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Can the Media Help Women Be Better at Math? Stereotype Threat, Selective Exposure, Media Effects, and Women's Math Performance

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This study examines women's media selections when under the gender–math stereotype threat and the subsequent media effects on their math performance through the lens of the Selective Exposure Self- and Affect-Management (SESAM) model, mood management theory, and social comparison theory. Female college students were randomly assigned to the stereotype threat condition or the control condition; then, they selectively browsed magazine pages showing female role models in stereotypical domains (beauty or family) and counterstereotypical domains (career or science) before taking the math test. The results show that women spent more time on career magazines when under threat, and this selective exposure's effect on their math performance was moderated by their assimilation to the role models.

Keywords: Stereotype Threat, Selective Exposure, Media Effects, Female Role Models, SESAM Model, Social Comparison, Assimilation vs. Contrast, Gender Roles, Women in STEM.

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Despite the progress that women have achieved in the last few decades with regard to participation in STEM (science, technology, engineering, and mathematics) fields, female underrepresentation remains a persistent issue. According to the Census Bureau's 2009 American Community Survey, women comprised 48% of the U.S. workforce but only 24% of STEM workers (Beede et al., 2011; Landivar, 2013). Among the potential reasons for this underrepresentation, math anxiety and stereotype threat have been proposed to have a strong impact on women's math performance and career aspiration (Good, Rattan, & Dweck, 2012). Many studies have explored the extent of this negative effect as well as possible ways to alleviate the stereotype threat and improve women's math performance and confidence (details

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reviewed below). However, the threat reduction methods examined in this line of research, while effective as experimental manipulations, are not practical nor realistic as women are not likely to encounter or apply them when they are faced with a challenging math test in real life. We posit that media messages, on the other hand, have the potential to be a readily available and easily employed means to counter stereotype threat. The present study aims to focus on the gender–math stereotype threat, examining the impact of exposure to stereotypical and counterstereotypical female portrayals in popular magazines on women's math performances under stereotype threat.

Gender–math stereotype threat

The belief that men are inherently better than women at math because they innately possess better mathematics aptitude and ability is widely and strongly held (Quinn & Spencer, 2001). More generally, men are implicitly associated with math and science, while women are implicitly associated with arts and humanities (Kiefer & Sekaquaptewa, 2007). These seemingly innocuous beliefs exert a strong impact on women's self-concept (Steele & Ambady, 2006), and thus act as a stereotype threat on their math performances. Being aware of the negative stereotype, women feel at risk of confirming it, and the resulting apprehension disrupts their math performance (Spencer, Steele, & Quinn, 1999).

Empirical studies have shown that this gender–math stereotype is mainly based on the ingrained sociocultural assumption: Women are more susceptible to the stereotype threat when their gender identity is invoked and the connection between their gender and math is made salient in their working self-concept (Kiefer & Sekaquaptewa, 2007; Schmader, 2002). The working self-concept, which can be understood as the self-concept of the moment, is an individual's currently accessible self-knowledge and is continually shifting depending on situational cues (Markus & Wurf, 1987). In the context of gender–math stereotype threat, research has shown that women who identify more strongly with their gender are more susceptible to the stereotype threat (Steele & Ambady, 2006). In fact, female schoolchildren start to become susceptible to the stereotype threat after reaching a certain age and becoming familiar with the stereotype (Ambady, Shih, Kim, & Pittinsky, 2001). This effect typically occurs at the end of elementary school and continues well into adulthood, suppressing math performance even in highly qualified and motivated women (Good, Aronson, & Harder, 2008).

The good news is that there may be remedies to the issue because the gender–math stereotype threat is culture-based and contingent upon the salience of gender identity and its connection to the stereotype in the individual's working self-concept. In other words, the threat is context-dependent and susceptible to external influence. Thus, researchers have examined multiple ways to reduce or suppress the threat, allowing women to overcome the apprehension and perform better at math.

Reducing gender–math stereotype threat

Several studies focusing on the gender–math stereotype threat explored a variety of methods in threat reduction and math performance improvement. Self-affirmation was shown to be effective in reducing stereotype threat and improving math performance for women (Martens, Johns, Greenberg, & Schimel, 2006). Schmader (2002) found that when gender identity is made irrelevant to math performance, women's performance was equivalent to men's regardless of how strongly they identified with their gender. Other studies showed that the threat's effect on women's math performance can be eliminated by informing participants that the test does not yield gender differences (Spencer et al., 1999) or that the test is not diagnostic of mathematical ability (Quinn & Spencer, 2001). Priming participants with another identity (student at a selective private college, McGlone & Aronson, 2006; or Asian, Shih, Pittinsky, & Ambady, 1999) that can counter the identity linked to the stereotype threat (female) was found to achieve the same effect. McIntyre, Paulson, and Lord (2003) employed the salience of group achievements to help women overcome the threat: Female college students who were told that women make better participants in psychology experiments than men do (Study 1) or who read biographies of successful women in traditionally male domains (Study 2) performed significantly better in a difficult math test than those in the control groups. Finally, positive female role models also successfully reduced the threat as shown when women's math performances were improved when the test was administered by a female experimenter with high perceived math competence as opposed to a male experimenter (Marx & Roman, 2002).

Together, these studies showed that once confronted with the stereotype threat, women's gender identity is automatically activated, and they apply the negative stereotype to their working self-concepts. Thus, the key to reducing the gender–math stereotype threat is either to unlink women's working self-concepts from their gender identity and the associated negative stereotype (mentioning the irrelevance of gender, priming another identity) or to replenish their gender identity and working self-concepts with positive beliefs (self-affirmation, providing positive female role models). The present study aims to take this second approach and examine the use of media messages to provide women with successful female role models in traditionally male domains and affirm their gender identity. As mentioned above, as ways to reduce the stereotype threat, having beliefs about their intelligence altered, being told that the test is gender-neutral and nondiagnostic, doing a self-affirmation task, or encountering a positive real-life role model are experimental manipulations and not common, natural, or available means for women who are immediately faced with the threat. Media exposure, on the other hand, is prevalent and can readily provide women with positive female role models who can help them counter the threat on their own. This study aims to explore women's patterns of selective exposure to magazine stimuli when they are confronted with the gender–math stereotype threat and the effects of such exposure on their subsequent math performances.

The Selective Exposure Self- and Affect-Management (SESAM) Model

The SESAM model provides a theoretical framework for individuals' selective exposure based on the current working self as well as available media messages (Knobloch-Westerwick, 2015). The model postulates that media users select media messages in order to regulate their working self-concepts along with their current cognitive and affective states. They base their selections on the anticipated effects of available media messages, and their motivations for exposure will, in turn, shape their interpretation of the messages. Finally, this interpretation will affect their working self-concept, influencing subsequent media exposure motivations and selections. The model posits that self-consistency, self-enhancement, and self-improvement are the main motivations for selective exposure. Depending on what self-concept is activated, media users may seek out media messages to reinforce that dimension (self-consistency motive), to downwardly compare to feel better about themselves on that dimension (self-enhancement motive), or to upwardly compare to learn how to advance and improve themselves on that dimension (self-improvement motive).

The SESAM model and the stereotype threat literature are connected by the use of the working self-concept as an explanatory mechanism. Steele and Ambady (2006) proposed that the working self-concept can serve as the mediator between gender identity salience and stereotype-consistent beliefs; that is, when participants' gender identity is made salient, gender becomes more important in individuals' working self-concepts, prompting them to apply the gender stereotype on themselves. Within the SESAM framework, these gendered self-concepts have been shown to predict men's and women's selective exposure to gender-typed magazines (Knobloch-Westerwick & Hoplamazian, 2012). We thus expect the stereotype threat to invoke women's gender identity and stereotype-consistent beliefs in their working self-concepts, which would then influence their media selection.

Among the motivations for selective exposure proposed by the SESAM model, self-consistency and self-improvement motives are the most applicable with regard to exposure to portrayals of women in popular magazines, as opportunities for self-enhancement comparison are rather limited because magazines typically predominantly feature success stories or tips to improve oneself (Willis & Knobloch-Westerwick, 2014). Participants can choose to view stereotypical portrayals for self-consistency motives (Knobloch-Westerwick & Hoplamazian, 2012; Knobloch-Westerwick, Robinson, Willis, & Luong, in press) or to view counterstereotypical portrayals for self-improvement motives. When the stereotype threat is factored in, we postulate that participants who are confronted with the threat will seek out portrayals of successful women in counterstereotypical roles in order to activate this self-concept and better prepare for the upcoming challenge (self-improvement motive), while participants who are not confronted with the threat will select stereotypical portrayals, seeking reinforcement of their traditional gendered self-concept (self-consistency motive). Therefore, we proposed these hypotheses:

H1a: Women who anticipate a math task will spend more time with counterstereotypical portrayals of women in magazines compared to women who do not anticipate such a task.

H2a: Women who anticipate a math task will spend less time with stereotypical portrayals of women in magazines compared to women who do not anticipate such a task.

Gender–math stereotype threat, anxiety, and mood management

Another proposed negative effect of stereotype threat is the anxiety it produces. Steele (1997) hypothesized that for a member of a social group, being aware of the negative stereotype associated with said group and feeling at risk of confirming the stereotype and suffering from personal embarrassment will result in anxiety. This anxiety, in turn, hinders the individual's performance. Osborne (2001) found that racial differences in academic performances and gender differences in math performances in high school seniors could be attributed to the anxiety created by stereotype threat. Bosson, Haymovitz, and Pinel (2004) showed that participants' nonverbal measure of anxiety served as a mediator between stereotype threat and lowered performance. Thus, besides gender identity and the working self-concept, anxiety can provide an alternate explanation for the negative effect of stereotype threat on performance.

Mood management theory (Zillmann, 1988), as a prominent theory of selective exposure, is particularly suited to predict individuals' media selection under anxiety-induced mood. The general tenets of mood management theory propose that individuals are motivated to select media to optimize their mood in accordance with the hedonic principle. Specifically, individuals would select media content that (a) is excitationally opposite to their current arousal state, (b) has positive valence above their current state, and (c) has low semantic affinity with their current state if they are in a negative mood (Zillmann, 1988). For example, an individual who is bored (low arousal and negative valence) would seek out an exciting comedy–adventure movie (high arousal and positive valence) to manage his or her mood. If the individual's negative mood is associated with a certain topic, such as a breakup or a family dispute, he or she would tend to avoid media content related to said topic, such as a romantic comedy or a family movie.

Mood management theory has received ample empirical support over the years (Biswas, Riffe, & Zillmann, 1994; Bryant & Zillmann, 1984). However, studies also found conflicting evidence (De Wied, Zillmann, & Ordman, 1995; Oliver, 1993), which prompted subsequent theoretical development resulting in mood adjustment theory (Knobloch, 2003). Mood adjustment theory states that a hedonically optimal mood is not desirable in all circumstances, and thus, people aim to select media content to optimize their mood for the current situation. In the context of the current study, mood management and mood adjustment theory can provide a helpful framework, albeit with opposing predictions to those made by the SESAM model. As women who are under the stereotype threat would feel stressed and anxious (high

arousal and negative valence), they would be more likely to select media content that is low in arousal and positive in valence. All female role models selected for this study are portrayed in a positive manner, but stereotypical magazines can be posited to induce lower arousal than counterstereotypical magazines because of less demanding content and women's greater familiarity and consumption of stereotypical magazines (Knobloch-Westerwick & Hoplamazian, 2012). Therefore, we propose the following competing hypotheses (as opposed to H1a and H2a):

H1b: Women who anticipate a math task will spend less time with counterstereotypical portrayals of women in magazines compared to women who do not anticipate such a task.

H2b: Women who anticipate a math task will spend more time with stereotypical portrayals of women in magazines compared to women who do not anticipate such a task.

Social comparison to counterstereotypical portrayals of women

Although women can select messages with the self-improvement motive to regulate their self-concepts and prepare for the upcoming task, these selections do not always lead to the desired effects. Media users routinely base these selections in part on the anticipated effects of those messages, but these anticipations are not always confirmed (Knobloch-Westerwick, 2015). While it is commonly accepted that exposure to stereotypical gender roles can hamper women's self-confidence and performance, the evidence for the positive influence of exposure to counterstereotypical role models tends to be mixed and complicated.

On one hand, many studies found support for this positive impact: Exposure to female role models in traditionally male domains positively influences women's self-evaluations and leadership behaviors (Latu, Mast, Lammers, & Bombari, 2013), reduces automatic gendered self-stereotyping (Dasgupta & Asgari, 2004), decreases negative self-perceptions, and increases leadership aspirations (Simon & Hoyt, 2012), as well as negates the effect of the gender–math stereotype threat on women's math performance (Marx & Roman, 2002). On the other hand, several studies showed that exposure to such counterstereotypical female role models can backfire. Rudman and Phelan (2010) primed female participants with traditional gender roles or nontraditional roles and found that traditional roles increased participants' automatic gender stereotypes, while nontraditional roles decreased participants' leadership self-concept. Women exposed to successful female leaders reported lower self-evaluation and self-competence, greater feelings of inferiority, and overall reduced leadership aspirations (Hoyt & Simon, 2011).

These contradictory findings have been proposed to be the result of the assimilation versus contrast effect that occurs in social comparison (Lockwood & Kunda, 1997). Within the context of social comparison to counterstereotypical female role models, it has been demonstrated that assimilation (converging self-evaluations to the

target of comparison) occurs when individuals perceive the role models to be similar to themselves and results in positive effect, while contrast (diverging self-evaluations to the target of comparison) occurs when individuals perceive the role models to be different from themselves and results in negative effect (Marx & Ko, 2012). Similarly, within the context of the SESAM model, the effect of social comparison with self-improvement motive to a particular media message is said to depend on "the attainability of a comparison standard and perceived closeness to the comparison target" (Knobloch-Westerwick, 2015, p. 10). These theories and findings prompt the following hypothesis:

H3: The effect of selective exposure to counterstereotypical portrayals of women in magazines on women's math performance will depend on women's assimilation to the role models, in that a higher level of assimilation will lead to a more positive relationship between exposure time and math performance.

Finally, as exposure to stereotypical portrayals of women has been universally shown to increase implicit female stereotypes, increase stereotypical gendered self-concepts, and reduce interest in traditionally male domains (Knobloch-Westerwick & Hoplamazian, 2012; Rudman & Phelan, 2010), we expect a negative impact from such exposure on participants' math performance. We thus propose the last hypothesis:

H4: Selective exposure to stereotypical portrayals of women in magazines will decrease women's math performance.

Methods

Overview

An online between-subjects experiment was conducted with 167 college women. Participants first completed a pretest and a distractor task. They were then randomly assigned to the experimental (stereotype threat) or control (nonthreat) condition. They answered a mood question as a manipulation check and then selectively browsed magazine pages. Immediately after, participants completed a math test, and finally, they were thanked and debriefed.

Sample and recruitment

A total of 167 female participants completed the study. Participants were undergraduate students recruited from a large university in the Midwestern United States and received course credit for participating. Five participants had a total magazine exposure time of less than 15 seconds, indicating they were not paying attention and were thus excluded from the sample. The resulting sample ($N = 161$) had a mean age of $M = 20.45$ years ($SD = 2.48$), with 138 (85.7%) self-identifying as White, 10 (6.2%) as Black/African American, five (3.1%) as Hispanic/Latino, 14 (8.7%) as Asian/Pacific Islanders, one (0.6%) as Native American, and one (0.6%) as "Other."

Procedure

Pretest

Participants first reported demographic information, current college GPA (grade point average, out of 4.0), and perceived math ability by answering the question "How would you describe your mathematic ability?" on a 100-point slider. On average, participants had a GPA of $M = 3.14$ ($SD = .42$) and reported their level of math ability as $M = 54.5$ ($SD = 22.1$). Participants then filled out pretest measures of gender identity, masculinity and femininity, and state self-esteem to be used at covariates in our analyses (see the *Measures* section for more details).

Distractor task

After completing the pretest measures, participants were prompted to engage in a distractor task. They were asked to look at a series of 10 patterned images and evaluate how positively or negatively they felt toward the images on a 7-point scale.

Manipulation

After the distractor task, participants were randomly assigned to the threat ($N = 82$) or nonthreat ($N = 79$) condition. The experimental manipulation was adopted from previous studies (Kiefer & Sekaquaptewa, 2007; Quinn & Spencer, 2001) and has been shown to successfully invoke the stereotype threat in female participants. The instruction for participants in the stereotype threat condition is indicated in square brackets below, the nonthreat condition in decorative brackets:

> "You have completed the first part of the study. You now have a magazine viewing session and [a MATH test] {a skills exploration session} left.
> For the magazine viewing, you will see an index page where you can make a selection of what you would like to read. You can choose from any of the categories presented and you may spend as long as you wish viewing the pages.
> [For the MATH test, please try to do your best, as it is DIAGNOSTIC of your MATHEMATICS ability as well as crucial for the study. It will test your ability to correctly apply MATHEMATICS formula to solve complex problems, your LOGICAL REASONING skills, and your overall QUANTITATIVE ability.] {For the skills exploration, please try to do your best, as we are pilot testing these questions and it is crucial for the study that you provide us with accurate feedback.}
> Please click below to start your magazine viewing session."

Manipulation check

After reading one of these two messages, participants were told that magazine evaluation depends on their current mood and were asked to indicate their current mood using a 100-point slider ranging from "not at all" to "extremely" on several mood indicators. A one-way analysis of variance (ANOVA) showed a significant effect of the experimental condition on the "happy" and "distracted" items: Participants in the threat condition were less happy, $M_{\text{threat}} = 53.07$ ($SD = 26.42$) versus $M_{\text{nonthreat}} = 61.31$ ($SD = 26.53$), $F(1, 157) = 3.84$, $p = .052$, and less distracted, $M_{\text{threat}} = 33.32$ ($SD = 28.82$) versus $M_{\text{nonthreat}} = 42.85$ ($SD = 32.34$), $F(1, 157) = 3.85$,

$p = .051$. In other words, the gender–math stereotype induction made the women feel less positive and more focused. Other mood items such as "excited" or "tense" did not show a significant effect.

Magazine viewing session

Participants were then asked to make four magazine selections. They first browsed the magazine index page, made a selection, and then clicked through the corresponding magazine excerpt (see the *Stimuli* section for a detailed description). After viewing each selection, participants were asked to evaluate how interesting and informative those pages were to enforce the cover story. Embedded in these questions, to capture assimilation versus contrasting, participants were also asked to indicate how different they perceived the women in the magazine pages were to themselves after each selection of beauty, family, career, and science content. Current affairs selections were not followed by a measure of assimilation because they did not feature individuals. Participants were instead asked a question about their level of agreement with the views presented on the pages. In total, participants viewed three magazine selections, with the fourth selection recorded but the pages not displayed (with a message to participants that the scheduled time had expired).

Math test

After finishing the magazine viewing session, participants started on the math test. The test was comprised of 10 questions, selected from the GRE sample questions for quantitative reasoning, to be completed in 15 minutes. For an example of the questions used, see Supporting information, Appendix S1. On average, participants took $M = 5.21$ minutes to complete the test ($SD = 2.42$) and answered $M = 6.25$ questions correctly ($SD = 2.07$).

Stimuli

Participants made a total of four selections, three of which they actually viewed the pages. There were 20 selections on the index page, four selections each in five categories: two stereotypical, *Beauty & Looks* and *Home & Family*; two counterstereotypical, *Business & Career* and *Science & Technology*; and one neutral, *Current Affairs*. Each selection included five pages, three articles and two advertisements in an alternate order, and was represented on the index page by a small image of its first article. The articles contained relatively equivalent proportions of text and pictures across selections to ensure that participants' selections were not based on the amount of text suggested by its image on the index page.

The advertisements and articles were taken from magazines published between 2006 and 2013. The verbal content of the magazine pages was naturally related to the imagery. The pages in the stereotypical (*Beauty & Looks* and *Home & Family*) and counterstereotypical (*Business & Career* and *Science & Technology*) categories portrayed positive images of women in specific roles according to each category. The pages in the *Current Affairs* category featured political or economic topics and contained no mention or image of any specific people. The differentiation between these

categories, as well as the stimuli's relevance to young, college-aged women, was confirmed by female participants in a previous study (Knobloch-Westerwick, Kennard, Westerwick, Willis, & Gong, 2014). Appendix S2 under supporting information, shows the index page.

Measures

Gender identity

Gender identity was measured using Luhtanen and Crocker (1992)'s collective self-esteem scale, modified for gender. The scale includes 16 items divided into four dimensions: membership self-esteem, private collective self-esteem, public collective self-esteem, and importance to identity. Sample items included "Overall, being a woman has very little to do with how I feel about myself" and were presented with a 100-point slider scale with the anchors "Strongly Disagree" to "Strongly Agree." On average, participants reported a mean score of $M = 74.94$ ($SD = 10.06$, Cronbach's $\alpha = .73$).

Masculinity and femininity

Masculinity and femininity were assessed using the short-form Bem's sex-role inventory (Campbell, Gillaspy, & Thompson, 1997). The short-form scale includes 20 items, 10 for *masculinity*, such as "I defend my beliefs," and 10 for *femininity*, such as "I am affectionate." The response format was a 100-point slider scale with the anchors "Strongly Disagree" to "Strongly Agree." On average, participants reported a mean score $M = 64.14$ ($SD = 16.72$, Cronbach's $\alpha = .88$) for masculinity and a mean score $M = 71.47$ ($SD = 16.59$, Cronbach's $\alpha = .89$) for femininity.

State self-esteem

State self-esteem was measured with Heatherton and Polivy (1991)'s 20-item state self-esteem scale. Sample items included "I am worried about whether I am regarded as a success or failure." The response format was a 100-point slider scale with the anchors "Strongly Disagree" to "Strongly Agree." On average, participants reported a mean score $M = 57.33$ ($SD = 17.51$, Cronbach's $\alpha = .92$).

Selective exposure

Participants were asked to make four selections in total. On average, they selected beauty segments $M = 1.93$ times ($SD = 1.04$), family segments $M = .63$ times ($SD = .61$), career segments $M = .41$ times ($SD = .54$), science segments $M = .36$ times ($SD = .49$), and current affairs segments $M = .67$ times ($SD = .59$).

In addition to what segment participants selected, the online application recorded how much time was spent on each individual page. On average, participants spent $M = 5.17$ minutes ($SD = 4.77$) on all three selections, including $M = 2.26$ ($SD = 2.44$) on beauty segments, $M = .94$ ($SD = 1.84$) on family segments, $M = .56$ ($SD = 1.68$) on career segments, $M = .57$ ($SD = 1.67$) on science segments, and $M = .84$ ($SD = 1.55$) on current affairs segments. For each individual page, on average, participants spent an average of $M = 6.84$ seconds ($SD = 7.44$) on a beauty page, $M = 2.98$ seconds

($SD = 5.87$) on a family page, $M = 1.68$ seconds ($SD = 5.08$) on a career page, $M = 1.71$ seconds ($SD = 5$) on a science page, and $M = 2.54$ seconds ($SD = 4.72$) on a current affairs page.

Assimilation

Assimilation to female role models was measured at the end of each selection with one item, "I felt different from the women on the page," on a 7-point scale, from "*1 = Strongly Disagree*" to "*7 = Strongly Agree*." The item was reverse coded so that a higher score indicates stronger feelings of assimilation to the female role models. On average, participants reported a mean score $M = 3.32$ ($SD = 1.78$) for career pages, $M = 2.85$ ($SD = 1.44$) for science pages, $M = 2.80$ ($SD = 1.54$) for beauty pages, and $M = 2.91$ ($SD = 1.81$) for family pages.

Results

Impacts of stereotype threat on women's selective magazine exposure

Hypotheses 1a, 1b, 2a, and 2b pertained to women's differential selections of magazine content because of the gender–math stereotype threat. H1a and H1b predicted selections of counterstereotypical portrayals of women in magazines, with H1a suggesting that women who anticipate a male-typed challenging math task will be more likely to select such portrayals (per the SESAM model) and H1b suggesting they will be less likely to select such portrayals (per mood management theory) compared to women who do not anticipate such a task. H2a and H2b predicted selections of stereotypical portrayals of women in magazines, with H2a suggesting that women who anticipate a male-typed challenging math task will be less likely to select such portrayals (per the SESAM model) and H2b suggesting they will be more likely to select such portrayals (per mood management theory) compared to women who do not anticipate such a task.

Four between-subjects analyses of covariance (ANCOVAs) were run to test these hypotheses with the threat versus nonthreat condition as the main factor, and career, science, beauty, and family exposure time as the dependent variable in each analysis. Age, GPA, perceived math ability, pretest scores of gender identity, masculinity and femininity, state self-esteem, and total exposure time served as control variables. Age, academic abilities, and self-esteem could bolster against the math stereotype (Martens et al., 2006), whereas gender-related traits might intensify it. Furthermore, participants will vary in how much time they take in general for the experimental procedure and selective exposure task, which will be reflected in the total exposure time.

The analyses showed that stereotype threat was a significant predictor of selective exposure to career magazine pages, $F(1, 149) = 4.99$, $p = .027$, $\eta^2 = .032$, in that participants in the threat condition ($M = 49.91$, $SD = 10.20$) spent more time reading career magazine pages than those in the nonthreat condition did ($M = 17.37$, $SD = 10.13$). However, selective exposure to science magazine pages was not significantly influenced by stereotype threat, $F(1, 149) = 1.1$, $p = .31$, $\eta^2 = .007$. Therefore, H1a was partially supported in favor of H1b.

Regarding stereotypical content, stereotype threat failed to have a significant effect on both exposure time to beauty magazine pages, $F(1, 149) = .85$, $p = .36$, $\eta^2 = .006$, and to family magazine pages, $F(1, 149) = .14$, $p = .71$, $\eta^2 = .001$. Thus, neither H2a nor H2b was supported.

Impacts of selective exposure to counterstereotypical portrayals on math performance

H3 proposed that the effect of selective exposure to counterstereotypical portrayals on women's math performance is moderated by women's assimilation to the role models. Two simple moderation analyses were conducted using the PROCESS macro (Hayes, 2013) to test the interaction effect, with the first model including exposure time to career magazine pages as the focal predictor and the second model including exposure time to science magazine pages as the focal predictor. Assimilation to the female role models served as the moderator; the number of math questions answered correctly by participants as the outcome variable; and threat (dummy coded with 0 and 1), age, and total exposure time served as control variables in both models. For career magazine pages, the results showed that assimilation significantly moderated the relationship between exposure time and women's math performance, $\beta = .0037$, $SE = .0017$, $\Delta R^2 = .12$, $p = .037$. As illustrated in Figure 1, among women who highly assimilated to the role models, exposure time had a positive effect on their math performance. In contrast, among women who showed low assimilation to the role models, exposure time had a negative effect on their math performance. Among women with moderate assimilation, the slope of the effect was negative as well.

This pattern of results observed for exposure time to career magazine pages is consistent with the hypothesized assimilation versus contrast effect: The effect of

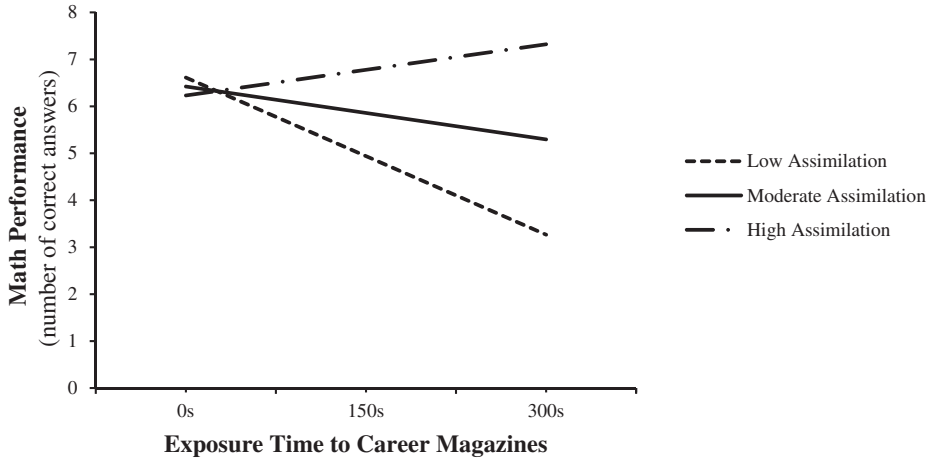

Figure 1 The moderating effect of assimilation to female role models on the relationship between exposure time to career magazine pages on women's math performance.

Table 1 Impacts of Exposure Time to Career Magazine Pages, Assimilation to Female Role Models, and Perceived Math Ability on Women's Math Performance

	Math Performance		
	Coefficients	Standard Error	*p*
Predictors			
Exposure time	−.069	.025	.012
Assimilation	−1.97	.869	.032
Perceived math ability	−.032	.053	.545
Interaction terms			
Exposure time × Assimilation	.018	.007	.014
Exposure time × Perceived math ability	.0008	.0004	.072
Assimilation × Perceived math ability	.029	.015	.068
Exposure time × Assimilation × Perceived math ability	−.0002	.0001	.050
Control variables			
Age	−.429	.292	.155
Threat (yes/no)	1.346	.704	.067
Total exposure time	.0053	.0026	.051
R^2		.525	

social comparison to counterstereotypical role models on women's self-concept and performance depends on the extent to which they assimilated to the role models, lending support to H3 and the SESAM model.

An additional exploratory analysis was conducted (in response to a reviewer's request) to consider the role of perceived math ability as a moderator of the relationships tested in H3. It revealed a significant three-way interaction between exposure time to career magazine pages, assimilation to role models, and perceived math ability, $\beta = -.0002$, $SE = .0001$, $\Delta R^2 = .077$, $p = .05$. The overall model was also significant, $F(10, 26) = 2.88$, $p = .015$, $R^2 = .525$. Both exposure time ($\beta = -.069$, $SE = .025$, $p = .012$) and assimilation ($\beta = -1.97$, $SE = .87$, $p = .032$) emerged as significant predictors, but perceived math ability did not ($\beta = -.032$, $SE = .053$, *n.s.*) (see Table 1 for all coefficients and their significance levels). As seen in Figure 2, when women perceived themselves to be low in math ability, the effect of exposure time on math performance depended on how similar to themselves they perceived the role models to be, but among women with greater perceived math ability, this moderating effect of assimilation on the relationship between exposure time and math performance disappeared.

For science magazine pages, the interaction between exposure time and assimilation to role models was not significant, $\beta = .0033$, $SE = .0021$, $\Delta R^2 = .05$, *n.s.* Furthermore, the same three-way interaction model as for career pages exposure was applied to science magazine exposure but did not yield significant findings. Thus, the effect of exposure time to career magazine pages on women's math performance

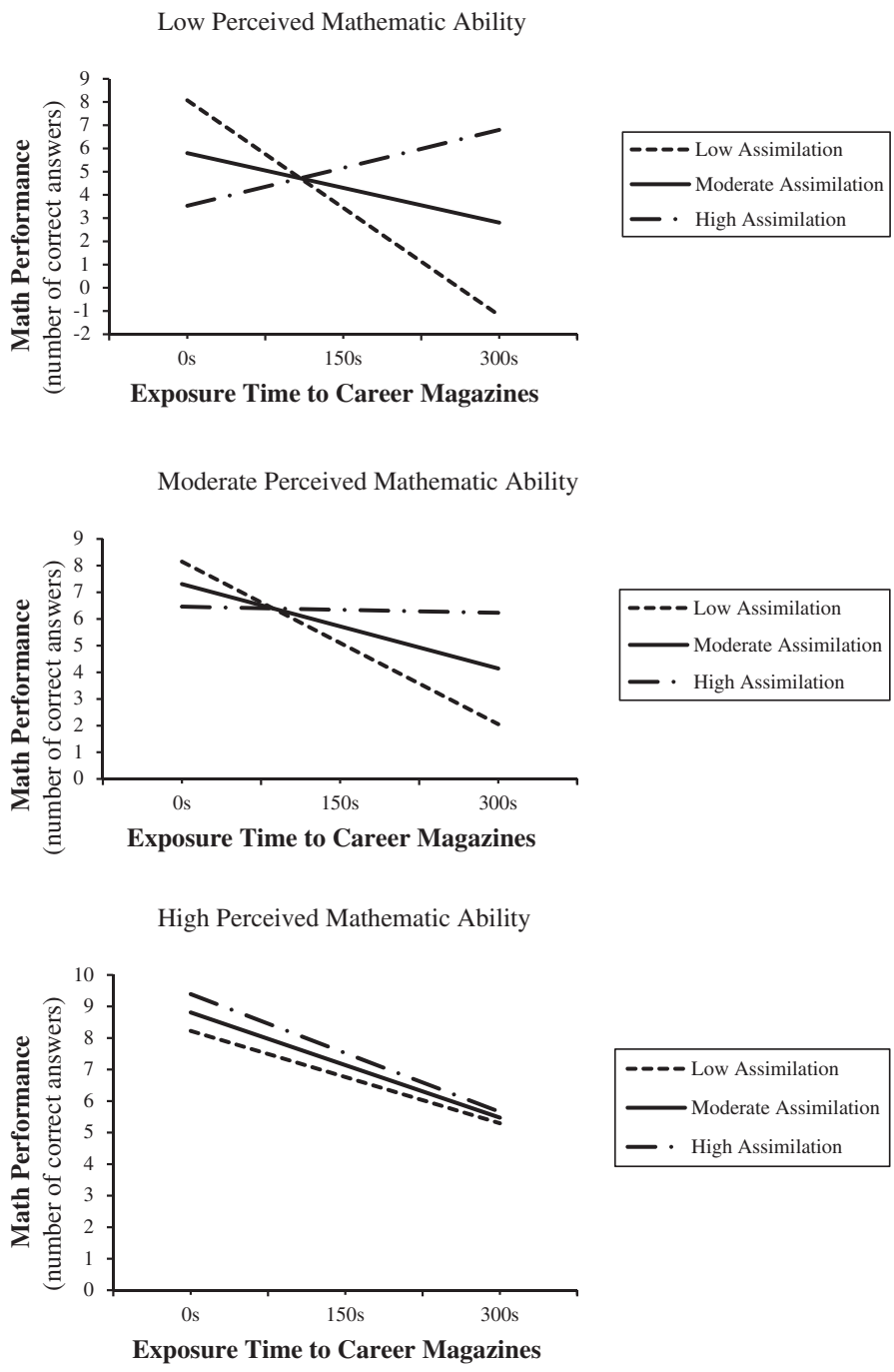

Figure 2 The three-way interaction between exposure time to career magazine pages, assimilation to female role models, and perceived math ability on women's math performance.

Table 2 Impacts of Exposure Time to Stereotypical Magazine Pages on Women's Math Performance (Coefficients With p Values in Parentheses)

	Math Performance		
	Coefficients	Standard Error	*p*
Predictors			
Beauty magazine pages	.002	.001	.097
Family magazine pages	−.003	.002	.074
Control variables			
Age	−.065	.063	.307
Threat (yes/no)	.365	.311	.242
Total exposure time	.002	.001	.015
R^2		.134	

depended on their assimilation to said role models, but the effect of exposure time to science magazine pages on women's math performance did not.

Impacts of selective exposure to stereotypical portrayals on math performance

Finally, a multiple regression analysis was run to test H4, which posited that selective exposure to stereotypical portrayals of women in magazines will negatively affect participants' math performance. Mirroring the analyses run for H3, exposure time to beauty and family magazine pages served as the predictors; the number of math questions answered correctly by participants as the dependent variable; and threat, age, and total exposure time as control variables. Overall, the regression equation was significant, $F(5, 155) = 4.81$, $p < .005$, $R^2 = .134$. Both predictors, exposure time to beauty magazine pages, $\beta = .163$, $SE = .001$, $p = .097$, and to family magazine pages, $\beta = -.172$, $SE = .001$, $p = .074$, approached significance (see Table 2 for the coefficients of all predictors and control variables). Thus, H4 was not supported.

Discussion

The present study explored the potential use of media messages to help counter the negative effect of the gender–math stereotype threat by focusing on how the threat affects women's selective exposure to female role models in popular magazines and what influence this media exposure has on women's math performance. For the media *selection* process, the SESAM model predicted more exposure time to counterstereotypical content (H1a) and less exposure time to stereotypical content (H2a) for women under threat compared to those not under threat. On the contrary, mood management theory predicted less exposure time to counterstereotypical content (H1b) and more exposure time to stereotypical content (H2b) for women under threat compared to those not under threat. For the media *effects* process, the SESAM model and the assimilation versus contrast effect suggested that the impact of exposure to counterstereotypical female role models on women's math performance depends on their

level of assimilation toward the role models (H3). Finally, exposure to stereotypical portrayals of female role models in magazines was expected to further decrease women's math performance (H4).

The results showed that the stereotype threat did affect women's media choices when it came to counterstereotypical content: When threatened, women spent significantly more time with career magazine pages; however, they did not spend more time with science magazine pages when under the same threat. Therefore, H1a was partially supported (per SESAM model) in favor of H1b (per mood management theory). Furthermore, there was no significant difference in selective exposure to stereotypical magazine content between those who were under threat and those who were not. Thus, neither H2a nor H2b was supported.

The effect of selective exposure to counterstereotypical magazine content on women's math performance was significantly moderated by assimilation to the female role models, providing support for H3. For women who highly assimilated to the career role models, longer exposure time led to better math performance. When assimilation was at medium level, this positive effect was smaller and it became negative for a low level of assimilation. Exploratory analyses further revealed a significant three-way interaction between exposure to counterstereotypical role models, assimilation, and perceived math ability: When perceived math ability was low, the effect of exposure time on women's math performance depended on assimilation, but this moderation effect was not apparent among women with higher perceived math ability. However, the same interaction effects were not found for science magazine pages. Finally, exposure to stereotypical magazine content, both beauty and family pages, produced only a marginally significant impact on women's math performance. H4 was thus not supported.

Regarding theoretical integration, the present study connects the stereotype threat literature with communication research, specifically research on selective exposure and media effects. In doing so, this study sheds light on the potential role of media exposure and mediated portrayals of female role models on women's working self-concept when under stereotype threat. It also serves as a test for conflicting predictions about women's media selections (SESAM vs. mood management) as well as for the role of assimilation when women engage in social comparison to counterstereotypical role models in response to the stereotype threat. The results support the SESAM model when it comes to selective exposure and media effects. It should be noted, however, that this pattern of results did not hold for selective exposure to and effects of counterstereotypical portrayals in science magazine pages, the other operationalization of counterstereotypical domains. This lack of impact is potentially due to science occupations being generally less common than business careers in the immediate social environment, as well as science magazines and the female scientist role models being less available in everyday media environment. Thus, participants may be less likely to purposefully seek out this type of content to engage in social comparison to manage their self-concepts and when they do, less likely to perceive it to be self-congruent and efficiently process it.

Regarding practical implications, the study examined the possibility of women to use popular media content to overcome the gender–math stereotype threat and perform better in math as a traditionally male domain. Compared to other commonly used manipulations in previous studies (Martens et al., 2006; Marx & Roman, 2002; McIntyre et al., 2003; Quinn & Spencer, 2001; Spencer et al., 1999), media use is much more accessible in everyday life as well as independent from the features of the math test itself. Media content can present an easy and natural way for women and people from other minority groups to cope with stereotype threats. The study also explored various boundary conditions in which media exposure can be productive or counterproductive to reducing the stereotype threat and improving performance.

The present findings showed that women do appear to select counterstereotypical magazine content to manage their gender identity and working self-concepts when faced with the gender–math stereotype threat. However, this type of selective exposure did not always produce the desired effect: For women who highly assimilated to the role models, longer exposure time helped increase their math performance, but for those who did not, social comparison became a threat, and longer exposure time hurt their math performance. Furthermore, this pattern of result only affected women with low perceived math ability; for those with high perceived math ability, assimilation played no role in the effect of exposure time on their math performance. The fact that the positive effect of exposure on performance is contingent upon assimilation for women who think they are bad at math emphasizes the importance of relatable, self-relevant female role models in counterstereotypical, traditionally male domains if exposure to such role models is to help rather than hurt women who are most vulnerable to the threat.

As for the effects of exposure to stereotypical content on women's math performance, Markus (1977)'s work regarding self-schemata and Higgins (1987)'s self-discrepancy theory can help to interpret the related findings. They suggest that incongruency between an individual's current self-schematic and a contextually salient standard can hinder information processing about the self and produce discomfort and negative affect, respectively. In other words, a person who encounters self-incongruent portrayals might experience negative self-related affect and decreased information processing because he or she perceives a mismatch between his or her self-concepts and the outlined standards, which in turn can undermine performance. As our sample contained college-aged women whose current life stage is more congruent with the beauty gender role than with the family gender role, the pattern of results in which exposure to beauty magazines appeared to improve performance while exposure to family magazines appeared to decrease it is consistent with the aforementioned theories. Self-congruent portrayals could have worked in a manner similar to self-affirmation, which was proven effective in reducing stereotype threat (Martens et al., 2006). Previous studies have shown that women experience positive affect after exposure to beauty gender roles (Knobloch-Westerwick & Hoplamazian, 2012), which can explain the positive effect of exposure to beauty magazine pages on women's math performance.

Limitations of this study include the use of a college student sample. However, as female college students are one of the groups that are more likely to encounter and be affected by the gender–math stereotype threat, the use of a college student sample is justifiable. Another possible limitation is that the study was conducted online, which may have lowered participants' motivation to perform well on the math test or, conversely, allowed participants to seek help online for the test. However, as mentioned in the Methods section, participants answered 62.5% of the GRE quantitative reasoning questions correctly, which roughly equates to a 152 GRE score (ETS, 2015), comparable to the average GRE quantitative reasoning GRE score of 148.7 that women who target social sciences receive (ETS, 2012, p. 13). Hence, the participants appeared to be motivated when answering the questions, yet they spent only 31 seconds on average on a test question (the GRE test allows about 100 seconds per question). Although this time average does not definitively rule out the possibility that participants sought assistance while taking the test, it can help mitigate the concerns for the validity of the results.

Future studies should examine the selection and effects of media messages on stereotype threat with different types of media content in different populations who suffer from different threats. Other boundary conditions and message features should also be explored to minimize the harmful influence and optimize the positive effect of exposure on performance. It is possible that other message features might be more effective in alleviating the threat and improving performance for different populations, or that each particular type of threat might interact with various message features in specific ways. The use of readily available media content to counter the negative effects of stereotype threat and improve performance has tremendous potential. It offers a promising research area to connect the stereotype threat literature and communication research and to explore new theoretical connections, as well as to devise sound message strategies to protect women's performance from stereotype threat and give them a better and fairer chance in counterstereotypical domains. As long as stereotypes undermine women's academic and intellectual performance, society misses out on potential contributions of half of the population — a crying shame.

Supporting Information

Additional supporting information may be found in the online version of this article:

Appendix S1. Sample math questions, selected from the GRE sample questions for quantitative reasoning.

Appendix S2. Index page for the magazine selective exposure task.

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