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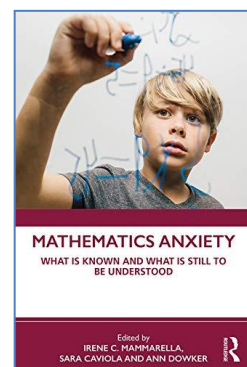
Chapter 10

Gender stereotypes, anxiety, and math outcomes in adults and children

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Whenever African American students perform an explicit scholastic or intellectual task, they face the threat of confirming or being judged by a negative societal stereotype – a suspicion – about their group’s intellectual ability and competence. This threat is not borne by people not stereotyped in this way. And the self-threat it causes – through a variety of mechanisms – may interfere with the intellectual functioning of these students.

[Steele & Aronson, 1995, p. 797]

Introduction

Being a member of a stigmatized social group is stressful. A long-standing tradition of research at the intersection between sociology (e.g., Goffman, 1963) and psychology (see Major & O’Brien, 2005) has outlined that individuals who belong to disadvantaged groups are at risk of experiencing a variety of negative life outcomes, including poorer health (Hatzenbuehler, Phelan, & Link, 2013) and reduced psychological well-being (Schmitt, Branscombe, Postmes, & Garcia, 2014), that stem from the physiological and psychological responses to the unpleasant feeling of being the target of prejudice and negative stereotypes. In 1995, Steele and Aronson outlined for first time that the same mechanisms may account for other important consequences namely, the finding that members of disadvantaged groups actually tend to underperform on tasks that assess competencies that their groups are assumed to lack, as compared to their non-stereotyped counterparts. Steele and Aronson termed this predicament stereotype threat. In the subsequent decades, stereotype threat became one of the most widely studied topics in social psychology. The case of women’s tendency to underperform on math tasks and withdraw from maths-related fields – consistent with the societal stereotype stating that women are not good at math – has since been the subject of most

of the studies on the causes and consequences of stereotype threat (see Spencer, Logel, & Davies, 2016).

Linking anxiety to stereotype threat

Anxiety as a mediator of stereotype-related performance drops

In their seminal work in 1995, Steele and Aronson defined stereotype threat as the negative situation encountered by members of disadvantaged groups due to the anticipated concern that one's (poor) performance in a stereotype-relevant domain may inadvertently confirm an existing negative stereotype about one's group. When facing such a concern, stereotyped individuals activate a variety of stress responses at the physiological (e.g., autonomic activation), cognitive (e.g., negative thoughts, vigilance for threatening cues), and emotional (e.g., anxiety) states. Self-monitoring and suppression processes are then activated to buffer these negative states. However, intensive monitoring and volitional suppression efforts also entail unintended consequences. On the one hand, these processes overload working memory resources, ultimately disrupting performance on controlled and complex tasks that recruit executive control. On the other hand, undue vigilance interferes with the completion of tasks relying on over-learned skills, for which automatized procedures are more effective than controlled ones (Schmader, Johns, & Forbes, 2008).

Within the complex cascade of mechanisms outlined above, anxiety has been intuitively suggested as a pivotal mediator of the link between negative stereotyping and poor performance. However, until the early 2000s, no single piece of evidence was provided to show that anxiety may be involved in the process, despite the fact that an increasing number of studies had already demonstrated that performance decrements were consistently associated with exposure to negative stereotypes among the members of a variety of stigmatized groups. In the original work by Steele and Aronson (1995), for example, African American students systematically obtained significantly lower scores on diverse measures of verbal intelligence

when the diagnostic purpose of the tests (Studies 1–3) or the participant’s racial identity (Study 4) was stressed, thus making the stereotype salient and threatening. Across the four studies, numerous ancillary measures were also obtained, which suggested that threatened participants were more likely to strive to disconfirm the stereotype, blame the unfair nature of the task, or adopt self-handicapping strategies to justify a possible failure (e.g., by reporting having slept some two hours less than non-threatened participants the night before the test). However, no difference in reported anxiety (Study 2) or perceived stress (Study 3) emerged between threatened and non-threatened students.

Four years later Spencer, Steele, and Quinn (1999) demonstrated for the first time that stereotype threat was also responsible for a decrease in women’s performance on standardized math tests. Again, even though a widely used self-report measure of anxiety was included in one of their experiments (Study 3) as a potential mediator, they also failed to detect clear evidence that women under stereotype threat were more likely to feel anxious than those for which the threat was alleviated. For instance, Spencer and colleagues observed that women for whom the stereotype was made less relevant (i.e., those forewarned that the test produced no difference between women and men) tended to report a slightly lower level of anxiety during the testing session, but the observed difference was small and did not reach significance. Subsequent studies focusing on gender stereotyping of math, in which a measure of anxiety was also included, also yielded strikingly similar results (e.g., Aronson et al., 1999 ; Keller & Dauenheimer, 2003).

Disentangling the role of emotionality, worry, and physiological arousal

In sum, no evidence supporting the role of anxiety as a determinant of stereotype-induced performance drops was provided until the early 2000s. Different findings emerged, though, in subsequent years, when alternative approaches were adopted, in particular by separating the effects of affective, cognitive, and physiological components of anxiety.

Cadinu and colleagues, for example, asked female university students to list any thought that came to their mind immediately before solving each of seven difficult math problems (Cadinu, Maass, Rosabianca, & Kiesner, 2005). Thought listing is an effective method for tapping into the cognitive component of anxiety, rather than into the emotional

component. The cognitive component is particularly relevant to the stereotype mechanism because verbal rumination – as well as the production of irrelevant thoughts – occupies verbal working memory resources, therefore reducing the availability of such resources for the maintenance and elaboration of task-relevant information. As predicted, Cadinu et al.'s study indicated that negative thoughts increased throughout the test, from the first to the seventh problem, and that women under stereotype threat reported a higher number of negative maths-related thoughts than those for whom the threat was alleviated. More importantly, the number of negative thoughts produced mediated the disruptive effect of stereotype threat activation on math performance. Similar results were also obtained by Beilock, Rydell, and McConnell (2007), who showed that this relation was due to a consumption of verbal working memory resources.

Important evidence also comes from other studies, in which physiological indices, rather than behavioral or self-reported measures of anxiety, were used to assess arousal and emotional activation. Osborne (2007), for example, observed that performance of college students on math items drawn from the Graduate Record Examinations test strictly followed the prediction of the stereotype threat model, with female students having their performance disrupted when reminded of the stereotypes that women do worse than men in math, as compared to those reassured that the stereotype was not relevant to the test. More importantly, by monitoring participants' physiological parameters during the test, Osborne also observed that female participants in the high stereotype threat condition displayed significant evidence of physiological reactivity, such as increased skin conductance, higher surface skin temperature, and increase diastolic blood pressure.

The role of negative emotional activation under stereotype threat has been further clarified with neuroimaging techniques. By using functional magnetic resonance imaging (fMRI), for example, Krendl, Richeson, Kelley, and Heatherton (2008) monitored both the activation of neural regions involved in mathematical cognition and executive control, such as the inferior prefrontal cortex, left inferior parietal cortex, and bilateral angular gyrus, and of regions associated with emotional regulation and social cognition, such as the ventral anterior cingulate cortex. Results illustrated that female participants who were reminded of the negative gender stereotype about math displayed reduced activation of the brain areas relevant to task completion (i.e., those associated with numerical processing and control), and increased activation of areas implied in the elaboration of emotional and social stimuli.

Overall, the evidence summarized above suggests that variations in stereotype-induced anxiety may be relatively difficult to detect via self-report measures, and therefore physiological indices may be more adequate in capturing emotional responses under stereotype threat. It is indeed plausible that at least some individuals under stereotype threat do not consciously perceive themselves to be worried or under stress merely because their social identity is made salient, especially when their social identity is not blatantly stigmatized (such as in the case

of women). Moreover, whereas individuals with high levels of math anxiety, or lower self-efficacy in math, may be perfectly aware that performing a math task may causes them fear or apprehension, individuals under stereotype threat may paradoxically be perfectly at ease with the task at hand. Women who are highly competent in math, and probably disavow the gender stereotype about women's math ability, are nevertheless susceptible to stereotype threat because the fear of confirming or being judged in the light of the societal stereotype stems from the mere fact that the stereotype exists (Aronson et al., 1999; Schmader et al., 2008).

Finally, stereotype threat may be triggered by very subtle cues, such as being the only woman in a math class (e.g., Huguet & Regner, 2007), or being examine by a male vs. a female

experimenter (Stone & McWhinnie, 2008). In all these cases, it is quite unlikely that women under stereotype threat will be consciously aware of an increased feeling of apprehension related to the task at hand. And yet, stress responses may operate in the background and ultimately damage performance regardless of the individual's awareness of the ongoing threat.

More than simple mediation: Alternative roles of anxiety in the stereotype threat model

Beyond being suggestive of a mismatch between subjective self-reports of anxiety and physiological measures, the mixed results regarding anxiety as a potential mediator of performance outcomes may also be indicative of the complexity of the relations that link stereotype threat susceptibility to performance outcomes.

In the framework of the stereotype threat model, anxiety is typically conceived as a situational response to threatening cues activated by either the nature of the task (i.e., the task taps into an ability for which one's group is negatively stereotyped), or the relevance of one's social identity within the testing context (i.e., membership into the stigmatized group is made salient). In other words, stereotype threat research has typically assessed transitory and context-specific negative emotional responses elicited by identity-threatening cues (i.e., state anxiety).

However, anxiety also encompasses dispositional and non-transitory tendencies to appraise a variety of contests and situations as potentially threatening (i.e., trait anxiety; Endler & Kocovski, 2001). Even more important, inter-individual variability exists in both the general tendency to appraise situations as threatening (i.e., general anxiety), and in the peculiar sensitivity to display negative emotional reactions in specific contexts or activities, such as assessment situations (i.e., test anxiety), or single academic domains (e.g., math anxiety).

Given the multidimensional nature of anxiety, it is quite conceivable that dispositional aspects of anxiety, and not just context-driven transitory feelings of apprehension, may be involved in individuals' response to potentially stereotype-threatening cues. In line with this reasoning, Tempel and Neumann (2014) administered a word-problem math test to a sample

of female university students in two alternative conditions of stereotype threat (i.e., by merely presenting the task as a math test) or stereotype removal (i.e., by reassuring participants that the test was gender-fair). Results showed that women who had scored higher at a previous assessment of trait test anxiety were not affected by the stereotype threat manipulation and consistently performed at a low level. By contrast, female students with low trait test anxiety performed significantly lower under stereotype threat – at the level of their highly anxious counterparts – but had their performance restored when stereotype threat was removed. In other terms, anxiety as a dispositional trait may act as a moderator, rather than a mediator, of vulnerability to stereotype threat.

Even more complex relations between anxiety and stereotype threat emerged from a study by Gerstenberg, Imhoff, and Schmitt (2012). Across three studies, they found that female university students with a strong explicit math self-concept (i.e., who rated themselves as good at math), but with a weak implicit math self-concept (i.e., with only weak associations between the concept of self and the concept of math) were particularly susceptible to stereotype threat when gender identity was made salient prior to test taking. Importantly, when assessed for their current worries immediately before the math test – but after the stereotype threat manipulation – these participants displayed the highest level of intrusive troublesome thoughts (e.g., “I ask myself whether my performance will be good enough”) when stereotype threat was activated, and increased worry was found to mediate the stereotype threat effect.

Finally, recent works have included anxiety within more complex sequential mediational models, in which anxiety is conceived as either triggered by other first-order mediators of stereotype threat (e.g., achievement goals; Brodish & Devine, 2009), or as the cause of subsequent processes (e.g., mind-wandering; Mrazek, Chin, Schmader, Hartson, Smallwood, & Schooler, 2011) that ultimately disrupt math performance.

When stereotypes are positive: Performance boost or choking under pressure?

It is quite evident that negative stereotypes are detrimental to performance, so should we assume that positive stereotypes are beneficial? In part, the answer is yes: positive stereotypes are helpful, at least under some circumstances. First of all, most descriptive stereotypes are essentially dual in nature, meaning that the inferiority of a group on a given task is benchmarked against another group's alleged superiority. As a case in point, women's ability in math is stereotypically judged as low in comparison with another group (usually, men), which is stereotyped as more competent. Therefore, when members of the advantaged group are evaluated on a stereotype-relevant task, and their social identity is made salient, they may take advantage from a favorable downward social comparison with the negatively stereotyped outgroup (Walton & Cohen, 2003). In other terms, by comparing themselves with a devalued group, they may expect to be judged by others in positive terms and increase their sense of self-efficacy on the task, which may increase their ability to concentrate, preserve a positive attitude in the presence of frustrations, and ultimately achieve a better performance. This process may account for several findings from the earliest studies on stereotype threat, showing that members of the advantaged group performed slightly better in conditions that were stereotype-threatening for the disadvantaged outgroup (e.g., when social identity was made salient), as compared to when the threat to the outgroup was removed (e.g., Aronson et al., 1999; Shih, Pittinsky, & Ambady, 1999; Spencer et al., 1999). In an early meta-analysis, Walton and Cohen (2003) – who termed this phenomenon as stereotype lift – observed that such an effect was relatively small in size as compared to the corresponding stereotype effect for the disadvantaged groups, and only tended to appear in a subset of the studies conducted at the time. As regards the role of anxiety in explaining stereotype lift, however, very little evidence is available, as most of the meta-analyses were only conducted on the stereotype-threatened – and not the stereotype-advantaged – groups.

A second circumstance under which positive stereotypes have been found to exert beneficial effects is when individuals who may be subject to stereotype threat as members of a devalued social group may simultaneously also benefit from a positive social identity as members of other groups that are positively stereotyped with regard to the same ability. An example is the case of Asian American women, who can alternatively be negatively stereotyped as weak at math – as women – or very skilled at math – as Asian. In line with this reasoning, Shih and colleagues found that – at least in a US sample (Study 1) – Asian American female university students performed better on a difficult math task when asked to report their (positive) ethnic identity prior to the test, compared to when they had to report their gender identity or no social identity (Shih et al., 1999).

In a similar vein, individuals may be influenced by whether a given social identity implies a positive or a negative stereotype, depending on the label attached to a given task. A mental rotation task, for example, may be reasonably labeled as a geometry test – for which a woman would be negatively stereotyped as lacking relevant abilities – or as a “perspective taking” task – for which the same woman may benefit from a positive stereotype regarding the ability to put themselves into others’ shoes. By using this paradigm, Wraga, Helt, Jacobs, and Sullivan (2007) demonstrated that women’s mental rotation performance varied as a function of the positive or negative stereotype activated (Wraga et al., 2007). More importantly from our point of view, Wraga and colleagues also collected online fMRI measures of activation of cortical regions associated with spatial and social-emotional processing during the task completion. They showed that areas associated with emotional self-regulation and social knowledge (rostral-ventral anterior cingulate cortex and right orbital gyrus) were less strongly activated when the positive stereotype was made salient, and that this difference in brain activity mediated the observed difference in women’s spatial performance in response to stereotype threat.

In addition to the evidence reported above, evidence also exists showing that individuals for whom positive stereotypes exist as to a given ability, may unexpectedly fail – rather than having their performance improved – when the positive stereotype becomes salient. Cheryan and Bodenhausen (2000), for example, observed results opposite of those of Shih and colleagues (1999) when observing Asian American women take a difficult math test. Specifically, Cheryan and Bodenhausen (2000) found that their female participants' performances dropped when the (positive) Asian identity was made salient, and that this effect was mediated by their reported inability to concentrate during the task. Although the two opposite phenomena may be difficult to reconcile, the possibility to drop following a positive stereotype activation parallels a widely studied phenomenon in social and cognitive psychology, termed choking under pressure (Baumeister, 1984). The unexpected underperformance of individuals who are supposed to do well on a task – either because of their abilities or self-confidence, or because of a positive stereotype attached to their group – may be explained in terms that are very similar to those invoked to account for stereotype threat: an extra pressure arises – in this case, due to the fear of not confirming a positive expectation – that triggers negative emotions, worries, and physiological stress reactions, which ultimately consume working memory resources (Ashcraft and Kirk, 2001; Beilock and Carr, 2005).

Consistent with this account, several studies have also found unexpected negative effects of positive stereotypes and suggest that when the pressure to succeed is excessive, the stereotype lift effect may reduce and even reverse, thus giving rise to choking under pressure. Unlike Shih and colleagues (1999), who subtly activated either gender or ethnic group membership by merely asking participants to answer questions regarding these aspects of their identity, Cheryan and Bodenhausen (2000) brought up the stereotype much more directly, by explicitly mentioning the positive or negative stereotype to participants (i.e., Asians are good at math vs. women are bad at math). Rosenthal and Crisp (2007) reminded their male participants of one or both of their available positive identities (i.e., being male and attending prestigious

courses). Results revealed that male students who studied math, for whom the task was more relevant, had their performance damaged in the double-positive-stereotype condition, thus suggesting that an exceedingly positive expectation may have exceeded their ability to cope with the pressure to succeed.

It is indeed critical to determine in advance when positive stereotypes may be advantageous or exceedingly demanding. Individual dispositions may play an important role, and stable tendencies to appraise events or situations as threatening (i.e., state anxiety) may moderate individuals' susceptibility to both positive and negative pressures induced by relevant stereotypes (Mattarella-Micke, Mateo, Kozak, Foster, & Beilock, 2011).

The link between stereotype threat and anxiety in young children: Do these dissociate, or is this still not proved?

Compared to the large amount of studies on stereotype threat with adults, relatively few studies have sought to demonstrate whether, when, and possibly how children are susceptible to stereotype-induced variations in their cognitive achievements. Overall, a meta-analyses including 47 studies found evidence for a small-size negative effect of stereotype threat on girls' math performance, in spite of mixed findings and some evidence of publication bias (Flore & Wicherts, 2015).

In their pioneering work focused on children, Ambady and colleagues reported that 5-year-old Asian American girls displayed evidence of both stereotype threat – when their gender identity was activated – and stereotype lift effects – when their ethnic identity was evoked (Ambady, Shih, Kim, & Pittinsky, 2001). Subsequent work with elementary school children suggested that – as with adult women – stereotype threat appears only when tasks are highly demanding (Neuville & Croizet, 2007) and operates regardless of personal endorsement of existing societal stereotypes (Huguet & Régner, 2009).

However, few studies of stereotype threat among children have adopted additional measures to disentangle the role of age-specific mediators, and only one study included a measure of anxiety (McKown & Weinstein, 2003). In this case, the study pertained to the negative impact of racial stereotypes on intellectual performance of African American children, and consistent with previous studies with adults, self-reported anxiety did not emerge as a significant mediator of the observed effects. As regards gender stereotypes and mathematics, a mediational role was observed for implicit gender stereotypes, even in the absence of explicit stereotype awareness, among 6-year-old girls (Galdi, Cadinu, & Tomasetto, 2014). In other terms, girls' performance under stereotype threat was found to depend on the salience of automatic associations between female gender and language rather than math. These findings indicate that among young children, stereotype-induced performance drops may appear even in the absence of awareness of any ongoing threat, suggesting that anxiety-driven mechanisms may be less relevant to stereotype threat among children than among adults.

However, research with young children is still scarce, and no study to date has included alternative and more sensitive measures of anxiety to provide a more compelling test of its role. The lack of research tapping into gender stereotypes about math and anxiety in children is unfortunate, as numerous relations have already emerged between implicit or explicit gender stereotypes and a number of maths-related outcomes, including not only actual performance (as in stereotype threat studies) but also subjective perception of math ability (e.g., Passolunghi, Rueda-Ferreira, & Tomasetto, 2014), identification with math (Cvencek, Meltzoff, & Greenwald, 2011), and desire to enroll in math-related courses (Steffens, Jelenec, & Noack, 2010).

Conclusions

Research on stereotype threat has captured the interest of a large number of researchers throughout the last two decades; and yet, the role of some key mechanisms linking individuals' social identity to their abilities to perform at an optimal levels in a variety of domains is still only partially clarified (Pennington, Heim, Levy, & Larkin, 2016). As regards the role of anxiety, convincing evidence has been produced illustrating the role of its cognitive (e.g., worry, rumination) and physiological components (e.g., autonomic activation and neural correlates) in determining performance drops and – in some cases – performance boosts in response to negative or positive stereotypes. Importantly, most of the work linking anxiety to stereotype threat has shed light on the role of gender stereotypes about women's proficiency in mathematics. However, most of the studies conducted thus far have failed to determine a clear role for anxiety, especially when anxiety had been assessed by means of self-report measures, or when the focus has been on the emotional component of anxiety.

Another important limitation of the vast majority of the studies reviewed above is that attention has been mainly devoted to transitory anxiety states experienced in the assessment context. By contrast, only few studies have attempted to clarify whether and how levels of dispositional anxiety – either as a general stable disposition, or as a specific tendency to negatively react to a specific domain of activity, such as mathematics – contribute to increasing or decreasing individuals' vulnerabilities to stereotypes attached to their social groups.

Finally, the role of anxiety has been surprisingly overlooked in research on stereotype threat with young children. It is hoped that future research will address this gap, as the mechanisms and the boundary conditions that influence susceptibility to stereotype threat in adult women and in young girls may not necessary overlap (see Galdi et al., 2014).

Clarifying all these gaps will indeed help us to design more effective interventions aimed at reducing performance drops stemming from negative societal stereotypes, as well as those originating from positive stereotypes, as in the case of the phenomenon of choking under pressure.

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