

Mentioning Menstruation: A Stereotype Threat that Diminishes Cognition?

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Abstract To investigate menstruation as a stereotype threat that could have the effect of diminishing cognitive performance, 92 undergraduate women from a small, urban university in the Mid-Atlantic region of the United States (US) completed two cognitive tasks, a Stroop test, and an SAT-based mathematics test, as well as a Menstrual History Questionnaire (MH) and the Menstrual Attitudes Questionnaire (Brooks-Gunn and Ruble 1980). The MH served as the menstruation stereotype threat. Some women were also presented with positive information about menstruation, which served as the positive prime. The order of materials varied to yield four conditions: Menstruation Threat/No Positive Prime—MH first, then cognitive tasks; Menstruation Threat/Positive Prime—MH first, then positive information, then cognitive tests; Positive Prime/No Menstruation Threat—positive information first, then cognitive tasks, then MH; and No Positive Prime/No Menstruation Threat—cognitive tests first, then MH. In all four conditions, participants completed the Menstrual Attitudes Questionnaire last. Results indicated that participants receiving the Menstruation Threat completed significantly fewer items on the Stroop test. In addition, subjects in the No Positive Prime/Menstruation Threat condition performed more poorly on the Stroop the closer they were to their next period. This effect was absent for the Positive Prime/Menstruation Threat condition and reversed for participants in the Positive Prime/No Menstruation Threat. This suggests that positive priming moderates the relationship between closeness to menstruation and cognitive performance. Implications of the

results for addressing stigma associated with menstruation are discussed.

Keywords Stereotype threat · Positive priming · Menstruation · Stroop · Cognition

Introduction

The phenomenon of stereotype threat, first studied by Steele and Aronson (1995), refers to being at risk of confirming a negative stereotype about one's group. This theory assumes that when negative stereotypes are made salient, or primed, this risk increases. Studies of stereotype threat have demonstrated its negative impact on cognitive ability tests among African Americans (e.g., Steele and Aronson 1995) and women's performance on mathematics tests (e.g., Spencer et al. 1999). These findings, derived from samples of male and female college students in the United States, have prompted subsequent research into specific negative beliefs that may serve as stereotype threats and diminish cognitive performance among various populations. For example, feelings of stereotype threat related to negative beliefs about the association of poor memory and aging have been found to negatively affect the memory performance of older adults living in a community dwelling compared to younger, college-aged adults in a Canadian sample (Chasteen et al. 2005). Similarly inspired, the research reported here was designed to investigate the notion that the mention of menstruation, long associated with debilitated function (see Stubbs 2008), serves as a stereotype threat that diminishes women's cognitive performance.

At the same time, previous research indicates that positive priming about menstruation, that is, providing information that focuses on positive aspects of menstruation, such as

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menstruation as a sign of healthy biological function, or a focus in menstrual education for young girls on menstruation as a sign of growing up, results in more positive menstrual attitudes (e.g., Chrisler et al. 1994). Accordingly, the research reported here also investigated the impact of positive priming about menstruation on reducing associated stereotype threat and enhancing cognitive performance. The current research is expected to broaden our understanding of stereotype threat, and more specifically, to add to the literature about how attitudes towards menstruation operate behaviorally in women's lives. The literature reviewed for this study is based largely on samples from the United States unless otherwise noted.

It is reasonable to assume that mention of menstruation might serve as a stereotype threat given the persistence of negative attitudes towards menstruation throughout history, a view that is common in many cultures (see reviews and commentary by Delaney et al. 1977; Houppert 1999; Stubbs 2008; and Weideger 1977). Recent investigations indicate that menstruating women are indeed still stigmatized. For example, Kowalski and Chapple (2000) found that college-aged menstruating women who thought an interviewer knew they were menstruating, compared to menstruating women who thought the interviewer was unaware of their menstruation, believed that the interviewer liked them less and yet were less motivated to try to engage in behaviors that might counteract that impression. The authors conclude that stigma associated with menstruation influences women's perceptions of others' views of them as well as their efforts to manage these impressions. In addition, Roberts et al. (2002) found that others' perceptions of a menstruating woman include stigmatization. In their study, both male and female university students rated a woman who dropped a tampon as less competent and likeable, and also physically distanced themselves from her, compared to a woman who dropped a barrette. Roberts (2004) studied the relationship between menstrual attitudes and self-objectification (Fredrickson and Roberts 1997), that is, viewing oneself as an object and valuing qualities that an observer values in comparison to one's own valued characteristics. Roberts collected data from a convenience sample of 200 premenopausal women ranging in age from 12 to 61 who completed surveys anonymously at various locations including both a residential and a commuter college campus and an airport. She found that women with high levels of self-objectification had negative feelings about and attitudes of loathing toward menstruation. Roberts and Waters (2004) warn that in a culture that objectifies women and disparages menstruation and other bodily processes unique to women, such as breast feeding and childbirth, girls and women may alter the body to transform it into the ideal body as a survival strategy which could ultimately serve to disconnect them from their bodies as well as other females (see also Stubbs and Costos 2004).

Moreover, negative attitudes are emphasized in menstrual educational materials and current marketing of products to manage menstruation, including cycle-stopping oral contraceptives. With respect to menstrual education materials for young girls, which are often provided by product manufacturers, Erchull et al. (2001) concluded from their review that a neat, clean body that doesn't leak is well represented. Simes and Berg (2001) note that manufacturers promote their products as the best for concealing odor and preventing leaking, some even touting the applicator as a way to avoid touching menstrual fluid. Similarly, Kalman (2000) found negative messages about menstruation present in teen magazine articles. Both Simes and Berg (2001) and Charlesworth (2001) argue that mixed messages from product advertisers are especially problematic for girls. On the one hand they are told that menstruation is important, but at the same time, that they should ignore it, and behave the same way they would on any other day. The implication is that there is something not normal about menstruation, and that girls should hide the experience and distance themselves from it as much as possible.

With respect to the promotion of cycle-stopping products, in their review of articles in the popular press prior to the approval of Seasonale© in the US, Johnston-Robledo et al. (2006) found that menstruation was presented as messy, inconvenient, bothersome and even unnecessary, all avoidable with suppression. Potential health risks were not prominently featured in the articles compared to mention of the benefit of improving the quality of life for all women, not just those experiencing menstrual disorders. Johnston-Robledo and colleagues suggest that the articles may have primed women to think favorably, but not critically, about suppression, which is a more likely outcome, to the extent that as Kissling (2006) argues, "a woman's relationship to her menstrual cycle is largely defined through consumer products" (p. 123).

While it is beyond the scope of this paper to review negative characterizations of menstruation internationally, a plethora of studies of menstrual attitudes and experience in a variety of countries throughout the world have been conducted and indicate that negative attitudes are certainly prevalent (e.g., Çevirme et al. 2010; O'Flynn 2006; Marván et al. 2007; Marván et al. 2008; Sharma et al. 2008; Uskul 2004; Yeung et al. 2005). In addition, in some international locations, health care workers are currently acknowledging and attempting to address how the menstrual taboo, deeply reinforced in religious and ritual practice (see Guterman et al. 2008), collides with sanitation challenges to prevent girls from participating fully in education. For example, Fernandes (2010), working in rural India, Nahar and Ahmed (2006) working in Bangladesh, Kirk and Sommer (2006), working in sub-Saharan Africa and Asia, and researchers affiliated with the Said Business School (2010) working in

Ghana, all report that beliefs about menstruation as shameful, a lack of pads and their high cost, and the lack of adequate functioning water and toileting facilities at schools prevent girls from engaging in healthy menstrual hygiene, and subsequently from attending school while menstruating.

One exception to this accumulating data is research by Oster and Thornton (2010) who compared school attendance rates of girls in Nepal who had been randomly given menstrual cups and those of girls who had not. Their results suggest that improved sanitary technology does not improve school attendance and that estimates of the number of days girls miss school because of menstruation are exaggerated. Though the researchers acknowledged that their results were setting specific, a local Nepali expert reacted with concern. The expert worried that the study findings would hinder more systemic efforts to improve menstrual management and sanitation in the region, and argued that the experience of girls from one of the country's well-developed urban areas was not likely to represent that of poor, rural girls who live in less sanitary locations (Integrated Regional Information Networks 2010). While ongoing research is clearly needed to clarify this issue, the degree to which menstruation is a barrier to education is an obvious demonstration of its negative impact on cognitive function.

Other researchers have studied the impact of menstruation on cognition from a different, though related, perspective. For example, in one early study of beliefs about menstruation, Ruble (1977) was able to convince college-aged women that they were premenstrual when in fact they were not. Demonstrating the importance of belief on self-assessment, Ruble found that women who believed they were premenstrual reported more negative symptoms compared to those who had no expectations about when their next menstrual period would begin. Additionally, early work with women ages 30 to 45 years old by Golub (1976) and with college-aged women by Sommer (1972) indicated that although women believed their cognitive performance would be affected negatively by menstruation, objective measures failed to show any performance decrements associated with actual cycle phase. More recently, researchers have continued to demonstrate the impact of belief on behavior. Ehrlinger and Dunning (2003), for example, found that undergraduate women who performed as well as undergraduate men on a test of scientific reasoning beliefs, reported less positive views about their scientific ability than men did, underestimated their performance on the test, and were less enthusiastic about signing up for a subsequent competition involving scientific reasoning.

Although critiques of the early studies that *did* suggest negative cognitive performance associated with cycle phase highlighted methodological flaws (Dan 1979; Sommer 1973), researchers have continued to investigate the relationship between cycle phase and cognitive performance. In

a recent review, Farage et al. (2008) concluded that small, consistent differences in cognitive performance exist between men and women and are related to menstrual cycle phase such that on tasks in which men usually outperform women, e.g., mental rotation, women do better during menstruation, while on tasks in which women usually outperform men, e.g., memory, concentration, fine motor or word matching, women do better in the mid-luteal phase and worst during menstruation. Changes in sensory function related to menstrual cycle phase were also reported, though findings with respect to increased or decreased sensitivity of hearing, smell, vision, touch/pain, and taste appetite varied across the studies included for review. Some studies of undergraduate women find no differences in cognitive performance as a function of cycle phase (e.g., Atkins et al. 1997). Comparing the cognitive performance of college-aged men and women, Both McCormick and Teillon (2001) and Epting and Overman (1998) found some sex-related differences in performance on some of cognitive tasks but no differences in performance as a function of menstrual cycle phase. Similarly, working with a sample of male and female medical students from eastern Turkey, Halpern and Tan (2001) found that women scored slightly higher than men on a Finding A's test, while men performed slightly better than women on a mental rotation task. But in addition, women performed slightly better during the preovulatory phase on both the tasks, which the researchers suggest may be related to increased levels of estrogen during that time. Maki et al. (2002) working with a Canadian sample of undergraduate women report cycle phase differences such that increased estrogen levels were positively correlated with verbal fluency but negatively related to mental rotations and perceptual priming. Thus, existing data from studies on the impact of menstruation on cognition do not reveal a consistent pattern of results.

Regardless, the cultural belief that women's cognitive ability *is* diminished premenstrually and during menstruation is widespread. Consider the recent leap from a study finding that female rats with higher estrogen levels took longer to learn a new task than those with lower levels (Quilan et al. 2010) to headlines in popular media such, "Can't Focus? Maybe it's the wrong time of the month, finds estrogen study on attention and learning" (Science Daily 2010, para 1); "High estrogen levels linked to lack of concentration" (Mandal 2010, para 1); "Estrogen levels affect women's ability to learn" (Mental Health Blog 2010, para 1); and "Is it that time of the month?" (Park 2010, para 7). We can only hope that any girls currently prevented from attending school for reasons related to the management of menstruation will not have to confront stereotypes about debilitated cognitive function related to menstruation once they get there, and that results from studies like this one might provide insight about how such stereotyping operates and can be counteracted.

Research into aspects of stereotype threat that influence its impact on cognitive performance has also informed the current study. For example, Nguyen and Ryan (2008) conducted a meta-analysis of 116 studies of stereotype threat on test performance among minorities and women. Most of the studies reviewed ($n=91$) involved US undergraduates; the remaining studies involved American, German or Dutch high school students and undergraduates or secondary school students from Germany Britain, Australia, the Netherlands, and Canada. Nguyen and Ryan found that while stereotype threat affected both groups, moderating variables impacted those effects. The moderating variables studied were test difficulty, the degree of threat activation or removal (subtle/implicit, moderate, blatant/explicit), and participant identification with the task domain (e.g. level of care about or investment in the domain). Among findings pertinent to women's performance, analyses revealed that women performed more poorly than minorities in response to subtle, compared to blatant threat activation. In addition, when tests were difficult, stereotype threat led to smaller decrements for women than for minorities. Other researchers have demonstrated that an explicit threat can provoke overperformance among people who recognize the threat as a limit to their freedom and react oppositionally to disprove it (Kray et al. 2001).

Finally, Nguyen and Ryan found that identification with the task domain also mediated the impact of stereotype threat. In their work focusing on math performance, they found that women who were moderately math-identified performed more poorly than highly math-identified women, and low-math-identified women were affected least by stereotype threat.

Based on these findings, in this study, we chose to use a subtle stereotype threat—a short questionnaire asking women a few questions about their own menstrual cycle. Although we did not measure the degree of math identification among our participants, we chose to use an SAT-like math test as one of our tests of cognitive ability. We included the Stroop test (Stroop 1935) as a second cognitive task. We chose these measures because we wanted our findings to relate to the larger body of work on stereotype threat in which both a mathematics test and the Stroop have been widely used both in the United States (e.g., Gervais et al. 2011; Kaiser et al. 2006; Richeson and Trawalter 2005; White and Gardner 2009) and elsewhere (see Steele 1997; Spencer et al. 1999).

Other research is also pertinent to the current study. While priming negative stereotypes serves to stimulate stereotype threat, interventions to counteract it range from reframing the task, for instance mentioning that a math task is gender fair, to providing those in a negatively stereotyped group examples of people from that group who have achieved success in a particular domain and engaging them

in self-affirmation over a longer period of time (Singletary et al. 2009). One can argue that these suggested interventions represent positive priming, that is, the presentation of positive information intended to counteract a stereotype. There is reason to test the notion that positive priming might also work to diminish stereotype threat associated with negative attitudes toward menstruation. Such information can be brought to bear in countering negative stereotypes related to menstruation and has been documented as part of menstrual experience. While early measures of menstrual attitudes queried women about their experience of negative physical or psychological symptoms related to menstruation (e.g., the Moos (1968) Menstrual Distress Questionnaire), newer measures included items that explored menstruation as a complex and multifaceted phenomenon and permitted a broader range of responses than just those reflecting negative menstrual experience (e.g., Brooks-Gunn and Ruble 1980). As a result, subsequent investigations revealed that girls and women, in addition to acknowledging negative attitudes, also endorsed positive attitudes about various aspects of menstrual experience (e.g., Brooks-Gunn and Ruble 1982; Frank and Williams 1999; Koff et al. 1981; Koff et al. 1978; Stubbs et al. 1989).

In addition, because girls who said they were well prepared for menstruation also reported a more positive reaction to menstruation (Koff and Rierdan 1995a; 1995b; McPherson and Korfine 2004), some researchers have focused on how best to prepare girls for more positive menstrual experience. For example, Rembeck and Gunnarsson (2004), working with a Swedish sample, found that an active intervention with the goal of providing a “favorable impression and arousing curiosity about womanhood” (p. 684) served to improve premenarcheal girls' attitudes towards menstruation compared to girls exposed to standard pubertal education. Such an intervention parallels those designed to diminish stereotype threat mentioned earlier.

More broadly, efforts to counteract negative attitudes about menstruation among young girls have been a focus of critiques of advertisements for menstruation management products (e.g., Johnston-Robledo et al. 2006; Stubbs 2008) and finally, the promotion of menstruation as a vital sign has been espoused by health care practitioners interested in enhancing adolescent menstrual health (e.g., Popat et al. 2008). Nevertheless, these examples of positive attitude shift among young girls, critiques of negative advertising and the promotion of menstruation as a vital sign in some parts of the medical community are virtually invisible in cultural representations of the cycle. As such, it is not surprising that they are perhaps underemphasized in menstrual education efforts designed to counteract associated stigma.

Also relevant to the current research is that within the study of positive aspects of menstruation, some researchers have actually investigated whether it is possible to prime

positive attitudes towards menstruation among adult women. Chrisler et al. (1994), using a counterbalanced design, found that women who answered the Menstrual Joy Questionnaire (Delaney et al. 1977) first reported more positive cyclic changes and more positive attitudes towards menstruation than women who answered the Menstrual Distress Questionnaire (Moos 1968) first. Chrisler and colleagues also noted that some participants contacted following the study reported that answering the Menstrual Joy Questionnaire had changed their thinking about menstruation and that they had not previously thought about any positive aspects of the cycle. Replication research by Aubeeluck and Maguire (2002) confirmed the finding that positive attitudes about menstruation can be primed, regardless of women's past menstrual experiences. Investigating women's attitudes towards menstrual suppression, Rose et al. (2008) hypothesized that women presented with positive priming and who had positive attitudes about menstruation would be less willing to suppress menstruation than women who were negatively primed and had negative attitudes towards menstruation. While results only partially supported their hypotheses (e.g., positive priming increased reporting of positive cycle-related changes, but did not influence willingness to suppress menstruation), this study, together with those cited above, stands as a good example of research into positive priming about menstruation, and all inform this work.

In the current study, a 2 (Menstruation Threat/No Menstruation Threat) \times 2 (Positive Prime/No Positive Prime) factorial design yielding four conditions was used to investigate the impact of menstruation as a stereotype threat and positive priming about menstruation on cognitive performance. It was hypothesized first, that participants in the Menstruation Threat conditions (Menstruation Threat/Positive Prime; Menstruation Threat/No Positive Prime), that is, those simply being asked about their own menstruation before completing cognitive tasks, would perform more poorly on both cognitive tasks than women in the No Menstruation Threat conditions (No Menstruation Threat/Positive Prime; No Menstruation Threat/No Positive Prime).

Our second hypothesis was that the Positive Prime would counteract the influence of the Menstruation Threat, such that participants in the Menstruation Threat/Positive Prime condition would perform no differently from the participants who did not receive a menstruation Threat. However, we considered the possibility that the Positive Prime, although intended to be positive, might activate stereotype threat simply because menstruation was mentioned.

We also considered that the Menstruation Threat might only impact cognitive performance among women who believed that menstruation was bothersome and/or debilitating, and in particular for women who believed that

menstruation affected their cognitive performance negatively. On the other hand, if the women in our sample did not endorse these beliefs, then we might not see any effect of our subtle Menstruation "stereotype" Threat. Accordingly, women's attitudes toward menstruation as bothersome and debilitating were also assessed. In addition to assessing these more generalized attitudes, we also assessed women's specific belief that that menstruation diminishes cognitive performance, thus allowing for a more specific analysis of our results. While our primary rationale for measuring these attitudes was to obtain descriptive information about participants' menstrual experience that might shed light on how menstruation threat or positive priming about menstruation might be operating, and help guide future research on the topic, our third hypothesis was that women who thought menstruation was bothersome and/or debilitating, and those who specifically endorsed the belief that menstruation negatively impacted their cognitive performance, would not do as well on either of the cognitive tasks compared to women who did not hold these beliefs. We expected women in the Menstruation Threat conditions, in which these negative beliefs had been primed, to perform least well on both cognitive tasks, compared to the women in the other conditions.

Finally, assuming the generalized cultural belief that menstruation interferes with cognitive performance, our fourth hypothesis was that women in the Menstruation Threat conditions would perform more poorly on both cognitive tasks than women in the No Menstruation Threat conditions, the closer they were to menstruating.

Method

Participants

Participants were 92 undergraduate women from a small, urban, university in the Mid-Atlantic region. Drawn from a population that was primarily European American (87 %), participants ranged in age from 18 to 29 years ($M=20.76$, $SD=2.57$). Four participants were eliminated from the study who were 30 years old or older, in order to restrict the sample to a traditional undergraduate age range. Further, two participants whose number of days since the last day of their last menstrual period exceeded 40 days were also eliminated, since the normal range of menstrual cycle length in adults is 24–38 days (Hilliard 2002). Fifty percent of the participants reported taking oral contraceptives. Results from a Chi-Square analysis were not significant, indicating that these women were evenly distributed across all conditions. The results reported below are based on the data from the 75 participants who provided the complete set of responses needed for analysis.

Materials

Menstruation History/Threat

The Menstruation History is a 6-item survey developed by the researchers that asked participants to provide descriptive information about their own menstrual cycles including: age of first menstruation, length of a typical menstrual period, an estimation of how many days since the last day of the last period, and how many days until the first day of the next expected period, whether or not the participant was menstruating on the day of participation in the study and whether or not the participant was using any form of hormonal contraception (see Appendix 1). These questions also served as the Menstruation Threat. The questions were chosen to bring menstruation to mind without conveying any explicit negative stereotype associated with menstruation or its assumed impact on cognition.

Positive Prime

The Positive Prime was a short paragraph created by the researchers noting some positive aspects of menstruation related to cognition, e.g., heightened creativity, improved divergent thinking (see Appendix 1).

Cognitive Tasks

The two cognitive tasks used in this study were the Stroop test (Stroop 1935), and a short SAT-like Math test. As mentioned, these were chosen because both have often been in studies of stereotype threat. The Stroop test consists of 50 words printed in a color that does not match the color named. A correct response requires the participant to ignore the meaning of the word and name the color displayed. Participants had 30 s to complete the task. A 15-item test developed by the authors and based on the SAT math section was used as a measure of mathematics performance. Participants had 15 min to complete this task.

Attitudes toward Menstruation

The Menstrual Attitude Questionnaire (MAQ) (Brooks-Gunn and Ruble 1980) was used in this study to assess women's attitudes about menstruation as debilitating and bothersome. The MAQ is a 33-item questionnaire that includes five subscales intended to measure attitudes about five aspects of menstrual experience. For this study, we included two of those subscales: the degree of debilitation associated with menstruation (e.g., Women are more tired than usual when they are menstruating); and menstruation as bothersome (e.g., Menstruation is just something I have to put up with). Tests for internal consistency of the subscales within this sample indicated acceptable levels of internal

reliability: (Debilitation, $\alpha=.75$; Bothersome, $\alpha=.75$). One item from the Debilitation subscale, MAQ 20, assesses the specific belief that menstruation impacts cognitive/intellectual performance: I (don't) believe that my menstrual periods affect how well I do on intellectual tasks. Subscale (and item) scores can range from 1 to 7, with higher scores (after reverse scoring for some items) indicating more endorsement.

Procedure

The 92 participants were randomly assigned to one of the four conditions in which the order of the material varied. Participants in the Menstruation Threat conditions (Menstruation Threat, Positive Prime, $n=22$; Menstruation Threat, No Positive Prime, $n=20$) completed the Menstruation History before attempting the cognitive tasks. Participants in the No Threat conditions (No Menstruation Threat, Positive Prime, $n=17$; No Menstruation Threat, No Positive Prime, $n=18$) completed the Menstruation History after the cognitive tasks. Participants in the Positive Prime conditions initially received the paragraph noting positive aspects of menstruation. Participants in the No Positive Prime conditions did not receive positive prime. All subjects received the Menstrual Attitudes Questionnaire subscales last.

Results

To test the first two hypotheses, first, that women in the Menstruation Threat conditions would perform more poorly on the cognitive tasks than women in the No Menstruation Threat conditions and second, that exposure to a Positive Prime would counteract the threat, a 2×2 MANOVA was calculated examining the effects of Menstruation Threat (Menstruation Threat vs. No Menstruation Threat) and Positive Prime (Positive Prime vs. No Positive Prime) on Stroop and mathematics performance. Results only partially support these hypotheses. A main effect was found for Menstruation Threat on Stroop performance, $\Lambda=.874$, $F(2, 68)=4.909$, $p<.01$. Participants in the Menstruation Threat conditions completed significantly fewer items correctly on the Stroop than participants in the No Menstruation Threat conditions, $F(1, 69)=9.48$, $p<.01$. Participants in the No Menstruation Threat/No Positive Prime condition had the best score while participants in the Menstruation Threat/Positive Prime condition had the worst score (see Table 1). There was no effect of Menstruation Threat on math performance, $F(1, 69)=.021$, $p>.05$. There was no effect for Positive Prime, $\Lambda=.988$, $F(2, 68)=.422$, $p>.05$, or for the Menstruation Threat/Positive Prime interaction, $\Lambda=.990$, $F(2, 68)=.343$, $p>.05$ on either Stroop or mathematics performance.

Table 1 Means for number of correct Stroop and mathematics responses for Menstruation Threat and Positive Prime conditions

Menstruation Threat			
	Menstruation Threat Mean (SD)	No Menstruation Threat Mean (SD)	Marginal Means (SD)
Positive Prime			
Stroop	16.56 (8.92)	24.14 (10.47)	20.35 (10.25)
Math	8.00 (3.14)	7.57 (3.16)	7.79 (3.10)
No Positive Prime			
Stroop	19.19 (7.42)	25.50 (10.84)	22.34 (9.76)
Math	7.42 (2.91)	8.09 (3.96)	7.76 (3.46)
Marginal means			
Stroop	17.88 (8.09)*	24.82 (10.57)*	
Math	7.71 (2.98)	7.83 (3.63)	

Stroop scores could range from 0 (none correct) to 50 (all correct). Mathematics scores could range from 0 (none correct) to 15 (all correct). Means with asterisks are significantly different from one another, $p < .01$

To investigate the third hypothesis, that women who more strongly endorsed menstruation as bothersome, debilitating and contributing to their diminished cognitive performance would perform more poorly on the cognitive tasks than those who did not, and especially in the Menstruation Threat conditions, we first calculated the overall mean scores on the MAQ subscales and item MAQ 20 (see Table 2). Women were neutral (neither negative nor positive) in their assessment of menstruation as debilitating and bothersome. In addition, they were neutral in their belief that menstruation would impact how well they did on intellectual tasks. Correlational analyses to test for any meaningful relationships between MAQ subscales and MAQ 20 and correct responses on the Stroop test or the mathematics test were conducted and revealed no significant results (see Table 2). In addition, correlations among these variables were calculated for each cell and revealed only two significant relationships. In the Menstruation Threat/No Positive Prime condition, the more menstruation was viewed as Bothersome, the fewer correct Math responses, $r(21) = -.46$, $p < .036$. For participants in the No Threat/No Positive

Prime condition, the more menstruation was viewed as Debilitating, the more correct responses on the Stroop, $r(20) = .494$, $p < .027$.

Next, a MANOVA was conducted to test for differences in subscale scores and responses to MAQ 20 across conditions. A significant effect was found for Menstruation Threat, $\Lambda = .838$, $F(6, 71) = 2.282$, $p < .045$. However, results did not support the prediction that women in the Menstruation Threat conditions would endorse menstruation as more bothersome, debilitating and contributed to their diminished cognitive performance. On the contrary, participants in the Menstruation Threat conditions viewed menstruation as *less* debilitating than those in the No Menstruation Threat conditions. Similarly, participants in the Menstruation Threat conditions viewed menstruation as *less* bothersome = than those in the No Menstruation Threat conditions. And finally, participants in the Menstruation Threat conditions viewed menstruation having *less* impact on intellectual tasks than those in the No Menstruation Threat conditions (see Table 3). No significant

Table 2 Summary of means, standard deviations and correlations with Stroop and mathematics scores for MAQ subscales and MAQ 20

MAQ Subscales	Mean (SD)	Correlation with Stroop (p)	Correlation with Math Correct (p)
Debilitation	3.78 (1.21)	.140 (.218)	.136 (.265)
Bothersome	4.43 (1.24)	.181 (.109)	-.122 (.316)
MAQ 20	3.87 (1.58)	.121 (.364)	.057 (.667)

MAQ refers to The Menstruation Attitudes Questionnaire (Brooks-Gunn and Ruble 1980). MAQ 20 asks for agreement or disagreement with the following: I (don't) believe my menstrual period affects how well I do on intellectual tasks. Subscale (and item) scores can range from 1 to 7, with higher scores (after reverse scoring for some items) indicating more endorsement

Table 3 Means for the Debilitation and Bothersome MAQ subscale scores, and MAQ 20 for the Menstruation Threat and Positive Prime conditions

Menstruation Threat			
	Menstruation Threat Mean (SD)	No Menstruation Threat Mean (SD)	Marginal Means
Positive Prime			
Debilitation	3.75(1.35)	3.78(1.30)	3.76 (1.31)
Bothersome	4.72 (1.09)	4.74 (1.04)	4.73 (1.05)
MAQ 20	3.33(1.68)	3.67 (1.57)	3.49 (1.62)
No Positive Prime			
Debilitation	3.33 (1.68)	4.70 (1.14)	3.99 (1.30)
Bothersome	4.06 (1.35)	5.06 (0.95)	4.55 (1.26)
MAQ 20	3.10 (1.79)	4.30 (1.72)	3.68 (1.84)
Marginal Means			
Debilitation	3.54 (1.22) ^a	4.27 (1.29) ^a	
Bothersome	4.39 (1.26) ^b	4.91 (0.99) ^b	
MAQ 20	3.21 (1.71) ^c	4.00 (1.66) ^c	

MAQ refers to The Menstruation Attitudes Questionnaire (Brooks-Gunn and Ruble 1980). MAQ 20 asks for agreement or disagreement with the following: I (don't) believe my menstrual period affects how well I do on intellectual tasks. Subscale (and item) scores can range from 1 to 7, with higher scores (after reverse scoring for some items) indicating more endorsement. Means sharing superscripts are significantly different from one another, $p < .05$

effects were found for Positive Prime, $\Lambda = .963$, $F(6, 71) = .454$, $p > .05$, or a Menstruation Threat/Positive Prime interaction, $\Lambda = .849$, $F(6, 71) = 2.10$, $p > .05$.

To test the fourth hypothesis, that women in the Menstruation Threat conditions would perform more poorly than women in the No Menstruation Threat conditions the closer they were to menstruating, we performed correlations between the number of days since the last day of the last menstrual period and correct Stroop and Math responses for each condition. Results provide partial support for our fourth hypothesis. The correlation between the days since last menstruation and correct Stroop responses was significant for the Menstruation Threat/No Positive Prime condition, indicating that the closer participants were to their next period, the more *poorly* they performed on the Stroop test (see Table 4). The correlation between closeness to menstruation and correct Stroop responses, though not statistically significant, was

reversed for the No Menstruation Threat/Positive Prime condition, indicating that the closer these participants were to their next period, the *better* they performed on the Stroop. There were no significant correlations for the No Menstruation Threat/No Positive Prime condition, $r(18) = -.385$, $p > .05$, or the Menstruation Threat/Positive Prime condition, $r(22) = .027$, $p > .05$.

We then compared the correlations between closeness to menstruation and correct Stroop responses for each condition with each other, using an r to z transformation. Results revealed a significant difference between the Menstruation Threat/No Positive Prime and No Menstruation Threat/Positive Prime correlations. There were also significant differences between the correlations for Menstruation Threat/No Positive Prime and Menstruation Threat/Positive Prime condition, and the No Menstruation Threat/No Positive Prime and No Menstruation Threat/Positive Prime (see Table 5).

Table 4 Correlations for last day of last menstrual period and correct Stroop responses by condition

Condition	r (N)	p
Menstruation Threat/No Positive Prime	-.557 (20)	.011*
Menstruation Threat/Positive Prime	.027(22)	.904
No Menstruation Threat/No Positive Prime	-.385 (18)	.114
No Menstruation Threat/Positive Prime	.460 (17)	.061

Stroop scores could range from 0 (none correct) to 50 (all correct).

* $p < .05$

Table 5 Z-test for significant differences between correlations for last day of last menstrual period and correct Stroop responses

Condition (r)	Condition (r)	z	p
Menstruation Threat/No Positive Prime (–.557)	No Menstruation Threat/No Positive Prime (–.385)	–1.12	.131
Menstruation Threat/No Positive Prime (–.557)	Menstruation Threat/Positive Prime (.027)	–1.96	.025*
Menstruation Threat/No Positive Prime (–.557)	No Menstruation Threat/Positive Prime (.46)	–3.352	.001**
No Menstruation Threat/No Positive Prime (–.385)	Menstruation Threat/Positive Prime (.027)	1.167	.120
No Menstruation Threat/No Positive Prime (–.385)	No Menstruation Threat/Positive Prime (.46)	2.43	.008**
Menstruation Threat/Positive Prime (.027)	No Menstruation Threat/Positive Prime (.46)	1.34	.09

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

Discussion

This study was designed to investigate the hypothesis that mentioning menstruation serves as a stereotype threat that diminishes cognition, and further, that positive priming about menstruation counteracts menstruation threat and/or enhances cognition. The Menstruation Threat used in this study was a set of questions about a participant's own menstrual cycle, e.g., age at first menstruation, length of a typical menstrual period. These questions did not imply any negative stereotype about menstruation or its effects on cognition and as such was considered an implicit or subtle threat. The Positive Prime about menstruation offered to some participants was much more explicit in nature, implying that menstruation did not have a negative impact on cognition and instead was associated with enhanced creative and divergent thinking.

The main effect of Menstruation Threat, such that women in the Menstruation Threat conditions scored lower on the Stroop than women not exposed to Menstruation Threat, indicates support for the hypothesis that when menstruation is brought to mind, it does serve as a threat that diminishes at least one area of cognition. The data also provide for support for our second hypothesis, in that women who were not exposed to either the Menstruation Threat or the Positive Prime scored highest on the Stroop. Women receiving the Positive Prime, but no Menstruation Threat, also had high scores, although slightly lower and not significantly different from the scores of the women in the highest scoring group. Finally, women presented with the Positive Prime and then exposed to Menstruation Threat had the least number of correct Stroop scores. Thus, the data suggest that the Positive Prime used in this study did not counteract the effect of Menstruation Threat but served rather to intensify it. These findings appear to be robust, considering that women in the Menstruation Threat conditions believed that menstruation was less debilitating, less bothersome and specifically, would have less impact on how well they would do on intellectual tasks compared to women in the No Menstruation Threat conditions who held more negative attitudes. It is reasonable to expect that women in the

Menstruation Threat conditions might think menstruation would be more debilitating, more bothersome and more likely to impact performance on intellectual tasks, but this was not the case. In spite of reporting more positive attitudes, these women did more poorly on the Stroop.

The findings related to correlations between days since last menstrual period and Stroop scores for women in the various conditions shed light on the role of positive priming related to menstruation. We expected that women in the Menstruation Threat conditions would perform more poorly the closer they were to menstruation, while women receiving the Positive Prime only, and no Menstruation Threat, would perform better the closer they were to menstruation, and this pattern did emerge in the examination of the correlations pertaining to Stroop performance. However, women in the Menstruation Threat/No Positive Prime condition performed more poorly on the Stroop the closer they were to menstruation, (as measured, the further away from the last day of their last menstrual cycle). Women in the No Menstruation Threat/Positive Prime condition performed better on the Stroop the closer they were to menstruating. These findings provide some evidence of positive priming as a moderator of the relationship between closeness to menstruation and enhanced performance. These results also add support to the notion tested in previous research (e.g., Chrisler et al. 1994) that positive priming about menstruation is possible and may improve cognitive performance, in addition to attitudes about menstruation. Even though this study's results do not indicate that positive priming counteracts menstruation threat or improves cognitive performance per se, the correlational analyses indicate that further study on the impact of positive information about menstruation on cognition would be fruitful in itself, and also in further study of menstruation threat.

Further investigation of positive priming about menstruation should take into consideration participants' menstrual experience as well as attitudes. In this study, menstrual experience was not assessed but menstrual attitude subscale scores revealed participants' moderate, not extreme attitudes. Moreover, correlations of menstrual attitude subscale scores and number of correct Stroop or math responses

revealed no meaningful pattern. In future studies it would be useful to explore interactions among menstrual experience and/or attitudes, varying levels of menstruation threat and threat removal (e.g., priming with positive information about menstruation). Women's menstrual attitudes and experiences are complex, and the design of studies investigating the impact of menstruation should reflect that complexity, including the use of other measures of menstrual attitudes. Finally, we were able to assess women's specific beliefs about the impact of menstruation on cognition/performing intellectual tasks because one of the questions on the Debilitation subscale called for a response to this specific area of performance. Ideally, in future studies of the impact of menstruation stereotype threat on cognition, a more independent and direct assessment of participants' beliefs about how menstruation affects their cognition, both in general and in the domain being tested, should be included.

While these findings provide some support for the hypothesis that menstruation serves as a threat that diminishes cognitive performance, it would be premature to assume that the menstruation threat has a negative impact on women's cognition broadly considered, since only two cognitive tests were used, and there were no effects of menstruation threat on women's performance of the math test. It is not clear why there were no effects of menstruation threat on the math test. As mentioned earlier, previous research suggests that test difficulty and domain identification are important moderating variables in studies of the impact of stereotype threat on test taking (Nguyen and Ryan 2008). In this study, neither the level of challenge of the math test, nor the degree of math identification was assessed, although it can be assumed that the math test was moderately challenging (e.g., designed to mimic an SAT test) and therefore not easy or advanced. While these moderating variables should be included in the design of future studies, it seems more likely that the notion that women can't do math is one that is already widely recognized, and can't be easily modified by either negative or positive priming. However, there are no widely recognized gender expectations with respect to performance on the Stroop, and as such it can be argued that the Stroop is a good outcome measure to use in a first test of the impact of menstruation threat.

The most important finding from this study is that menstruation threat can be elicited by asking women to answer some descriptive questions about their own menstrual cycles and diminishes performance in at least one area of cognition. Second, the study provides evidence that positive priming, absent calling attention to one's own menstruation, moderates the relationship between closeness to menstruation and performance on the

Stroop. The findings are useful in serving as the basis for further study of menstruation threat. In future studies, various levels of menstruation threat and removal, e.g., subtle, moderate or extreme, should be tested. For example, in addition to asking about one's own menstrual experience, a more explicit prime emphasizing the negative stereotype that women do not perform as well on cognitive tasks premenstrually and during menstruation could be used and might have a greater impact on cognitive performance. Similarly, it is possible that a more effective positive prime could be devised and if so, could counteract menstruation threat more effectively and/or actually enhance cognitive performance, since in this study women exposed to the menstruation threat and positive information about menstruation had the lowest Stroop scores compared with women in the other conditions. Finally, additional tests of cognition should be used as outcome measures to test any impact of menstruation threat on cognition more broadly considered.

It is regrettable, though perhaps not surprising, that merely mentioning menstruation can serve as a stereotype threat among women and girls, and that positive information about menstruation adds to this threat. Although research on the menstrual cycle has revealed this biopsychosocial experience as multifaceted and varied among females across the lifespan, negative stereotypes about menstruation and their negative impact on women's lives persist. These stereotypes may be more pronounced now than even a decade ago. Current cultural discourse about the "benefit" of eliminating menstruation, hailed as a lifestyle "choice" and touted as a feature of some hormonal contraceptives, reinforces these stereotypes (see Hitchcock 2008) and has reached adolescent girls (see Stubbs 2008). Especially in this context, continuing research is needed to document the extent to which widely held negative views of menstruation stigmatize girls and women when menstruation is made salient, and most importantly, the specific assumption that menstruation negatively influences girls' and women's thinking. This assumption has important implications not only for girls' and women's psychological but also economic and political well-being. Girls and women who believe that they are less cognitively able because of menstruation may be all too willing to accept diminished status in many arenas. Future research should thoroughly investigate how this assumption may operate to influence girls' and women's functioning, attitudes and experiences. Although there is a risk that this and subsequent study of menstruation threat could perpetuate the previous research focus on the debilitating effects of menstruation, we hope that it will instead inform interventions that help to counteract it.

Appendix 1

Menstruation History/Threat

Please answer these questions:

Today's date: _____

How old were you when you began to menstruate? _____

How many days does your period usually last? _____

Are you menstruating today? ____Y ____N

Estimate how many days it has been since the last day of your last period _____

Positive Prime

Contrary to popular belief, research has shown that there are no negative effects of menstruation on cognition. In one study, healthy women aged 18–22 years were given cognitive performance tasks during various phases of the menstrual cycle. In a comparison of women who were premenstrual or menstruating with those who were not premenstrual or menstruating, there was no difference found in the ability to concentrate, or in motor abilities. Moreover, as measured by The Torrance Test of Creative Thinking, creativity, and divergent thinking were improved for premenstrual and menstrual women in comparison with women who were not premenstrual or menstruating. Research has also shown that the sensory perception is enhanced during menstruation. This heightened sensitivity can enhance women's self-awareness as well as their sensitivity towards environmental cues, and in turn contribute to personal growth, and improved relationship and practical problem-solving skills.

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