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Mild Test Anxiety Influences Neurocognitive Performance Among African Americans and European Americans: Identifying Interfering and Facilitating Sources

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The current study examined ethnic/racial differences in test-related anxiety and its relationship to neurocognitive performance in a community sample of African American (n = 40) and European American (n = 36) adults. The authors hypothesized the following: (a) Test-anxiety related to negative performance evaluation would be associated with lower neurocognitive performance, whereas anxiety unrelated to negative evaluation would be associated with higher neurocognitive performance. (b) African American participants would report higher levels of anxiety about negative performance evaluation than European Americans. (c) European Americans would report higher levels of anxiety unrelated to negative performance evaluation. The first two hypotheses were supported: Ethnic/racial differences in test-taking anxiety emerged such that African Americans reported significantly higher levels of negative performance evaluation, which was associated with lower cognitive performance. The third hypothesis was not supported: African Americans and European Americans reported similar levels of test-anxiety unrelated to negative evaluation.

Keywords: anxiety, assessment, cognition, ethnicity, performance

Although neurocognitive tests are designed to assess cognitive ability, it is widely recognized that emotional factors such as anxiety and depression can adversely affect test performance. Overall, studies demonstrate that anxiety interferes with cognitive performance (Castaneda, Tuulio-Henriksson, Marttunen, Suvisaari, & Lönnqvist, 2008; Terfehr et al., 2011); however, there is considerable variability across studies. For instance, some studies have suggested that general anxiety affects performance efficiency, but not performance outcome (Eysenck & Calvo, 1992; Hoffman & al'Absi, 2004). Individuals who report moderate levels of anxiety have been found to perform better on cognitive testing than those who report minimal or high levels (Keeley, Sayac, & Correia, 2008; Seipp, 1991; Salehi, Cordero, & Sandi, 2010; Yerkes & Dodson, 1908), suggesting that a moderate degree of arousal can facilitate performance. Therefore, inconsistencies in the literature about the relationship between anxiety and cognitive performance may be partially attributed to severity (Boldrini et al., 2005; Christensen, Won Kim, Dysken, & Maxwell Hoover, 1992; Penades, Catalán, Andrés, Salamero, & Gastó, 2005; Zielinski, Taylor, & Juzwin, 1991), the reasons underlying anxiety or methodological differences in assessment (Castaneda et al., 2008).

Anxiety surrounding test performance (commonly referred to as *test anxiety* or *evaluative anxiety*) has been reliably demonstrated to interfere with actual performance (Cassady & Johnson, 2002; Chapell et al., 2005; Putwain, & Best, 2011). Fear-of-failure is a

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central characteristic of test anxiety (Meijer, 2001; Zeidner, 1998) and has distinct cognitive, affective-physiological, and behavioral components (Zeidner & Matthews, 2005). The cognitive component refers to negative thoughts that arise during the assessment situation (worries and self-depreciating statements) and are most consistently associated with performance declines (Hembree, 1988). The affective-physiological component refers to the subjective perception of autonomic arousal occurring during the assessment situation, which is closely linked to cognitive appraisal.

Unlike trait-anxiety, which tends to be nonspecific and tied to the individual's personality, test anxiety is a situation-dependent reaction. In a study that examined the effects of receiving anxiety-provoking information on memory, it was found that participants who were exposed to anxiety-provoking information recalled significantly fewer words than those who were given neutral information (Senn & Radomsky, 2012). There is evidence that stress reactivity (measured by cortisol) and self-reported generalized worry are associated with cognitive impairments in executive functioning (Eysenck & Derakshan, 2011; Lupien, Gillin, & Hauger, 1999; McAllister-Williams & Rugg, 2002) and declarative memory (Lupien & McEwen, 1997). Thus, the current investigation is focused on situational test-related anxiety given its particular relevance to the context of cognitive assessment.

Relatively few empirical studies have addressed the impact of situational test anxiety on global measures of neurocognitive functioning. Of the few investigations conducted, anxiety has been linked to poorer performance on neuropsychological tests, especially on measures of learning and memory (Gass, 1996; Kizilbash, Vanderploeg, & Curtiss, 2002), attention and executive function (Gass et al., 2005), processing speed (Firetto, Walker, & Davey, 1972; Lee et al., 2007), reading comprehension (Minnaert, 1999), and working memory (Darke, 1988; Ikeda, Iwanaga, & Seiwa, 1996; Lee, 1999).

A recent study found that individuals who were randomly assigned to a condition simulating testing anxiety performed worse on working memory and declarative memory compared to individuals in the control condition (Leininger & Skeel, 2012). Further, cortisol levels showed no significant relationships with cognitive performance whereas self-reported anxiety showed an inverse relationship with performance. The authors concluded that self-reported anxiety may be particularly useful for understanding poor performance on cognitive assessment.

Although it has been suggested that increased anxiety may reduce cognitive resources required for optimal test performance (Crandall & Eshleman, 2003; Devine, 1989; von Hippel, Silver, & Lynch, 2000), appropriate levels of anxiety can enhance memory, attention, motivation, that can result in improved test performance (Salend, 2011). A study of state anxiety among older adults revealed positive effects of mild and moderate state anxiety for verbal fluency and general cognitive functioning (Potvin, Bergua, Meillon, Goff, Bouisson, Dartigues, et al., 2013). Together, these results suggest that the degree (i.e., mild vs. severe) and source (e.g., cognitive worry) of test anxiety can produce different performance outcomes. Given the evaluative nature of neurocognitive assessment it is reasonable to posit that for individuals who are prone to evaluative anxiety, test results might underestimate actual cognitive capacity, or worse, be misinterpreted as evidence of compromised brain functioning.

Ethnic/Racial Differences in Test-Related Anxiety

Certain groups (e.g., ethnic/racial minorities) may be more prone to experience performance anxiety, particularly if a negative stereotype about performance is linked to group membership (e.g., "African Americans do not perform well on achievement tests"). Research has consistently reported elevated levels of test anxiety among African Americans compared to European Americans and other racial/ethnic minorities. For example, studies have shown that African American students score higher on measures of test anxiety compared to their peers (Payne, 1984; Wren & Benson, 2004) and also exhibit more test-taking behaviors indicative of anxiety (e.g., more answer-changing during test-taking; Payne, 1984). African American children were rated by study examiners as being more shy or anxious during testing than White children (Kim, Baydar, & Greek, 2003). Among African American middle school children, those identified as having test anxiety had significantly poorer academic performance compared to their nonanxious African American peers, and also reported more negative self-evaluation of their cognitive and social functioning (Turner, Beidel, Hughes, Turner, 1993).

Stereotype Threat and Perceived Discrimination: A Catalyst to Evaluative Anxiety

Stereotype threat refers to the risk of confirming a negative stereotype about one's group (Steele & Aronson, 1995) irrespective of one's belief about the stereotype. Steele (1997) has explained that this phenomenon occurs when well-known, negative stereotypes exist about one's group (e.g., low intellectual abilities and academic achievement in African Americans). When individuals of a stigmatized group are placed in situations where the stereotype is relevant (e.g., an African American student taking a test of academic achievement), pressure to not perform to the stereotype is placed on the individual, which in turn results in underperformance. In a recent experimental investigation by members from our group, it was found that activating stereotype threat (by manipulation of test instructions) resulted in poor cognitive test performance among a nonclinical sample of African Americans (Thames et al., 2013). Other studies have found that stereotype threat only partially mediated race effects on a test of cognitive ability (McKay, Doverspike, Bowen-Hilton, McKay, 2003; Ployhart, Ziegert, & McFarland, 2003), suggesting that additional key variables may be involved, such as test-taking anxiety, that contribute to poor performance.

Therefore, the purpose of the current study was to examine the relationship between evaluative/test anxiety and neurocognitive performance among a community sample of 76 African American ($n = 40$) and European American ($n = 36$) individuals. We were primarily interested in isolating the sources of anxiety that interfere and facilitate cognitive performance for each ethnic/racial group, and if these sources of anxiety differed between ethnic/racial group. Study hypotheses were as follows:

> *Hypothesis 1:* Test anxiety about negative performance evaluation would be associated with lower neurocognitive performance, whereas anxiety unrelated to negative evaluation will be associated with higher neurocognitive performance.

Hypothesis 2: African American participants would report higher levels of anxiety about negative performance evaluation than European Americans.

Hypothesis 3: European Americans would report higher levels of anxiety unrelated to negative performance evaluation.

Method

Participants

The sample consisted of 76 African American (n = 40) and European American (n = 36) adults who were recruited through fliers distributed around the local community. Recruitment fliers stated the following: "Recruiting healthy volunteers for a study examining factors involved in cognitive test performance." There was no indication of race. If participants called who did not identify as African American or European American, they were given the option to participate in another study. Participants lived in the greater Los Angeles community in predominately multiethnic areas. All participants were screened and excluded for neurological, psychiatric, and medical confounds. Institutional review board approval was obtained prior to beginning study procedures. All participants provided written informed consent.

Measures

Test Anxiety Inventory. Participants completed the Test Anxiety Inventory (TAI; Moore, 2004), which is a 50-item inventory that assesses three behavioral "expressions" of test anxiety: (a) bodily reactions, (b) thought disruptions, and (c) general test-taking anxiety, as well as four main cognitive sources of test anxiety that pertain to concerns about: (a) how others will perceive poor performance, (b) self-image, (c) future security, and (d) test preparation. This scale yields a total of 10 potential composite scores that include the TAI total score, an overall measure of behavioral expressions of test anxiety total score (which is made up of the three abovementioned subtests), and an overall score for cognitive sources of test anxiety (made up of above mentioned four subscales). A forced-choice (i.e., yes/no) format was used for responses. All yes responses were scored as a 1 and no responses were scored as a 0. The range of total possible scores is 0–50. Higher scores indicate greater levels of test anxiety.

Neurocognitive assessment. Participants were administered a brief cognitive test battery that included measures with demonstrated validity with respect to premorbid intellectual ability (Wechsler Test of Adult Reading [WTAR]; Wechsler, 2001), speed of information processing (Wechsler Adult Intelligence Scale, 4th ed. [WAIS-IV] Digit Symbol and Symbol Search subtestsWechsler, 2008) attention/working memory (Trail Making Test–Part A; Reitan, 1958, Stroop Test (Color and Word conditions); Golden, 1978; WAIS-IV Letter-number sequencing subtest), learning and memory (Brief Visual Memory Test—revised, Benedict, 1997; Hopkins Verbal Learning Test—revised, Brandt & Benedict, 2001- Immediate and Delayed subtests), and executive functioning (Trail Making Test–Part B and Stroop Test [Color-Word Condition]). All raw scores were converted to z-scores and grouped into one of four cognitive domains (i.e., attention/working memory, information processing speed, learning/memory, and executive functions). Age, gender, and education were included as covariates in the model when appropriate. Global neuropsychological performance was calculated by averaging z-scores from individual cognitive tests.

Procedures

The Principal Investigator (April D. Thames) provided an overview of study procedures with each participant upon their arrival. They were also informed that their participation was voluntary and that upon completion of the study, they would be compensated for their participation. Once informed consent was obtained, participants were given a demographic questionnaire and a test anxiety inventory to complete. After completing the questionnaires, participants underwent neurocognitive assessment.

Statistical Analyses

Tests of assumptions. Distributions for all dependent measures were inspected for normality and linearity. TAI total scores were not normally distributed (skewness = .46 [SE = .28]; kurtosis = −.98 [SE = .55]; range [2–28]) and violated the Shapiro-Wilk test of normality (S-W = .933, df = 76, p = .008). Inspection of raw scores revealed that our sample reported mild-to-moderate degrees of test anxiety, which resulted in a positive skew of the data. WTAR scores were also nonnormally distributed (S-W = .82, df = 76, p = .000). On the other hand, global neurocognitive performance was normally distributed, (S-W = .97, df = 76, p = .34), as well as cognitive domains of attention/working memory, learning and memory, information processing speed and executive functioning (all ps > .05).

Nonparametric t tests (Mann–Whitney U) were used to examine differences between ethnic/racial groups on TAI and WTAR scores. Ethnic/racial groups were compared on age, gender, education, and WTAR to identify potential covariates. Correlations between those demographic variables that differed between groups and neurocognitive test scores were conducted to determine whether they should be included in the models.

Statistical Procedures

To test the first hypothesis, nonparametric correlations (Spearman) were used to examine relationships between test anxiety and neurocognitive performance for the entire sample and then by ethnic/racial group. To test the second and third hypotheses, Mann–Whitney U was conducted using participant race (African American, European American) as the independent variable and overall test anxiety score as the dependent variable (using $\alpha <=$ .05 cutoff for statistical significance). Follow-up analyses by individual test-taking anxiety subscales were conducted in a similar fashion. Next, z tests (i.e., using r-to-z transformation) were conducted to examine whether the correlation coefficients representing the relationship between global test-anxiety and neurocognitive performance was significantly different between ethnic groups. Given the number of statistical comparisons for hypotheses related to ethnic differences among measures of test anxiety, we adjusted our alpha level using false discovery rate (Benjamini & Hochberg, 1995) to control for Type I error. Instead of controlling for the chance of any false positives (e.g., Bonferroni method),

false discovery rate controls for the expected proportion of false positives within a total number of comparisons.

Results

Demographics

Although there were no significant differences between African Americans and European American on self-reported years of education or age, African Americans demonstrated significantly lower performance on the WTAR, Mann–Whitney U (1, 75) = 411.5, p = .04. There were no significant gender differences between ethnic/racial groups, $\chi^2(1, 75) = 3.27, p = .58$. Please see Table 1 for complete demographic information.

TAI Results

As hypothesized, in the overall group, there was a negative association between test anxiety and global cognition, such that higher test anxiety was associated with lower global cognitive performance, rs (74) = −.29, p = .01. Among the cognitive sources of anxiety subscales, concerns about test preparation was negatively associated with learning and memory performance, rs (74) =-27, p = .02. On the other hand, concerns about future security was positively associated with performance on measures of information processing speed, rs (74) = .26, p = .02. Among the behavioral expressions of anxiety subscales, general test-taking anxiety was positively associated with performance on measures of attention and working memory, rs (74) = .26, p = .02. There were no other statistically significant associations.

Test Anxiety by Ethnic/Racial Group

There was a statistical trend of test anxiety score differences between ethnic groups, Mann–Whitney U (1, 75), = 508.50, p = .06. Given that the Sources and Expressions components of the test anxiety inventory are considered separate, but related subscales, we examined racial/ethnic differences between subscales. Results revealed significant differences between the groups on the sources of anxiety, Mann–Whitney U (1,75) = 500.5, p = .05, but not expressions, Mann–Whitney U (1,75) = 566.0, p = .21. Follow-up analysis demonstrated that African Americans, relative to European Americans, reported significantly greater concern about negative performance evaluation, Mann–Whitney U (1, 75) = 456.0, p = .03. In other words, African Americans reported higher concerns about how others would view poor performance than European Americans.

Table 1
Sample Demographics and Results From Test Anxiety and Neurocognitive Measures

	African American (n = 40)	European American (n = 36)	F, χ^2, or U		
	M (SD) or %	M (SD) or %	value	p value	Effect size
Age	35.9 (12.8)	35.5 (9.6)	F = 1.01	.32	
Gender, % male	36%	63%	χ^2 = 13.7	<.001	
Education	14.8 (1.6)	14.9 (2.4)	F < 1.0	.99	
Currently in college	75%	70%	F < 1.0	.99	
Income			χ^2 = 6.25	.25	
Less than $6,000	9.7%	5.6%			
$6,000–$11,999	22.6%	35.9%			
$12,000–$24,999	9.7%	0			
$25,000–$49,999	45.1%	43.9%			
$50,000 or more	12.9%	14.6%			
Employment status			χ^2 = 4.56	.54	
Employed	32.3%	30.3%			
Unemployed	67.7%	69.7%			
WTAR (premorbid IQ) Scaled score	97.5 (16.4)	108.7 (11.7)	U = 411.5	.004	r^2 = 0.11
Overall test anxiety score[a]	15.4 (7.5)	12.2 (7.3)	U = 508.5	.06	r^2 = .04
TAI sources[b]	7.9 (4.7)	5.6 (3.1)	U = 500.5	.05	r^2 = .05
Concerns about others' view of poor performance	2.5 (1.4)	1.5 (1.0)	U = 456.0	.03	r^2 = .06
Concerns about self-image	2.1 (1.6)	1.6 (1.4)	U = 556.5	.17	r^2 = .02
Concerns about future	1.6 (1.5)	1.3 (1.2)	U = 587.5	.30	r^2 = .01
Concerns about not being prepared for a test	1.7 (1.6)	1.2 (1.1)	U = 561.5	.18	r^2 = .02
TAI Expressions[c]	7.5 (4.6)	6.6 (5.5)	U = 566.0	.21	r^2 = .02
Bodily reactions	1.8 (1.7)	1.8 (1.6)	U = 655.5	.79	r^2 = .0009
Thought disruptions	3.5 (2.4)	3.2 (2.8)	U = 597.0	.36	r^2 = .01
General test-taking anxiety	2.2 (1.4)	1.6 (1.5)	U = 541.5	.12	r^2 = .03
NC z-score[d]					
Global	−.07 (.46)	.06 (.43)	F = 1.8	.18	η^2 = .02
Attention/WM	.09 (.88)	−.17 (.72)	F = 2.0	.15	η^2 = .03
Info processing	−.14 (.96)	.02 (.71)	F < 1.0	.40	η^2 = .01
Learning/memory	−.11 (.90)	.08 (.68)	F = 1.13	.29	η^2 = .02
Executive	−.15 (.71)	.19 (.45)	F = 2.4	.11	η^2 = .02

Note. WTAR = Wechsler Test of Adult Reading; TAI = Test Anxiety Inventory; NC = Neurocognitive; WM = working memory.
[a] Total anxiety score (total possible score = 50). Higher scores represent more anxiety. [b] TAI Sources subscales (total possible score = 26). [c] TAI Expressions subscales (total possible score = 24). [d] Neurocognitive z-score. Higher positive values represent better performance.

Relationships Between Test Anxiety and Cognitive Performance by Ethnic/Racial Group

When data were stratified by ethnic/racial identity, differential relationships between test-related anxiety and neurocognitive performance emerged. Among the African American group, the overall total test-anxiety score was inversely related to global neurocognitive performance, r_s (38) = −.45, p = .01, which is consistent with the overall sample findings (see Table 2). Follow-up analyses by test anxiety subscales revealed that the inverse relationship between test anxiety and cognition was driven primarily by cognitive sources of test anxiety rs (38) = −.47, p = .02, and more specifically by concerns related to how others would view poor performance rs (38) = −.42, p = .02, and concerns about self-image rs (38) = −.38, p = .04. Among the individual cognitive domains, each of these significant negative associations between test anxiety and cognition was most strongly related to executive functioning in particular (ps < .05). In general, higher test-related anxiety was associated with lower cognitive performance among African Americans in this sample, and this test-related anxiety was most driven by specific cognitive concerns about how they might be perceived by others, particularly how others might view their poor performance and concerns about self-image.

For European American participants, a distinctly different pattern emerged. There was no significant relationship between cognition and overall test anxiety score. Follow-up analyses assessing the relationship between test anxiety subscales (i.e., cognitive sources and behavioral expressions) revealed a significant relationship between cognitive sources of test anxiety and global cognition, rs (34) = .40, p = .03, though the relationship was in the positive direction with higher cognitive sources of test anxiety being associated with better cognitive performance. Among the cognitive sources subscales, there was a positive relationship between concerns about the future and global cognition, rs (34) = .38, p = .04, a relationship that was driven mostly by executive functioning, rs (34) = .44, p = .03. In contrast, there was a negative association between concerns about test-preparation and cognition, such that higher levels of concern about test-preparation were associated with lower performance on tasks of learning/memory in particular, r_s (34) = −.46, p = .03 (see Table 3).

Follow-up analyses were conducted to determine whether the relationships between test-anxiety and cognition differed between ethnic groups. Results revealed that the correlation between global test-anxiety and neurocognitive performance was significantly different between groups, z (76) = −2.76, p = .003.

Table 2
Spearman Correlations Between Test Anxiety Subscales and Neurocognitive Performance Among African Americans (n = 40)

	Global	Attn/WM	Info	Lrn/Mem	Exec
Total anxiety score	−.45*	−.29	−.02	−.13	−.44*
Sources subscale (total)	−.47*	−.11	.07	−.19	−.32*
Concerns about how others will view	−.42*	.10	.22	−.12	−.36*
Poor performance					
Concerns about self-image	−.38*	−.27	−.15	−.08	−.31*
Concerns about future	−.13	.13	.28	−.18	−.21
Concerns about test preparation	.06	.03	−.20	−.14	−.09
Expressions subscale (total)	.10	.07	−.15	−.26	−.34
Bodily reactions	.06	.12	−.05	.11	.10
Thought disruptions	−.20	−.10	.04	−.32*	−.10
General test-taking anxiety	.009	.21	.004	−.34	−.15

Note. Attn/WM = attention/working memory; Lrn/Mem = learning/memory; Exec = executive.
* p < .05.

Table 3
Correlations Between Test Anxiety Subscales and Neurocognitive Performance Among European Americans (n = 36)

	Global	Attn/WM	Info	Lrn/Mem	Exec
Total anxiety score	.25	.29	.26	.08	.20
Sources subscale (total)	.40*	−.14	.07	−.11	.40*
Concerns about how others will view	−.03	−.29	.01	.08	.31
Poor performance					
Concerns about self-image	.11	.16	.18	−.13	.14
Concerns about future	.38*	.23	.22	.03	.44*
Concerns about test preparation	−.18	.07	−.07	−.46*	.20
Expressions subscale (total)	−.08	.13	.12	.15	.29
Bodily reactions	−.09	.36*	−.07	.03	−.25
Thought disruptions	−.03	.18	.15	.02	.06
General test-taking anxiety	−.02	.27	.18	.03	.23

Note. Attn/WM = attention/working memory; Lrn/Mem = learning/memory; Exec = executive.
* p < .05.

Discussion

The focus of the current study was to examine whether test/evaluative anxiety differed as a function of ethnic/racial group identity among a community sample of African American and European American adults. Our first hypothesis was supported such that test-anxiety related to negative performance evaluation was associated with lower neurocognitive performance, whereas anxiety unrelated to negative evaluation was associated with higher neurocognitive performance. These results are consistent with prior work that suggests that anxiety can either interfere or facilitate performance depending upon the source and severity of anxiety. Although physical distractions such as increased autonomic activity (e.g., sweaty palms and muscle tension; Birjandi & Alemi, 2010) can interfere with performance, this is likely influenced by negative self-evaluative statements and task-irrelevant thoughts.

Our second hypothesis was also supported in that African Americans reported significantly more test-related anxiety about negative performance anxiety than our European American participants. Although our results are generally consistent with prior work on ethnic/racial differences in test-related anxiety and stereotype threat theory (Steele et al., 1995), we would like to highlight some key differences between the current study and those that have elicited stereotype threat (e.g., Steele & Aronson, 1995; Thames et al., 2013). In studies of stereotype threat, the stereotype generally becomes activated explicitly (e.g., examinee

must indicate their race prior to testing, test instructions explicitly state that some groups do not do well), which results in underperformance. However, this study demonstrates that despite African Americans and European Americans performing similarly on cognitive testing (as demonstrated in the results), the sources of anxiety that are associated with poor performance differ for each ethnic/racial group. Our results suggest that African Americans may be more prone to fears about negative performance evaluation given existing stereotypes about intellectual inferiority, whereas for European Americans, perceptions of being ill prepared for a test is likely to interfere with optimal performance. We believe these findings build upon the work of stereotype threat rather than simply replicate prior findings. Study results provide greater insight into the components of anxiety that are salient for African Americans and European Americans. Again, our results demonstrated that both ethnic/racial groups reported experiencing anxiety in the test-taking context; however, the type of anxiety that was associated with lower cognitive performance differed between groups. If these fears are somehow activated (whether experimentally or contextually), underperformance is likely to occur for both groups. It can certainly be argued that stereotype threat emerged after our African American participants indicated their race on the demographic questionnaire, which in turn may have influenced their responses on the test-anxiety inventory. However, there are two reasons that we are less concerned that stereotype threat is the sole explanation for the current results. First, participants are instructed to report typical experiences with anxiety during test-taking as opposed to current experience. Therefore, responses reflect how participants usually feel in the context of test-taking. Had our African American participants responded to a questionnaire about current test-taking anxiety, we would then be more concerned that their responses were influenced by the activation of stereotype threat. Second, although African Americans may have concerns about negative performance evaluation, which is associated with lower cognitive performance, at the group level, this does not result in dramatic underperformance compared to European Americans (as demonstrated by studies of stereotype threat). Nevertheless, we cannot entirely rule-out that stereotype threat did not occur, which may have influenced participant responses on the test anxiety questionnaire. Given that this study examined performance on cognitive assessment, it remains unclear whether fears related to negative performance evaluation would transfer to other tasks or activities (e.g., athletic performance) of which positive stereotypes are attached.

When we stratified our data by race/ethnicity, it yielded unexpected, yet interesting results. Differential relationships between test anxiety and neurocognitive performance emerged between African Americans and European Americans. For European Americans, a positive correlation between test anxiety and neurocognitive performance emerged, which suggests that anxiety served as a facilitating effect. However, for European Americans, concerns about test preparation interfered with performance on learning and memory tasks. For African Americans, anxiety about how others would view poor performance and self-perceptions were the sources that were associated with lower neurocognitive performance. Further, for African Americans, thought disruptions also negatively affected neurocognitive performance in the domain of learning and memory. Given the nature of this research design, we cannot state whether or not anxiety interfered with neurocognitive performance, or, if African Americans were already more prone to anxiety, which amplified underperformance. However, given that the test anxiety measure was administered before the neurocognitive tests, we believe that the hypothesis that anxiety interfered with neurocognitive performance is likely and warrants further study.

The differential effects of anxiety and NP suggest that the source of anxiety rather than its mere presence should be considered when examining its impact. In other words, anxiety can work to enhance or interfere with performance on cognitive tests. Our results demonstrated that for African Americans, a major source of test-related anxiety pertained to fears of being judged negatively by others and self-image, which may represent the struggles that African Americans have faced with regard to negative stereotypes about intellectual incompetence in mainstream society. These findings are also in accordance with Smith and Kirby's (2001) appraisal theory, which describes a parallel process that occurs when appraising an anxiety-provoking situation that involves that activation of associative memories (related to the anxiety provoking stimulus) and a more slow deliberate reasoning process. Hence, African Americans may be more likely to recall memories related to receiving negative judgment, which in turn results in fears about negative performance evaluations by others.

Furthermore, we should highlight that most of our participants indicated that they were either in college, or had attended college; therefore, it is likely that high importance was placed on performing well. According to stereotype threat theory and research on anxiety and performance (Osborne, 2001; Steele, 1997), for these threats to occur, the examinee must place high importance on performing well. Although we did not directly assess the level of importance that participants placed on performance, this is a plausible explanation for the current results. In the context of standard clinical assessment, one could envision that patients who are selected to undergo neuropsychological testing are justifiably concerned about their cognition and—for the most part—are motivated to perform well. Therefore, it would be interesting to understand how sources of anxiety that are common among clinical settings (e.g., "Am I losing my memory?") interact with anxiety about negative performance evaluation.

Given that the study focus was on the assessment of test-related/evaluative anxiety, we did not assess general levels of anxiety (i.e., trait-based anxiety), which do not allow for us to make inferences about general levels of anxiety based-upon responses to the test anxiety scale. We also highlight that our overall sample generally reported mild-to-moderate levels of evaluative anxiety (highest total score reported was 28 out of 50); therefore, our results may differ in a sample of individuals who report high levels of evaluative anxiety. Again, our sample consisted of individuals with higher educational backgrounds. Therefore, it is possible that our sample of participants were accustomed to taking tests, which would lower their overall test-taking anxiety. Although many studies on ethnic/racial differences in neuropsychological test performance have reported significant differences, we did not find such effects. This could have occurred in our sample given their level of college attainment and possibility of having integrated classes throughout their education, which could have impacted their test performance. Our findings are likely to yield different results in a sample of older African American groups or those from

a different geographic region who may have not had such opportunities for higher education and exposure to testing.

A limitation of the current study is that these results only generalize to individuals who report mild-to-moderate levels of evaluative anxiety. Although this limits the generalizability of the findings, it is important to highlight the subtle effects of mild levels of anxiety on cognition, which adds to the extant literature on test anxiety and neurocognitive performance. We recognize that the relationship between test-anxiety and cognitive performance is purely correlational, and that it is possible that this relationship is influenced by some third variable that was not assessed in the current study. As mentioned previously, African Americans have been historical targets of negative stereotypes about intellectual inferiority; therefore, it is not surprising that this group would report higher levels of test-related anxiety. Although stereotype threat was not directly tested in the current study, it would be interesting to determine how stereotype threat may interact with self-reported test anxiety. Nevertheless, our results provide preliminary evidence that anxiety about negative performance evaluation should be consider when interpreting performance on neurocognitive testing.

Although our sample was generally younger, it would be interesting to understand how the effects of anxiety and fears of negative evaluation increase with age. Older African American adults are likely to have been exposed to more overt racial/ethnic prejudice over a longer period of time, which may create discomfort about being evaluated—particularly by a member of a different racial/ethnic group. Individuals raised in different geographic areas may have also experienced different dynamics of prejudice and discrimination based on race/ethnicity.

We should caution that the measure used to assess test-related anxiety did not assess the degree to which participants experienced various sources of anxiety; therefore, we were unable to examine whether severity of test-related anxiety correlated with neurocognitive test performance. The test anxiety measure used in the current study had a restricted range of scores, which may have contributed to our nonsignificant findings when examining the sample as a whole. Furthermore, the TAI is limited in that if an examinee endorses a particular statement as true, it does not further query about the impact. Adding Likert-scale items to this measure would help to address its current limitations. Although other measures of test-anxiety were considered for the current study (e.g., Spielberger's Test Anxiety Inventory), we elected for the TAI because items targeted specific concerns about how others would view poor performance, which is particularly important when examining performance among culturally diverse groups that may history of negative stereotypes about performance.

Furthermore, we did not assess whether our African American participants had real-life experiences of having test performance judged negatively by others. Although the incidence of overt discrimination has decreased in recent decades, microaggressions continue to persist (i.e., Morrison & Morrison, 2008). Microaggressions usually pertain to interpersonal interactions and have been described as brief daily verbal, behavioral, or environmental indignities, whether intentional or unintentional, that convey negative insults toward minority individuals (Sue et al., 2007). Overtime, microaggressions can impact an individual's self-perception in mainstream society and create anxiety surrounding evaluation. Thus, more information about test-related anxiety and its particular context is necessary for determining its impact in future studies. Furthermore, it is possible that certain individual (e.g., coping style) and contextual factors may increase one's vulnerability to stressful experiences, which in turn, may have influenced how anxiety is appraised and managed.

Despite these limitations, we feel that our results have important implications for neurocognitive assessment. First, our results demonstrate differential relationships between test-related anxiety and neurocognitive performance as a function of ethnic/racial identity. Second, our results demonstrate that the relationship between anxiety and neurocognitive performance is complex and that many factors that are intrinsic to the examinee (e.g., perceived discrimination level) and the testing situation should be considered when evaluating whether anxiety has an adverse impact. Although this study was conducted in a nonclinical sample, future studies may want to consider the impact of evaluative anxiety in a sample of individuals with clinical levels of depression or anxiety. In sum, our results identify another significant source of testing variance with particular relevance to ethnic minorities and support the practice of careful interpretation of test scores in these groups.

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