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BRIEF REPORT

Domain Identification Moderates the Effect of Positive Stereotypes on Chinese American Women's Math Performance

Carmel S. Saad
Westmont College

Oanh L. Meyer
University of California, Davis School of Medicine

Manveen Dhindsa and Nolan Zane
University of California, Davis

We examined whether an individual difference factor, math domain identification, moderated performance following positive stereotype activation. We hypothesized that positive stereotype activation would improve performance for those more math identified (compared to a control condition), but would hinder performance for those less math identified. We examined 116 Chinese American women (mean age = 19 years). Participants were assigned to the positive stereotype activation condition or to the control condition before completing a math test. Positive stereotype activation led more math identified participants to perform significantly better than the control condition, whereas it led less math identified participants to perform significantly worse than the control condition. Domain identification moderates the effect of positive stereotype activation. Educators should consider how testing situations are constructed, especially when test takers do not identify highly with the domain.

Keywords: Chinese Americans, domain identification, math, positive stereotypes

Stereotype threat involves underperformance resulting from the risk of confirming a negative stereotype about one's group (Steele, 1997; Steele & Aronson, 1995). The activation of negative stereotypes can diminish performance on important tasks, such as standardized exams and high-level courses (Brown & Josephs, 1999; Good, Aronson, & Harder, 2008; Spencer, Steele, & Quinn, 1999; Steele & Aronson, 1995). As this threat persists, it may lead students to disidentify with academics and decrease participation in intellectual domains overall (Aronson, Fried, & Good, 2002; Major, Spencer, Schmader, Wolfe, & Crocker, 1998; Schmader, Johns, & Barquissau, 2004; Steele, 1997). Most research has focused on how stereotype threat applies to negative stereotypes, whereas relatively few studies have examined how it applies to positive stereotypes.

Positive stereotypes are prevalent in society, and it is important to examine how they affect stereotyped group members. For example, Asian Americans are commonly stereotyped as performing well in mathematics (Kao, 1995; Steen, 1987). Most research examining the effect of activating this positive stereotype has focused on situational factors (e.g., subtle vs. blatant activation; Cheryan & Bodenhausen, 2000; Shih, Pittinsky, & Ambady, 1999; Shih, Ambady, Richeson, Fujita, & Gray, 2002). The current study examined whether an individual difference, how much one identifies with the math domain, moderated the effect of positive stereotype activation on performance. We held the situation constant by subtly activating the positive stereotype of Chinese American math excellence (Shih et al., 1999, 2002) and examining how this affected Chinese American female college students' math performance. Because previous research has focused on Asian American women, we sought to extend this past research while keeping the sample consistent (Shih et al., 1999, 2002).

Moreover, given the differences in perceptions of Asian subgroups (Leong & Okazaki, 2009; Ngo & Lee, 2007), we examined the largest Asian ethnic group in the U.S. population, Chinese Americans (U.S. Census Bureau, 2010), to reduce interethnic variability. Chinese Americans have the longest history in the U.S. (Siu, 1996), and several works note that they are among the groups especially likely to be characterized by math excellence stereotypes (Lin, Kwan, Cheung, & Fiske, 2005; Siu, 1992, 1996; Zinzius, 2005). Because the stereotype need not be endorsed but needs only to be prevalent in society (Steele & Aronson, 1995; Steele, 1997), we examined a population for which the stereotype was particularly prevalent.

Shih et al. (1999) found that making Asian American female college students' Asian identity salient increased their math performance compared to a control condition in which their Asian

Carmel S. Saad, Psychology Department, Westmont College; Oanh L. Meyer, Alzheimer's Disease Center, Department of Neurology, University of California, Davis School of Medicine; Manveen Dhindsa and Nolan Zane, Psychology Department, University of California, Davis.

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Correspondence concerning this article should be addressed to Carmel S. Saad, Department of Psychology, Westmont College, Santa Barbara, CA 93108. E-mail: csaad@westmont.edu

identity was not made salient. They concluded that subtle positive stereotype activation boosts performance, referred to as a stereotype-consistent effect. Additionally, other researchers have shown that positive stereotype activation increases performance. Activating a positive stereotype about women's verbal ability increased their performance in negotiations (Kray, Galinsky, & Thompson, 2002). Similarly, African Americans performed better on a golf task when it was framed as a measure of natural athletic ability (Stone, Lynch, Sjomeling, & Darley, 1999).

Moreover, Shih et al. (1999) demonstrated that making ethnic identity salient is enough to automatically activate stereotypes. This supports research indicating that such subtle manipulations, even without making the stereotype overt, can automatically activate associated stereotypes and affect performance in stereotypical ways (Ambady, Shih, Kim, & Pittinsky, 2001; Inzlicht & Ben-Zeev, 2000; Steele & Ambady, 2006; Steele & Aronson, 1995). To activate the positive stereotype of Asian American math excellence, Shih et al. asked participants commonplace questions regarding their ethnic background (e.g., how many generations of their family had lived in America), which implicitly activated the stereotype.

Although Shih et al. (1999) found that subtly activating positive stereotypes increased performance, they described their sample as relatively highly math identified (p. 81). This supports some research indicating that stereotype activation affects the performance of only those who identify highly with the stereotyped domain (e.g., Cadinu, Maass, Frigerio, Impagliazzo, & Latinotti, 2003; Steele, 1997; Walton & Cohen, 2003). Domain identification refers to the extent to which one views the domain as central to his or her identity, is confident in his or her domain-relevant abilities, and invests time in the domain because it is important to perform well (Aronson et al., 1999; Cadinu et al., 2003; Keller, 2007; Steele, Spencer, & Aronson, 2002).

Among the several operationalizations of math identification, one examined by recent research is the number of math classes taken in college. Rather than examining self-reported identity centrality, researchers suggest that relying on a more behavioral measure that elicits feedback in the domain, such as math classes taken, may produce stronger effects. Steele et al. (2002) posit that domain identification is "the degree to which one's self-regard, or some component of it, depends on the outcomes one experiences in the domain" (p. 390). Incorporating these outcomes into the assessment of domain identification is important, because it sheds light on how stereotypes affect students who have received feedback and decided to continue in the domain. Moreover, judgments of math classes taken will be more easily recalled and more reliable (because of their recency and discreteness) than are self-reports of identification (Nisbett & Wilson, 1977; Tversky & Kahneman, 1973). Moreover, students who take more math classes in college often feel that math is more central to their identity (e.g., Good et al., 2008; Marx & Roman, 2002; Pronin, Steele, & Ross, 2004; Schmader et al., 2004; Smith & White, 2002).

Shih et al.'s (1999) findings were important in demonstrating how subtle positive stereotype activation increases performance for more math identified Asian American women. However, it is unclear how positive stereotype activation affects less math identified Asian American women. Researchers have posited that stereotype activation increases arousal (e.g., Keller, 2007; O'Brien & Crandall, 2003). When the task is well-learned or practiced, as it may be for more identified individuals, arousal will increase performance. Individuals may feel that they have the experience and capacity to meet the high expectations made salient by the activated positive stereotype, which can create an optimal level of arousal (Yerkes & Dodson, 1908) and boost performance. However, when the task is complex or difficult, as it may be experienced by less identified individuals, arousal may actually decrease performance (Bolles, 1967; Markus, 1978; O'Brien & Crandall, 2003; Smith & Johnson, 2006; Zajonc, 1965). That is, less identified individuals may feel threatened by the activated positive expectation and their ability to meet it, which may interfere with performance. They may feel pressure to fulfill the positive expectation but fear they cannot confirm it in the way other ingroup members can (Dijksterhuis et al., 1998; Levy, 1996; Suls & Fletcher, 1983). This arousal may thus lead less math identified individuals to "choke under the pressure" of the high expectation (Beilock & Carr, 2001; Cheryan & Bodenhausen, 2000; Smith & Johnson, 2006).

Current Study

Prior research on positive stereotypes revealed that subtle positive stereotype activation enhances performance (Shih et al., 1999). However, it is unclear whether this applies to all positively stereotyped individuals or to only highly math identified ones (Smith & Johnson, 2006). We propose that math identification moderates the effect of subtle positive stereotype activation. We hypothesized that when a positive stereotype is subtly activated, more math identified Chinese American women will perform better than a control condition (i.e., stereotype-consistent effect) but those less math identified will perform worse than the control condition (i.e., stereotype-inconsistent effect).

Method

Participants

Participants were 116 Chinese American female students at UC Davis. Participants received course credit for their participation. Mean age was 19 years ($SD = 1.32$). Seventy-one percent of the sample was born in the United States. Because previous research suggests limiting samples to those with exposure to American stereotypes (Shih et al., 2002), we restricted the sample to those who had lived in the United States for at least five years.

Procedure

We followed Shih et al.'s (1999) paradigm of asking commonplace questions about participants' ethnic background without invoking the stereotype directly. After signing an informed consent form, participants were randomly assigned to either the positive stereotype activation condition or the control condition. In the positive stereotype activation condition, participants were asked to report their ethnicity, place of birth, generations their family had lived in the United States, preferences for speaking an Asian language, and about Asian holidays and food. In the control condition, participants were asked about their class level, the number of classes they were taking in the present term, the last food they ate, the current season, and birth year.

Participants were then given 20 minutes to complete a challenging math test consisting of 20 multiple choice items from the GRE. Lastly, participants completed a demographics questionnaire, of which one item asked about their mathematics SAT score and one about the number of math classes taken in college on a scale from 1–8 (1 = *0 classes*, 8 = *more than 6 classes*). The study was approved by the UC Davis Institutional Review Board.

Math performance was calculated by dividing the number of items answered correctly by the number completed (Shih et al., 1999; Steele & Aronson, 1995). Because the test must be difficult to detect effects (Aronson et al., 1999; Spencer et al., 1999; Steele & Aronson, 1995; Steele et al., 2002), we ensured that our test was as difficult as in previous research (Shih et al., 1999; Steele & Aronson, 1995).

Data Analysis

We conducted all analyses within a multiple regression framework, as we examined the interaction between a categorical variable (stereotype activation condition) and a continuous variable (mean-centered math identification). We effects coded the positive stereotype activation condition in the initial analysis and then dummy coded it to probe the interaction, in line with Aiken and West's (1991) recommendations. To examine the nature of the interaction, we conducted simple slopes analyses. Aiken and West recommended predicting values at one standard deviation above and below the mean to examine how more math identified individuals performed compared to less math identified individuals. We statistically controlled for mean-centered math SAT score in all analyses (Shih et al., 2002; Steele & Aronson, 1995)[1].

Results

Table 1 displays descriptive statistics and intercorrelations for all variables. The mean performance accuracy of .41 (SD = .17) aligns with previous research (Shih et al., 1999; Steele & Aronson, 1995).

We hypothesized a stereotype activation condition (positive stereotype activation vs. control) by math identification interaction such that for more identified participants, activating the positive stereotype would increase performance compared to the control condition. However, we hypothesized that among less identified participants, activating the positive stereotype would decrease performance compared to the control condition.

There was no significant main effect for stereotype activation condition ($M_{\text{stereotype activation}} = .41$, $SE = .02$, $M_{\text{control}} = .41$, $SE = .03$, $\beta = .07$, $p > .05$). There was a significant main effect for domain identification ($\beta = .26$, $p < .01$), such that more domain identified individuals performed better on the math task. As expected, this was qualified by a significant interaction between stereotype activation condition and math identification ($\beta = -.29$, $p < .01$). Adding this interaction explained significantly more variance in math performance ($\Delta R^2 = .08$, $p < .01$; see Table 2).[2]

Simple slopes analyses confirmed our hypothesis by revealing that more math identified participants performed significantly better when the positive stereotype was activated than when it was not ($\beta = .22$, $p < .05$). Conversely, less math identified participants performed significantly worse when the positive stereotype was activated than when it was not ($\beta = -.35$, $p < .05$; see Figure 1).

Additionally, simple main effects analyses revealed that when the positive stereotype was activated, more math identified participants performed significantly better than participants who were less math identified ($\beta = .44$, $p < .01$). However, in the control condition, more math identified participants' performance did not differ significantly from less math identified participants' performance ($\beta = -.20$, $p > .05$).

Table 1
Intercorrelations of Study Variables (N = 116)

Variable	M (SD)	Range	1	2	3
1. Math identification	2.85 (1.51)	1–8	—	−.01	.22*
2. Math SAT score	586.90 (106.34)	280–790		—	.38**
3. Math performance	.41 (.17)	.15–.82			—

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

Table 2
Summary of Regression Analysis for Relationship Between Stereotype Activation, Math Identification, and Math Performance (N = 116)

	Math performance		
	Model 1	Model 2	
Variable	β	β	95% CI
Stereotype activation condition	−.01	.07	[−.11, .24]
Math identification	.23*	.26**	[.09, .43]
Math SAT	.38**	.34**	[.18, .51]
Stereotype activation condition × Math identification		−.29**	[−.45, −.12]
R^2	.20**	.28**	
ΔR^2		.08**	
F for change in R^2	6.77**	8.37**	

Note. CI = confidence interval. Math identification ranged from 0 to more than 6 math classes and was mean centered.
* $p < .05$. ** $p < .01$.

Discussion

Findings revealed that when positive stereotypes were subtly activated, more math identified Chinese American women performed better on a difficult math task compared with a control condition, whereas less math identified Chinese American women performed worse than a control condition. These findings confirmed our hypothesis that subtle positive stereotype activation increases performance for more math identified participants (i.e., stereotype-consistent effect), whereas it decreases performance for less math identified participants (i.e., stereotype-inconsistent effect). These findings emerged even while controlling for math ability, indicating that positive stereotypes differentially affect performance even relative to participants' capabilities.

[1] One participant was excluded because of an SAT score that was more than three standard deviations below the mean. Results were nearly identical before and after this exclusion.

[2] We tested whether the interaction between stereotype activation condition and math identification was qualified by generational status, but the 3-way interaction was nonsignificant ($\beta = -.12$, $p > .05$).

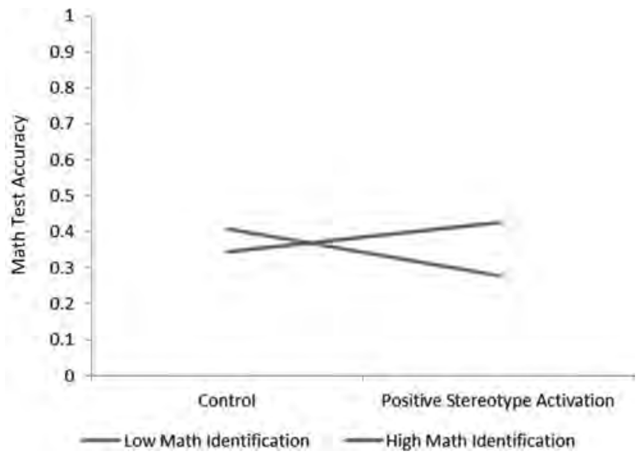

Figure 1. Moderating effect of math identification on the relationship between stereotype activation and math performance among Chinese American women.

Findings support Shih et al.'s (1999) research by confirming that subtly activated positive stereotypes facilitate performance, but only for more math identified individuals. However, less math identified individuals may choke under the pressure of high expectations (Beilock & Carr, 2001; Cheryan & Bodenhausen, 2000; Smith & Johnson, 2006). The current study clarifies how subtle positive stereotype activation affects a wider array of positively stereotyped group members. Examining the person by situation interaction enables more precision in predicting stereotype effects.

Because more math identified women had more experience in the domain, the heightened arousal from the activated stereotype may have improved their performance (O'Brien & Crandall, 2003). However, the heightened arousal may have interfered with less math identified women's performance because of their relative lack of experience and the difficult nature of the test. Whereas O'Brien and Crandall (2003) posit that arousal accounts for stereotype activation effects, we did not measure arousal directly. Therefore, future research should examine whether arousal mediates the effects of subtle positive stereotype activation on performance.

For example, during performance situations, a challenge appraisal occurs when environmental demands are appraised as within the person's resources or ability to cope, leading to efficient or organized mobilization of physiological resources. However, perceiving that environmental demands exceed one's resources or ability to cope can result in a threat appraisal, characterized by inadequate or disorganized mobilization of physiological resources (Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996). Future research could examine whether more math identified individuals exhibit more physiological markers of challenge and whether less identified individuals exhibit more physiological markers of threat following subtle positive stereotype activation (Vick, Seery, Blascovich, & Weisbuch, 2008).

The present findings should be interpreted within the context of the study's limitations. While we focused on a group that is often stereotyped as being good at math, Chinese American women (Siu, 1992, 1996), this restricts our ability to generalize to other ethnicities and to men. Future research should examine whether our findings replicate across these groups. Second, because we examined a more experiential measure of identification, we may have excluded from the more identified participants those who identified with math subjectively but had not taken many math classes in college. Some may posit that because math classes may indicate ability independently of subjective identification, the results may be different when examining subjective identification (Smith & Johnson, 2006). Although this may be true, the fact that we statistically controlled for ability means that our results indicate the predictive power of objective identification (e.g., motivation, experience, persistence in the domain) when ability is partialed out. Still, it is important to replicate our findings with more subjectively identified individuals. Moreover, findings represent the effects of subtle positive stereotype activation. Because the effects of subtle activation often differ from blatant activation (Shih et al., 2002), future research should examine how blatant activation may be moderated by domain identification.

Educators should consider how eliciting positive stereotypes may influence students' academic performance. Because of the pressure to achieve in school (Sue & Okazaki, 1990), many Chinese Americans may feel pressure to live up to the positive stereotype of math excellence. Whether their performance is facilitated by positive stereotype activation, however, depends on their math identification. Therefore, careful consideration should be given to how testing situations are constructed in schools. Efforts should be made toward reducing or nullifying stereotype cues, even subtle ones. This is especially true in contexts in which the target audience is less domain identified. Assumptions about Asian American math excellence may obfuscate attempts at devising methods to protect against the mitigating effects of positive stereotype activation.

Contexts with relevant cultural cues may, over time, increase math identification among already highly identified individuals. However, the already low levels of math identification among those less identified may diminish further over time (Major et al., 1998; Schmader et al., 2004; Steele, 1997). Thus, it is important to extend research on interventions to diminish stereotype threat, even for positive stereotypes.

The current study built on prior research by demonstrating the boundary conditions for the facilitative effect of subtle positive stereotype activation. Researchers and educators should consider domain identification when determining whether subtle positive stereotype activation will produce stereotype boost or choking under pressure. As O'Brien and Crandall (2003) stated, different groups "may take math tests in the same room but they are not in the same situation" (p. 788).

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