STIGMA AND GLUCOSE LEVELS:
TESTING EGO DEPLETION AND AROUSAL EXPLANATIONS OF STEREOTYPE THREAT EFFECTS

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ABSTRACT

Stereotype threat research shows that when stigmatized group membership is made salient, group members' cognitive performance is lowered; however, the mechanism through which this effect operates is not well understood. This study tests between arousal and ego depletion accounts of stereotype threat by examining whether stereotype threat effects are mitigated or exacerbated by increasing glucose levels. In a study of the effects of stereotype threat on women's mathematics performance, we find that glucose exacerbated stereotype threat effects, lending support to an arousal-based theory of stereotype threat. Findings also suggested the plausibility of an additional mechanism driving threat effects in which stigmatized individuals conserve scarce cognitive resources for use in subsequent, non-stigmatized domains.

INTRODUCTION

Stereotypes - generalizations about the characteristics of members of social groups - have long been known to play a powerful role in shaping expectations and actions (Fiske 1993). Further, decades of research shows that a salient negative stereotype - i.e., "stereotype threat" - can have self-fulfilling effects, impeding individual performance in domains like test-taking (e.g., Steele and Aronson 1995). This power of stereotypes need not be confined to categories traditionally associated with discrimination such as race, class, and gender, as stereotypes can be created around otherwise trivial distinctions (e.g., left/right-handedness, eye color) artificially associated with low status by researchers (Peters 1971; Lovaglia et al. 1998).

Research on stereotype threat shows that making a negative stereotype salient can lead to performance deficits, especially in domains closely related to the content of the stereotype. For example, when gender is made salient prior to a mathematics test, women tend to score worse than if gender stereotypes were not primed (Spencer et al. 1999). Studies examining gender

differences have shown that gender can be made salient through stimuli as diverse and subtle as a mixed gender setting (Inzlicht and Ben-Zeev 2000), gender stereotypical television commercials (Davies et al. 2002), and telling research subjects that gender differences are due to genetic (as opposed to social) factors (Dar-Nimrod and Heine 2006). Some research even suggests that gender will be salient to mathematics performance unless expressly disassociated from the task at hand (e.g., Davies et al. 2002), in which case we would expect stereotype threat effects to operate widely. However, even as we learn more about the scope of the effects that stereotypes have on individual performance, the mechanisms through which they operate are not well understood.

Here we examine two potential mechanisms for stereotype threat effects: arousal and ego depletion. In the sections that follow we first present background research suggesting that these factors are plausible mechanisms underlying stereotype threat effects. We then present the methods and results of an experimental study that uses a manipulation of glucose levels to empirically evaluate these two proposed mechanisms. Finally, we conclude with a discussion of the implications for the study of stereotype threat.

Stereotype Threat and Arousal

O'Brien and Crandall (2003) and Ben-Zeev et al. (2005) suggest that stereotype threat effects may be attributable to an increase in arousal, a state characterized by a high degree of attention, motivation, energy, anxiety, and stress. As noted by the Yerkes-Dodson law (1908), arousal has a curvilinear effect on cognitive performance such that increasing arousal enhances cognitive performance up to a point, but becomes detrimental above that point. Ben-Zeev et al. (2005) thus suggest that stereotype threat increases arousal to levels that are detrimental to cognitive performance.
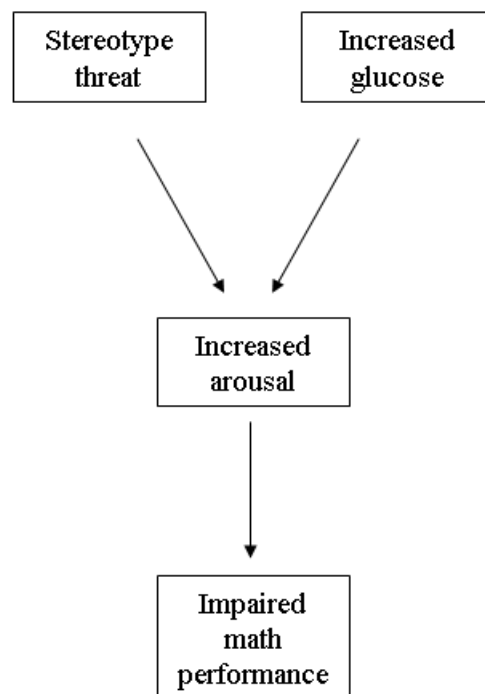
Previous research on stereotype threat provides some support for an arousal-based mechanism. Research examining the physiological correlates of stereotype threat finds that targets of stereotype threat experience a range of arousal-related physiological responses (e.g., Blascovich et al. 2001; Croizet et al. 2004). Drawing on research suggesting arousal interferes only with more difficult tasks, and facilitates easy tasks, O'Brien and Crandall (2003) argue that threat effects should raise women's scores on easy mathematics tests, and lower their scores only on difficult mathematics tests. Their research supports these predictions, and they suggest that this might explain why previous work has found that stereotype threat effects are generally more pronounced on difficult tasks.

Ben Zeev et al. (2005) likewise find that women who are the targets of stereotype threat perform worse on complex tasks, but better on simple tasks. Further, they show that when participants misattribute the arousal caused by stereotype threat to a subliminal noise, the effect of stereotype threat is attenuated. Neither O'Brien and Crandall (2003) nor Ben-Zeev et al. (2005) experimentally manipulate levels of arousal, though such an approach would help to establish a causal link. We build on these studies by manipulating arousal, drawing on research by Thayer (1989) that suggests that glucose can increase arousal.

Given that the arousal-based theory of stereotype threat holds that stereotype threat increases

arousal levels above the optimal level for cognitive performance, increasing participants' arousal levels before they are stereotype threatened should exacerbate threat effects. The arousal-based theory of stereotype threat is summarized by Figure 1.
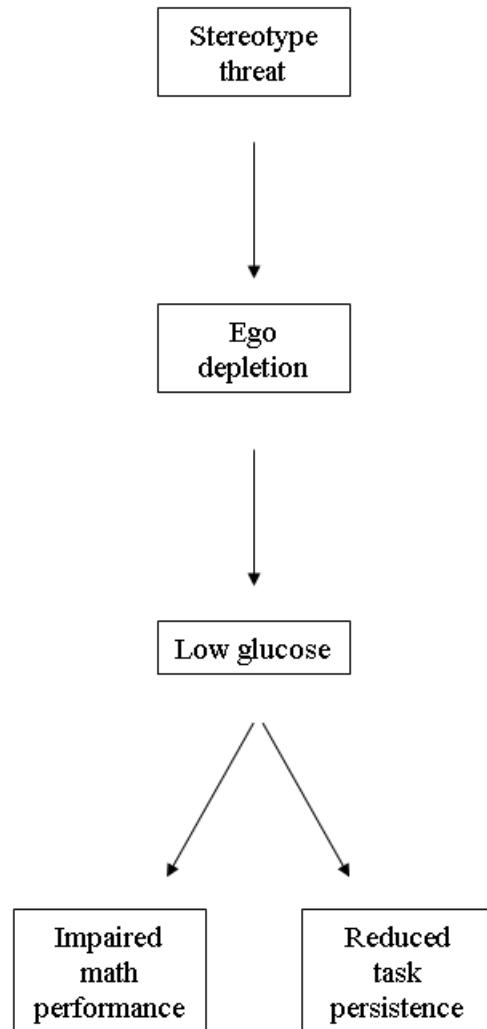
Figure 1: An arousal based theory of stereotype threat

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  ┌─────────────┐        ┌─────────────┐
  │  Stereotype │        │  Increased  │
  │   threat    │        │   glucose   │
  └─────────────┘        └─────────────┘
          \                    /
           \                  /
            ↘                ↙
           ┌─────────────┐
           │  Increased  │
           │   arousal   │
           └─────────────┘
                  │
                  ↓
           ┌─────────────┐
           │  Impaired   │
           │    math     │
           │ performance │
           └─────────────┘
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Stereotype Threat, Ego Depletion, and Working Memory Capacity

The arousal-based theory suggests that stereotype threat effects operate through increasing arousal levels, such that further increases, such as those produced by high levels of glucose, would magnify these effects. However, another line of reasoning makes the opposite prediction: that increasing glucose levels might reduce stereotype threat effects because stereotype threat depletes important cognitive resources that can be restored via increased levels of glucose. Inzlicht et al. (2006) show that being the target of negative stereotypes is "ego depleting," in that it reduces resources available for self-regulatory processes (Baumeister et al. 1998). In turn,

Figure 2: An ego depletion based theory of stereotype threat

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          ┌─────────────┐
          │  Stereotype │
          │   threat    │
          └─────────────┘
                 │
                 ▼
          ┌─────────────┐
          │     Ego     │
          │  depletion  │
          └─────────────┘
                 │
                 ▼
          ┌─────────────┐
          │ Low glucose │
          └─────────────┘
             ╱        ╲
            ▼          ▼
   ┌─────────────┐  ┌─────────────┐
   │  Impaired   │  │   Reduced   │
   │    math     │  │    task     │
   │ performance │  │ persistence │
   └─────────────┘  └─────────────┘
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Gailliot et al. (2007) find that the effects of ego depletion can be offset by increasing glucose levels (but see also Kurzban 2010).

Studies of ego depletion show that self-regulatory processes (e.g., Baumeister et al. 1998) rely on limited resources, so that completing tasks requiring self-regulation results in diminished ability for self-regulation on subsequent tasks. Examples of the kinds of tasks shown to be ego depleting include: suppressing emotion while watching a sad, disgusting, or humorous video (Gailliot et al. 2007), writing down thoughts while trying not to think about a white bear (Muraven et al. 1998), restraining from eating tempting foods (Baumeister et al. 1998),

suppressing prejudice in interracial interactions (Richeson and Shelton 2003), and, most importantly for our purposes, taking a test under stereotype threat (Inzlicht et al. 2006). The degree to which cognitive resources are depleted by a task is typically measured using a second task, for example persistence on difficult or unsolvable anagrams (Muraven et al. 1998), persistence on an unsolvable figure tracing task (Webb and Sheeran 2003), persistence watching a boring movie (Baumeister et al. 1998), or performance on a Stroop task (Richeson and Shelton 2003).

In addition to depleting self-regulatory resources, Schmeichel et al. (2003) also note that ego depletion impairs intellectual performance on difficult tasks. Given that Inzlicht et al. (2006) show that being the target of stereotype threat is ego depleting, we might expect that ego depletion functions as the mechanism through which stereotype threat effects operate. Recent research on ego depletion shows that increasing participants' glucose levels, for example via a sugar-filled drink, can counteract the effects of ego depletion (Gailliot et al. 2007). Gailliot et al. (2007) thus argue that these self-regulatory resources correspond to biological resources, in this case, glucose. Other research links cognitive functioning to glucose levels, with findings suggesting that "effortful cognitive processes may be 'fuel limited' and therefore augmented by the simple provision of metabolic substrates" (Kennedy and Scholey 2000:64). This literature typically finds that higher levels of glucose result in increased cognitive functioning (e.g. Martin and Benton 1999), though there is some ambiguity as to whether all cognitive tasks are similarly impacted (Benton and Owens 1993).

This resource dependence paradigm is also present in research on stereotype threat, where Schmader and Johns (2003) and Croizet et al. (2004) argue that stereotype threat triggers a higher mental load, which they suggest could lead to lower performance due to the limited capacity of working memory, potentially because the pool of attentional resources has been exhausted. It thus seems plausible that ego depletion and stereotype threat effects might be intertwined, and that glucose could mitigate the effects not only of ego depletion, but also of stereotype threat.

In examining the effect of stereotypes and ego depletion on task persistence, Inzlicht et al. (2006) examine reaction time for a mental task (Stroop test) and stamina on a physical task (hand grip). Our study is thus the first to examine whether persistence on a mental task is diminished by stereotype threat. Examining the effect of stereotype threat on mental task persistence is interesting because while stereotype threat is typically thought of as contributing to differences in test performance, it could also contribute to the underrepresentation of women and minorities in certain fields by influencing persistence in stigmatized domains. In addition, while previous stereotype threat research has examined physiological considerations such as heart rate (Croizet et al. 2004), blood pressure (Blascovich et al. 2001), and testosterone (Josephs et al. 2003), the present research is the first to examine how stereotype threat interacts with glucose levels. In doing so, we bring together the substantial literatures on the effects of glucose on cognitive performance (e.g., Donohoe and Benton 1999), the link between ego depletion and glucose (Gailliot et al. 2007), and the link between stereotype threat and ego depletion (Inzlicht et al. 2006). The ego depletion theory of stereotype threat effects, and how they relate to glucose levels, is summarized in Figure 2.

Empirical Overview

The study that follows explores ego depletion and arousal-based accounts of stereotype threat by examining the impact of an indirect manipulation of glucose levels on stereotype threat effects. Both arousal and ego depletion accounts of stereotype threat are relatively new and have thus far received only preliminary support. Further, the relationship between stereotype threat and glucose levels, has not yet been studied. Thus, our contribution is to test two plausible mechanisms theorized to drive this socially significant phenomenon, using a physiological, experimental manipulation that is novel to this literature.

To this end we conducted an experiment with male and female undergraduate participants in which we experimentally manipulated the presence of stereotype threat regarding women's performance in mathematics domains. We also manipulated participants' glucose levels by providing some with a glucose-rich drink at the beginning of the study (Gailliot et al. 2007). We were interested in how these two factors might shape participants' mathematics test performance. Arousal-based theories of stereotype threat predict that female participants with higher levels of glucose will be more negatively affected by stereotype threat, performing worse on a mathematics test as a result. The ego depletion account of stereotype threat, however, predicts that female participants with higher levels of glucose will be less affected by the stereotype threat, performing better on a mathematics test than stereotype-threatened, female participants who did not receive the glucose drink. We do not expect male participants to be affected by the manipulation of glucose levels, as the presence of stereotype threat is not expected to substantially affect their performance, though it is possible that stereotype threatened males who receive the drink might perform better (e.g., Walton and Cohen 2003). We also investigate participants' task persistence in a non-mathematical domain as a further measure of ego depletion. The ego depletion account predicts a negative effect of stereotype threat on task persistence, and a positive interaction effect between stereotype threat and blood glucose levels on task persistence.

METHOD

Participants. Participants were 54 female and 53 male undergraduate students at a large, West Coast, public university who received extra credit for taking part in the experiment.[1]

Design. The study featured a 2 (participants were male/female) x 2 (stereotype threat on/off) x 2 (participant consumed a drink with sugar/Splenda) between-subjects design, creating eight experimental conditions.

Procedure. Upon arriving in the lab, participants were told the study involved examining the link between sensory perception and intelligence. They were then asked to drink a glass of lemonade. Following Gailliot et al. (2007), half of the participants received 12 ounces of lemonade sweetened with 3 tablespoons of refined sugar, and half received lemonade sweetened with 3 tablespoons of Splenda. In order to ensure that there were no noticeable differences between the lemonade sweetened with sugar and Splenda, participants then filled out a survey about the taste of the lemonade. After completing the survey, participants took a timed 30 minute mathematics test. Participants were either told the test had been used by previous research to show that there

were large gender differences in mathematics achievement, or no gender differences, depending on whether they were randomly assigned to the stereotype threat condition or not. Both groups of participants received the same test, comprised of items from the Graduate Record Exam (GRE) general test's practice exam (2004). The test was scored by following the standard procedure of adding the number of questions answered correctly and subtracting a fifth of a point for each question answered incorrectly.

The mathematics test was followed by an unsolvable anagram task adapted from Muraven et al. (1998), which was used to measure task persistence and the participants' levels of ego depletion. Participants were given six anagrams, three of which were unsolvable, and told that this was a test of verbal abilities. They were informed that they could spend as much time as they wanted on the test, which would be scored based on how many anagrams they answered correctly. Participants were surreptitiously timed on how long they persisted working on the anagrams, and were stopped after 20 minutes if they were still working. Participants then answered a short questionnaire including background information and items about their gender and mathematics identification, after which they were debriefed. Participants were guided through the study by a female research assistant, who was unaware of whether participants were stereotype threatened or not and whether the drink they ingested possessed sugar or Splenda, making the study design double blind.

RESULTS

Following previous stereotype threat research, we restricted the sample to include only students who identified at least minimally with the mathematics domain (e.g., Davies et al. 2002; Marx and Roman 2002; Smith and Johnson 2006).[2] This is important because stereotype threat effects depend on the participants being invested in mathematics as part of their identity. This resulted in dropping 23 cases from our analysis, so that the analyses included 40 men and 44 women. Figure 3 shows the mean mathematics test scores for men and women in the stereotype threat and non-threat conditions. Consistent with previous findings, we find that women scored worse when they were told that there was a male advantage ($t=1.95$, $p=.058$). We did not find that men scored significantly higher upon being told that there was a male advantage ($t=0.31$, $p=.761$), an effect referred to as "stereotype lift" (Walton and Cohen 2003). While we did not find a statistically significant gender difference among students who were not stereotype threatened ($t=0.72$, $p=.476$), the difference between the men and women for whom stereotype threat was made salient was statistically significant and in the predicted direction ($t=3.45$, $p=.001$). This suggests that the gender difference in mathematics achievement found here was attributable to stereotype threat effects.

Figure 3: Mean mathematics score by stereotype threat and gender
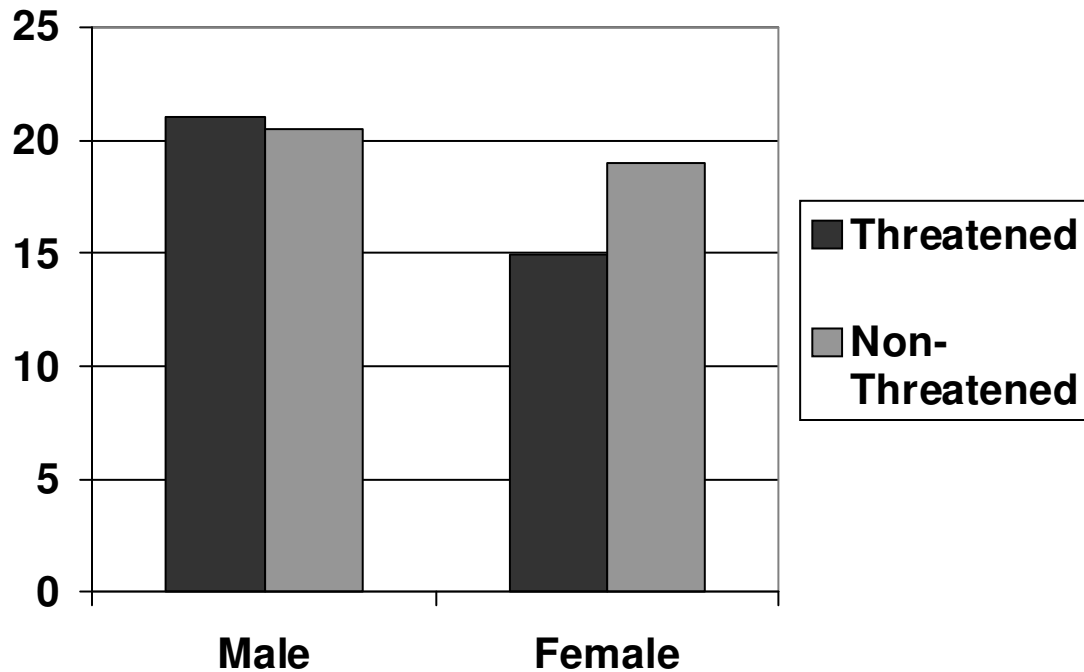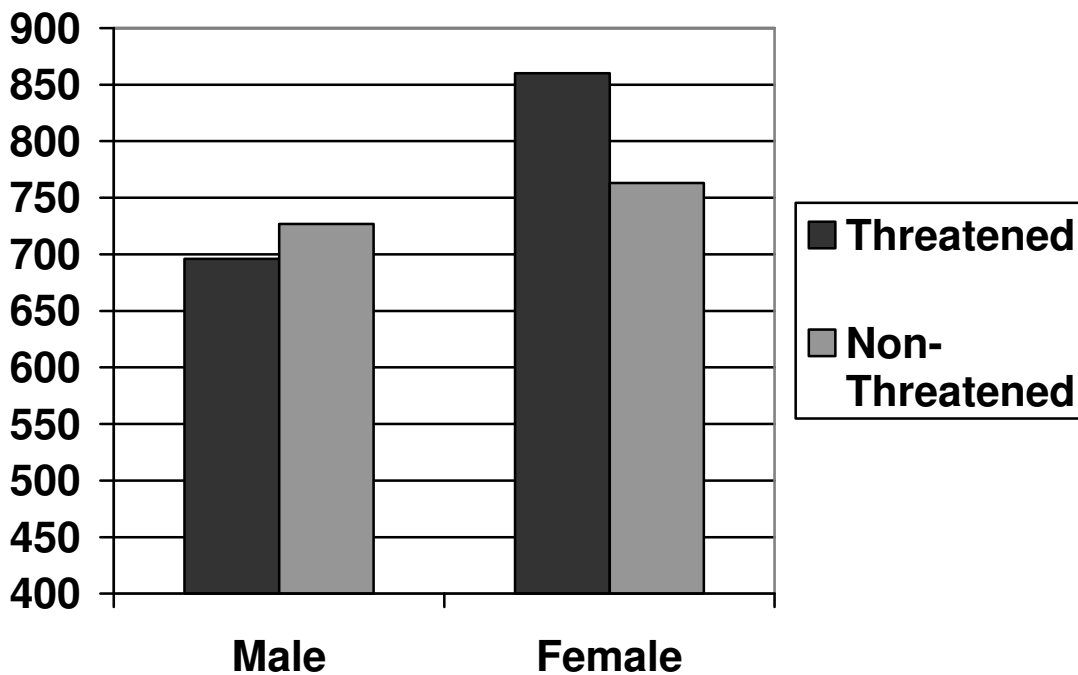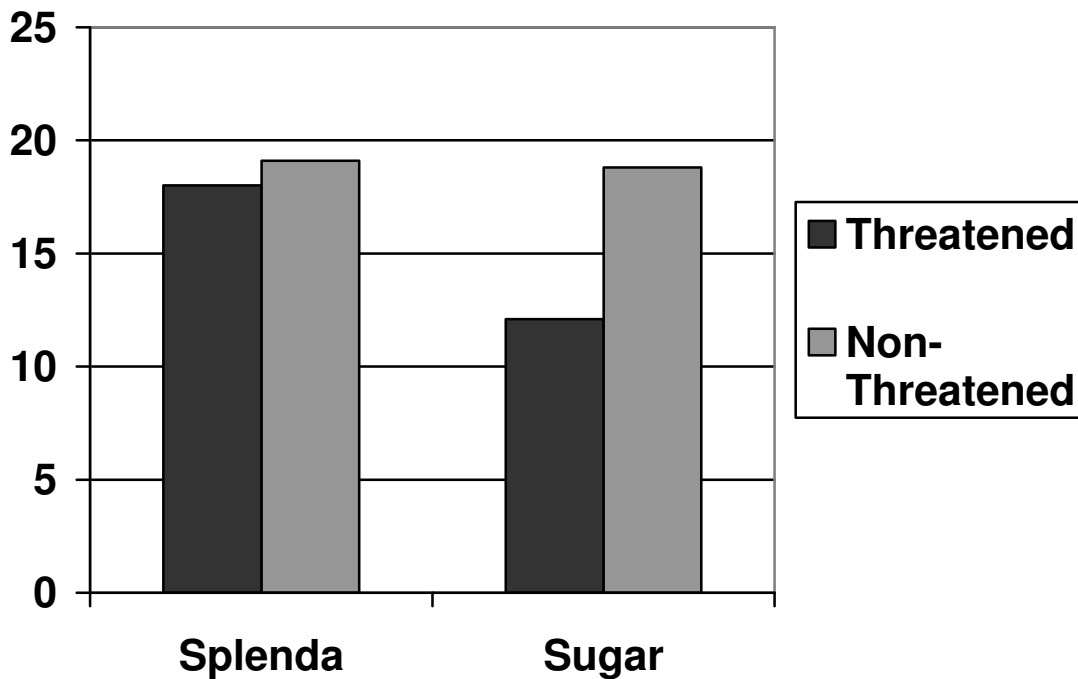

Figure 4 shows the mean task persistence in seconds for men and women in the stereotype threat and non-threat conditions. These results are surprising as they show that women who were stereotype threatened persisted longer on the unsolvable anagrams task than those who were not threatened, though this effect only approached marginal significance ($z=-1.64$, $p=.102$).[3] This finding suggests that women were not ego depleted due to the stereotype threat, or if they were, it did not affect their persistence on unsolvable anagrams, a widely used measure of ego depletion. If anything, stereotype threatened women retained more cognitive resources than those who were not threatened, contrary to what we would expect from an ego depletion account of stereotype threat. One explanation for this finding could be that the stereotype threatened women persisted longer because the presence of a stigma indicating they would perform poorly on the mathematics test led them to conserve effort, leaving greater cognitive resources available for use on the non-mathematical measure of task persistence.

Figure 4: Mean persistence on unsolvable anagram task (time in seconds) by stereotype threat and gender

We next turn to the possible differential effects of increased blood glucose among women who were stereotype threatened versus those who were not. Figure 5 shows how stereotype threat interacts with the glucose manipulation. Because we found stereotype threat effects only for women, and no evidence of ego depletion lowering task persistence for either men or women, we focus on the stereotype threat effect on women's mathematics test scores. Figure 5 reports the mean mathematics score for stereotype threatened and unthreatened women who drank lemonade sweetened with either Splenda or sugar. We found no evidence of a stereotype threat effect among the women who drank the lemonade with Splenda ($t=0.36$, $p=.722$), while among those who received lemonade with sugar there was a statistically significant effect of stereotype threat ($t=2.55$, $p=.019$). These findings suggest that, rather than mitigating stereotype threat effects, increased glucose levels exacerbated them. This is consistent with an arousal based theory of stereotype threat, and inconsistent with predictions based on ego deletion research.

Figure 5: Women's mean mathematics score by stereotype threat and sugar/Splenda

DISCUSSION

This study tested arousal and ego depletion accounts of stereotype threat by examining how stereotype threat effects might vary across participants who did and did not receive a glucose rich drink. An ego depletion based explanation for stereotype threat suggests that: 1) stereotype threatened participants would be less persistent on the subsequent anagram task, and 2) that the stereotype threatened participants who received glucose would both score better on their mathematics test and persist longer on the anagram task than stereotype threatened participants who did not receive glucose. In contrast, an arousal-based explanation of stereotype threat suggests that the stereotype threat effects would be more pronounced when glucose levels were elevated.

Our results offer support for the arousal-based account. The effect of stereotype threat on mathematics performance was only detected among female participants who received glucose. This is consistent with the claim that stereotype threat impairs performance by creating high levels of arousal that impair test performance, an effect magnified by our glucose manipulation. Our results offer evidence against an ego depletion account, as we found that stereotype threatened participants persisted longer on the unsolvable anagram task, a common measure of ego depletion. Thus, if anything, stereotype threatened participants seemed to have *more* self-regulatory resources remaining following the mathematics test.

Though this last result only approached marginal significance, it may suggest the plausibility of an additional explanation of stereotype threat effects. We found that women whose glucose levels were artificially increased and for whom the stereotype of women's mathematics

performance was made salient not only performed worse, but also retained more cognitive resources as revealed by persistence on a subsequent task in an unrelated domain. As noted above, this pattern is consistent with an explanation of stereotype threat effects based on effort conservation. It may be that individuals faced with a salient social stigma in some domain experience physiological arousal and respond by conserving cognitive resources, resources that can later be usefully applied in domains where they do not face such stigmas. In other words, faced with evidence that one is likely to perform poorly in a setting, it may be that individuals "rationally" conserve effort for possible investment in future domains where success is more likely. Further, the fact that the subsequent task where they persisted longer was a verbal task (anagrams), a female typed domain (Nosek, Banaji, and Greenwald 2002), is also consistent with an account based on rational effort investment.

This mechanism would be complementary to the arousal-based mechanism tested here, since it would argue that people infer the strength of the stigma in part from the level of arousal they feel, and then conserve or expend cognitive resources accordingly. This constitutes a new and promising explanation of stereotype threat effects, and is consistent with previous research suggesting that individuals perceive fewer rewards for their efforts in stigmatized domains (Lovaglia et al. 1998), and that stereotype threat leads to less allocation of cognitive resources in such domains (Schmader and Johns 2003). However, further research is necessary to evaluate the validity of this mechanism.

By contrast, we found no support for the ego depletion account. Glucose did not reduce the effect of stereotype threat on women, rather it exacerbated it. One reason for this finding could be that the link between glucose and ego depletion is not as robust as prior research has implied, a conclusion suggested by a recent critical review of this line of work (Kurzban 2010). In a similar vein, it is worth noting that we do not find evidence of a stereotype threat effect in the Splenda condition, even though previous research on stereotype threat suggests that we should.

Conclusion

This study explored the interaction of stereotype threat and glucose in an effort to better understand gender differences in mathematics achievement. We find evidence that such differences were unlikely to be the result of ego depletion. We did, however, find support for explanations of stereotype threat based on arousal. We also found evidence suggestive of still another mechanism based on effort conservation. Future research should further examine the possibility that the effects of stigma on performance may occur through high levels of arousal, possibly using physiological measures to complement existing stereotype threat research on blood pressure and heart rate variability (Blascovich et al. 2001; Croizet et al. 2004). In addition, further work is needed on the possibility that effort investment in tasks occurs through a strategic - though likely nonconscious - investment of scarce cognitive resources.

REFERENCES

Aronson, Joshua, Michael J. Lustina, Catherine Good, and Kelli Keough. 1999. "When white men can't do math: Necessary and sufficient factors in stereotype threat." *Journal of Experimental Social Psychology* 35:29-46.

Baumeister, Roy F., Ellen Bratslavsky, Mark Muraven, and Dianne M. Tice. 1998. "Ego depletion: Is the active self a limited resource." *Journal of Personality and Social Psychology* 74(5):1252-1265.

Ben-Zeev, Talia, Steven Fein, and Michael Inzlicht. 2005. "Arousal and stereotype threat." *Journal of Experimental Social Psychology* 41:174-181.

Benton, David and Deborah S. Owens. 1993. "Blood glucose and human memory." *Psychopharmacology* 113:83-88.

Blascovich, Jim, Steven J. Spencer, Diane Quinn, and Claude Steele. 2001. "African Americans and high blood pressure: The role of stereotype threat." *Psychological Science* 12:225-9.

Croizet, Jean-Claude, Gérard Després, Marie-Eve Gauzins, Pascal Huguet, Jacques-Philippe Leyens, and Alain Méot. 2004. "Stereotype threat undermines intellectual performance by triggering a disruptive mental load." *Personality and Social Psychology Bulletin* 30:721-731.

Dar-Nimrod, Ilan and Steven J. Heine. 2006. "Exposure to scientific theories affects women's math performance." *Science* 314:435.

Davies, Paul G., Steven J. Spencer, Diane M. Quinn, and Rebecca Gerhardstein. 2002. "Consuming images: How television commercials that elicit stereotype threat can restrain women academically and professionally." *Personality and Social Psychology Bulletin* 28:1615-1628.

Donohoe, Rachael T. and David Benton. 1999. "Cognitive functioning is susceptible to the level of blood glucose." *Psychopharmacology* 145:378-385.

Fiske, Susan T. 1993. "Controlling other people: The impact of power on stereotyping." *American Psychologist* 48: 621-628.

Gailliot, Matthew T., Roy F. Baumeister, C. Nathan DeWall, Jon K. Maner, E. Ashby Plant, Dianne M. Tice, Lauren E. Brewer, and Brandon J. Schmeichel. 2007. "Self-control relies on glucose as a limited energy source: Willpower is more than a metaphor." *Journal of Personality and Social Psychology* 92(2):325-336.

Graduate Record Examinations. 2004. *General Test Practice Book*. Princeton, NJ: Educational Testing Service.

Inzlicht, Michael and Talia Ben-Zeev. 2000. "A threatening environment: Why females are

susceptible to experiencing problem-solving deficits in the presence of males." *Psychological Science* 11:365-371.

Inzlicht, Michael, Linda McKay, and Joshua Aronson. 2006. "Stigma as ego-depletion: How being the target of prejudice affects self-control." *Psychological Science* 17:262-269.

Josephs, Robert A., Matthew L. Newman, Ryan P. Brown, and Jeremy M. Beer. 2003. "Status, testosterone, and human intellectual performance: Stereotype threat as status concern." *Psychological Science* 14:158-163.

Kennedy, David O. and Andrew B. Scholey. 2000. "Glucose administration, heart rate and cognitive performance: Effects of increasing mental effort." *Psychopharmacology* 149:63-71.

Kurzban, Robert. 2010. "Does the brain consume additional glucose during self-control tasks?" *Evolutionary Psychology*. 8(2):245-260.

Lovaglia, Michael J., Jeffrey W. Lucas, Shane R. Thye, and Barry Markovsky. 1998. "Status processes and mental ability test scores." *American Journal of Sociology* 104:195-228.

Lovaglia, Michael J. 2003. "From summer camps to glass ceilings: The power of experiments." *Contexts* 2: 42-49.

Lucas, Jeffrey W. 2003. "Theory testing, generalization, and the problem of external validity." *Sociological Theory* 21(3):236-253.

Martin, Pearl Y. and David Benton. 1999. "The influence of a glucose drink on a demanding working memory task." *Physiology and Behavior* 67(1):69-74.

Marx, David M. and Jasmin S. Roman. 2002. "Female role models: Protecting women's math test performance." *Personality and Social Psychology Bulletin* 28:1183-1193.

Muraven, Mark, Dianne M. Tice, and Roy F. Baumeister. 1998. "Self-control as limited resource: Regulatory depletion patterns." *Journal of Personality and Social Psychology* 74:774-789.

Nosek, Brian A., Mahzarin R. Banaji, and Anthony G. Greenwald. 2002. "Math = male, me = female, therefore math ≠ me." *Journal of Personality and Social Psychology* 83, 44-59.

O'Brien, Laurie T. and Christian S. Crandall. 2003. "Stereotype threat and arousal: Effects on women's math performance." *Personality and Social Psychology Bulletin* 29:782-789.

Peters, William. 1971. *A Class Divided*. Doubleday, Garden City, NY.

Richeson, Jennifer A. and J. Nicole Shelton. 2003. "When prejudice does not pay: Effects of interracial contact on executive function." *Psychological Science* 14:287-90.

Schmader, Toni and Michael Johns. 2003. "Converging evidence that stereotype threat reduces working memory capacity." *Journal of Personality and Social Psychology* 85:440-452.

Schmeichel, Brandon J., Kathleen D. Vohs, and Roy F. Baumeister. 2003. "Intellectual performance and ego depletion: Role of the self in logical reasoning and other information processing." *Journal of Personality and Social Psychology* 85:33-46.

Smith, Jessi L. and Camille S. Johnson. 2006. "A stereotype boost or choking under pressure? Positive gender stereotypes and men who are low in domain identification." *Basic and Applied Social Psychology* 28:51-63.

Spencer, Steven J., Claude M. Steele, and Diane M. Quinn. 1999. "Stereotype threat and women's math performance." *Journal of Experimental Social Psychology* 35:4-28.

Steele, Claude M. and Joshua Aronson. 1995. "Stereotype threat and the intellectual test performance of African Americans." *Journal of Personality and Social Psychology* 69:797-811.

Thayer, Robert E. 1989. *The Biopsychology of Mood and Arousal*. Oxford, UK: Oxford University Press.

Walton, Gregory M. and Geoffrey L. Cohen. (2003). "Stereotype lift." *Journal of Experimental Social Psychology* 39:456-467.

Webb, Thomas L. and Paschal Sheeran. 2003. "Can implementation intentions help to overcome ego-depletion?" *Journal of Experimental Social Psychology* 39:279-286.

Yerkes, Robert M. and John D. Dodson. 1908. "The relation of strength of stimulus to rapidity of habit-formation." *Journal of Comparative Neurology and Psychology* 18: 459-482.

ENDNOTES

[1] While the use of convenience samples of undergraduate students in laboratory experiments in the social sciences is often debated (e.g., Lucas 2003, Lovaglia 2003), this seems a highly defensible population for our purposes. The issue of stereotype threat effects on women's performance in mathematics is most often related to the academic trajectories of young men and women. Thus, the use of 18-22 year old men and women in this study approximates a population of significant interest for the application of this research.

[2] Participants were screened using their responses to three statements: "My math ability is important to me;" "My math ability is an important reflection of who I am;" and "In general, my math ability is an important part of my self-image." Participants responded using a scale ranging from 1 (strongly disagree) to 7 (strongly agree). As these three items had an alpha of .84, they were combined by averaging them into one measure; respondents were dropped if on average they more than somewhat disagreed with these statements (i.e., they scored below 3 on the combined scale).

[3] The z-score and p-value are obtained using a Cox proportional hazards model.

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