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Research Report

Race Bias Tracks Conception Risk Across the Menstrual Cycle

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ABSTRACT—*Although a considerable body of research explores alterations in women's mating-relevant preferences across the menstrual cycle, investigators have yet to examine the potential for the menstrual cycle to influence intergroup attitudes. We examined the effects of changes in conception risk across the menstrual cycle on intergroup bias and found that increased conception risk was positively associated with several measures of race bias. This association was particularly strong when perceived vulnerability to sexual coercion was high. Our findings highlight the potential for hypotheses informed by an evolutionary perspective to generate new knowledge about current social problems—an avenue that may lead to new predictions in the study of intergroup relations.*

Recently, research on the effects of the menstrual cycle on women's perceptions of men has revealed cyclic changes in women's valuation of males' genetic quality, social dominance, health, and willingness to invest in a relationship (reviewed in Garver-Apgar, Gangestad, & Thornhill, 2008). However, investigators have yet to explore the relationship between such effects and one of the most fundamental features of interpersonal social evaluation: race bias.

Given the geographic distribution of human physical variation, it is only recently (in the timescale of evolution) that individuals have encountered members of other races (Stringer & McKie, 1997). Accordingly, the phenotypic differences now used to classify people on the basis of race are likely processed by features of the mind that evolved to identify social groups and coalitional alliances (Kurzban, Tooby, & Cosmides, 2001; Machery & Faucher, 2005). Natural selection is thus unlikely to have shaped the human mind to produce race bias per se; rather, such forms of bias are the epiphenomenal consequence of an evolved psychological system adapted to address the challenges of living in a world of groups and coalitions. This understanding of race bias as an evolutionary by-product provides a framework for generating hypotheses about the origins and maintenance of modern forms of intergroup bias. In the work described here, we sought to combine this perspective with an existing line of research exploring the effects of the menstrual cycle on social evaluation; this combination yielded novel predictions regarding the influence of women's fertility on attitudes toward men of other racial groups.

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AVOIDANCE OF SEXUAL COERCION

Women are less likely to engage in behaviors that would put them at risk for sexual coercion at peak fertility than at other times, a pattern consistent with the elevated fitness costs of sexual assault during this period (Bröder & Hohmann, 2003; Chavanne & Gallup, 1998; Petralia & Gallup, 2002). Correspondingly, women are more sensitive to indications that a given man may engage in coercive sexual tactics at peak fertility than at other times (Garver-Apgar, Gangestad, & Simpson, 2007). In ancestral populations, a man's group membership may have been an important feature: Out-group members may not have been subject to the same social controls as in-group members and would have constituted a threat in antagonistic situations (Daly & Wilson, 1988). It is therefore plausible that out-group males may have posed a greater risk of sexual assault than in-group males. Thus, if the psychological system underlying the avoidance of agents who could compromise female reproductive choice evolved such that the avoidance system increases in sensitivity when the costs of coercion are at their highest, and if group membership was a feature frequently relevant to assessing the risk posed by a given agent, then the mental representations associated with avoiding contact with out-group men should be

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particularly salient when conception risk is high. In turn, such representations should increase intergroup bias.

In its most general form, this hypothesis suggests that women at peak fertility can be expected to hold more negative attitudes toward out-group men than toward in-group men. That is, they should show greater *intergroup bias*. Correspondingly, to the extent that race is processed as if it were a cue of group or coalition membership, the same holds true of attitudes toward men of other races. However, although a basic in-group/out-group categorization process might suffice as a hazard heuristic, the computation of the potential for harm from men of racial outgroups might also weigh the purported dangerousness of men of specific races, as depicted in socially transmitted stereotypes. In either case, this *coercion-avoidance* perspective suggests that race bias against Black American men should vary as a function of conception risk across the cycle among White American women.

The coercion-avoidance perspective dovetails with a focus on individual differences in fearfulness, in that variation in personal attributes and past experience likely lead to differences in women's self-appraised vulnerability to sexual coercion. Because precautions entail costs (e.g., time, attention, energy, and forgone opportunities), an evolutionary approach suggests that precautionary behavior should be calibrated as a function of vulnerability. The coercion-avoidance perspective thus includes the ancillary prediction that women who perceive themselves to be particularly vulnerable to sexual coercion, as revealed in self-reported vigilant behavior and fearful attitudes, should show even greater bias at peak fertility than women who do not perceive themselves as vulnerable to sexual coercion; that is, the relationship between race bias and conception risk should be strongest among women who view themselves as highly vulnerable to sexual coercion.

We tested these predictions in a study employing various measures of race bias.

METHOD

Participants

One hundred fifteen White and Black Americans initially volunteered through Michigan State University's Psychology Study Pool. Of these, 28 were excluded for failing to complete all items ($n = 5$); reporting menstrual cycles of aberrant length, defined as being less than 20 or greater than 40 days ($n = 13$); using oral contraceptives ($n = 7$); being pregnant ($n = 2$); or being unsure of pregnancy ($n = 1$). Because the number of Black women who were eligible for inclusion was very small ($n = 10$), their data were excluded from analysis. We report data on 77 White undergraduates who were normally ovulating (mean age = 19.0 years, $SD = 0.9$ years, range = 18–22 years).

The experiment was described as a study on social attitudes and mate choice.

Procedure

Participants were run in groups of 3 to 5 individuals. Independent and dependent measures were assessed electronically using Medialab and DirectRT questionnaire- and stimulus-presentation tools. The three measures of explicit attitudes were presented in separate blocks; order of the blocks and of the items within each block was random. Implicit measures were presented at the end of the procedure, with a measure of implicit race stereotyping preceding a measure of implicit race evaluation. Participants completed all measures at their own pace and were debriefed and thanked after finishing.

Independent Variables

Conception Risk

Position in the menstrual cycle was assessed by the forward-counting method (Gangestad & Thornhill, 1998). The degree of fertility (or conception-risk value) corresponding to the day of the cycle was estimated using actuarial data from Wilcox, Dunson, Weinberg, Trussell, and Baird (2001). Each participant was assigned a value from 0 to .1, with higher values denoting greater conception risk ($M = .025$, $SD = .028$).

Vulnerability to Coercion

Perceived vulnerability to sexual coercion (VSC) was measured using the Fear of Rape Scale (Senn & Dzinas, 1996), which employs items assessing behavior (e.g., "Before I go to bed at night I double check to make sure the doors are securely locked") and attitudes (e.g., "I am afraid of being sexually assaulted"). Responses were made on a 7-point scale ($M = 3.78$, $SD = 0.88$, $\alpha = .80$).

Dependent Variables

The dependent variables consisted of five separate measures of race bias: race bias in implicit stereotyping, implicit evaluation, fear of male targets, mate attraction, and explicit attitudes.

Implicit Stereotype Bias

We employed the Implicit Association Test (IAT) as a measure of nonconscious race bias in the accessibility of category-based stereotypes (the stereotype IAT from Amodio & Devine, 2006). Specifically, we measured the accessibility of physical and mental concepts stereotypically applied to White and Black Americans (e.g., "math," "brainy," "athletic," "strong") by measuring participants' reaction times in associating Black and White targets with physical- and mental-related words in stereotype-congruent word pairs (e.g., African American with physical) versus stereotype-incongruent word pairs (e.g., White American with physical). Reaction times for incongruent versus congruent pairings were scored as individual difference scores using the scoring algorithm described in Greenwald, Nosek, &

Banaji (2003), with higher values denoting greater stereotyping ($M = 0.20$, $SD = 0.28$).

Implicit Evaluation Bias

We used a variant of the IAT to measure nonconscious evaluative bias against African Americans (the evaluative IAT from Amodio & Devine, 2006). This test measured the accessibility of evaluative concepts (e.g., "agony," "horrible") that have high affective valence but are not typically associated with racial stereotypes ($M = 0.43$, $SD = 0.34$). Evaluative bias has been shown to predict behavioral race bias more consistently than either explicit attitudes or implicit stereotypes. The measure we used has been found to have high predictive validity for behavioral race bias (e.g., physical proximity preferences) and is correlated with activation in the amygdala—a brain area implicated in fear and aggression (reviewed in Amodio, 2008).[1]

Explicit Race Bias

We measured explicit race bias using the Attitudes Toward Blacks Scale (Brigham, 1993), a measure of conscious, declarative knowledge of negative attitudes toward African Americans (e.g., "Generally, Blacks are not as smart as Whites"; "It is likely that Blacks will bring violence to neighborhoods when they move in"). Participants rated statements on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*; $M = 2.78$, $SD = 0.96$, $\alpha = .92$). We also measured explicit negative attitudes regarding White Americans by presenting a parallel version with the word "Whites" substituted for "Blacks" ($M = 2.36$, $SD = 0.54$, $\alpha = .69$). Explicit race bias was thus operationalized as the difference between negative attitudes toward Blacks and negative attitudes toward Whites ($M = 0.42$, $SD = 0.66$).

Race Bias in Mate Attraction

To assess race bias in potential mate attraction, we used MyVirtualModel software to create artificial digital images of four seminude male exemplars representing Black and White American race categories. Within race categories, only muscle size was varied (see Fig. S1 in the Supporting Information available on-line; see p. 665), with facial features, skin color, and hairstyle held constant. Between race categories, images differed solely with respect to skin color, hairstyle, and nose and lip width, with muscle size held constant. Three items assessed the extent to which participants found each exemplar "attractive," "sexy," and worthy of a "romantic encounter" (White male: $M = 3.63$, $SD = 1.26$, $\alpha = .94$; Black male: $M = 3.18$, $SD = 1.26$, $\alpha = .95$). Bias in mate attraction was operationalized as the difference between attraction toward White targets and attraction toward Black targets ($M = 0.45$, $SD = 1.34$), with higher values denoting greater preference for the in-group target compared to the out-group target.

Fear of Male Targets

To assess whether an out-group male target was evaluated as having a more frightening appearance than an in-group male target, we used the four digital images in Figure S1, asking the following question for each: "To what extent do you think this person looks 'scary'?" Participants rated each image on a 7-point scale (1 = *not at all scary*, 7 = *very scary*). Responses were averaged across both exemplars within each race category (Black male: $M = 3.16$, $SD = 1.20$, $\alpha = .75$; White male: $M = 2.62$, $SD = 1.20$, $\alpha = .83$). The mean rating for White males was then subtracted from the mean rating for Black males to create a difference score for fear bias that indicates the extent to which fear of out-group targets is greater than fear of in-group targets ($M = 0.54$, $SD = 1.26$).

RESULTS

In evaluating the effects of variation in conception risk over the menstrual cycle on race bias, we computed the bivariate correlations of conception risk and the five race-bias measures. The results revealed that conception risk was associated with elevated race bias in implicit evaluation, implicit stereotyping, mate attraction, and fear of male targets, such that greater risk of conception was associated with greater bias on these measures (Table 1). The relationship between conception risk and explicit race bias was only marginally significant, $p = .08$. When merged into a composite race-bias variable (standardized by variable, then averaged), the composite score had a significant correlation with conception risk across the menstrual cycle, $r = .45$, $p < .0001$ (Fig. 1).

To test the ancillary prediction that the relationship between conception risk and race bias would be strongest among participants for whom perceived VSC is high, we conducted a regression analysis in which composite race bias was the dependent variable and zero-centered values of conception risk, VSC, and their interaction term were the independent predictors. The results of this analysis supported the prediction (Fig. 2); the effects of VSC, $\beta = .25$, $t(73) = 3.20$, $p = .002$, and conception risk, $\beta = .48$, $t(73) = 4.76$, $p < .0001$, were qualified by a significant two-way interaction, $\beta = .20$, $t(73) = 2.07$, $p = .04$. Simple effects assessed at 1 standard deviation above and below mean VSC revealed that the relationship between conception risk and race bias was strongest when VSC was high, $\beta = .73$, $t(73) = 4.23$, $p < .0001$, and less strong when VSC was low, $\beta = .27$, $t(73) = 2.18$, $p = .03$.

DISCUSSION

In a study designed to investigate the effects of menstrual-cycle position on various measures of race bias, we found that bias in

[1]For the IAT, digitized images were taken from the International Affective Picture System (Center for the Study of Emotion and Attention, Gainesville, FL). All faces had neutral expressions.

TABLE 1

Correlations Among Conception Risk, Vulnerability to Coercion, and Measures of Race Bias

Variable	Conception risk	Implicit evaluative bias	Implicit stereotype bias	Race bias in mate attraction	Fear of out-group males	Explicit race bias
Conception risk	—					
Implicit evaluative bias	.28*	—				
Implicit stereotype bias	.25*	.05	—			
Race bias in mate attraction	.29*	.32**	.13	—		
Fear of out-group males	.40***	.34**	.05	.43***	—	
Explicit race bias	.20	.30**	.05	.53***	.24*	—
Vulnerability to coercion	−.09	−.03	.19	.11	.03	.26*

*$p < .05$. **$p < .01$. ***$p < .001$.

implicit attitudes, attractiveness ratings, and fear of an out-group exemplar tracked conception risk. The relationship between conception risk and explicit race bias was marginal; however, when all five measures were combined into a composite measure of race bias, a robust link between this composite measure and conception risk emerged. The effect was particularly strong for women whose self-appraised VSC was high.

These results suggest that at least some facets of modern race bias are by-products of an evolved system predisposing women to avoid persons and situations perceived as dangerous, particularly when costs are high. On the one hand, the system underlying the effects we observed may rely on an in-group/out-group heuristic that latches onto any socially marked group boundary, in which case similar patterns should hold across different combinations of race of subject and race of target—perhaps even in minimally defined, basic social categories. On the other hand, the system may rely on socially transmitted information regarding the potential for danger from men of particular groups in the local environment, in which case the effect will apply only to out-groups that are stereotyped as being dangerous. The results described here are not sufficient to distinguish whether basic categorization, social transmission, or both processes are operative in producing greater race bias when fertility rises. Further work is necessary to more fully understand the mechanistic processes underlying this effect.

These results do not preclude the possibility that women may be equipped with mechanisms that increase the attractiveness of out-group men during the fertile window as a way to increase genetic heterogeneity in offspring; indeed, some perspectives might predict as much (see Marlowe, 2004; Roberts & Little, 2008). However, in the event that both coercion-avoidance processes and heterogeneity-attraction processes are operative, it may be difficult to find evidence of the latter in a cultural milieu where negative stereotypes (including those involving sexual victimization) of social out-groups are pervasive because the emotional output of the coercion-avoidance processes may mask any increased preference for out-group males. Effects of heterogeneity-attraction processes may be detectable only in contexts where negative stereotypes are not cognitively accessible or do not include associations with danger. Further investigations are therefore necessary to fully elucidate the psychological systems that produce variability in race bias across the menstrual cycle. We are hopeful that the perspective we have discussed, though perhaps unsettling, will inspire re-

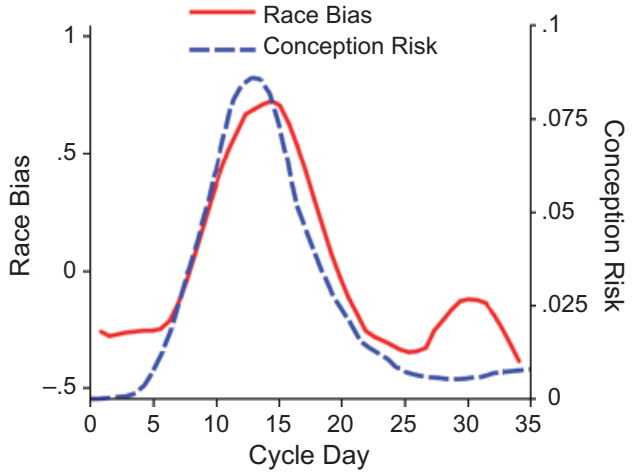

Fig. 1. Mean composite race bias and conception risk across the menstrual cycle. Curves reflect a smoothed local average.

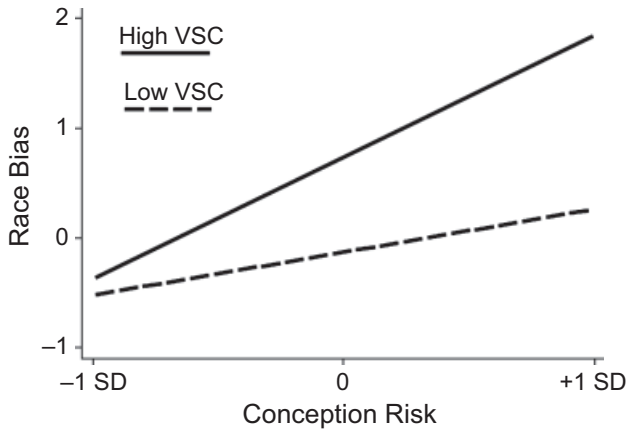

Fig. 2. Race bias as a function of conception risk among participants with low ($M - 1SD$) and high ($M + 1SD$) vulnerability to sexual coercion (VSC).

searchers to generate new hypotheses regarding the evolved psychological architecture underlying the persistent modern problem of race bias.

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REFERENCES

Amodio, D.M. (2008). The social neuroscience of intergroup relations. *European Review of Social Psychology*, *19*, 1–54.

Amodio, D.M., & Devine, P.G. (2006). Stereotyping and evaluation in implicit race bias: Evidence for independent constructs and unique effects on behavior. *Journal of Personality and Social Psychology*, *91*, 652–661.

Brigham, J.C. (1993). College students' racial attitudes. *Journal of Applied Psychology*, *23*, 1933–1967.

Bröder, A., & Hohmann, N. (2003). Variations in risk taking behavior over the menstrual cycle: An improved replication. *Evolution and Human Behavior*, *24*, 391–398.

Chavanne, T.J., & Gallup, G.G. (1998). Variations in risk taking behavior among female college students as a function of menstrual cycle. *Evolution and Human Behavior*, *19*, 27–32.

Daly, M., & Wilson, M. (1988). *Homicide*. Hawthorne, NY: Aldine.

Gangestad, S.W., & Thornhill, R. (1998). The analysis of fluctuating asymmetry redux: The robustness of parametric statistics. *Animal Behaviour*, *55*, 497–501.

Garver-Apgar, C.E., Gangestad, S.W., & Simpson, J. (2007). Women's perceptions of men's sexual coerciveness change across the menstrual cycle. *Acta Psychologica Sinica*, *23*, 536–540.

Garver-Apgar, C.E., Gangestad, S.W., & Thornhill, R. (2008). Hormonal correlates of women's mid-cycle preference for the scent of symmetry. *Evolution and Human Behavior*, *29*, 223–232.

Greenwald, A.G., Nosek, B.A., & Banaji, M.R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, *85*, 197–216.

Kurzban, R., Tooby, J., & Cosmides, L. (2001). Can race be erased? Coalitional computation and social categorization. *Proceedings of the National Academy of Sciences, USA*, *98*, 15387–15392.

Machery, E., & Faucher, L. (2005). Social construction and the concept of race. *Philosophy of Science*, *72*, 1208–1219.

Marlowe, F.W. (2003). The mating system of foragers in the standard cross-cultural sample. *Cross-Cultural Research*, *37*, 282–306.

Petralia, S.M., & Gallup, G.G. (2002). Effects of a sexual assault scenario on handgrip strength across the menstrual cycle. *Evolution and Human Behavior*, *23*, 3–10.

Roberts, S.C., & Little, A.C. (2008). Good genes, complementary genes and human mate preferences. *Genetica*, *132*, 309–321.

Senn, C.Y., & Dzinas, K. (1996). Measuring fear of rape: A new scale. *Canadian Journal of Behavioural Science*, *28*, 141–148.

Stringer, C., & McKie, R. (1997). *African exodus: The origins of modern humanity*. London: Cape.

Wilcox, A.J., Dunson, D.B., Weinberg, C.R., Trussell, J., & Baird, D.D. (2001). Likelihood of conception with a single act of intercourse: Providing benchmark rates for assessment of post-coital contraceptives. *Contraception*, *63*, 211–215.

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SUPPORTING INFORMATION

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Figure S1

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