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An Integrated Process Model of Stereotype Threat Effects on Performance

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Research showing that activation of negative stereotypes can impair the performance of stigmatized individuals on a wide variety of tasks has proliferated. However, a complete understanding of the processes underlying these stereotype threat effects on behavior is still lacking. The authors examine stereotype threat in the context of research on stress arousal, vigilance, working memory, and self-regulation to develop a process model of how negative stereotypes impair performance on cognitive and social tasks that require controlled processing, as well as sensorimotor tasks that require automatic processing. The authors argue that stereotype threat disrupts performance via 3 distinct, yet interrelated, mechanisms: (a) a physiological stress response that directly impairs prefrontal processing, (b) a tendency to actively monitor performance, and (c) efforts to suppress negative thoughts and emotions in the service of self-regulation. These mechanisms combine to consume executive resources needed to perform well on cognitive and social tasks. The active monitoring mechanism disrupts performance on sensorimotor tasks directly. Empirical evidence for these assertions is reviewed, and implications for interventions designed to alleviate stereotype threat are discussed.

Keywords: stereotype threat, stress and coping, working memory, vigilance, self-regulation

Stereotype threat has become one of the most widely studied topics of the past decade in social psychology. In 2003, Steele and Aronson's (1995) seminal article on the subject was named a modern classic (Devine & Brodish, 2003; Fiske, 2003). Although a large body of work now testifies to the reliability and generalizability of stereotype threat effects on performance, lingering questions remain about precisely what processes underlie these effects. Researchers have found evidence for variables such as anxiety (S. J. Spencer, Steele, & Quinn, 1999), stereotype activation (Davies, Spencer, Quinn, & Gerhardstein, 2002), self-doubt (Steele & Aronson, 1995), working memory (Schmader & Johns, 2003), and arousal (Ben-Zeev, Fein, & Inzlicht, 2005). Unfortunately, limitations of experimental research necessitate that only one or two process variables can be explored in any single study. Although these studies have advanced a basic understanding of the putative mechanisms of stereotype threat, one unintended consequence of this systematic dismantling of process is an unrealistic expectation that there is a single mediator of stereotype threat effects on performance. Complex behavior, however, is likely to result from an interrelated sequence of processes. In the present article, we describe an integrated process model in which motivational, affective, physiological, and cognitive processes interact to impair performance in a stereotype-relevant context.

A Primer on Stereotype Threat

In 1995, Steele and Aronson published research testing a provocative explanation for the long-standing finding that African Americans tend to underperform on standardized tests (Steele & Aronson, 1995). They reasoned that knowledge of the prevalent cultural stereotype asserting the intellectual inferiority of African Americans could interfere with Black students' performance on intellectual tests through fear of confirming that stereotype. In support of this hypothesis, their experiments revealed that African American college students performed worse than their White peers on standardized test questions when this task was described to them as being diagnostic of their verbal ability but that their performance was equivalent to that of their White peers when the same questions were simply framed as an exercise in problem solving (and after accounting for prior SAT scores). Part of the popular, practical, and scientific appeal of stereotype threat as an explanation for group differences in test scores is that it can be created in the performance situation itself. The threat is "in the air," as Steele (1997) argued, and by implication, once the air is cleared, group differences should be diminished.

Since the publication of that seminal research, stereotype threat effects have been extended to account for a wide variety of performance decrements observed among those who are targeted by negative stereotypes. When a task is described as diagnostic of intelligence, Latinos and particularly Latinas perform more poorly

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than do Whites (Gonzales, Blanton, & Williams, 2002), children with low socioeconomic status perform more poorly than do those with high socioeconomic status (Croizet & Claire, 1998), and psychology students perform more poorly than do science students (Croizet, Després, Gauzins, Huguet, & Leyens, 2003). Even groups who typically enjoy advantaged social status can be made to experience stereotype threat. Specifically, White men perform more poorly on a math test when they are told that their performance will be compared with that of Asian men (Aronson et al., 1999), and Whites perform more poorly than Blacks on a motor task when it is described to them as measuring their natural athletic ability (Stone, 2002; Stone, Lynch, Sjomeling, & Darley, 1999). In addition, Whites also show stereotype threat effects on tasks where they might fear confirming the stereotype that Whites are racist (Frantz, Cuddy, Burnett, Ray, & Hart, 2004).

Performance decrements have been observed in response to both explicit manipulations that call attention to one's stigmatized status in a domain (e.g., S. J. Spencer et al., 1999) and more subtle manipulations in which the researcher's expectations for poor performance are less likely to be consciously primed (e.g., Inzlicht & Ben-Zeev, 2000; J. L. Smith & White, 2002; Stone & McWhinnie, in press). Furthermore, recent evidence confirms that such manipulations increase one's motivation to try to disconfirm the negative stereotype, at least for those who are highly identified with the domain (Forbes, Schmader, & Allen, 2007; Jamieson & Harkins, 2007). Some have suggested that stereotype threat has little impact outside of the laboratory (Cullen, Hardison, & Sackett, 2004; Stricker & Ward, 2004). However, in a recent reanalysis of a field experiment by Stricker and Ward (2004), Danaher and Crandall (in press) revealed that marking one's gender after (as compared with before) an advanced placement calculus test led to a 33% reduction in the gender gap in performance. Taken together, this research suggests that activating negative stereotypes about a social identity one possesses motivates individuals to try to combat that stereotype but that this creates some sort of extra situational burden that interferes with the ability to perform as well at a task as might otherwise be possible. In the present article, we unpack the sequence of processes that are likely to account for this pattern of interference.

An Integrated Process Model of Stereotype Threat

In our view, stereotype threat is triggered by situations that pose a significant threat to self-integrity, the sense of oneself as a coherent and valued entity that is adaptable to the environment (Steele, 1988). This self-integrity threat stems from a state of cognitive imbalance in which one's concept of self and expectation for success conflict with primed social stereotypes suggesting poor performance. This state of imbalance acts as an acute stressor that sets in motion physiological manifestations of stress, cognitive monitoring and interpretative processes, affective responses, and efforts to cope with these aversive experiences (see also Major & O'Brien, 2005). The general outline of the proposed model is presented in Figure 1. In short, we assert that the threat to self-integrity stereotype threat elicits during or in anticipation of a performance cues a sequence of processes that can disrupt optimal performance on a variety of tasks. Developing an integrated mediational model of stereotype threat requires consideration of both the nature of the predictor (i.e., how do situations trigger stereotype threat?) and the outcome (i.e., what kind of performance is impaired?). Thus, we first outline the psychological process that we believe underlies the experience of stereotype threat and how situational cues and person characteristics combine to trigger that experience. We then consider how stereotype threat undermines performance on cognitive and social tasks that necessitate *controlled processing*. We identify working memory as the domain-general executive resource associated with efficient performance on a wide range of cognitive and social tasks that necessitate coordinated information processing while inhibiting interference from distracting information (Path *a* in Figure 1).

Having identified working memory as a core cognitive faculty that is implicated in cognitive and social stereotype threat effects, we then consider the discrete processes likely to be engaged in threatening situations that would rely on and disrupt this cognitive resource. These processes include an increased physiological stress response (Path *b* in Figure 1) paired with increased monitoring of cues (Path *d* in Figure 1) to disambiguate what that situation implies about the self and/or one's group. We assert that this increased monitoring, paired with increased physiological arousal

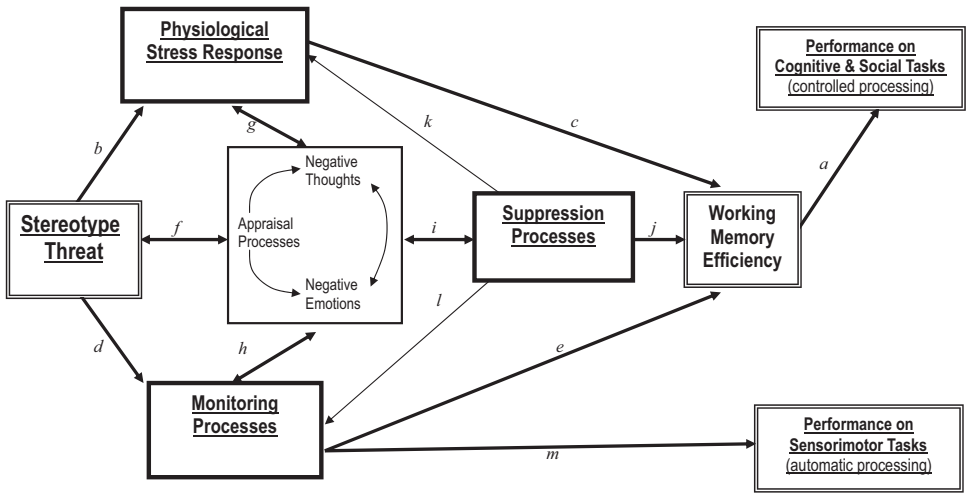

Figure 1. An integrated process model of stereotype threat effects on performance.

and a primed state of cognitive imbalance created by stereotype threat, can lead people to appraise their experience in a biased manner that produces negative thoughts and feelings (Paths *f, g,* and *h* in Figure 1). However, because targets of stereotype threat are motivated to avoid stereotype confirmation by performing well, they engage in active efforts to suppress stereotypic and anxious thoughts that are inconsistent with their task goals (Path *i* in Figure 1).

Within this set of processes, there are three primary reasons why task performance could be impaired. These include (a) a direct physiological impairment of prefrontal processing caused by activation of the hypothalamic-pituitary-adrenal axis (Path *c* in Figure 1), (b) increased vigilance toward endogenous or exogenous cues to assess the self within the situation (Path *e* in Figure 1), and (c) active efforts to suppress or push out of mind stereotypic thoughts and anxious feelings (Path *j* in Figure 1). An understanding of this interrelated set of mechanisms requires a review of literatures on working memory, stress and cognition, and self-regulatory processes that might be involved in a target's active attempt to understand and cope with the threat of confirming a negative stereotype.

After describing the specific components of the model, we consider research showing the effect of stereotype threat on tasks where performance does not rely on controlled processing but benefits from the use of *automatic processes* to guide behaviors outside of executive attention. Research suggests that working memory impairments cannot easily account for the effect of stereotype threat on such tasks (e.g., Beilock, Jellison, Rydell, McConnell, & Carr, 2006). However, because performance on automated tasks suffers to the degree executive resources are used to monitor and control one's behavior—a process also implicated in performance on cognitive and social tasks—we believe the model can be applied to explain these findings. We conclude our description by considering how the model can account for these effects (Path *m* in Figure 1).

Conceptualizing the Nature of Stereotype Threat

To understand the mechanisms that underlie performance impairments, we first consider the process by which situational cues trigger stereotype threat. In our view, all situations of stereotype threat involve activation of three core concepts: the concept of one's ingroup, the concept of the ability domain in question, and the self-concept. However, it is not merely the activation of these three concepts but the activated *propositional relation* (Gawronski & Bodenhausen, 2006) between them that we believe underlies the experience of stereotype threat. A positive unit relation means that the two concepts are defined in that context with respect to one another (My group has this ability; I am like my group; I have this ability). In contrast, a negative link primed between any of these two concepts would indicate that, in that context, one concept is defined in opposition to another (My group does not have this ability; I am not like my group; I do not have this ability). Drawing on balance theory (Heider, 1958) and similar to the framework posed by Nosek, Banaji, and Greenwald (2002), we conceive of stereotype threat as stemming from a situationally induced state of imbalance between these implied propositional links that the individual is motivated to, and struggles to, resolve (My group does not have this ability, I am like my group, but I think I have this ability). Figure 2 depicts the imbalance among these three components that is created in situations of stereotype threat by the presence of situational primes and/or individual-differences variables found to increase threat susceptibility.

The imbalance created by stereotype threat stems from the simultaneous activation of three implied links: First, cues in the environment signal a negative propositional relation between one's concept of the ingroup and ability in a given domain such that the group is defined as deficient in that context. In prior research, such cues have involved manipulations of the diagnosticity of a test, (Steele & Aronson, 1995), explicit statements that one's ingroup would do poorly in the domain (S. J. Spencer et al., 1999), or stereotypic group portrayals (Davies et al., 2002). The negative stereotypes activated by such manipulations are a manifestation of the primed negative link between the group and the domain. Furthermore, individual differences in stereotype endorsement (Schmader, Johns, & Barquissau, 2004) or stigma consciousness (Brown & Pinel, 2003) might increase susceptibility to stereotype threat because the negative link between group and domain is either stronger (as in the case of stereotype endorsement) or more likely to be activated in the face of ambiguous cues (as in the case of stigma consciousness).

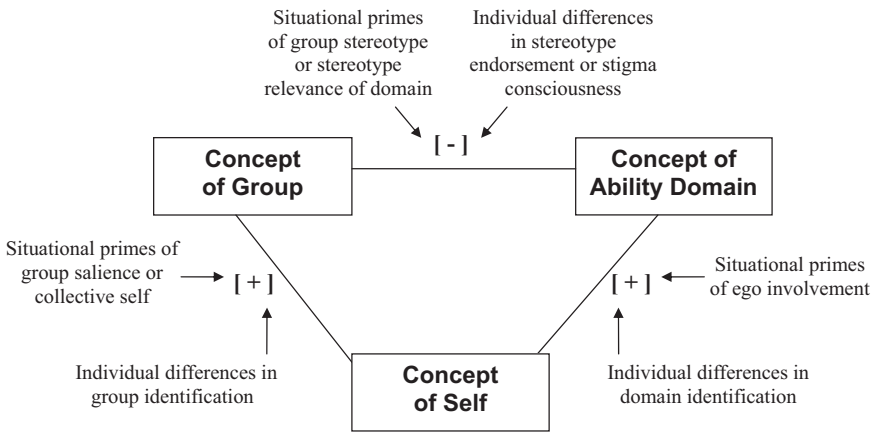

Figure 2. Stereotype threat as a cognitive imbalance triggered by person and/or situation factors.

Second, cues in the environment make salient one's membership in the stigmatized group by activating a positive link between one's concept of self and one's concept of the group such that the self is defined in terms of group membership in that context. Past studies provide evidence for this association by showing that manipulations of group salience such as solo status (Inzlicht & Ben-Zeev, 2000), group priming (Shih, Pittinsky, & Ambady, 1999), and group representativeness (Schmader, 2002) produce stereotype threat effects. Work by Marx, Stapel, and Muller (2005) confirmed that situations of stereotype threat activate the collective self, which is a manifestation of a positive link between the concepts of self and group. Similarly, individuals high in group identification are predisposed to activate this link even in otherwise ambiguous circumstances, increasing their susceptibility to stereotype threat (Schmader, 2002).

The third link that contributes to the imbalance is a positive propositional relation primed between self and domain such that the self-concept is associated with doing well in that context because of either an expectation of success or a strong motivation to excel. Indeed, the original theory states that the high-achieving vanguard of a stigmatized group will be most affected by stereotype threat, suggesting that personal investment in the domain is a necessary precondition (Steele, 1997). Moreover, studies have shown that individuals experience stereotype threat to the degree that doing well in the domain is personally important to them (Aronson et al., 1999; Stone et al., 1999). Situationally, this personal investment in the domain is accomplished in studies by providing cues to ego involvement such as reminding participants that the task, though challenging, should be within their abilities or by selecting participants with a history of success in the domain (Schmader & Johns, 2003; S. J. Spencer et al., 1999; Steele & Aronson, 1995). Such procedural elements help to increase experimental realism and garner participant involvement, but it is worth emphasizing that this is likely to be an important ingredient of stereotype threat.

Nosek et al. (2002) described a similar state of stable intrapersonal associations that lead women to implicitly disassociate their sense of self from the math domain. In the present model, we expand upon these ideas to understand stereotype threat as the discrete experience of imbalance activated in a given performance situation. The implication is that each of the associations described above must be activated to produce clear signs of stereotype threat. In contrast, much of the literature to date has assumed that stereotype threat can be elicited through many separate pathways (e.g., by priming the group or by changing the task frame). Although further research is needed to bolster our conceptualization, available evidence generally supports the idea that each linkage must be activated to experience stereotype threat.

Most of the studies that have relied on group salience to manipulate threat also have described the central task that participants complete as a stereotype-relevant task (e.g., Inzlicht & Ben-Zeev, 2000; Schmader, 2002; Schmader & Johns, 2003; Shih et al., 1999). Interestingly, one study that paired race salience with a nondiagnostic test description showed only a marginal effect (Steele & Aronson, 1995). Similarly, manipulations that on the surface seem designed to activate only one of the concepts in this triad can also activate other components in the model (e.g., Marx et al., 2005). We also have some preliminary evidence suggesting that self-relevance may be a necessary feature of stereotype threat (Schmader, Zhang, & Johns, 2007). We were able to reduce stereotype threat and elevate math performance among a sample of math-identified women simply by giving them a false name (either female or male) and literally detaching their personal identity from a typically stereotype threatening situation. This finding compliments work by Wheeler, Jarvis, and Petty (2001), who showed that individuals perform consistently with an outgroup stereotype only when the outgroup is temporarily incorporated into their own working self-concept. Thus, even if one is not chronically identified with a negatively stereotyped group, manipulations can temporarily prime a sense that the group defines the self, inducing the cognitive imbalance that underlies stereotype threat.

We can also understand different forms of stereotype threat (e.g., a threat to either one's self or group concept; Shapiro & Neuberg, 2007) in terms of where the imbalance is most pronounced. For those concerned about the implication of the stereotype for personal identity, the greatest tension might emanate from a strong link between self and domain (i.e., I really want to do well, but the activated set of cognitions primes a negative link). In contrast, those who are more concerned about confirming the stereotype for one's social identity might feel the greatest cognitive tension as a result of a strong association between group and domain (i.e., I really want my group to do well, but the activated set of cognitions primes a negative link).

Furthermore, Shapiro and Neuberg's (2007) predictions that different variables will make individuals more or less susceptible to threat in public or private settings can also be understood within this balance framework. For example, the person susceptible to public forms of group-concept stereotype threat might activate the negative link between group and domain only when he or she believes his or her group membership and performance will be publicly known. A variable such as stigma consciousness makes this link more accessible for these individuals even in ambiguously threatening situations. In contrast, the person susceptible to private forms of group concept threat will have the group–domain link activated even in situations that are private and to the degree that he or she personally endorses the stereotype. Thus, the balance framework represents a more general meta-model that describes how external information interacts with intraindividual cognition to produce the specific forms of threat identified by Shapiro and Neuberg.

Perhaps the most critical aspect of our model is the assumption that a primed state of imbalance creates a state of tension that the individual is motivated to resolve. Thus, as with other models of cognitive inconsistency, this experience of cognitive imbalance should have downstream consequences for arousal, thought emotion, and self-regulation as the individual seeks resolution to that imbalanced state (Carver & Scheier, 1998; Crandall, Silvia, N'Gbala, Tsang, & Dawson, 2007; Festinger, 1957; Higgins, 1987: Swann & Reid, 1981). The integrated process model that we articulate specifies these downstream effects and articulates the implications that these processes can have for performance.

Working Memory as a Proximal Mediator of Stereotype Threat Effects in Cognitive and Social Performance Situations

A review of the literature on stereotype threat and related phenomena reveals three broad categories of stereotype threat

outcomes. Most research has focused on how stereotype threat impairs performance on cognitive tasks such as verbal tests (Steele & Aronson, 1995), complex mathematical tasks (Quinn & Spencer, 2001), tests of memory (Hess, Auman, & Colcombe, 2003), and mental rotation (Wraga, Duncan, Jacobs, Helt, & Church, 2006). However, additional studies that can be characterized in terms of stereotype threat have involved tasks that are inherently social (Bosson, Haymovitz, & Pinel, 2004; Richeson & Shelton, 2003), such as maintaining a fluid interaction with someone in the face of negative stereotypes suggesting malicious intentions in that interaction. The third category of outcomes includes sensorimotor skills or other tasks that entail fluid movement or automated behavioral processes (e.g., Beilock et al., 2006; Stone et al., 1999). The primary focus of our model is on the first two types of performance situations (high-order cognitive tasks and intergroup interactions). Because the processes underlying performance decrements on sensorimotor tasks are governed by a specific component of the model—performance monitoring (Beilock et al., 2006)—we discuss these types of performance situations after we have described this component in detail.

To identify the processes that underlie stereotype threat effects, we start by focusing on what mechanism is common among the complex cognitive and social tasks that stereotype threat affects. Although these tasks seem quite different, they share one important element in common: They all require a certain degree of controlled attention, effortful processing, and active self-regulation. For example, stereotype threat produces gender differences in math performance only on a difficult math test (S. J. Spencer et al., 1999) and specifically on complex word problems that require the formation of strategies to extract the relevant information to solve the problem (Quinn & Spencer, 2001). In fact, if tasks are easy or well learned, the motivation to disconfirm the stereotype leads to better performance (O'Brien & Crandall, 2003). Similarly, in social contexts, cognitive depletion effects are only observed by White Americans speaking in front of a Black American if they are in a position of having to consciously think about the wording they use to communicate their opinion (Richeson & Trawalter, 2005).

This pattern of evidence suggests that stereotype threat degrades the ability to regulate attention during complex tasks where it is necessary to coordinate information processing online and inhibit thoughts, feelings, and behaviors counterproductive to one's current goals. Cognitive psychologists describe the mechanism that is responsible for this sort of efficient regulation as executive functioning or working memory (e.g., Engle, 2002). We next define working memory to provide the conceptual foundation for examining how stereotype threat impairs performance on cognitive and social tasks.

Working Memory Defined

Contemporary models of working memory all posit that a central executive processor coordinates cognitive and behavioral protocols in the service of task completion (Feldman-Barrett, Tugade, & Engle, 2004; Miyake & Shah, 1999). Although these models tend to differ with respect to the interrelationship between information storage and executive control (Conway, Jarrold, Kane, Miyake, & Towse, 2007), there is consensus that working memory is situated in the prefrontal cortex, which is responsible for controlling attention and deploying inhibitory processes (Gray, Chabris, & Braver, 2003; Kane & Engle, 2002). Most models also endorse the basic idea that the central executive processor is of limited capacity and therefore is sensitive to variations in information-processing demands (Conway et al., 2007).

Our perspective on working memory is based on the work of Engle, Kane and colleagues. These researchers have developed dual-processing measures of working memory that predict performance on a wide variety of cognitive tasks, ranging from Raven's Advanced Progressive Matrices (Engle, Tuholski, Laughlin, & Conway, 1999) to Stroop color naming (Kane & Engle, 2003). They proposed that working memory represents executive attention—the general but limited ability to keep task-relevant information and goal representations accessible in the face of interference from task-irrelevant information and competing responses (Engle, 2002; Kane, Conway, Hambrick, & Engle, 2007). Thus, we use the term *working memory* to represent a limited-capacity executive process that coordinates cognition and controls behavior to achieve performance goals in the presence of exogenous or endogenous information that competes for attention.

It should be noted that although different researchers have used either working memory or executive function terminology to describe the process of interest to us here, these two terms largely refer to the same domain-general ability to control the focus of one's attention and regulate behavior. We adopt the term *working memory* to maintain consistency with the work of Engle, Kane, and colleagues, although we consider this usage compatible with the terms *executive function* and *executive control.* It should also be noted that although working memory measures all involve the storage of information in short-term memory, current definitions of working memory are not equated with short-term memory. In fact, the amount of information that can be stored in short-term memory is unrelated to performance on measures of fluid cognition (Engle et al., 1999; Kane et al., 2004). It is this finding that working memory predicts high-order cognitive ability, while short-term memory does not, that has largely contributed to the development of the executive-based conceptualizations of working memory that is the focus of our model.

Evidence That Stereotype Threat Taxes Working Memory

Although research has often treated working memory as an individual-differences variable, when conceptualized as a state variable, working memory becomes a prime candidate for mediating stereotype threat effects in performance situations requiring controlled processing. Not only has research directly implicated this mechanism in performance on the same standardized tests that are the focus of the achievement gap between racial or gender groups (Conway, Cowan, Bunting, Therriault, & Minkoff, 2002; Engle et al., 1999; Süβ, Oberauer, Wittmann, Wilhelm, & Schulze, 2002; Unsworth & Engle, 2005), it is also clear that working memory captures variation in general executive processes critical for coping with acute stressors. For example, high working memory predicts the ability to maintain the accessibility of task goals (Kane & Engle, 2003) as well as the ability to control attention (Kane et al., 2007) and minimize the influence of intrusive thoughts while completing resource-demanding tasks (Rosen & Engle, 1998). These findings suggest that working memory is critical for efficient thought regulation in situations that place

heavy demands on attention. Thus, it is reasonable to predict that stereotype threat temporarily degrades working memory efficiency in a manner that could account for the diversity of performance impairments found in the literature. There are now several pieces of evidence to support this assertion.

First, our own work has directly tested the hypothesis that reduced test performance under stereotype threat is attributable to decreased working memory (Schmader & Johns, 2003). In our initial studies, college students completed the operation span task to measure their working memory (Turner & Engle, 1989). In a typical trial of the task, participants are presented with a mathematical equation—for example, $(2 \times 3) - 5 = 1$—and must decide whether the answer given is correct or incorrect. They are then given a word to remember for recall at a later point. These trials are grouped into sets such that participants might be presented with a set of five equation and word pairings before being cued to recall the five words. Participants' ability to correctly recall all of the words in each set provides an index of working memory in that it reflects the ease with which they can process the equations while simultaneously holding the words in their mind.

In our first experiment, male and female college students completed the operation span task, which was either described to them as a reliable measure of working memory (control) or as a reliable measure of quantitative capacity and highly related to math ability (stereotype threat). As predicted, women in the stereotype threat condition showed significantly lower working memory scores (i.e., they recalled fewer words) than did men in the same condition or than women in the control condition. A second study replicated these effects among Latinos and Latinas who were told that the operation span task is highly indicative of general intelligence.

Finally, a third experiment tested whether reductions in working memory mediate the negative effects of stereotype threat on women's math performance. In the stereotype threat condition, women learned that they would be taking a math test as the only woman in a room of men. In the control condition, women learned that they would perform a problem-solving exercise in an all-female session. After these instructions, women completed a modified measure of working memory (instead of solving equations, participants had to count the number of vowels in a sentence) followed by a 20-min math test. Replicating earlier studies, women in the stereotype threat condition showed significantly lower working memory and performed worse on the math test. More importantly, mediation analyses demonstrated that the direct effect of stereotype threat on math performance was significantly reduced and became nonsignificant when controlling for working memory, which was significantly associated with math performance. This set of experiments provides the most direct evidence that situations of stereotype threat reduce working memory specifically and that this reduction in executive attentional processes mediates the effects on test performance.

Since we published this work, other studies have provided converging support for general impairments in executive function in stereotype threatening situations. Croizet et al. (2004) found that when psychology and engineering students were aware of intellectual stereotypes favoring engineers, both groups of students showed a decrease in heart rate variability while taking a diagnostic test. However, only psychology students performed more poorly on the test and showed test scores that were correlated with their heart rate variability. Although fluctuations in heart rate variability can indicate a number of things (e.g., emotion regulation; Applehans & Luecken, 2006), some research has linked situational decreases in heart rate variability to increased mental load (Jorna, 1992; Mulder, 1992). Thus, these findings suggest that stereotype threat might increase the cognitive load of stigmatized individuals under stereotype threat.

Other research shows that working memory interference could be an important consequence of stereotype threat. For example, Beilock, Rydell, and McConnell (2007) recently showed that individuals under stereotype threat do more poorly on a series of mathematical problems but only if those problems are complex enough to require working memory. These effects were eliminated when participants were given the opportunity to practice the difficult math problems, presumably because practice decreased the need to rely on working memory resources to solve the problems.

Additional research has specifically isolated stereotype threat effects on the ability to inhibit response conflict—a central function of working memory (Kane & Engle, 2003). For example, Inzlicht, McKay, and Aronson (2006) showed that situations of stereotype threat impair Black college students' performance on a Stroop task, a standard measure of cognitive interference. In a similar vein, Jamieson and Harkins (2007) showed that women under threat make more errors on an antisaccade task, a task that requires inhibition of a prepotent response. These findings suggest that increased motivation (due to stereotype threat) can produce the ironic effect of derailing performance on tasks where inhibition is necessary to avoid errors (Harkins, 2006).

In addition to threat experienced during tests of intellectual ability, we also see the role of working memory in other, nonacademic domains where attention regulation is likely involved. Whereas Blacks, Latinos, and American Indians are stereotyped in terms of intellectual skill, White Americans are stereotyped as being racist (Sommers & Norton, 2006; Vorauer, 2003). Thus, White Americans are likely to experience stereotype threat during interracial interactions or on tasks that they believe will reveal their racial biases. Not only does research support these predictions but the effects found specifically implicate the same sorts of central executive processes. For example, Richeson and colleagues (e.g., Richeson & Shelton, 2003) found that White participants with implicit negative biases against Blacks exhibit a decrease in performance on a test of executive function (a Stroop task) following an interracial interaction. Richeson and colleagues followed up on this work by showing activation in the anterior cingulate cortex and dorsolateral prefrontal cortex (regions of the brain thought to be involved in executive attention and control) that corresponds to increased self-regulation during an interracial interaction (Richeson et al., 2003; see also Amodio, Devine, & Harmon-Jones, 2007; Cunningham, Raye, & Johnson, 2005; B. K. Payne, 2005).

In a similar vein, Lambert et al. (2003) found that non-Black perceivers who are both socially anxious and racially biased have difficulty inhibiting a stereotyped judgment of a Black target when they anticipate public evaluation of their judgment. As a result, those who might be most concerned about saying the wrong thing in public actually make the most negative stereotypic judgments (see also Frantz et al., 2004). By applying a process dissociation procedure, these researchers showed that the effect was due more to decreases in cognitive control than to increases in stereotype accessibility. The fact that social anxiety moderates this effect

suggests that stress is a factor in reducing the inhibitory processes needed to regulate responding in this kind of social situation.

In sum, evidence converges to suggest that when individuals find themselves in situations where self-relevant negative stereotypes are made salient, they exhibit reduced efficiency of working memory. More importantly, this disruption in working memory corresponds with diminished performance on both cognitive and social interaction tasks. However, this information is merely descriptive unless we can offer an understanding of why situations of stereotype threat impact this specific mechanism.

Cognitive, Physiological, and Affective Processes That Tax Working Memory

Knowing that stereotype threat interferes with difficult cognitive tasks by consuming working memory leads us to ask what precise processes are responsible for this effect. Why might marking one's race on a test booklet (Steele & Aronson, 1995), taking a math exam in a room of men (Inzlicht & Ben-Zeev, 2000; Sekaquaptewa & Thompson, 2003), or speaking about racial issues (Richeson & Shelton, 2003) lead Black students, women, and Whites, respectively, to experience impairments in attention regulation processes? We propose that these effects are produced by an interrelated set of cognitive, physiological, and affective processes (see Figure 1). We describe each of these processes and the evidence to support them in more detail below.

Physiological Stress Response

Before discussing how stress impacts attentional resources such as working memory, we first review the evidence that situations of stereotype threat are, in fact, stressful. Theoretically, the cognitive imbalance that results when stigmatized individuals are placed under stereotype threat should lead to increased arousal, distress, or discomfort that motivates a need for cognitive consistency. For example, studies have shown that individuals who experience other forms of self-inconsistency, such as cognitive dissonance, report a greater sense of discomfort (Elliot & Devine, 1994) and show increased activation of the sympathetic nervous system (SNS) as indicated by increased heart rate (Etgen & Rosen, 1993) and skin conductance (Harmon-Jones, Brehm, Greenberg, Simon, & Nelson, 1996; Losch & Cacioppo, 1990). Thus, we might expect that as individuals find themselves in situations of stereotype threat, attempts to reconcile the imbalance between self, group, and domain associations may in and of itself be distressing.

Although attempts to document stress under stereotype threat using self-report measures have yielded mixed results (Gonzales et al., 2002; Schmader, 2002; Schmader & Johns, 2003; S. J. Spencer et al., 1999), studies relying on physiological and other indirect measures of stress-based arousal (Ben-Zeev et al., 2005; O'Brien & Crandall, 2003) have yielded more promising support for Path *b* in Figure 1. For example, Murphy, Steele, and Gross (2007) recently observed greater SNS activation among women merely watching a gender-imbalanced group of male and female college students discuss a math and science conference. Similarly, Blascovich, Spencer, Quinn, and Steele (2001) showed that Black, but not White, students experience increased blood pressure while performing a test described as diagnostic of intellectual ability. Similarly, White Americans, who are likely to feel threatened by the stereotype that Whites are racist, exhibit a physiological threat profile of cardiovascular responses (increased cardiac output combined with increases in total peripheral resistance) when interacting with a Black male (compared with a White male; Mendes, Blascovich, Lickel, & Hunter, 2002). Whites also perform more poorly on a verbal task in this condition. Although these studies have not shown a direct link between increases in cardiovascular threat reactivity and poorer cognitive performance, they have provided general evidence that individuals in situations of stereotype threat experience stress-induced physiological arousal.

However, a complete understanding of how stereotype threat impairs attentional resources requires a nuanced account of arousal. Specifically, the physiological processes elicited under situations of acute stress—of which stereotype threat is one kind—are likely to include activation of both the sympathetic-adrenal-medullary system and the hypothalamic-pituitary-adrenal axis that reflect an increase in SNS activation (as seen in the studies reviewed above) and the release of corticosteroids and catecholamines as part of an integrated stress response (Schommer, Hellhammer, & Kirschbaum, 2003). Although these stress reactions serve the function of orienting the individual to the demands of a taxing situation, they might also impair cognitive performance (Eysenck & Calvo, 1992). Moreover, stress could have its biggest impact on cognitive processes that rely on the hippocampus and prefrontal cortex due to the high concentration of receptors in these regions sensitive to cortisol (Blair, 2006; Metcalfe & Jacobs, 1998). This would explain why stress can specifically impair processes such as memory consolidation and spatial memory that are mediated by the hippocampus (e.g., J. D. Payne, Nadel, Allen, Thomas, & Jacobs, 2002; Revelle & Loftus, 1990) and tasks involving executive function, attentional focus, and working memory that are mediated by the prefrontal cortex (e.g., Baumeister, Twenge, & Nuss, 2002; Pruessner, Hellhammer, & Kirschbaum, 1999). Such evidence has implications for the types of tasks on which stereotype threat effects might be most pronounced.

In addition, research on stress and cognition more generally shows evidence for the role of stress-induced cortisol levels in these cognitive impairments (e.g., Bohnen, Houx, & Nicholson, 1990; Kirschbaum, Wolf, May, & Wippich, 1996), particularly in prefrontal processes such as working memory (Elzinga & Roelofs, 2005). Thus, in addition to research showing a correlation between chronic stress and less efficient working memory (Klein & Boals, 2001), this research suggests that acute social stressors elevate cortisol levels, which might directly reduce the efficiency of executive processes. Interestingly, the effects of cortisol on general arousal, selective attention, and memory form an inverted-U shape where some level of cortisol facilitates focused attention and resulting memory, but extreme levels impair these same processes (Lupien & McEwen, 1997), particularly when paired with high levels of SNS activation (Elzinga & Roelofs, 2005). This would explain why some studies find improved performance on selective attention tasks in high-pressure performance situations (Chajut & Algom, 2003; Ellenbogen, Schwartzman, Stewart, & Walker, 2002), while others show impairment on similar types of tasks that include greater cognitive load (Bernstein-Bercovitz, 2003; Vedhara, Hyde, Gilchrist, Tytherleigh, & Plummer, 2000).

The above findings suggest that performance should be most impaired when stress levels are more extreme and the task requires more complex cognitive processing. When tasks are easy and do

not require sustained attention provided by working memory, increased arousal elicited under stress can provide a boost in performance. However, as tasks become complex, perhaps even contributing to one's overall level of arousal, stress-induced arousal has the potential to directly impair performance via its impact on specific executive processes such as working memory (e.g., Blair, 2006). These observed patterns in the general stress and attention literature parallel the finding that stereotype threat manipulations have their largest effects when the task is complex (O'Brien & Crandall, 2003; Quinn & Spencer, 2001).

Furthermore, cortisol increases are highest in situations where one fears being negatively evaluated during a task on which individuals are motivated to do well (Dickerson & Kemeny, 2004). Thus, it seems likely that individuals who experience stereotype threat will show increased levels of cortisol in addition to other increases in sympathetic activity. Although there have been no studies that link increased cortisol reactivity to lower performance in a stereotype threat context, there has been some research suggesting a relationship between cortisol reactivity and social identity threat more generally (Matheson & Cole, 2004). In this research, individuals who were presented with a threat to their social identity (a suggestion that students at their university are less competent) showed increased levels of cortisol to the degree that they had an emotion-focused coping style, and they exhibited lower levels of cortisol to the degree that they had a problem-focused coping style. This evidence indicates that cortisol is likely to be increased even in experimental inductions of stereotype threat. Furthermore, the interactive effects of coping style suggest that people's appraisals of, or response to, the situation also play a role in modulating their physiological stress response. For this reason we represent Path *g* in Figure 1 as a reciprocal pathway where stress can elicit appraisal processes but appraisal processes could also modulate the stress response.

When pairing this evidence of cortisol reactivity in response to social identity threat with evidence that injections of cortisol directly impair cognitive functioning (Kirschbaum et al., 1996), it is clear that a physiological stress response could play a direct role in impairing task performance under stereotype threat (Path *c* in Figure 1). More research is needed to examine whether this specific hypothesis holds both in naturalistic situations of stereotype threat where the real-world implications of performance have greater power to produce a strong physiological stress response and in short-term laboratory contexts where the stakes are often lower.

Monitoring the Self-Relevance of Performance

As specified earlier, we conceive of stereotype threat as a primed state of imbalance among concepts of self, group, and domain. In addition to eliciting an acute physiological stress response, this state of imbalanced self-perception also elicits vigilance to performance cues, internal states, and social feedback in an effort to disambiguate the uncertainty aroused by stereotype threat. Disambiguating that experience can be accomplished by attending to information that will change the links summarized in Figure 2 to create a more balanced state.

For example, if one's preexisting identification with the domain is very strong (e.g., a stable positive link between self and domain), individuals might search for cues that allow them to restore balance by reversing the link between self and group. Indeed, research has shown that Blacks and math-identified women under threat distance themselves from activities, interests, and attributes commonly associated with members of their group (Pronin, Steele, & Ross, 2004; Steele & Aronson, 1995). Furthermore, some individuals might be able to restore balance if information in the situation suggests that the link between the group and the domain is positive. For example, stereotype threat effects can be eliminated if people are provided with positive or stereotype-inconsistent exemplars of their group (Marx & Roman, 2002; McIntyre, Paulson, & Lord, 2003). Thus, situations that contain these cues hand targets the tools they need to restore balance in a way that preserves the positive link between self and domain. However, in the prototypical situation of stereotype threat, the negative link between self and domain that is suggested by stereotype threat, in combination with the motivation to disconfirm the stereotype, translates into a strong motivation to avoid failure. As a result, targets focus attention on themselves and their performance, becoming more vigilant to detect signs of failure. Although others have suggested that avoidance motivation is a key element of stereotype threat (e.g., J. L. Smith, 2004), here we extend these ideas to outline the cognitive mechanisms that might explain why this particular motivation can disrupt performance.

Becoming more conscious of the self and one's performance. One aspect of the motivation to avoid failure under stereotype threat is that it switches people from a more automated state of functioning into a more conscious and controlled state of monitoring the self within the situation. Adopting a more conscious and controlled processing strategy is designed to resolve the discrepancy represented in the triad of primed constructs. In some respects, this reaction is similar to that seen in any high-pressure performance situation where attention is more likely to be focused on oneself (Baumeister, 1984; Lewis & Linder, 1997). However, situations of stereotype threat are unique because the concern with one's performance stems from one's association with a negatively stereotyped group. Put another way, the person under threat finds him- or herself confronting two alternative hypotheses about his or her performance: "Will I do well, consistent with my personal link to the domain?" or "Will I do poorly, consistent with the negative link to the domain suggested by the stereotype?" Although these alternatives are unlikely to be consciously considered, the primed state of cognitive imbalance manifests phenomenologically as a more conscious focus on the self and one's performance. As a result, behavior that might have been enacted efficiently is now attended to more consciously in an effort to test these alternative outcomes against available cues.

In line with this logic, Seibt and Förster (2004) showed in a series of experiments that individuals under stereotype threat become more focused on avoiding failure, leading to more cautious and systematic performance, as opposed to the eager and creative performance seen by those who are positively stereotyped. In addition, Beilock et al. (2007) recently found that women under stereotype threat about their math abilities reported worrying more about and monitoring their performance. Beilock et al. suggested that such thoughts contribute to the effect of stereotype threat because working memory becomes loaded with distracting information that competes for attentional resources.

Increased vigilance to threat- and failure-related cues. The second aspect of this monitoring process is that, because individ-

uals feel cognitive conflict between an imbalanced set of cognitions, they then become more vigilant to internal or external cues that might help disambiguate this conflict. It has been well documented that when an individual experiences visceral arousal engendered by an environmental threat, systems are brought online to focus attention on the perceived threat (Davis & Whalen, 2001). For example, recent studies using an emotional Stroop or dot-probe task showed that anxious individuals are more likely to be vigilant to anxiety-related stimuli (MacLeod & Mathews, 1988; Williams, Mathews, & MacLeod, 1996). Although this past research suggested that such attentional shifts to threat stimuli happen automatically, such automatic vigilance to task irrelevant cues has the potential to harm performance on complex tasks that depend heavily on working memory efficiency to maintain focus on the task at hand (e.g., Conway, Cowan, & Bunting, 2001). Moreover, if situations of stereotype threat are episodes of acute stress, it follows that targets of threat might also show similar signs of vigilance to threat-related cues, particularly those that are highly self-relevant. For example, women anticipating working with a sexist man become more vigilant to identifying sexism-related cues in their environment (Kaiser, Vick, & Major, 2006), and cues to minority status in a stereotyped domain increase women's vigilance to domain-relevant items in their physical environment (Murphy et al., 2007).

However, in active performance situations, stereotyped targets are likely to be monitoring not only for signs of threat but also for cues that might offer evidence for how one is coping with that situation. The question to be answered is whether one is in fact behaving in a stereotype-consistent way. This means that the monitoring process, informed by the motivation to avoid failure, will be more biased to detect any signs of failure at the task. For example, Amodio et al. (2004) have found that when White Americans perform a task that will reveal their racial biases, their bias-consistent errors on the task activate neural regions critical for monitoring responses that conflict with goals. Importantly, the level of activation to errors consistent with racial bias is greater than that observed to errors that are not indicative of bias. Thus, White Americans become more vigilant to internal signs of bias in situations where they are aware that such biases could be revealed. As is discussed more below, this vigilance is likely to be a necessary first step in controlling those biases that conflict with impression-management goals (Amodio, Kubota, Harmon-Jones, & Devine, 2006).

The above example focuses on situations of stereotype threat that involve some real or imagined social interaction; however, vigilance processes can also play a role in the academic testing contexts when individuals become vigilant to external feedback that might indicate that one is performing poorly and confirming the stereotype. To test this idea, we used the same event-related potential (ERP) methodology employed by Amodio et al. (2004) to examine stereotype threat effects on minority students' tendency to be vigilant to task errors (Forbes et al., 2007). Black and Latino college students completed a rather basic response-conflict task (i.e., a flankers task) described as diagnostic of intelligence or as a neutral pattern recognition task. While they completed the task, ERPs were recorded from scalp regions located above the dorsal anterior cingulate cortex, a region of the brain involved in monitoring behavior that conflicts with goals. Previous research showed that when individuals make errors on this type of task, their ERP waveforms contain a negative deflection approximately 30–180 ms after the response that is not present on correct responses (Gehring, Goss, Coles, Meyer, & Donchin, 1993). This error-related negativity (ERN) pattern is indicative of a performance-monitoring process sensitive to behaviors or outcomes that conflict with current goal states. Results from Forbes et al. (2007) revealed that academically identified minority students showed larger ERN amplitudes when the task was described as an intelligence test compared with a more neutral test frame. In other words, these engaged students under stereotype threat showed neural activity indicative of increased vigilance to their errors on the task.

However, in addition to monitoring the situation for actual signs of failure, individuals under threat might also become more vigilant toward their internal states that could aid in drawing inferences about how one is coping. For example, women anticipating a difficult math test show increased attention toward anxiety-related words, suggesting an increased vigilance for cues to their own level of anxiety (Johns, Inzlicht, & Schmader, 2007). Moreover, a recent functional imaging study showed that women in a stereotype threat condition exhibited greater activation in the ventral anterior cingulate cortex, a region that has been implicated in detecting and processing emotionally relevant information (Krendl, Richeson, Kelley, & Heatherton, in press). Furthermore, studies have shown that threat-induced performance decrements can be reduced by providing individuals with an external explanation for arousal experienced under stereotype threat (Ben-Zeev et al., 2005; Johns, Schmader, & Martens, 2005; Stone et al., 1999). These same reappraisals have no effect on those who are not targeted by stereotype threat, suggesting that it is only those susceptible to threat who are prone to monitor their internal states and seek an explanation for them. Together, these findings indicate that awareness of one's anxious feelings and thoughts could signal that one is performing poorly on a test just as awareness of biased reactions might be an important self-relevant cue to the person facing the threat of being seen as racist.

How do monitoring processes tax working memory? The process of monitoring performance for self-relevant information is likely to rely on the same working memory resources necessary to do the task efficiently. As working memory is often defined in terms of controlled processing (Kane et al., 2007; Miyake & Shah, 1999), any activity that involves consciously attending to the self as a performer of that task will rely on this central executive resource (e.g., Beilock et al., 2006). With respect to the vigilance aspect of this process, even basic research on sustained attention suggests that remaining vigilant to cues in the immediate environment is an effortful cognitive process (Grier et al., 2003). We might also expect that monitoring emotionally arousing cues is particularly taxing to working memory (Dolcos & McCarthy, 2006). However, we make the point not just that individuals are vigilant to threatening cues but that their vigilance is designed to reconcile two competing cognitions in the form of a negative link between self and domain or a positive link between self and domain. Unfortunately, such resolutions are likely to come at some cost to executive resources.

For example, E. R. Smith and Henry's (1996) demonstration that individuals are slower to make judgments about themselves on traits for which they and their social group differ suggests that stereotypic knowledge about one's ingroup that conflicts with self-knowledge requires additional processing. Similarly, reaction

time measures such as the implicit association test that are used to measure the cognitive association between one's self-conceptions and one's group conceptions are based on an assumption that inconsistencies between these two concepts will slow processing speed (e.g., Nosek et al., 2002). In other words, longer response latencies when a set of imbalanced cognitions are simultaneously activated clearly reflect the difficulty of attentional switching between inconsistent cognitions.

The process of engaging in heightened vigilance and attentional switching alone could account for impairments in working memory. However, as we discuss in the next section, the combination of cues that are gleaned from this monitoring process and how they are interpreted could engage coping efforts that might also be resource demanding.

Thought-Suppression Processes Tax Working Memory Resources

A third mechanism contributing to cognitive inefficiency under stereotype threat includes suppression processes aimed at actively regulating negative thoughts and feelings. Before turning to those suppression processes, we consider the origin of the threatening thoughts and feelings that individuals are motivated to suppress. We suggest that stereotype threat elicits appraisal processes engaged to help an individual make sense of the cues that are detected. Moreover, the cues that feed into the appraisal process stem from the primed state of cognitive imbalance (Path *f* in Figure 1), the heightened state of stress (Path *g* in Figure 1), and the monitoring system (Path *h* in Figure 1). Because threatened targets' focus of attention might be particularly drawn toward negative emotional stimuli and signs of failure (Forbes et al., 2007), we reason that negative thoughts and feelings will often be the outcome of these appraisal processes.[1]

The above line of reasoning suggests that stigmatized and nonstigmatized individuals would have different phenomenological experiences during a performance situation. Those who benefit from positive stereotypes might feel challenged, confident, and exhilarated, whereas those who bear the burden of negative stereotypes might experience self-doubt and feelings of anxiety. Indeed, stereotype threat has been shown to activate thoughts of self-doubt (Steele & Aronson, 1995), negative expectancies (Stangor, Carr, & Kiang, 1998), feelings of dejection (Keller & Dauenheimer, 2003; Marx & Stapel, 2006b), and task-related worries (Beilock et al., 2007). Similarly, Cadinu, Maass, Rosabianca, and Kiesner (2005) showed that women taking a difficult math test reported having more negative thoughts under stereotype threat. Moreover, the number of negative thoughts they had during the first half of the test mediated the effect of stereotype threat on lower performance during the second half of the test.

While the above research suggests that stereotype threatened targets do experience more negative thoughts and feelings, it must be mentioned that studies have not always been so successful at detecting these phenomenological experiences when using standard self-report measures (see Wheeler & Petty, 2001, for a review). However, studies that have used less conscious indicators of anxiety have been more revealing. For example, Bosson et al. (2004) found that homosexual men under stereotype threat exhibited more nonverbal anxiety than did heterosexual or nonthreatened homosexual men when asked to interact with preschool children. However, these same men did not explicitly report feeling more anxious.

Given this evidence that stereotype threat makes individuals anxious, why do they not report this feeling on a questionnaire? One possible reason for the mixed results on self-reported anxiety measures is that in addition to trying to do well at the performance situation, targets of negative stereotypes are also engaged in efforts to regulate unwanted thoughts and emotions that result from the experience of threat, perhaps as part of a more general tendency to deny the experience of threat (von Hippel et al., 2005). Thus, the negative phenomenological experience that results from the appraisal process should elicit attempts to regulate these stressful experiences (Path *i* in Figure 1).[2] In addition, people have an intuitive belief that feeling anxious during a performance task or social interaction can interfere with the goal of doing well (T. W. Smith, Snyder, & Handeslman, 1982). Imagine the student giving a speech who loses her train of thought because she is consciously trying to not feel anxious in front of an audience. Because she is trying to suppress or even deny that she is anxious, when asked on a questionnaire, she may not freely admit (even to herself) the anxiety she is feeling. However, indirect measures such as nonverbal behavior or subtle shifts in attention can reveal those anxious feelings.

The problem with this sort of coping strategy is that such acts of emotional suppression and thought suppression more generally are effortful and therefore present another pathway by which stereotype threat impairs working memory (Path *j* in Figure 1). Evidence for the depleting effects of emotion regulation comes from various sources. First, it is generally assumed that suppressing unwanted thoughts from consciousness is an effortful and resource-depleting process (e.g., Muraven & Baumeister, 2000; Wenzlaff & Wegner, 2000). Furthermore, recent neuroimaging evidence supports the role of the prefrontal cortex in thought suppression over a sustained period of time (Mitchell et al., 2007). More specific to emotional suppression, efforts to regulate emotional responses have been found to tax cognitive resources (e.g., Gross, 2002; Richards & Gross, 2000; Schmeichel, 2007) and have the ironic effect of increasing accessibility of anxiety-related thoughts (Wegner, Erber, & Zanakos, 1993). Thus, if working memory is used to suppress irrelevant information (Rosen & Engle, 1998), the same cognitive process needed for successful performance might be hijacked under stereotype threat for the purpose of regulating one's emotions. Even if the physiological stress-arousal mechanism or increased vigilance described previously does not affect working memory directly, self-regulation is still another process by which

[1] Appraisal processes are not represented as directly taxing working memory because studies showing that reappraisal or misattribution can buffer working memory resources or task performance would suggest that appraisals alone do not lead to performance impairments (Johns et al., 2007).

[2] Negative thoughts and emotions are not represented as directly taxing working memory given evidence that active expression of negative thoughts and feelings has psychological, physiological, and performance benefits rather than costs (e.g., Mendes et al., 2003). The links between negative thoughts/emotions and suppression are represented as reciprocal pathways in light of evidence that active suppression leads to the ironic effect of these states becoming more accessible (Wegner & Erber, 1992; Wegner et al., 1993).

performance on difficult cognitive tasks could be impaired in situations of stereotype threat.

There is emerging research showing that targets under threat try to suppress negative thoughts. For example, S. Spencer (2003) reported that adding further cognitive load to women who are already experiencing stereotype threat leads to a heightened activation of stereotype-related constructs, supporting the notion that the load interferes with their attempts to suppress this information. Research has also shown that instructing women to replace stereotypic thoughts during the test with less threatening thoughts eliminates the negative effects of stereotype threat on performance (McGlone & Aronson, 2007). We suspect that individuals under threat might not always have negative stereotypes consciously brought to mind, particularly when cues to threat are subtle. However, individuals are likely to be conscious of the anxiety and discomfort that are the outcomes of the monitoring processes described above. If active regulation of thoughts and feelings requires some degree of conscious awareness of those thoughts or feelings, then targets might more commonly attempt to regulate and push out of mind their own feelings of anxiety or self-doubt rather than more abstract negative stereotypes about their group.

We have recently obtained additional evidence that individuals under stereotype threat attempt to regulate their feelings of anxiety during a performance situation and that these attempts at self-regulation predict lower working memory. Earlier, we described a study using a dot-probe task that allowed us to measure attention being directed toward threat-related stimuli (Johns et al., 2007). In one condition, women under stereotype threat showed evidence that their attention was directed toward threat-related words, indicating that they were anxious in the situation. We included a second condition where we described how the dot-probe task measures anxiety. Our reasoning was that if women know that this task is a measure of anxiety and they know how the task works (that anxious individuals would tend to look toward anxiety-related words), then a motivation to regulate one's anxiety would be evidenced by women trying to look away from the anxiety-related words. This tendency would be revealed in the time it takes them to identify a dot that appears in the same position as, or opposite position from, the target word. The findings suggest that women under stereotype threat attempt to suppress the expression of anxiety when they know that their anxiety is being assessed. Moreover, the more participants engage in this suppression pattern, the more their working memory decreases on a subsequent task.

Other evidence for the role of emotion regulation in reducing processing efficiency under stereotype threat comes from a recent functional imaging study of women performing a mental rotation task under conditions designed to create stereotype threat (by emphasizing men's superior spatial skills) or stereotype lift (by emphasizing women's superior perspective-taking skills) compared with control (Wraga, Helt, Jacobs, & Sullivan, 2007). Results from that study revealed greater activation in the right orbital gyrus during threat compared with control that correlated with a greater number of errors made on the task in this condition. Given that the orbital gyrus has been implicated in the regulation of negative self-conscious emotions such as shame (Beer, Heerey, Keltner, Scabini, & Knight, 2003), this pattern of results adds support to our assertions that stereotype threat increases negative thoughts and feelings about the self that individuals are motivated to control.

If emotion regulation does underlie some of the cognitive deficits seen in situations of threat, then manipulations designed to redirect appraisal processes or prevent emotion-focused coping should eliminate stereotype threat performance deficits. Indeed, giving targets an external attribution for heightened arousal is one way to deflect stereotype threat effects on performance (Ben-Zeev et al., 2005). This finding suggests that it is because arousal gets interpreted as indicative of anxiety that individuals try to engage in self-regulatory processes in the first place. In addition, telling participants that anxiety does not harm test performance eliminates stereotype-induced reductions in working memory, presumably because such a reappraisal of anxiety eliminates the need to regulate emotion (Johns et al., 2007).

To summarize, our process model of stereotype threat argues that when individuals find themselves having to perform complex tasks, cues that activate negative self-relevant stereotypes set in motion a series of processes including a physiological stress response, monitoring of the performance situation for self-relevant information, and efforts to suppress negative thoughts and feelings that result from the previous two processes. Each of these mechanisms can impair the same executive resources (i.e., working memory) necessary for successful performance on many (but not all) of the types of tasks that have been studied in the stereotype threat literature.

Accounting for Stereotype Threat Effects Found on Tasks Requiring Automated Routines

To this point, the model has focused on stereotype threat effects on tasks that require some amount of working memory to coordinate controlled processing (e.g., solving mathematical or verbal problems, regulating behavior during an interaction). However, not all tasks that have shown performance impairments under stereotype threat require working memory for their successful execution. For example, programs of research by Beilock and Stone (Beilock et al., 2006; Stone et al., 1999) have shown that priming negative stereotypes about a certain athletic skill can hurt individuals' golf-putting performance. Other research has shown stereotype threat effects by men on tests of social or emotional sensitivity (e.g., Leyens, Désert, Croizet, & Darcis, 2000). Consideration of these effects requires recognition that optimal performance on some tasks does not require conscious attention to performance, and in fact, conscious attention to one's behavior or decision making can actually impair performance. For example, part of becoming an expert golfer means that one no longer has to consciously attend to one's stance, grip, swing, and follow-through; in fact, these well-practiced and now automated behaviors can be performed more reliably by not consciously attending to performance. Similarly, during social judgment, controlled attention leads one to overthink details and neglect gestalt impressions that are more accurate (Ambady & Gray, 2002). We briefly consider how our model accounts for stereotype threat impairments on tasks where successful performance depends on using more automated, as opposed to controlled, processes.

Beilock's research conclusively showed that performance on a proceduralized motor task like golf putting is impaired under stereotype threat but not because of reduced efficiency of working

memory. In fact, providing threatened participants with a concurrent cognitive load eliminates the effect of threat on putting performance (Beilock et al., 2006). This finding suggests that performance is reduced on these tasks because of the monitoring component already described (Path *m* in Figure 1). More specifically, individuals under threat become more conscious of their performance and more vigilant for signs of failure, leading to a controlled rather than automated form of behavior regulation. Because these monitoring processes rely on working memory, the addition of a cognitive load occupies this executive control mechanism and makes the individual unable to consciously monitor his or her performance. Thus, on these types of procedural tasks, hijacking working memory for a secondary task has the effect of enhancing performance under stereotype threat by allowing automatic processes to guide behavior.

Although skilled motor tasks have been the most common form of automatic tasks studied under stereotype threat, there is another class of stereotype threat phenomena that we consider under this umbrella of automated performance. These are tasks that require social judgments where a reliance on an automatic or heuristic mode benefits performance more than relying on a controlled or systematic mode of processing. For example, Koenig and Eagly (2005) compared the performance of women and men on a test of social sensitivity that involved answering questions about the relationships and intentions of the actors in a series of video clips. Men were less accurate in these assessments when reminded of women's superior social sensitivity skills. More relevant to our analysis, Koenig and Eagly found that the stereotype threat effect was strongest among men who reported using a deliberate, conscious strategy to interpret the scenes, whereas previous research showed that performance on this test is facilitated when respondents rely on their intuitions. Leyens et al. (2000) reported a parallel effect in which men under threat performed poorly on a supposed test of emotional sensitivity by overinterpreting the affective meaning of words. Together, these findings suggest that stereotype threat can harm performance in some situations simply by motivating targets to shift their attention to conscious monitoring and control of their behavior. Again, performance here is not being impaired because of degraded working memory per se but more specifically because of the conscious mode of processing enacted by the monitoring mechanism.

Note that the experience of threat in these kinds of performance situations could still involve increases in physiological stress arousal (e.g., Stone et al., 1999). Although prior research suggests that physiological arousal alone might increase performance on automated tasks by facilitating the well-learned or prepotent response (Zajonc, 1965), more recent work indicates that the specific nature of such arousal (threat or challenge) should moderate performance on such tasks, with threat leading to poorer performance (e.g., Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004; Mendes et al., 2002). Given this complex relationship between physiological arousal and performance on sensorimotor tasks, we do not represent a direct relationship between these constructs in Figure 1. Moreover, in the context of stereotype threat, the relationship between physiological stress and performance on sensorimotor tasks is likely to be mediated through the appraisal and monitoring processes articulated in the model (Paths *g* and *h* in Figure 1). Furthermore, individuals could also be engaged in suppression processes during automated tasks, which could leave them cognitively depleted. However, given the need to monitor for unwanted thoughts and feelings to suppress them, these suppression attempts are likely to exacerbate monitoring tendencies (Path *l* in Figure 1), even if the depletion that results from suppression may not be directly responsible for impairing performance.

Qualifications, Clarifications, and Comparisons

In articulating our model of the processes that underlie stereotype threat, we have reviewed evidence to support the proposed pathways by which activating self-relevant negative stereotypes impairs working memory. In many cases, a trail of studies drawn from a variety of literatures supports the role that these processes might have in stereotype threat. In other cases, the articulation of this model could be generative in highlighting future avenues of inquiry. In addition, because there has been a great deal written on stereotype threat in the years since Steele and Aronson's (1995) article, we next consider how our model relates to several other themes in the stereotype threat literature that have not been explicitly integrated into our discussion.

Assessing Alternative Perspectives to the Role of Working Memory in Stereotype Threat

There are several lines of research that seem to offer different views on the role played by working memory in stereotype threat. These merit more focused discussion.

Should We Expect Stereotype Threat to Cause Decreased Activation in Regions Associated With Working Memory?

We mentioned previously a functional imaging study by Wraga et al. (2006) of women performing a mental rotation task under conditions of stereotype threat, stereotype lift, or control. Although the study yielded the expected pattern of performance, it did not reveal significant differences between threat and control conditions in level of activation in regions associated with working memory (the anterior prefrontal cortex). A recent study by Krendl et al. (in press) also failed to find evidence of activation differences in working memory regions due to stereotype threat. These studies would seem to speak against the idea that stereotype threat has a negative effect on working memory.

However, there is reason to be cautious when interpreting these null effects. Participants in these studies all completed cognitive tasks that should activate areas associated with working memory. Therefore, a lack of change in activation suggests only that participants in all conditions were in fact using working memory at equal levels. This point is important because our model does not imply that working memory processes are not operating during stereotype threat or even that they are operating to a lesser degree. The more apt description is that stereotype threatened individuals use working memory resources for a purpose other than performing the task. Because measures of activation do not provide insight into what information or tasks working memory is engaged in, they cannot inform us about the nature of these processes, a problem that Krendl et al. (in press) echoed.

Do Individual Differences in Working Memory Moderate Stereotype Threat Effects?

One prediction that could follow from our model is that individuals with dispositionally high working memory should be less

affected by stereotype threat. That is, if stereotype threat impairs working memory, those who start out with a higher threshold for being able to juggle complex information should be better equipped to cope with threat. However, evidence by Beilock and Carr (2005) has shown that high–working memory individuals are actually harmed more by high-pressure performance situations. How do we reconcile these two viewpoints?

One difficulty in examining working memory from a dispositional approach is that this variable is likely to be confounded with task engagement. In Beilock and Carr (2005), the low–working memory individuals responded more slowly and did poorly regardless of whether or not the situation was highly threatening, suggesting lower engagement. Furthermore, a recent follow-up by Gimmig, Huguet, Caverni, and Cury (2006) suggests that the reason low–working memory individuals are less affected by evaluative threat is because they experience less anxiety due to this threat. Together, these findings imply that engagement is the variable that really distinguishes low–working memory individuals from high–working memory individuals. By this logic, if one was able to have individuals matched on task engagement who merely differ in terms of working memory efficiency, those with higher baseline working memory should show relatively less susceptibility to stereotype threat.

Does Evidence of "Mere Effort" Rule out a Role for Working Memory?

Jamieson and Harkins (2007) recently proposed that stereotype threat harms performance because it motivates mere effort at the task. According to their view, the motivation to do well increases activation of the prepotent response, which is often incorrect on difficult tasks (Zajonc, 1965). To provide evidence for this explanation, they examined the effect of stereotype threat on an antisaccade task. In this task, participants have to inhibit an automatic tendency to look toward a flashing stimulus that appears on one side of the screen, to correctly identify a target that appears briefly on the other side of the screen. Jamieson and Harkins found that women under stereotype threat perform more poorly at this task when the critical target is displayed only briefly because they are more likely to look toward the flashing stimulus. Stereotype threatened women do, however, launch corrective saccades more quickly and are able to perform the task well if it is made easier by displaying the target on the screen for longer. However, performance is again reduced if they are given a concurrent cognitive load.

Although we believe that these findings shed light on the component processes involved in working memory impairments, Jamieson and Harkins (2007) interpreted their results as being incompatible with the idea that stereotype threat affects working memory. In their view, stereotype threat motivates mere effort at the task, which then leads to an increased potentiation of a prepotent response. One problem with reconciling these two interpretations, however, is that their data cannot distinguish between the overproduction of a prepotent response (which is their view) and the failed inhibition of a prepotent response, which would result from working memory disruption and goal neglect (P. K. Smith, Jostmann, Galinsky, & van Dijk, in press).

In addition, the primary evidence Jamieson and Harkins (2007) invoked to support their interpretation is that stereotype threatened targets are faster to try to correct after making a reflexive (incorrect) response. They cited prior cognitive research showing that reduced working memory typically leads to slower corrections and inferred that since their participants were faster to make corrections, they could not be suffering working memory impairments. The problem with this inference is that lower working memory can sometimes be confounded with lower task engagement (Gimmig et al., 2006). Although situations of stereotype threat induce the kind of ego involvement that can impair cognitive processing while keeping motivation high, we have no such assurance that other working memory or cognitive load studies were able to retain high levels of motivation from their low–working memory participants.

In sum, we disagree with Jamieson and Harkins's (2007) assertion that an increased motivation to correct one's errors is inconsistent with taxed working memory. The fact that threatened participants continued to produce incorrect responses even though they appeared motivated to correct these mistakes suggests to us that the ability to inhibit the prepotent response and produce goal-consistent behavior is diminished. This is exactly what would be expected if working memory is impaired (Kane & Engle, 2003; Mitchell, Macrae, & Gilchrist, 2002).

Is Stereotype Threat a Cognitive or Motivational Phenomenon?

Wheeler and Petty (2001) published a provocative examination contrasting the literature on stereotype threat with the literature showing that priming stereotypes leads to automatic behavior effects. In comparing stereotype threat with ideomotor effects, Wheeler and Petty placed stereotype threat research in the context of a meta-theoretical debate that has surfaced in several research areas since the cognitive revolution (Schwartz, 1998). The basic question is whether stereotype threat is best explained as the result of a simple, "cold" cognitive process or a "hot" motivational one. However, as Wheeler and Petty pointed out, this distinction is likely to be an oversimplification of the complex processes that underlie social behavior.

The model that we propose is designed to move beyond overly simplistic accounts of stereotype threat to consider how motivated processes and activated cognitions interact to elicit physiological responses and active forms of processing that impair task performance. Our integrative approach compliments recent examinations of automatic priming effects that have begun to introduce the role of self-motivated processes (Cesario, Plaks, & Higgins, 2006). For example, Wheeler, DeMarree, and Petty (2007) proposed a model of automatic priming effects on behavior that assumes such effects only occur to the degree that primed content changes the currently active self-concept. Thus, situations can induce nontargeted individuals to assimilate an outgroup stereotype into their own working self-concept, but for those who are chronically the target of these preconceptions, self-relevance is the norm (Marx & Stapel, 2006a, 2006b).

The above work suggests that just as stereotype threat involves more than purely cognitive processes, stereotype priming effects seen with nontargets are also likely to involve motivational processes (Wheeler & Petty, 2001). This raises the possibility that general effects of primes on behavior might involve some of the processes outlined in our model. For example, nontargets who internalize a stigmatized identity temporarily might fall prey to the

same processes of increased stress arousal, vigilance, self-doubt, and self-regulation described in our model (e.g., Bosson, Prewitt-Freilino, & Taylor, 2005). Together, these findings suggest that situations that merely lead individuals (stigmatized or not) to see themselves as a member of a targeted group or to identify with someone experiencing threat can trigger the threat-based processes discussed in our model. This includes activation of negative stereotypes and increased feelings of doubt. The hypothesis that the specific processes identified here are involved in automatic priming effects, however, has yet to be examined.

Can This Model Also Explain Stereotype Lift Effects Stemming From Positive Stereotypes?

If the processes outlined here are important in reducing performance when stigmatized targets are primed with negative stereotypes, can they also help us understand the process by which stereotype lift occurs (Walton & Cohen, 2003)? Many stereotype threat studies report evidence of a small but noticeable increase in performance among the positively stereotyped group in the same condition that reduces the performance of those who are negatively stereotyped (Shih, Ambady, Richeson, Fujita, & Gray, 2002; Shih et al., 1999). Although it has seldom been significant in any given study, Walton and Cohen (2003) confirmed in a meta-analysis that this stereotype lift effect is reliable. How might our model account for the performance of positively stereotyped group members?

First, rather than activating negative stereotypes, situations in which stereotype lift occurs are likely to activate self-relevant positive stereotypes. Assuming the activation is implicit, this indirect priming of positive performance concepts should buffer against the typical stress responses that operate in any social evaluative setting, such as taking a standardized test. In terms of our balance framework, the primed positive stereotype and activation of the group concept yield positive links between group and domain and between self and group that facilitate a positive link between self and domain. This balanced state should reinforce the tendency to assume that one will do better than average at a given task, which should negate any need to monitor the performance situation for signs of threat. Finally, any interpretation that does occur should operate through the lens of a positive stereotype, which would bias self-assessments in a more favorable direction and eliminate any need to regulate thoughts and emotions. Without the influence of the processes that are likely to compete for working memory (i.e., stress arousal, performance monitoring, and suppression), individuals performing under the protective glow of a positive stereotype should have the best chance of performing up to their full potential.

Furthermore, it makes sense that the effect size for stereotype lift might be smaller than that seen for stereotype threat if we assume that a given sample of individuals in a control condition are performing close to, but not at, their maximum potential. Because any individual might feel social evaluative threat that could lead him or her to perform somewhat below his or her true ability, any testing instructions will likely create variance in performance in a condition where no group stereotype is activated. Priming a positive social stereotype, then, might reduce this variance and elevate scores. For those under stereotype threat, there is more room for failure, and thus performance is impaired more dramatically by priming negative stereotypes in situations where one might do quite well under less threatening circumstances.

Finally, choking under pressure is likely to involve some of the same processes outlined in our model. The lift effect described above assumes that a positive self-relevant stereotype is primed implicitly (Shih et al., 2002). However, choking is most likely to occur when a positive stereotype is primed for an individual who lacks confidence in his or her own ability to live up to that expectation (Cheryan & Bodenhausen, 2000). This situation should also induce a state of cognitive imbalance where the positive links between group and domain and between self and group prime a positive link between self and domain that is in conflict with a preexisting negative link between these two constructs. In other words, individuals find themselves trying to reconcile contrasting cognitions about the self: "According to the stereotype, I should do well; but what does it mean if I don't?" As already described, individuals might spend some of their attentional resources searching the environment for evidence to reconcile these competing hypotheses. This situation is the obverse of that faced by the stigmatized target who is confident about his or her personal ability but fears that his or her performance could confirm a negative stereotype. In both cases, the discrepant cognitions and explicit monitoring of the performance situation have the potential to redirect working memory for a purpose other than the task at hand.

How Is Stereotype Threat Different From Situations of Social Evaluative Threat or Test Anxiety?

Given our emphasis on how different mechanisms play into a larger process of impaired performance, some aspects of our model are likely to apply to other forms of social evaluative threat. For example, vigilance and cognitive interference are thought to contribute to individual differences in text anxiety (Ashcraft & Kirk, 2001; Sarason, 1984). Furthermore, research on social evaluative threat examines stress more generally by placing individuals in challenging performance situations that share many of the same features with those studied by stereotype threat researchers (Kirschbaum, Pirke, & Hellhammer, 1993). Is stereotype threat merely a subtype of social evaluative threat or test anxiety more generally? We contend that stereotype threat is unique in several key ways.

First, the most obvious difference is that only stereotype threat is triggered by activating one's membership in a negatively stereotyped group—an element that is absent from standard situations of test anxiety and social evaluative stress. In these more personalized cases of performance anxiety, a negative association between self and domain is probably cued directly and explicitly by the negative expectations that oneself (in the case of test anxiety) or others (in the case of social evaluative threat) have for one's performance. Thus, a unique aspect of stereotype threat is that individuals who typically view their abilities positively can find themselves in an ego-involving situation that is not explicitly evaluative and still perform poorly.

A related distinction between stereotype threat and these other forms of stress-induced performance impairments is that only situations of stereotype threat have been shown to increase one's motivation to do well as one tries to disconfirm the stereotype (Forbes et al., 2007; Jamieson & Harkins, 2007; Kray, Thompson,

& Galinsky, 2001; O'Brien & Crandall, 2003). It is less clear that test anxiety and social evaluative threat have the same positive effects for motivation. Instead, test-anxious students appear to become less motivated in evaluative contexts (e.g., Hancock & Dawson, 2001), and classic situations of evaluative threat promote behavioral disengagement from the task (e.g., Tomaka & Palacios-Esquivel, 1997).

The third way in which stereotype threat is distinct from other types of stress-induced performance impairments lies in phenomenological experience. As discussed earlier, stereotype threat can be induced through subtle cues that simultaneously impair performance but leave individuals unaware of (or unwilling to acknowledge) their resulting feelings of anxiety (Johns et al., 2007). In contrast, individuals who suffer from chronic test anxiety seem more willing to freely admit their predicament on standard self-report measures of test anxiety (Spielberger, 1980). Likewise, manipulations of social evaluative threat are designed to create an explicit sense of public critique during an impossibly difficult task (Dickerson & Kemeny, 2004). Thus, individualized forms of stress-induced performance impairments are readily observable and recognized by those who suffer their consequences. Perhaps as a result, these situations are unlikely to evoke the same degree of impression-management strategies undertaken by individuals trying to deny their experience of stereotype threat.

In sum, stereotype threat involves a conflict between one's positive self-concept and negative group concept in a stereotype-relevant domain; its experience can be cued by situations that are not explicitly threatening; it can have effects that individuals are unable or unwilling to consciously report; and in spite of these obstacles, individuals remain motivated to excel even while the situation conspires against their success. In contrast, situations of test anxiety and social evaluative threat are cued by directly priming a negative link between the self and the domain in a way that is explicit, readily acknowledged, and likely to lower motivation. Both types of situations might lead to the same physiological stress response and conscious vigilance to performance with a biased focus on errors—both processes that interfere with executive functioning. However, given the greater tendency toward denial in situations of stereotype threat, active suppression might be more unique to those situations. Finally, given that stereotype threat effects do not require public evaluation of one's performance (Inzlicht & Ben-Zeev, 2003), they are also likely to be activated for stigmatized individuals in a broader set of circumstances.

Considering the Relative Role of Each Pathway and Applying the Model to Reduce Stereotype Threat Effects

The model we present identifies separate pathways by which negative self-relevant stereotypes could impair working memory and lead to performance disparities between groups. We conceptualize these pathways as part of a system where each not only has the potential to directly affect working memory but also feeds back into other components in the model. For example, the link between suppression and a physiological stress response (Path *k* in Figure 1) reflects recent research suggesting that suppression elicits a profile of cardiovascular threat reactivity (Mendes, Reis, Seery, & Blascovich, 2003). Suppression is also shown as having a reciprocal link to monitoring processes (Path *l* in Figure 1) given Wenzlaff and Wegner's (2000) assertion that thought suppression engages both the search for to-be-suppressed thoughts and the controlled process of keeping such thoughts out of mind.[3] Given this systemic view, it might be unfeasible to design a study that would include perfect and simultaneous measures of each of the processes proposed in the model to estimate and compare the unique contribution of each of these variables. However, we might get more traction on the role of specific pathways in the model by considering the factors that moderate the effect of each component process in creating stereotype threat–induced cognitive impairments. This analysis not only allows us to consider the relative impact of specific processes but also helps to identify potential switches within an individual or situation that would essentially turn the threat off.

Moderating the Physiological Stress Response

We have argued that situations of stereotype threat often elicit an increased physiological stress response that could directly impair cognitive performance when stigmatized individuals are in highly evaluative situations. Thus, the physiological pathway could play a substantial role in real-world performance contexts such as standardized tests, interviews, or public speaking, especially for individuals prone to experiencing performance anxiety. In comparison to these real-world situations, more short-lived encounters that are of a private nature (Inzlicht & Ben-Zeev, 2003) might not be stressful enough to induce a large physiological response. Given that many laboratory studies of stereotype threat fall closer to this second category, we suspect that the physiological processes described in the model can exacerbate stereotype threat effects on performance but cannot alone account for the full complement of findings in the literature.

However, even if most laboratory inductions of stereotype threat are not strong enough to elicit hypothalamic-pituitary-adrenal activation, some degree of sympathetic responding could still be necessary for the biased processing of one's internal states that could lead to felt anxiety and efforts to suppress it. If this is the case, drug treatments that reduce activation of the SNS should be effective in reducing stereotype threat effects. If stigmatized individuals in a treatment group do not show performance impairments under stereotype threat conditions, this would provide some indication that sympathetic arousal does play a necessary role in the process. Indeed such treatments have had some success in reducing physiological stress and facilitating the performance of musicians suffering from stage fright (see Kenny, 2005, for a review).

Other nonpharmacological solutions to reducing stress could entail making the performance context seem less self- or group relevant, less of a test of inherent ability, or less evaluative. As an example, several years ago the College Board revised the A in SAT to emphasize assessment over aptitude. Such a change can help disabuse people of the lay intuition that a given testing session will reveal one's inherent ability and help lower their levels of stress.

[3] We do not represent physiological stress responses and monitoring processes as having direct links leading to suppression because these elements alone have little meaning before the appraisal process they elicit produces phenomenological experiences (doubt, anxiety) that would need to be suppressed.

Moderating Performance-Monitoring Tendencies

A second pathway by which working memory is directly reduced in situations of stereotype threat is through increased monitoring of the performance situation. Although we suspect that some degree of heightened vigilance is a hallmark of all stereotype threat situations, it is unclear whether vigilance alone is enough to produce the deficits in working memory that impair cognitive performance. However, any diversion of attention away from the task to situational cues or internal thoughts could arguably reduce performance on tasks that require controlled attention. Moreover, this impairment will be exacerbated by heightened levels of cognitive inconsistency or uncertainty. This analysis implies that certain individual differences could moderate the degree to which individuals engage in these monitoring processes. For example, individuals who are high in stigma consciousness might be especially prone to become hypervigilant to signs of social bias (Brown & Pinel, 2003). On the other hand, high self-monitors seem to be buffered from stereotype threat effects because they are more practiced at being socially vigilant and thus less bothered by having to do this in a given context (Inzlicht, Aronson, Good, & McKay, 2006).

In addition to these variables, other general personality factors could be important moderators of performance-monitoring effects. For example, individuals with a high need for cognition (Cacioppo & Petty, 1982) might engage in more cognitive work to reconcile discrepant cognitions about the self, further siphoning resources away from the task, whereas those high in self-concept clarity (Campbell et al., 1996) might have a more stable link between self and domain that is unaffected by the balance processes described. Any of these variables could moderate the influence vigilance processes exert in reducing the efficiency of working memory.

Drawing from these hypotheses about person variables moderating threat susceptibility, manipulations could also combat stereotype threat by suppressing this specific pathway. If the activation of imbalanced cognitions shifts people from automatic processing of their behavior to a more conscious monitoring of their behavior, then manipulations designed to restore ego-enhancing biases should also alleviate threat. For example, manipulations that affirm positive characteristics about oneself (Martens, Johns, Greenberg, & Schimel, 2006) or one's group (Marx & Roman, 2002; McIntyre et al., 2003) have been successful at reducing stereotype threat. Our model suggests that such manipulations work by specifically reducing vigilance processing, although this hypothesis remains to be tested directly.

Moderating Suppression Processes

The third pathway involves stigmatized individuals' active attempts to cope with or suppress the phenomenological manifestations of stereotype threat. Just as test anxiety would exacerbate the physiological stress response and stigma consciousness could exacerbate performance-monitoring processes, there are also person factors that should moderate the tendency to engage in suppression processes when under stereotype threat. For example, individuals who have a dispositional preference for emotion-focused styles of coping (e.g., Folkman & Lazarus, 1985) might be more likely to cope with stereotype threat by regulating their emotions as opposed to focusing solely on performing the task. Given Wegner and Erber's (1992) demonstration that suppression processes are likely to fail, we could expect to see hyperaccessibility of stress-related thoughts due to suppression attempts. This could explain the results of a study by Matheson and Cole (2004) whereby stigmatized individuals high in emotion-focused coping showed greater cortisol reactivity in response to a threat to their social identity.

This latter point highlights again the systemic nature of the model we describe. Even though suppression processes are considered to be downstream from other load-producing processing, it is a process that is still likely to have reciprocal relations with other variables in the model including physiological stress, monitoring, and negative thoughts and feelings (Paths *k, i,* and *l* in Figure 1). This implies that manipulations that reduce suppression tendencies can also reduce overall stereotype threat effects on working memory by down-regulating a more systemic threat response. For example, emotional expression is an adaptive way to cope with negative emotions in that it is associated with a challenged profile of cardiovascular reactivity (Mendes et al., 2003).

Another strategy to counteract suppression is to instead cope with negative thoughts and feelings by reappraising their source and meaning. We earlier mentioned that women in a stereotype threat condition who reappraise anxiety as being good for performance exhibit less expressive suppression, higher working memory, and better performance on a math test compared with women in a standard stereotype threat condition (Johns et al., 2007). In other research, we have employed a more naturalistic way to get stigmatized targets to reappraise their anxiety. Specifically, we tested the hypothesis that learning about stereotype threat as an external explanation for why one might feel anxious in a testing situation could effectively reduce the underperformance of women on a math test (Johns et al., 2005). In this study, women underperformed men on a math test when told that the study would be examining gender differences in math ability. They performed equally to men when told that the study would be examining individual differences on a problem-solving exercise. In a third condition, women were told that the study examined gender difference in math ability but were also told about stereotype threat and the way in which it might lead women to feel more anxious while taking a math test and underperform as a result. In this condition, even though women expected to do more poorly than men, they actually performed just as well as men, and their performance was predicted by the degree that they attributed their anxiety to gender stereotypes.

From this evidence, it is clear that how individuals interpret their experience when under threat plays a critical role in affecting their performance. For this reason, we have represented all of the pathways to the subcomponent appraisal process as reciprocal relationships because reappraisal might be an important means of down-regulating threat. Group differences might be substantially reduced, if not eliminated, by encouraging stigmatized individuals to reappraise what anxiety, arousal, or even task errors mean and to avoid interpreting them as signs of personal failure. While it seems likely that such reappraisal could reduce or qualitatively change the level of physiological stress (e.g., from threat to challenge), it is not known whether reappraisal also works in the other direction to reduce performance-monitoring tendencies. Testing these reciprocal relationships among the component processes in the model is an important avenue for future inquiry. However, the

research described by Johns et al. (2005) also offers some hope that interventions to reverse the long-standing group differences in intellectual performance could be as simple as educating the public about these effects.

Summary and Implications

The 21st century brings with it increasing diversity in organizations, schools, and communities, making it essential to understand how the salience of stigmatized status affects performance. We have outlined a model of stereotype threat that integrates physiological, affective, cognitive, and self-regulation processes to illuminate the unique challenges associated with situational stigma. We contend that most, if not all, situations of stereotype threat set in motion certain physiological and psychological processes that impair the domain-general executive resource needed for performance on a variety of different tasks. If physiological stress does not directly reduce working memory, then the increased vigilance to one's performance, or suppressing negative emotions, can. The predicament faced by those who are socially stigmatized is particularly pernicious because it is likely to be multidetermined by these various pathways.

As described, this model has the potential to explain a variety of phenomena ranging from why minorities and women underperform in certain academic arenas to why interracial interactions are often experienced as uncomfortable and awkward. Although anyone can experience the processes outlined in our model, for those who contend with negative stereotypes about their abilities, the chronic experience of stress, heightened vigilance, self-doubt, and emotional suppression not only can impair performance directly but also can lead them to avoid situations where these aversive phenomena reside (Davies, Spencer, & Steele, 2005; Steele, 1997). The far-reaching consequences of these effects increase the need to translate our understanding of basic processes into effective interventions. Fortunately, the strength and appeal of a stereotype threat perspective on group differences in behavior and ability are that situations, or people's appraisals of those situations, can be modified to reduce the threat. By demystifying the process by which stereotypes affect behavior, we are better equipped to alter those processes for the better.

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