationship between the representation of female students in the department (a very strong stereotype-activating cue; Sekaquaptewa and Thompson 2003), anticipated affect, and the intention to choose the subject as a major. We hypothesized that young women, but not young men, will anticipate more negative and less positive affect studying in a department with a lower proportion of female students (Hypothesis 3). We further hypothesized that young women, but not young men, will have lower intentions to choose a major in such a department than in one with a higher proportion of female students (Hypothesis 4). Finally, anticipated affect will, at least partially, mediate young women's low intentions to study subjects with strong underrepresentation of women (Hypothesis 5).

Study 1: Reactions to Stereotype-Activating Scenarios

In Study 1, we manipulated stereotype activation in a test scenario with two combined cues that have been shown to activate threatening stereotypes in actual performance situations in previous research: underrepresentation (Inzlicht and Ben-Zeev 2000) and diagnosticity of the test in a negatively stereotyped domain (Steele and Aronson 1995). We decided to combine these cues to ensure that the manipulation was strong enough to activate stereotypes in an imagined scenario and because we were more interested in the affective and motivational processes triggered by stereotype-activating contexts than the specific factors activating stereotypes themselves. From an applied perspective, underrepresentation of women is most likely the case in domains which are also stereotypically male (i.e., the cues can be expected to co-occur in practice).

The scenarios were developed and tested in two pilot studies. In Pilot Study 1, we tested whether stereotype-activating cues in an imagined scenario influence women's anticipated affect. In Pilot Study 2, we tested whether the experimental and control scenarios, which were improved to be more subtle after Pilot Study 1, differed in the extent to which they evoked a sense of stereotype threat in women.

Pilot Study 1: Anticipated Affect

In this pilot study, 28 female university students with a mean age of 22.32 years (*SD* = 2.36, range = 20–30) read and visualized a scenario of participating in an assessment center for an attractive job. In the stereotype activation condition, they were told by a male employer to show their mathematical abilities by explaining the solution of a geometrical problem to an all-male group of competitors. The employer further referred to gender by saying "Ladies first." In the no stereotype activation condition, participants were told by a female employer to prove their stress resistance by explaining the solution of the same problem to a mixed-gender group of competitors, and the employer only said "You go first." Participants then reported their anticipated positive (α = .76) and negative (α = .84) affect by rating the intensity of 12 emotions (anxious, ashamed, angry, insecure, frustrated, worried, proud, relaxed, content, optimistic, hopeful, relieved) on a 6-point scale ranging from 1 (*not at all*) to 6 (*extremely*).

The main results revealed a substantial but non-significant trend in which women reported more anticipated negative affect when imagining the stereotype activation scenario (*M* = 3.76, *SD* = 1.31) compared to the no stereotype activation scenario (*M* = 3.00, *SD* = 0.66), *t*(23.56) = 2.00, *p* = .06, *d* = .70. They also anticipated significantly less positive affect when stereotypes were activated (*M* =1.64, *SD* = 0.52) compared to when they were not activated (*M* = 2.15, *SD* = 0.75), *t*(26) = 2.15, *p* = .04, *d* = .81. The pilot study thus indicated that women

expected to feel less good in a stereotype-activating performance context. For a full description of the pilot study's methods and results, see Online Supplement 1.

Pilot Study 2: Stereotype Threat

For Pilot Study 2, we improved the scenarios in three ways resulting in the version which was applied in Study 1. First, to increase ecological validity, instead of a public performance in front of competitors in an assessment center, we described a private test for university admission. Second, the evaluating professors did not make a remark about gender. Third, the test was diagnostic for a cognitive ability in both conditions (math ability versus problem solving) in order to make the two conditions more similar to each other. The full scenario is described in the Method section of Study 1.

These scenarios were administered to a sample of 61 female university students with a mean age of 22.08 (*SD* = 3.64, range = 17–35). After visualizing either the stereotype activation or no stereotype activation scenario, participants rated their agreement with six statements on a 6-point Likert scale translated and adapted from Shapiro's (2011) scale of multiple threats. The items were introduced with "In this situation…" followed by statements about different aspects of stereotype threat: "my actions might poorly represent my gender"; "my actions could confirm, in my own mind, that a negative stereotype about men and women is true of me"; "my actions could prove that the stereotypes about my gender are true"; "I would be concerned that because of my gender, my actions could influence the way other people interact with me"; "my actions could reinforce other people's negative stereotypes about my gender"; and "my actions might confirm a negative stereotype about my gender in other people's minds."

In an exploratory factor analysis (principal axis factoring) both the Eigenvalue criterion and the scree plot suggested a one factor solution explaining 64.82% of the variance. Thus, we

averaged the six items to one scale (α = .92). Effect size analyses confirmed that the stereotype-activating scenario (M = 3.24, SD = 1.26) was perceived as more threatening than the control scenario (M = 2.59, SD = 1.31), $t(61) = 2.01$, $p = .05$, $d = 0.51$, 95% CI [0.001, 1.01]. In the following main study, such a measure of stereotype threat was not included to avoid drawing participants' attention to gender-related threats beyond the subtle cues in the scenarios. Pilot Study 2 was thus crucial to show that the cues varied between conditions and indeed triggered a sense of stereotype threat.

Study 1: Gender Differences

In Study 1, we expected that after imagining a stereotype-activating scenario, women's—but not men's—aspiration to pursue a math-related career would be lower than after imagining the control scenario, mediated by decreased positive and/or increased negative anticipated affect. The male control group is important because we argue that stereotype activation influences anticipated affect due to the salience of the stereotype that math is typically male, indicated in the present study mainly by the presence of male competitors and a male professor. This setting, which still reflects actual conditions in many STEM domains, has been shown to elicit stereotype threat in women, but not in men (Inzlicht and Ben-Zeev 2000; Sekaquaptewa and Thompson 2003).

Correspondingly, we expected a negative effect of experimental condition on women's anticipated affect and their aspirations to pursue a career in math, but not on men's. When looking at career motivation, domain identification is a very important predictor because it represents the general association of the self with the domain. A person who considers a domain important to the self will be more intrinsically motivated to pursue a career in that domain, and in turn the domain becomes important to the self if one wants to succeed professionally in it. The

current study examines the impact of a brief visualization, which we expect to have an incremental but comparably small effect on motivation. In addition, based on recent research suggesting not only math ability but also verbal ability matters in STEM career choice (Wang, Eccles, & Kenny, 2013), we took mathematical and verbal domain identification into account for analyses of math-related career motivation and looked at incremental effects of the imagined scenario.

Method

Participants. In total, 58 undergraduate men and 69 undergraduate women completed the online study (75 % of those who started it). However, the time spent on the study ranged widely from 6–127 minutes (*mdn* = 15 min.; *M* = 19 min, *SD* = 14 min). The exclusion of inattentive participants, who have been identified as an increased risk in online research, can increase the power to detect effects in online samples (Goodman et al. 2013). The two pilot studies provide further support for the effectiveness of the scenario manipulations and thus reduce the probability that the findings will be merely based on participant selection. In Pilot Study 1, 30 minutes was a sufficient amount of time for all participants to complete a comparable questionnaire in the laboratory; we thus set the upper time limit to 30 minutes for the present study as well. This led to the exclusion of 13 participants who took longer and thus very likely did not focus on the survey as required. In addition, 12 participants were excluded because they finished the study in less than 10 minutes, and thus they could not have read the scenario, instructions, and questions thoroughly. As discussed in Online Supplement 2, the results for the full sample are in line with the idea that the time range restriction eliminates data of participants less compliant with the experimental procedure. The final sample size was 102 participants; 56 of them female. Their age ranged from 17–34 years (*M* = 22.66, *SD* = 3.58). All of the

participants had *Abitur* (German advanced high school diploma required for university), and 93 (91.2%) of them were currently enrolled at a university.

Design and procedure. The design of this online experiment was a 2 (stereotype activation vs. no stereotype activation) x 2 (male vs. female) factorial design. The measured variables were anticipated negative and positive affect and motivation to pursue a math-related career. Participants were recruited via mailing lists of several German universities. After following the link to the online study but before they consented to participate, students were informed about their rights, the procedure of the study, and their chance to win a 20 € Amazon gift certificate. The online questionnaire began with a measure of math and verbal domain identification, as well as distractor items on identification with creative problem solving and general knowledge. After reading the scenario manipulation, participants filled in measures of anticipated affect, their ability to visualize the situation, and their aspiration to pursue a math-related career. At the end, participants were asked whether math ability and creative problem solving were generally attributed to men, women, or neither gender and then gave demographic information. Participants were probed for suspicion, given space to comment on the study, and debriefed.

Scenario manipulation. The scenarios in Study 1 depicted a private oral exam in front of a professor. This is a common form of testing in many courses of study at German universities and should therefore be familiar to our student sample. The scenario in the stereotype activation condition (translated) read as follows:

> A few weeks ago, you applied to university. You have been short-listed by your favorite university and invited for an admission test. The university is very renowned and has exceptionally high admission criteria. Upon arrival, you are led

> to a room where a couple of young men are already waiting for the test, which has several sections and is meant to measure your general abilities. After a short while the professor [Professor, the German word for male professor was used] leading the admission procedure comes in and informs you that you are going to be called in separately for an oral math ability test. When it is your turn, the professor asks you to follow him next door, to introduce yourself, and then to explain as clearly as possible the solution to the following problem: "Calculate the height of a tetrahedron (a pyramid of 4 equilateral triangles) with a side length of 15 cm."

In the no stereotype activation condition, the scenario was identical except that the waiting applicants were described as "a couple of young men and women," the German word for female professor (Professorin) was used, and the oral test was said to be diagnostic for creative problem solving, although it was the same math problem.

Domain identification. In order to measure identification with the mathematical and the verbal domains, participants rated four items, each on a 6-point Likert scale. The items were translated and adapted from Lesko and Corpus (2006). We used the four items focusing on the value a person assigns to the domain (e.g., "Doing well on mathematical/verbal tasks is very important to me") rather than their self-estimation of ability. Reliability was high for math domain identification ($\alpha = .90$) and, after exclusion of one item that decreased reliability, sufficient for verbal domain identification ($\alpha = .75$). In addition, we included eight distractor items on identification with creative problem solving and general knowledge.

Anticipated affect. Anticipated positive affect was measured with the same six items as in Pilot Study 1 ($\alpha = .84$). Two additional items (depressed, tense) mentioned by participants in the open ended question in Pilot Study 1 were included in the anticipated negative affect

measure, along with the six negative affect items from Pilot Study 1 (α = .91). These items were averaged such that higher scores indicated increased affect.

Visualization of the situation. Three items measured how easy it was for participants to imagine the situation ("I could imagine well how that situation would feel," "I am sure I know how I would feel in that situation," and "It was hard to imagine what I would think in such a situation," reverse coded). The 6-point scale ranged from 1 (*not at all true*) to 6 (*fully true*). Items were averaged so that higher scores indicated greater ease of visualization. Reliability of the combined scale was acceptable (α = .73).

Career aspirations. Students' occupational aspirations in math-related fields were measured with three items ("I would like to work in a field in which my math ability is most relevant," "I would like to work in an organization where mathematical and logical competencies are important for one's success," and "I am considering an occupation in the area of math, physics, or technology".) Participants rated these items on a 6-point scale ranging from 1 (*not at all true*) to 6 (*fully true*). The items were averaged (α = .88) such that higher scores indicated higher aspiration.

Statistical analyses. All analyses were conducted with SPSS 22 (IBM 2013). As recommended for small sample sizes, we applied non-parametric bootstrapping analyses (Preacher and Hayes 2004) to test indirect effects, using the corresponding SPSS macro. Cohen's *d*s of mean differences and their confidence intervals were calculated with a procedure described by Wuensch (2012; see also Smithson 2001). Following recommendations by Cumming (2014), we describe effects with effect sizes and their 95% confidence intervals. Many authors have cautioned that null hypothesis significance tests and *p*-values contain very little and often misleading information (Anderson et al. 2000; Cohen 1994; Cumming 2014; Finch et al. 2001;

Hubbard 1995). We include the *p*-values as additional information, however, we suggest considering the ranges of effect sizes in different studies for a better understanding of the effects of interest.

Results

Preliminary analyses. Participants were well aware of the stereotype of math as a male ability. Of the 102 participants (one missing), 86 held that math ability was typically attributed to men, and 15 opined that it was attributed to neither gender, but no one thought it was typically female. Creative problem solving was attributed mostly to women (61) or to neither gender (33). Only eight participants thought it was a typically male ability. Second, the visualization of the situation scale showed that the scenario was fairly easy to imagine. The mean was 4.99 (SD = 0.75), which is considerably above the scale midpoint of 3.5, $t(101) = 18.04$, $p < .001$, $d = 2.00$; 95% CI [1.36, 2.34]. There were significant differences between groups: Although men (M = 4.83, SD = 0.74) and women (M = 4.92, SD = 0.82) could imagine the no stereotype activation scenario equally well, $t(52) = .010$, $p = .992$, $d < 0.01$, 95% CI [-0.06, 0.06], women could imagine the stereotype activation scenario better (M = 5.36, SD = 0.69) than could men (M = 4.53, SD = 0.77), $t(46) = 4.38$, $p < .001$, $d = 0.64$, 95% CI [0.32, 0.95]. Visualization of the situation did not correlate with the dependent variables, and its inclusion as a covariate in the subsequent analyses did not change the results. Therefore, these group differences will be disregarded in the following. There were no interpretable differences between groups in identification with either domain (ps > .21; ds < 0.11). With regard to the zero-order correlations between variables, Table 1 shows that the proposed mediators and covariates were significantly related to career aspirations, but apart from the significant negative correlation between positive and negative affect, there were no other significant correlations.

Effects of scenario and gender on anticipated affect. To test our main hypotheses, non-parametric bootstrapped regression analyses with 10,000 bootstrapped samples were conducted to test the interaction effects of scenario and gender on anticipated affect (z-transformed). Hypothesis 1 predicted that stereotype activation in the scenario is related to higher negative and lower positive affect among women, but not among men. With regard to anticipated negative affect, we found no effect of gender, B = -.003, 95% CI [-.552, .546], SE= .28, p = .992,; a significant effect of stereotype activation, B = .604, 95% CI [.067, 1.141], SE = .27, p = .028; and the expected significant interaction effect, B = -.846, 95% CI [-1-645, -.047], SE = .40, p = .038. The means in Table 2 illustrate that the direction of these effects are in line with Hypothesis 1: The most negative affect is anticipated among women in the stereotype activation scenario. With regard to anticipated positive affect, the effects of gender, B = -.198, 95% CI [-.695, .299], SE = .25, p = .431; and of stereotype activation, B = -.412, 95% CI [-.898, .074], were nonsignificant. The expected interaction effect, B = .880, 95% CI [.157, 1.603], SE = .36, p = .018, was significant. As reported in Table 2, the women in the stereotype activation scenario expected the lowest, and men in that scenario the highest, positive affect. The findings support Hypothesis 1 by showing that in scenarios that make a stereotypically male ability and female underrepresentation salient, only women anticipate less pleasant feelings.

Indirect effects of scenario and gender on career aspiration. Hypothesis 2 predicted that the scenario's effect on anticipated affect (moderated by gender) indirectly reduced women's career aspirations in a math-related field. We tested this hypothesis with a bootstrapped moderated mediation model (Preacher and Hayes 2004), with scenario and gender as factors, anticipated positive and negative affect as mediators, and career aspiration as the outcome, which was adjusted for identification with mathematical and verbal domains. The results on the

hypothesized indirect effect via anticipated affect are shown in the lower part of Table 3: The stereotype activation by gender interaction indirectly influenced math-related career aspiration via anticipated positive, but not negative, affect. This pattern was mostly driven by the scenario's significant indirect negative effect on women. The indirect positive effect on men wa s not significant on the 5% level. This finding supports Hypothesis 2 partially: Only women's anticipated positive, but not their negative, affect mediated the effect of stereotype activation on women's career aspirations.

In addition, the upper part of Table 3 shows that the total interaction effect of gender and stereotype activation (Model 1) was not significant, despite a relatively high coefficient, B = 0.659. A higher coefficient of this interaction reflects larger gender differences in the slope of scenario on aspirations. For an indirect effect to be meaningful, significance of the total effect is not required (Hayes 2009). After the inclusion of the hypothesized mediators, anticipated positive and negative affect (Model 2), the interaction coefficient was only B = .297. The reduction of the interaction coefficient in Model 2 also points to the expected indirect effect, and the coefficients of affect further signal that the Hypothesis 2 was supported for the role of positive affect only. The finding that identification with the mathematical and the verbal domain was, as expected, highly predictive of career aspirations in Model 1 and 2, illustrating the importance of adjusting the outcome for it. These findings support our hypothesis that stereotype-activating cues in a career-relevant context shape anticipated affect in that context considerably and thereby reduce women's, but not men's, math-related career aspirations.

Discussion

Importantly, the stereotype-activating scenario in the present experimental manipulation was a very realistic portrayal of how performance is tested in STEM subjects at many German

universities. Therefore, comparing gender-specific reactions when imagining such a situation is highly relevant for understanding why some male-dominated domains are unattractive to women. The finding that the anticipated affect in a single visualized situation indirectly predicted math-related career aspirations is remarkable and points to the importance of examining the way stereotyped groups generally and regularly imagine career-relevant contexts in domains where they are the minority. Not surprisingly, compared to the individual's general domain identification, the impact of the visualized scenario on women's career aspirations by reducing anticipated positive affect was relatively small. Metaphorically speaking, it might just be like dripping water that does not have a clearly visible impact immediately, but wears away the stone over time if it is constant.

It has already been argued that negatively stereotyped groups are repeatedly exposed to stereotype-activating cues and that negative experiences accumulate over time, leading to disidentification with the domain (Woodcock et al. 2012). Similarly, career aspirations might be shaped more by the affect an individual anticipates across several situations, leading to an association of this affective response in the mental representation of a career in this setting than by the affect anticipated in a single situation. However, by testing the effect of a controlled scenario we can make a causal inference about the role of stereotype-activating cues for women's anticipated affect. This is an important step towards understanding the processes by which anticipated affect is involved in gendered career preferences. The next step is to test the practical relevance of these processes. A central point for women's career paths into stereotypically male fields is the choice of a major at university. It is thus interesting to examine if male and female high school students show differences in anticipated affect depending on

stereotype-activating attributes of the subjects and if these differences can predict academic intentions.

Study 2: Anticipated Affect and Study Intentions

In Study 2, we thus examined the affect female and male high school students anticipate when thinking about studying different subjects at university. Instead of controlling the content of participants' visualizations experimentally, we looked at the anticipated affective response to environments that are actually characterized by more or less stereotype-activating conditions (i.e., gender distribution). Previous research in the field of stereotype threat has shown that the lower the percentage of women in a domain where the performance stereotypes favor men, the stronger the stereotype threat effects on performance (Inzlicht and Ben-Zeev 2000). Underrepresentation has incremental effects on performance beyond other forms of stereotype activation (Sekaquaptewa and Thompson 2003); it can be a strong cue indicating that stereotypes matter in this field, and thus also might influence how stereotyped groups anticipate feeling in that environment.

We examined effects of gender distribution by asking participants to report their anticipated affect, their self-efficacy, and their intention to choose each of several popular majors at university that are characterized by different percentages of women. Because the aim of our study was to get a realistic impression of the way participants spontaneously visualize majoring in different subjects instead of priming them with stereotype-activating cues, the gender distribution was not mentioned to the participants. Self-efficacy in the subject of study is an important factor to take into account because it can be expected to greatly influence study choice (Crombie et al. 2005; Eccles 2005). Therefore it is important to examine whether anticipated affect explains incremental variance in study intentions, especially because domain identification

with university subjects that are not taught in high school might not yet be developed. Using an intra-individual approach, we tested the hypothesis that underrepresentation, as a stereotype-activating cue, reduces female high school students' academic intentions via anticipated affect. Our focus was thus on how positive or negative each individual student anticipates one subject of study to be in comparison to other subjects.

Method

Participants, design, and data structure. Participants were 91 students in grades 11 and 12 of the highest track of the German school system ("Gymnasium"). Students of Gymnasium graduate in grade 12 (or 13) with a degree that qualifies them to study at a university. The sample consisted of 48 young women and 43 young men with a mean age of 16.86 years (*SD* = 0.73, range = 15–19).

The study had a within-subjects design. Participants answered questions about their anticipated affect, self-efficacy, and their motivation to choose each of eight different possible university majors: male-dominated: electrical engineering (9.3% female students), computer science (16.8%), physics (20.5%), and math (47.4%); female-dominated: biology (62.6%), psychology (75.8%), German literature (76.6%), and education (77.1%) (Statistisches Bundesamt [German Federal Statistical Office] 2012). The data on the majors thus are nested within persons (illustrated by Fig. 1 in Online Supplement 3). All of the variables that vary within persons are referred to as Level 1 variables, including intention to choose a subject (outcome), proportion of women, anticipated affect, and self-efficacy in the major (predictors). Gender, on the other hand, is a Level 2 predictor because it varies between persons. The sample size on Level 1 thus is 728 data points.

Procedure and measures. For data collection, a female experimenter went to a high school and administered the questionnaire to students during class. She informed the students that the study was designed to examine emotions in different study majors and that they did not have to answer any questions if they did not want to, and she promised them chocolates as a reward at the end. Participants were furthermore told that the data would be stored and analyzed anonymously. Participants then filled in the paper-and-pencil questionnaire, which first asked about their general intentions to study at a university. Then, for each of the eight majors, a section with identical questions followed. Two versions of the questionnaire were handed out randomly, one which started with electrical engineering (a stereotypically male subject with a low percentage of female students) and one that started with German literature (a stereotypically female subject with a high percentage of female students). Each of the eight sections was introduced by asking the students to imagine studying this specific subject—including attending lectures and seminars, studying with fellow students, and writing exams at the end of the semester. Then in the questionnaire they answered items about the anticipated frequency of different positive and negative emotions, their intention to major in that subject, and their self-efficacy in the subject. This was repeated for all eight majors, alternating typical male-dominated majors with typical female-dominated majors. The questionnaire ended with demographic questions and a section to openly comment on the study. Finally, participants were debriefed, thanked, and received a bar of chocolate.

Selection of the included subjects and coding. The eight academic departments were chosen based on the following criteria. First, they had to be popular and well-known. This is important because it reduces the probability that the participants know too little about the subject to be able to anticipate their feelings about studying it. In addition, very rare majors are unlikely

choices by definition; thus we could not have expected much variance in intention to choose them. All eight subjects were among the 20 most common majors in 2011 (Statistisches Bundesamt 2012). Second, there should be some variation in their gender stereotypicality, represented by the percentage of women studying the subject. Half the subjects were more typical for men; the other half more typical for women. As Figure 1 in Online Supplement 3 shows, the percentage of female students in each major ranged from 9.3% to 77.1% (Statistisches Bundesamt 2012). The percentage of female students can be understood as a measure of the stereotypicality of the subject because the more the women's proportion is below 50% the more salient it will be that women are uncommon in the field. On the other hand, the underrepresentation of men in a field (e.g., proportion less than 50%) might not be as relevant to men because they are less likely to be stereotyped as incompetent even in stereotypically female domains (Fiske et al. 2002).

Anticipated affect and self-efficacy. Whereas in Study 1 the intensity of anticipated emotions was measured, in Study 2, we asked for their frequency, ranging from 1 (*never*) to 6 (*almost all the time*). This approach made more sense because the visualized time period (i.e., studying this subject as a major) was much longer in Study 2 than in Study 1 (i.e., the specific situation of taking a test). The same emotion words were used as in Study 1 and averaged to create a positive affect ($\alpha = .89$) and a negative affect ($\alpha = .92$) scale. A single item, "I am confident that I have the abilities required for this subject of study," with the same 6-point scale, measured participants' self-efficacy.

Intention to study subject. Two items measured participants' intention to study the respective subject: "I would like to major in ..." and "I will probably major in …" Participants rated their agreement to these items on a 6-point scale ranging from 1 (*not at all true*) to 6

(*absolutely true*). The items were highly correlated, r = .80, 95% CI [.77, .83], and were averaged for further analyses.

Statistical analyses. To take the nested data structure into account, we calculated hierarchical linear models with HLM 6.01 (Raudenbush et al. 2004). The 95% confidence intervals for regression coefficients were calculated as ± $t_{critical}$ * SE with $t_{critical}$ (89) = 1.99. We expected an interaction of participants' gender and proportion of women in the university department on anticipated positive and negative affect (Hypothesis 3) and on intentions to choose a subject as major (Hypothesis 4). We further expected this interaction effect to be reduced considerably by the inclusion of anticipated affect, pointing towards at least partial mediation (Hypothesis 5). Similar to the analyses in Study 1, Model 1 tested the total effect of the proportion by gender interaction on study aspirations, controlling for main effects. The cross level interaction effect is represented by the gender (Level 2) effect on slope of proportion (Level 1). The equation of the full model predicting the intention of person *j* to study subject *i* is:

$$[1]\ \text{intention}_{ij} = \gamma_{00} + \gamma_{01}*\text{gender}_j + \gamma_{10}*\text{proportion}_{ij} + \gamma_{11}*\text{proportion}_{ij}*\text{gender}_j + u_{1j}*\text{proportion}_{ij} + u_{0j} + r_{ij}$$

The same model was also calculated with each of the mediators, anticipated positive and negative affect, as outcome. The equation of Model 2 additionally includes the summands $\gamma_{20}*\text{APA}_{ij}$ and $\gamma_{30}*\text{ANA}_{ij}$ (anticipated positive and negative affect, respectively) in order to test their relevance for study intention and the differences in γ_{11} due to their inclusion. In addition, we were interested in whether the role of anticipated affect (Hypothesis 5) is incremental to the role of self-efficacy for study intention. Therefore, the equation of Model 3 includes the summand $\gamma_{40}*\text{self-efficacy}_{ij}$.

Results

Correlations. The intraclass correlations (ICC) of the variables anticipated positive affect, anticipated negative affect, study intention, and self-efficacy were relatively low. This means that the values of a person in these variables were not very constant across different subjects. Therefore, to get a general impression of the relationship among variables, we report the correlations across all persons and subjects without taking the nesting of data in persons into account (see Table 4).

Effects of proportion of women and gender on anticipated affect. The hierarchical regression of anticipated positive affect on proportion and gender showed that young women, as well as young men, reported a mean level of anticipated positive affect in the middle range (young women: $\gamma_{00} = 3.210$, 95% CI [3.079, 3.241]; young men: 3.106, 95% CI [2.941, 3,269]) at a proportion of 50% percent women in the major subject (coded as 0). There was no main effect of gender, $\gamma_{11} = -0.104$, 95% CI [-0.315, 0.108], $p = .330$. Figure 1 illustrates that whereas young women's anticipated positive affect increased with a higher proportion of women, $\gamma_{10} = 0.163$, 95% CI [0.123, 0.203], $p < .001$, this proportion had no effect on young men's anticipated positive affect, $\gamma_{10} = -0.005$, 95% CI [-0.059,0.049], $p = .861$. This effect of gender on the slope of proportion (i.e.; the cross-level interaction effect) was significant, $\gamma_{11} = -0.167$, 95% CI [0.101, 0.233], $p < .001$. This pattern supports Hypothesis 3 with regard to positive affect.

The mean level of anticipated negative affect was 3.222, 95% CI [3.077, 3.367] for young women and 3.053, 95% CI [2.896, 3.210] for young men, with no significant main effect of gender, $\gamma_{01} = 0.169$, 95% CI [-0.048, 0.386], $p = .126$. Gender, however, interacted with the proportion of women, $\gamma_{11} = 0.147$, 95% CI [0.085, 0.209], $p < .001$, in the way that the slope of proportion was negative for young women, $\gamma_{10} = -0.178$, 95% CI [-0.136, -0.220], $p < .001$, and it was not significantly different from zero for young men, $\gamma_{10} = - 0.031$, 95% CI [-0.077, 0.015],

p = .185 (see Fig. 2). This pattern supports Hypothesis 3 with regard to negative affect. In summary, these results show that, as expected, young women anticipated less positive and more negative affect in university departments where there are fewer other women present and their gender and related stereotypes would presumably be more salient. There was no corresponding effect of proportion on young men's anticipated affect.

Effects of proportion of women, gender, and anticipated affect on study intention. Hypothesis 4 further predicted that young women would have lower intentions to choose a major with a lower proportion of females. Table 5 shows the results of the corresponding analysis (Model 1). The mean level of study intention at a proportion of 50% percent women in the major subject (coded as 0) was γ_{00} =1.880 for young women and 1.964 for young men (see Fig. 3). Gender was coded as 0 for young women; the values of the other predictors thus refer to the slopes for young women. On average, a 10% higher proportion of women in a major comes with a γ_{10} = 0.148 higher rating of young women's intentions to choose it, 95% CI [0.094, 0.202], p < .001, whereas proportion did not significantly predict young men's intentions, γ_{10} = 0.071, 95% CI [-0.143, 0.072], p = .053. This cross-level interaction between gender and proportion was significant, γ_{11} = -.219, 95% CI [-0.309, -0.129], p < .001, supporting Hypothesis 4.

Model 2 shows, in line with Hypothesis 5, that differences in anticipated positive affect strongly predict ratings of study intention: An increase of one scale point in anticipated positive affect is associated with an increase of γ_{20} = 0.829, 95% CI [0.696, 0.962], p < .001, points in study intentions, whereas anticipated negative affect is not a relevant predictor of intentions (see Model 2, γ_{30}). This pattern is in line with the finding from Study 1, which showed a higher relevance of anticipated positive, compared to negative, affect for career aspirations. In addition, the coefficient of the cross-level interaction γ_{11} is lower in Model 2 than in Model 1, suggesting

that some of the variance in study intention accounted for by the interaction effect in Model 1 is explained by the mediation pathway via anticipated affect. Finally, as can be seen in Model 3, self-efficacy in a subject also explains unique variance in participants' intention to choose it as a major (γ_{40}= .359, p < .001). Anticipated positive (γ_{20} = .590, p < .001) affect remains a strong and significant incremental predictor of study intentions.

Discussion

The results of this correlational study are in line with our experimental Study 1, showing that young women's anticipated affect in performance settings varied with the presence of stereotype-activating cues—in this case, their gender's representation in the academic major. Anticipated positive, but not negative, affect strongly predicted students' intention to choose a subject as a major, independent of gender. Self-efficacy, which has previously been identified as a central factor in young women's low STEM motivation (see Wang and Degol 2013), also predicted the intention to study a subject. When taking a person's self-efficacy in a subject into account, his or her anticipated positive affect still significantly predicted study intention. This finding suggests that high school students do not feel inclined to choose a major in which they anticipate positive affect just because they also expect success. In contrast, there must be something motivating about anticipated positive affect that goes beyond confidence to do well.

In contrast to the findings for young women, the gender distribution in a subject did not affect young men's anticipated positive affect, not even in traditionally female domains where they are strongly underrepresented (e.g., education). The effect of gender distribution on young women's anticipated affect was significant, although we did not mention the proportion to the participants at any point in the study; instead, their expectations were completely shaped by their own perception of the subject majors and the respective peer group. The results thus reflect

actual affective expectations unaltered by experimental manipulations. Consequently, the effects of proportion have to be interpreted with caution because they are confounded with other variables such as the content of the subject. In other words, participants' anticipated emotion might be due to other aspects differentiating the subjects that covary with the proportion of women, such as the content of the subject or the anticipated use of technology. Further research should therefore examine the relative contribution of aspects of subject content and gender distribution on career motivation.

However, integrating the results of Study 2 with the results of Study 1, which showed that stereotype activation in imagined scenarios can alter women's aspirations within the same subject (i.e., math), it seems likely that a strong stereotype cue like underrepresentation plays at least a partial role in perceptions of subjects with negative performance-related stereotypes (i.e., electrical engineering, computer science, physics, math). In addition, even if the effects of Study 2 are partly driven by the content of the different majors, the main finding remains equally important: Young women are less motivated to choose typically male majors if they anticipate low positive affect in them, even if they are fairly confident to do well. This pattern implies that fostering young women's anticipated positive affect in domains like physics or engineering might increase their aspirations more effectively than focusing only on self-efficacy.

General Discussion

The aim of the present research was to look at whether stereotype-activating cues in performance contexts influence women's anticipated affect in the respective context. In addition, we looked at whether such cues, especially underrepresentation, reduce women's aspirations to choose careers in related fields precisely as a consequence of anticipated affect. The results of both main studies supported these hypotheses. In two pilot studies, we showed, first, that women

anticipated less positive affect in an imagined performance scenario if it contained stereotype-activating cues and that the scenario used in the first main study triggered a sense of stereotype threat. In the first main study, we similarly found that women anticipated less positive and more negative affect in an imagined performance scenario if it contained stereotype-activating cues, supporting Hypothesis 1. Study 1 also showed that women's lower anticipated positive affect in the stereotype-activating scenario, though not their higher negative affect, indirectly led to lower aspirations to embark on a STEM career. Hypothesis 2 was thus partly supported. As expected, the stereotype-activating scenario did not negatively influence men's affect or STEM career aspirations. The results are in line with previous studies showing detrimental effects of gender stereotype activation on women's aspirations (Davies et al. 2002; Murphy et al. 2007; Smith et al. 2013), and they provide novel insights into the role of affective processes in this relationship.

The second main study showed, in line with Hypothesis 3, that the lower the proportion of other women in a university department, the more negative and less positive affect female high school students expected to feel during their studies. As proposed in Hypothesis 4, female, but not male, high school students also preferred choosing their majors from subjects with a higher proportion of female students. Importantly, this was partially explained by the positive, but not the negative, affect they anticipated in that environment, supporting Hypothesis 5 partly and consistently with the findings from Study 1. Even though the list of major subjects also included some with a strong overrepresentation of women (e.g., education with more than 77 % women), the proportion did not have a significant influence on young men's anticipated affect. This difference might be because stereotypes about typically female domains tend to be less related to competence (Fiske et al. 2002) and thus underrepresentation might not activate a competence-related stereotype threat in males as it does in females.

However, for both the young men and young women in Study 2, anticipated affect in a subject, compared to others, was a good predictor of their intentions to major in it, even though only young women's positive affect was lower to the extent that fewer same-gender peers were enrolled in it. The finding that anticipated positive affect predicted study intentions over and above self-efficacy implies, however, that the variance in study intentions was not mainly due to differences in participants' confidence in their competence. In line with the results from Study 1, Study 2 points to the importance of anticipated affect, especially anticipated positive affect, for the diminution of women's career aspirations in male-dominated academic contexts.

Limitations

Maybe the most important limitation of the present research is that in both studies different stereotype-activating cues were confounded; thus a certain degree of uncertainty remains about what exactly triggered the observed differences in women's anticipated affect. In the scenarios of Study 1, stereotype activation was operationalized by combining different stereotype-activating cues namely by mentioning, on the one hand, the presence of only male competitors and a male professor (compared to a mixed-gender group and female professor), and on the other hand, the test's diagnosticity for math (compared to creative problem solving). Thus, solo status and diagnosticity were confounded. In Study 2, the stereotype-activating cue, that is the gender distribution in the major subject, was confounded with several variables such as the contents of the subject, and we did not measure participants' representations of the visualized content, that is, whether it differed between subjects with regard to the gender distribution. Further research is needed to determine the relative impact of each of the different stereotype-activating cues, and also to address the variance in anticipated affect that remains unexplained by the contextual cues examined in our paper. Despite these limitations, the present research makes

an important contribution insofar as it finds that academic contexts containing cues to the relevance of gender stereotypes, whatever their precise nature may be, suggest to women that they will not feel very good there.

In addition, it has to be noted with regard to the interpretation of Study 1 that the total effect of the cues in the scenarios on career aspiration, adjusted for preliminary domain identification, was relatively small and only marginally significant. This is not surprising, bearing in mind how brief and subtle the stereotype-activating manipulation was. The main finding consists not in the *total* effect, but the *indirect* effect of the scenario via anticipated positive affect. According to Hayes (2009), indirect effects can be meaningfully interpreted even in the absence of a statistically significant total effect. The small total effect is a limitation insofar as the findings from Study 1 should not be interpreted as evidence that a single incidence of a women's visualization of being tested in the presence of men will necessary trigger career-changing effects. The findings should be interpreted more as initial evidence for the affective associations of contextual stereotypic cues, which might only develop their full impact on aspirations additively with each exposure, each recall, and each envisaged occurrence.

Implications for Future Research

One open question concerns the apparently different roles of positive and negative affect. A not hypothesized, but consistent, finding in the present research was the relative importance of anticipated positive affect triggered by stereotype activation as a predictor of career aspirations. Research from a stereotype threat perspective has so far only linked stereotype-activating contexts to an increase in negative emotions (Johns et al. 2008; Keller and Dauenheimer 2003; Osborne 2001), with partly inconsistent results. The present studies are the first known to show that stereotype activation reduces anticipated positive affect. This might be because feelings in

an *actual* performance situation might differ from *anticipated* feelings in a hypothetical performance situation. The anticipatory perspective might allow participants to focus on aspects of the situations other than the immediate pressure to perform well and their worries about not doing well. For example, they might instead focus on their sense of how well they belong in this context (Good et al. 2012; Murphy et al. 2007), and feelings related to this might be different than feelings related to the act of performing. Further research should investigate this question in detail.

In addition, the finding that anticipated positive affect predicted career aspirations better than anticipated negative affect might be surprising from a stereotype threat perspective, but it is in line with a positive psychology perspective. Subjective well-being and striving for goals are interrelated, and "for many people […] the primary goal *is* to be happy" (Emmons 2003, p. 106, italics in the original). When people think about their future, it seems more likely that they will ask themselves the question "Which career will make me happy?" than the question "Which career will not make me unhappy?" In addition, most people search for meaning in their lives, and work, in the sense of a calling, is an important source of meaning and identity (Hirschi and Herrmann 2012; Steger and Dik 2009). Meaningfulness is experienced when positive affect is experienced (King et al. 2006), therefore it makes sense to direct one's efforts to fields where one expects positive affect, in order to find meaning.

Consequently, it might prove useful to examine further what draws women to non-STEM careers and how this attractiveness can be transferred to STEM contexts. In terms of the imagined not stereotype-activating (control) scenario of Study 1, anticipating a gender-balanced context might signal to women a relatively "safe" space for developing a positive identity within the field. Implied is the potential of examining the cues that might increase women's anticipated

positive affect in STEM. For example, emphasizing the presence of other women, or increasing perceived congruence of STEM with social goals, might be linked to increased anticipated positive affect (Diekman et al. 2011). It has to be considered and avoided, however, that measures with a positive effect on women might have unintended negative effects on men.

Another question for further research consequently concerns the factors that influence men's anticipated affect and career aspirations in different stages of their life. Study 1 showed, in a statistically non-significant trend, a *stereotype lift effect* (i.e. a positive effect of the activation of a stereotype favoring the ingroup) on men's anticipated positive affect and, indirectly, on career aspirations. However, this possibility needs to be examined in additional experimental studies, at best disentangling the aspects of male overrepresentation and diagnosticity for math. In Study 2, we found no evidence of a positive effect of the proportion of men on young men's anticipated positive affect and on study intentions. They did feel more positive about certain majors and preferred them over others, but gender distribution was not a good predictor of those preferences. Further research is needed to better understand the effect of gender stereotypes and stereotypic cues on males. A higher participation of men in stereotypically female domains, like healthcare, elementary education, and domestic (so called HEED roles), would have benefits for men and women alike (Croft et al. 2015).

Practice Implications

There have been many programs and policies aiming to increase young women's motivation and participation in STEM career fields, which have only been partially successful (Best et al. 2013). Two main practice implications for such endeavors can be deducted from the present research if it is seen in context of preliminary evidence-based knowledge about women's

stereotypical career decisions: First, in the future, we should take anticipated affect into account, and second, we should be aware of contextual cues present in STEM contexts.

Research across many decades (reviewed by Wang and Degol 2013) has concluded that young women need a higher ability self-concept and self-efficacy in math and science, and they need to value these subjects more, in order to pursue them. The present findings suggest that in addition to these factors, high anticipated positive affect is important for women's STEM career aspirations. Counselors and teachers should thus pay attention to the triggers of positive affect in STEM. The present research suggests that these triggers are likely to be different for young men and young women. These differences might go beyond the effects of the presence of reminders of stereotypes, but also relate to perceptions of how congruent a career option is with personal goals (Diekman et al. 2010; Evans and Diekman 2009). Because affective experiences function as feedback on goal achievement (Carver and Scheier 1990), the suggestion that a personal goal (e.g., fighting poverty, understanding human behavior, improving communication) can be achieved by developing strong math, science, or engineering skills might be a valuable approach to increase young women's (and young men's) anticipated positive affect with regard to STEM.

The second implication concerns the arrangement of STEM contexts, for example distribution of genders in science classes, remarks of science teachers, decoration of STEM classrooms (Cheryan et al. 2009), non-stereotypical role models (Cheryan et al. 2011), or pictures on information material (Smith et al. 2013). The present and previous research is not yet conclusive on the relative importance of various aspects of the context for anticipated affect. However, it implies that people and institutions creating STEM contexts need to be aware of the potential effects of small variations in that context, specifically insofar as they might raise stereotypes about gender and STEM. It may not be possible to eliminate all such stereotypical

cues from STEM contexts, and maybe this is not even a sensible goal. However, practitioners might help to increase women's anticipated positive affect and reduce their anticipated negative affect by implicitly "telling a different story" than the stereotype does, and thereby slowly and accumulatively shape how young and older women imagine their potential futures in STEM to be like, similar to a retraining of stereotypical associations (Forbes and Schmader 2010).

Conclusions

The present findings expand the existing knowledge about women's avoidance and opting out of STEM careers. Our results are the first known to show that in more stereotypical contexts (e.g., when women are underrepresented), women anticipate having more negative and lesser positive feelings. This conclusion is in line with findings that cues like underrepresentation can implicitly suggest to women that they will have to invest more than men will (Smith et al. 2013) and might feel like they do not belong (Murphy et al. 2007). A novel finding of the present research is also that women's lower anticipated positive feelings drive their lower STEM career aspirations, compared to men, more than the anticipation of negative feelings. The cues that are present in the context, and whether they remind of gender stereotypes, have been shown to be one aspect by which anticipated affect is influenced. This finding could contribute to identifying barriers for women that are easier to eliminate than attitudes developed over many years. We found not only that stereotypical contexts can impact aspirations in addition to stable attitudes like identifying with math or verbal abilities (Study 1) and belief in one's competence to do well (Study 2), but also that the presence of non-stereotypical contexts positively influences women's anticipated affect. In the long term, these non-stereotyped contexts even might change women's attitudes over time in the same way that chronic experiences with stereotypical contexts negatively affect attitudes (Woodcock et al. 2012).

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Table 1

Correlations Among Study Variables, Study 1

Variables	1.	2.	3.	4.
1. Math domain identification	--			
2. Verbal domain identification	.073	--		
3. Anticipated positive affect	.186	-.031	--	
4. Anticipated negative affect	-.063	.089	-.596**	--
5. Math-related career aspiration	.668**	-.324**	.406**	-.277**

Note. $N = 102$

** $p < .01$.

Table 2

Means and Standard Deviations by Gender and Scenario Type, Study 1

	No Stereotype Activation				Stereotype Activation			
	Women (n = 30)		Men (n = 24)		Women (n = 26)		Men (n = 22)	
Variables	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Positive affect	2.08	1.04	1.90	0.76	1.70	0.54	2.33	0.91
Negative affect	2.80	0.97	2.80	1.14	3.44	1.25	2.54	0.91
Career aspiration	2.77	1.41	2.96	1.41	2.41	1.18	3.21	1.56

Table 3

Effects of Gender and Stereotype-Activating Scenario on Math-Related Career Aspiration and the Mediating Role of Anticipated Affect, Study 1

	Model 1: Effect of factors			Model 2: Including mediators		
	Coefficient	*SE*	*p*	Coefficient	*SE*	*p*
Constant	2.940	.176	<.001	2.940	.124	<.001
Stereotype Activation	-0.494	.258	.059	-0.309	.249	.217
Gender (i.e.; being male)	0.033	.263	.900	0.117	.248	.638
Gender x Stereotype Activation Interaction	0.659	.382	.087	0.230	.370	.424
Positive Affect in Scenario				0.363	.123	.004
Negative Affect in Scenario				-0.047	.110	.667
Math Domain Identification	0.861	.093	<.001	0.802	.089	<.001
Verbal Domain Identification	-0.408	.095	<.001	-0.392	.090	<.001
R^2			.556			.619

Indirect Effects via Anticipated Affect

	Via Positive Affect		Via Negative Affect	
	Coefficient	95% CI	Coefficient	95% CI
Total (moderated mediation)	0.320	[0.056, 0.818]	0.040	[-0.107, 0.276]
Women	-0.150	[-0.439, -0.012]	-0.029	[-0.212, 0.070]
Men	0.170	[-0.003, 0.540]	0.012	[-0.028, 0.147]

Table 4

Bivariate and Intra-Class Correlations, Study 2

Variables	1.	2.	3.	ICC
1. Self-efficacy in Participant	--			.260
2. Anticipated Positive Affect	.596***	--		.088
3. Anticipated Negative Affect	-.569***	-.679***	--	.190
4. Study Intention	.600***	.644***	-.504***	.185

Note. $N = 720$.

*** $p < .001$.

Table 5

Predicting the Intention to Choose a Subject from Gender, Gender Proportion, Anticipated Positive and Negative Affect, and Self-Efficacy, Study 2

Fixed effects of predictors	Model 1: Effect of Predictors			Model 2: Including Affect			Model 3: Including Self-efficacy		
(coding of 1 in parentheses)	Coefficient	*SE*	*p*	Coefficient	*SE*	*p*	Coefficient	*SE*	*p*
Level 1 (*N* = 728)									
Intercept of Intention γ_{00}	1.880	.073	<.001	1.854	.073	<.001	1.848	.073	<.001
Proportion γ_{10} (+ 10% women)	0.148	.027	<.001	-0.003	.023	.884	-0.038	.021	.071
Ant. Positive Affect γ_{20} (+ 1 of 6)				0.829	.067	<.001	0.590	.074	<.001
Ant. Negative Affect γ_{30} (+ 1 of 6)				-0.091	.051	.072	0.060	.047	.202
Self-efficacy γ_{40} (+ 1 of 6)							0.359	.041	<.001
Level 2 (*N* = 91)									
Gender γ_{01} (being male)	0.083	.109	.449	0.109	.110	.326	0.107	.112	.340
Cross-Level Interaction									
Gender*Proportion γ_{11}	-0.219	.045	<.001	-0.066	.032	.040	-0.043	.029	.146
Random effects	Variance components			Variance components			Variance components		
Within: r_{ij} (σ^2)	.886			.527			.417		
Between/ Intercept: u_{0j} (τ_0)	.162		<.001	.213		<.001	.232		<.001
Between/ Slope: u_{1j} (τ_1)	.031		<.001	.013		<.001	.011		<.001

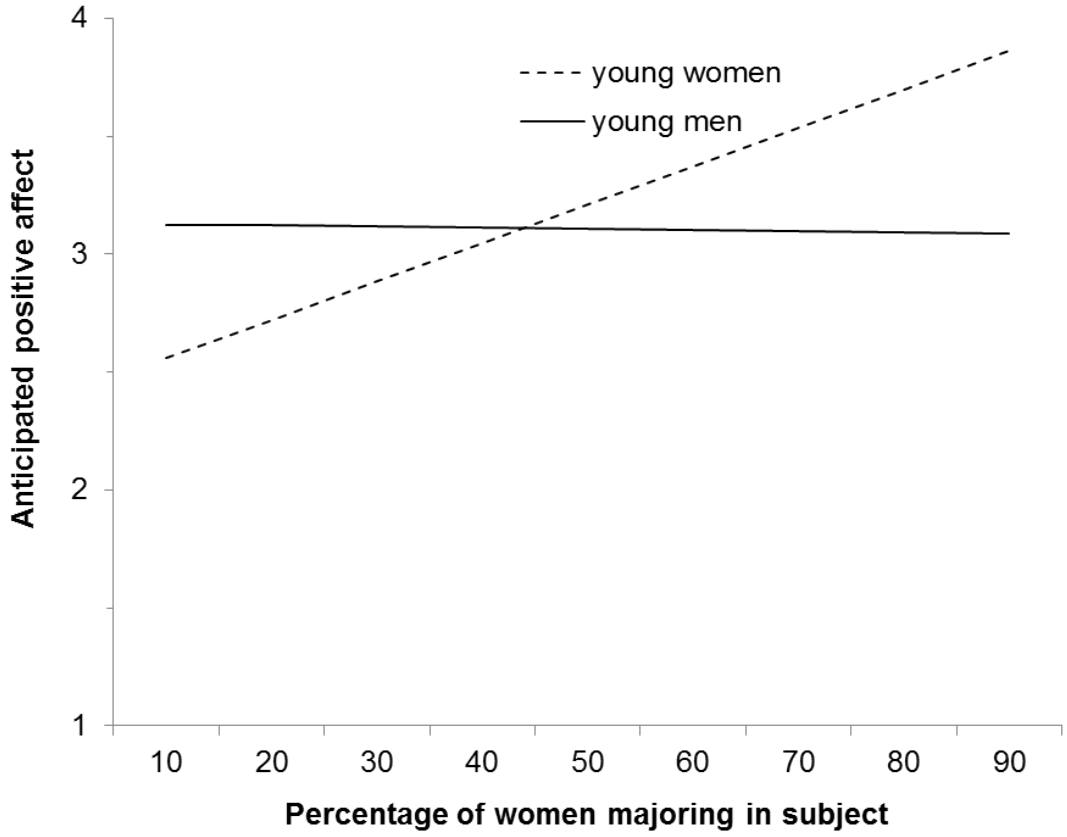

Figure 1. Slopes of gender distribution on anticipated positive affect by gender in Study 2

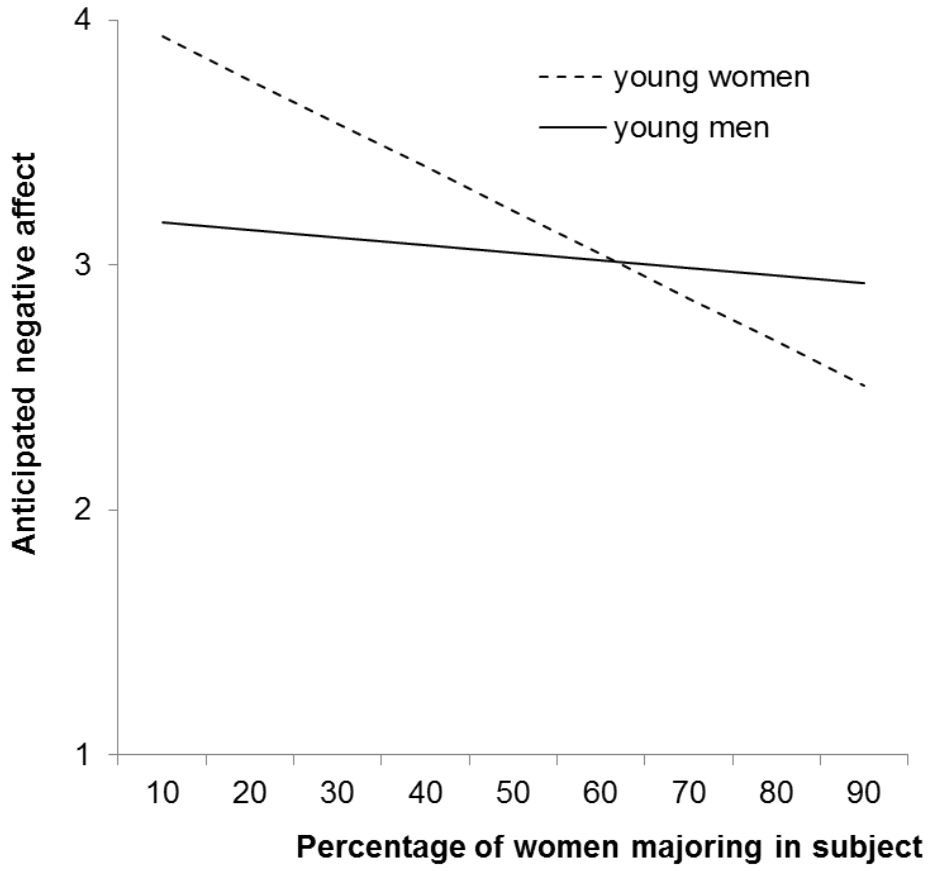

Figure 2. Slopes of gender distribution on anticipated negative affect by gender in Study 2

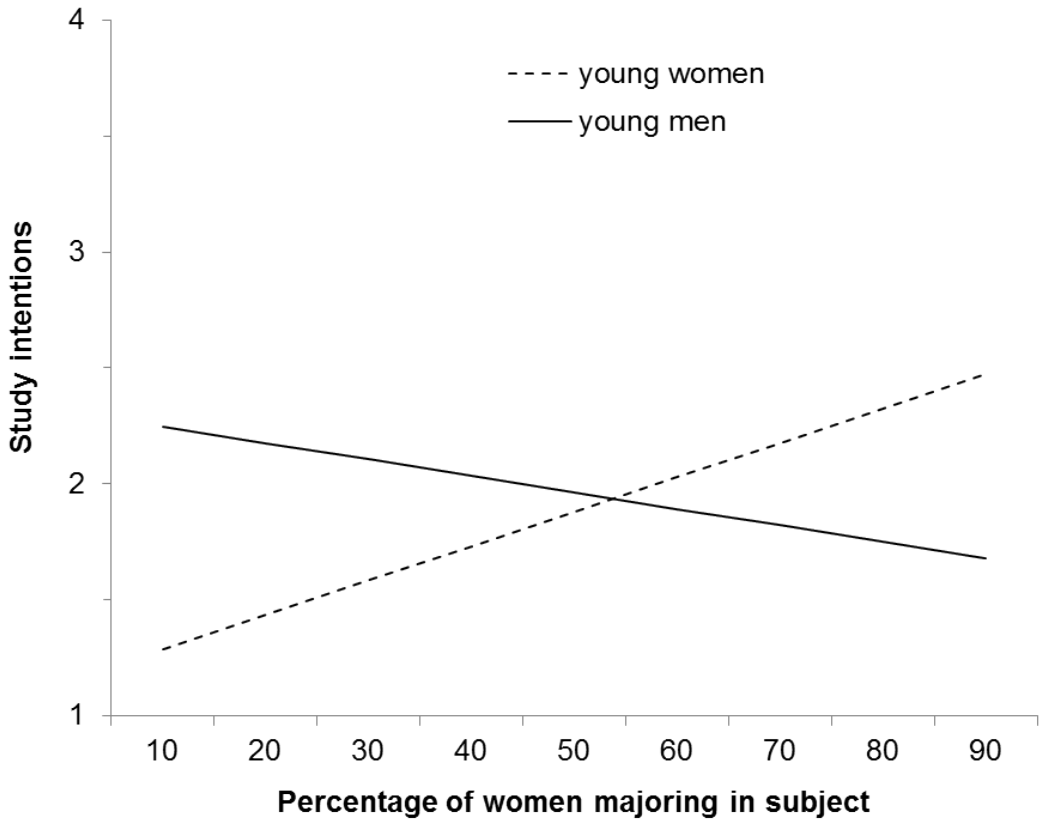

Figure 3. Slopes of gender distribution on study intention by gender in Study 2

Online supplement for Schuster, C., & Martiny, S. E. (2016). Not feeling good in STEM: Effects of stereotype activation and anticipated affect on women's career aspirations. Sex Roles. Carolin Schuster, University of Passau. Email: carolin.schuster@uni-passau.de

Pilot Study: Research Question and Hypotheses

This pilot study was constructed to test for the first time if imagined stereotype threat situations (i.e. performance situations where negative stereotypes are salient) increase women's anticipated negative emotions and thoughts. Based on previous research examining emotions and thinking in actual stereotype threat situations (Cadinu et al. 2005; Johns et al. 2008; Keller and Dauenheimer 2003), we expected increased negative thinking and increased negative emotions in a stereotype threat scenario. By that we refer to the description of a performance situation that contained some cues known to activate stereotypes in actual performance situations, resulting in the typical underperformance of the stereotyped group (Nguyen and Ryan 2008). Specifically, the stereotyped-activating cues we integrated in the scenario vignettes were diagnosticity of the test for math ability (e.g., Steele and Aronson 1995), solo status as a woman (Sekaquaptewaand Thompson 2003), and benevolent sexism (Dardenne et al. 2007). The cues were combined because cues in an imagined scenario might be weaker in effect than in an actual performance situation; the combination was to make it stronger. In addition, it is quite plausible that the prevalence of these cues actually covary: For example, when applying for a faculty job in the mathematics department it is likely that one's math ability is in question, that women are a minority, and that they are offered a little more help than their male colleagues. In addition to negative thinking and emotions, we included a measure of math-related career aspiration as another outcome that has been shown to suffer from stereotype threat experiences (e.g., Davieset al. 2002).

Method

Participants and Design

Twenty-eight female university students participated. Their ages ranged from 20 to 30 years (M = 22.32, SD = 2.36). We used a single factor design with two conditions: stereotype activation vs. no stereotype activation. The dependent variables were anticipated thoughts and anticipated negative and positive affect in the scenario, as well as their math-related career aspirations.

Procedure

After arriving at the laboratory, participants were informed that we were interested in people's ability to imagine situations, and signed a consent form. Participants were administered a written scenario and were instructed to read it thoroughly, close their eyes, and imagine it as well as they could. After 30 seconds the experimenter handed out a questionnaire, in which participants were asked to note all the thoughts that they imagined would come to their mind in the imagined situation, and to rate their anticipated feelings in the situation. Items followed about the visualization of the scenario (i.e., how easy it was to imagine), the motivation to pursue a career in a math-related field, and math domain identification. At the end, participants were asked whether math ability and stress resistance were generally attributed to men, women, or neither gender, and then gave demographic information. Finally, participants were debriefed and received 4 €.

Scenarios and manipulation of stereotype activation. Participants were told to imagine that they had applied for a job they really wanted and had been invited to the company's assessment center, which they had heard was very difficult. Upon arrival, the HR manager tells the waiting group of applicants that they will first take a test where they have to explain a problem's solution to the rest of the group, and picks the participant to be the first to try. The

problem was: *'Calculate the height of a tetrahedron (a pyramid of 4 equilateral triangles) with a side length of 15 cm!'* In the stereotype activation condition, the test aimed at assessing math ability, all other applicants – introduced by name – were male, and the male manager said to the participant: *'Ladies first!'* In the no stereotype activation condition the test aimed at assessing stress resistance, three of the five other applicants were women, and the female HR manager said "You are first!" Importantly, in both conditions participants imagined solving the same task.

Categorization of thoughts. Five categories were developed from the thought protocol, in which a rater blind to condition coded the reported thoughts: 1. *Constructive thoughts*, containing ideas about how to deal with situation (e.g., "I need Pythagoras' theorem here"), 2. *Memory search*, containing attempts to remember forgotten math knowledge (e.g., "How did that go again?"), 3. *Self-conscious thoughts*, containing negative thoughts about others' impressions (e.g., "I am about to embarrass myself"), 4. *Self-doubts*, containing negative thoughts about the self (e.g., "I have always been bad at math"), and 5. *Complaints*, containing negative thoughts about the situation (e.g., "It would be easier if I wasn't first"). In addition, thought protocols were coded for number of swear words used. A second person rated 45% of the thoughts again; inter-rater reliability was satisfactory (Cohen's $\kappa = .83$). The proportion of thoughts in each category was used for the following analyses.

Affect. The affect measure was based on the Positive Affect/Negative Affect Scale (PANAS; Watson and Clark 1999). Five of the original items (NA: anxious, ashamed, angry; PA: proud, content) were used in combination with seven further items (NA: insecure, frustrated, worried; PA: relaxed, optimistic, hopeful, relieved), in order to get an affect measure specific to affective reactions in academic contexts. Participants rated the intensity of each emotion on a 6-point Likert scale ranging from "not at all" to "extreme". Reliabilities of the positive ($\alpha = .76$)

and the negative (α = .84) affect scale were satisfactory. In addition, participants were given the opportunity to write down other feelings they anticipated.

Visualization of the situation. Three items measured how easy it was for participants to imagine the situation ("I could imagine well how that situation would feel"; "I am sure I know how I would feel in that situation"; "It was hard to imagine what I would think in such a situation", reverse coded). The 6-point scale ranged from "not at all true" to "fully true". Reliability of the combined scale was acceptable (α = .78).

Math-related career aspirations. Aspirations were measured with the item "How much would you like to work in a field in which your math ability is most relevant?" The item was presented alongside several distractor items with regard to abilities unrelated to the scenarios (e.g., social competence). Participants answered on a 6-point scale ranging from "by no means" to "definitely".

Domain identification. Identification with math was measured with five items ("I am good at math", "I like math", "I am not really cut out for math" (recoded), "Being good at math is important to me"; "I don't care if I am good at math" (recoded). The items were selected and adapted from previous measures (Lesko and Corpus 2006; Spencer et al. 1999) in order to include several aspects of domain identification. Reliability was high (α = .93).

Statistical Analyses

All analyses were conducted with SPSS 22 (IBM 2013). As recommended for small sample sizes, we used non-parametric bootstrapping analyses (Preacher and Hayes 2004) to test indirect effects, using their SPSS macro. Cohen's *d*s of mean differences and their confidence intervals were calculated with a procedure described by Wuensch (2012; see also Smithson 2001).

Results and Discussion

Preliminary Analyses

When asked about the gender stereotypes associated with math ability and stress resistance, 26 participants reported that math ability was attributed to men (2 indicated it was attributed to neither gender). With regard to stress resistance, 7 participants attributed it more to men, 8 more to women, and 13 to neither gender. In contrast to the well-known gender-math stereotype, there does not seem to be a clear stereotype for stress resistance.

Responses to the visualization of the situation scale (M = 5.32, SD = 0.58) suggest that participants were able to imagine the situation easily. Even the lowest value reported (*Min* = 3.67) was above the scale midpoint. There were no significant differences between the stereotype activation condition (M = 5.27, SD = 0.66) and the no stereotype activation condition (M = 5.39, SD = 0.47), $t(26) = 0.55$, d = 0.20 [-0.12; 0.52].

To test if math domain identification was indeed independent of the stereotype activation in the scenario, we tested for group differences. As expected, there was no difference between the stereotype activation condition (M = 3.18, SD = 1.27) and the no stereotype activation condition (M = 2.87, SD = 1.51), $t(26) = 0.56$, d = 0.22 [-0.54, 0.96].

Thoughts

We predicted that the activation of the gender-math stereotype would lead to increased negative thinking (i.e., the thought categories complaints, self-conscious thoughts, and self-doubts). Table 1 shows the effects of condition on the percentages of thoughts in each category. As can be seen by the 95 % confidence intervals of the effect sizes, only complaints about the situation differed significantly between conditions, with higher percentages in the stereotype-activating scenario. In addition, almost every other woman in the stereotype activation condition used swear words to describe her thoughts (M = 0.44, SD = 0.73), but no one in the no stereotype activation condition did, d = -0.92, *CI* [-1;72; -0.09]. This partially supports the hypothesis that

women expect stereotype threat situations to be accompanied by negative thoughts. Contrary to previous literature, which suggests an increase especially in self-doubts under stereotype threat (Cadinu et al. 2005), self-doubts were anticipated frequently in both conditions. This might be because high stakes test situations in general might be perceived as threatening and could thus evoke self-doubt whether there are gender stereotypes activated or not. However, we did find that participants' anticipated thoughts in the stereotype threat scenario were relatively more concerned with annoyance about the situation, and they were expressed in more aggressive terms.

Table 1
Effect of Stereotype-activating Scenario on the Percentages of Thoughts in Each Category

Thought category	Activating M (SD)	Not activating M (SD)	Effect size *d* [95% CI]
Complaints	11.02 (10.27)	2.71 (5.14)	1.07 [0.25; 1.87]
Self-conscious thoughts	11.40 (12.14)	9.71(10.94)	0.15 [-0.61; 0.90]
Self-doubts	22.03 (14.63)	23.12 (20.58)	-0.06 [-0.81;0.67]
Memory search	14.34 (12.18)	8.09 (10.60)	0.54 [-0.22;1.39]
Constructive thoughts	31.16 (27.36)	44.99 (26.58)	-0.51 [-1.27; 0.25]

Anticipated Affect

We also predicted that the activation of the negative stereotype would increase participants' anticipated negative affect. A t-test supports in trend, $t(23.56) = 2.00$, $p = .06$, $d = .70$, that women reported more anticipated negative affect when imagining a stereotype-activating scenario ($M = 3.76$, $SD = 1.31$) compared to a no stereotype-activation scenario ($M = 3.00$, $SD = 0.66$). In addition, a second t-test, $t(26) = 2.15$, $p = .04$, $d = .81$, showed that women anticipated less positive affect when stereotypes were activated ($M = 1.64$, $SD = 0.52$) compared to when they were not activated ($M = 2.15$, $SD = 0.75$). These findings show that imagined stereotype threat situations can indeed be associated with a more negative or at least less positive affective experience. In other words, people might anticipate an affective stereotype threat experience

when the context makes stereotypes salient. Further research should test more directly if this is due to an anticipation of a gender-related threat.

Career Aspiration

The mean aspiration to pursue a math-related career was 2.06 (SD = 1.57) in the stereotype activation condition, and 2.33 (SD = 1.67) in no activation condition. Career aspiration are closely related to the identification with the domain. Therefore, we ran an ANCOVA with the scenario condition as a factor and math domain identification as a covariate. Domain identification explained a large part (partial $\eta^2 = .77$) of the variance in aspiration, $F(27,1) = 84.34$, $p < .001$. In addition, there was a marginally significant effect of condition, $F(27,1) = 3.63$, $p = .07$, partial $\eta^2 = .13$. This result can has to be interpreted with caution, due to the small sample, and because of the single item measure, which might be unreliable. Yet it encourages further research on the motivation consequences of imagined stereotype threat.

Correlations

Another interesting exploratory result concerns the correlations between anticipated negative affect and anticipated positive affect in the imagined scenarios, and math-related aspiration and domain identification. As shown in Table 2, participants' anticipated positive affect in the briefly visualized scenario correlates on a medium level with the person's generally reported aspirations to pursue a math-related career. This is not the case for anticipated negative affect. This finding is remarkable, first, because the anticipation does not directly refer to the potential career, but merely a context where one has to solve a specific math problem. Second, this suggests further research should look into the possibility of anticipated positive affect as a mediator by which stereotype-activating cues could reduce career aspirations in stereotyped domains.

Table 2

Pearson's Correlations Among Measures

	Anticipated negative affect	Anticipated positive affect	Career aspirations	Math domain identification
Anticipated negative affect	--	-.500**	-.069	.036
Anticipated positive affect		--	.430*	.261
Career aspirations			--	.860**
Math domain identification				--

*$p < .05$. **$p < .01$.

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Notes on the Exclusion of Participants in Study 2

The following analyses are all exactly the same as in the original article, however calculated based on the initial sample (N = 127). The results reported in the main article were obtained after excluding all participants who did not complete the online survey within the time limit of 10 to 30 minutes. The intention behind the exclusion was to ensure that only data of participants who answered the survey without interruption, and who thoroughly read all materials, were taken into account. Uncompliant survey completion might prevent effects of the manipulation because only a thoroughly read and visualized scenario can have an effect, and potential effects of the visualization are likely to fade if participants get distracted with other things before completing the dependent measures.

Exclusion by Group

Table 1 shows the number of excluded participants by experimental group. Comparing frequency of exclusion between men and women, $\chi^2(1) = 0.068$, $p = .794$, and conditions, $\chi^2(1) = 0.993$, $p = .319$, shows no differences. As χ^2 tests require a minimum of 5 counts per cell, frequencies between the condition*gender groups should not be compared statistically.

Table 1

Excluded (of total) Participants by Experimental Group

	Men	Women	Total
Stereotype Activation	2 (24)	4 (26)	6 (50)
No Stereotype Activation	10 (24)	6 (30)	16 (54)
Total	12 (48)	10 (56)	22 (127)

Effects of Gender and Scenario on Anticipated Positive and Negative Affect

In the article we first analyzed the effects of scenario on anticipated positive and negative affect (*z*-transformed), moderated by gender. Based on the initial sample, the main effect of stereotype-activating scenario on anticipated positive affect was B = -0.323, SE = .240, CI [-0.779; 0.153], p = .181, the main effect of gender was B = -0.108, SE = .239, [-0.580; 0.364], p = .651. The effect of the interaction, in which we were interested, was B = 0.595, SE = .359, [-0.114; 1.305], p = .099. With regard to anticipated negative affect, the main effect of scenario was B = 0.473, SE = .237, [0.004; 0.940], p = .048; the main effect of gender was B = -0.028, SE = .235, [-0.492, 0.4370], p = .907, and the interaction effect was B = -0.644, SE = .353, [-1.342; 0.051], p = .070. In summary, the direction of results is similar, but the interaction effects turn out smaller and only marginally significant.

Indirect Effects of Scenario and Gender on Career Aspirations

Table 2 below shows the results of the test for indirect effects of the scenario on career aspirations. Again, none of the effects changes directions, compared to the final sample used in the article. However, there is no significant effect of the manipulation neither as a main effect nor in interaction with gender. The effect of anticipated positive affect in Model 2 is similar, and the coefficient of math domain identification is even larger than before.

Discussion with Regard to the Aim of the Exclusion

Considering the timely procedure of the study, the differences in the results are in line with the notion that the participants beyond the time limit did not dedicate the same continuous attention to the experiment. The manipulation, which required to read half a page of text and visualize the situation thoroughly, generally appears to have been less effective on the excluded participants, especially on the measure of aspiration, which came later on in the questionnaire. If they only read the scenario superficially, they might have missed most of the stereotype-

activating cues, and answered the subsequent questions based on their general affectivity in test situations and their attitudes. Thus, anticipated affect and especially domain identification would still be important predictors of career aspirations, but the manipulation would not be. We therefore interpret the results in Table 2 as confirmation for the usefulness of the time limit. However, further online research should include items to control participants' attention and understanding of the materials.

Table 2

Study1: Effects of Gender and Stereotype-Activating Scenario Without Excluding Participants Because of the Time Limit

	Model 1: Effect of factors			Model 2: Including mediators		
	Coefficient	SE	p	Coefficient	SE	p
Constant	3.048	.167	<.001	3.000	.157	<.001
Stereotype Activation	-.367	.242	.131	-.203	.230	.380
Gender (i.e. being male)	.023	.249	.914	.079	.225	.728
Gender*Stereotype Activation Interaction	.389	.359	.280	.126	.123	.713
Positive Affect in scenario				.311	.105	.004
Negative Affect in scenario				-.108	.105	.307
Math domain identification	.932	.090	<.001	.852	.086	<.001
Verbal domain identification	-.408	.090	<.001	-.396	.064	<.001
R^2	.526			.592		
	Indirect effects via anticipated affect					
	Via Anticipated Positive Affect			Via Anticipated Negative Affect		
	Coefficient	95% CI		Coefficient	95% CI	
Total (moderated mediation)	.185	[-.001, .543]		.069	[-.129, .212]	
Women	-.101	[-.313 , .020]		-.051	[-.243 , .021]	
Men	.085	[-.052, .347]		.035	[-.020 , .145]	

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Additional Information on the Data of Study 2

The following figure illustrates the nesting of the data on subjects within persons in Study 2. In addition, it provides the exact gender proportion of each subject. The proportions were coded according to the Annual Report of the Federal Statistical Office in Germany (Statistisches Bundesamt, 2012). Because the proportion varies between subjects, it is also a Level 1 variable.

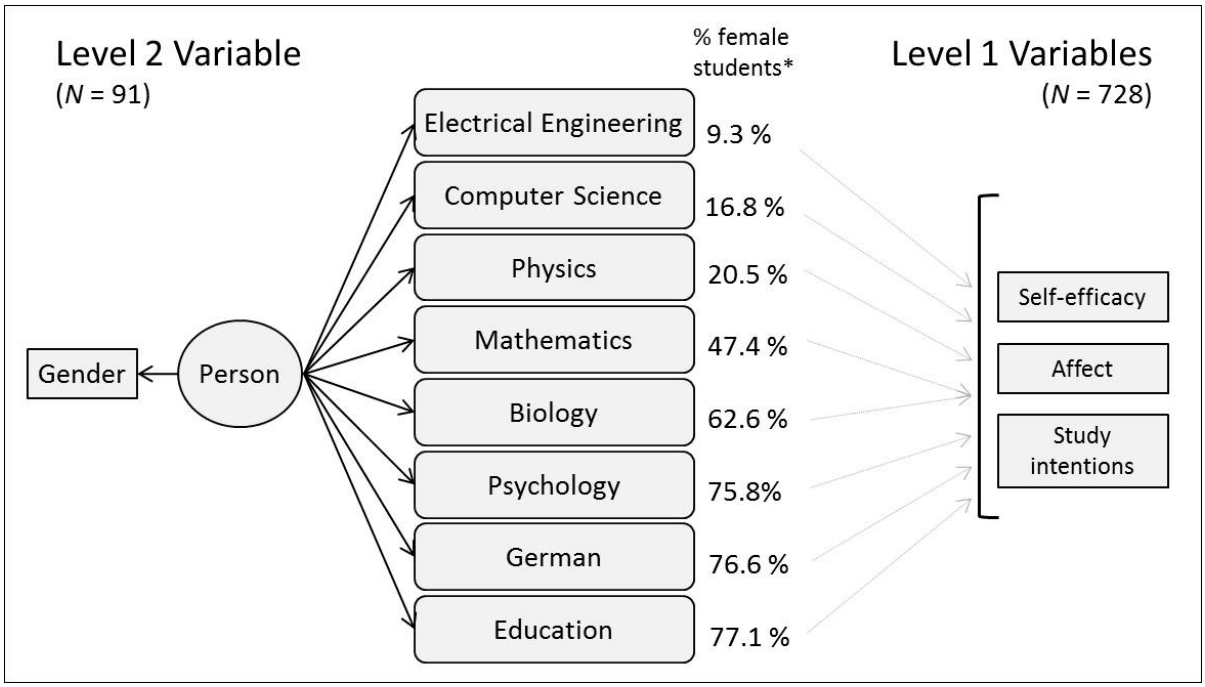

Fig. 1. Hierarchical Data Structure of Study 2