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Further exploration of the effect of "diagnosis threat" on cognitive performance in individuals with mild head injury

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Abstract

The present study further explored the phenomenon of "diagnosis threat" (Suhr & Gunstad, 2002), by examining the potential explanatory roles of anxiety, effort, and depression. Individuals with mild head injury history were randomly assigned to receive either neutral instructions (controls, $N = 25$) or to have attention called to their head injury history as a reason for invitation into the study (diagnosis threat, $N = 28$). Depression was measured at baseline. Following the neuropsychological battery, ratings of effort, test pressure, and state anxiety were completed. The diagnosis threat group performed worse than controls on attention/working memory, psychomotor speed, and memory tasks, but not on measures of executive functioning, post-test anxiety, or effort. Effort, anxiety and depression were not related to cognitive performance, nor did depression interact with expectations in explaining group differences in performance. Results provide further support for the "diagnosis threat" effect, but offer no support for effort, anxiety, or depression explanations for diminished performance. (*JINS*, 2005, *11*, 23–29.)

Keywords: Head injury, Memory, Expectations, Depression, Anxiety

INTRODUCTION

Stereotype threat research provides compelling evidence for the contribution of non-neurological factors to cognitive test performance. The assumption behind stereotype threat is that a member of a particular group, when faced with a task thought to be poorly performed by members of that group, feels threatened by the inferiority stereotype, which is assumed to interfere with his/her performance (Steele, 1997). While stereotype threat was initially identified as a factor contributing to observed cognitive differences between racial/ethnic groups, it has also been shown to affect cognitive performance in individuals from low socioeconomic backgrounds (Croizet & Claire, 1998), has been implicated as an explanation of sex differences on cognitive tasks (Leyens et al., 2000; Spencer et al., 1999; Walsh et al., 1999), and has been suggested as an explanation for cognitive decline in aging (Hess et al., 2003; Levy, 1996). Recently, Suhr & Gunstad (2002) applied the concept of stereotype threat to mild head injury. In that study, individuals with history of mild head injury told that they were selected for participation in a study examining the cognitive effects of head injury performed worse on measures of general intellect and memory, relative to matched controls who were unaware of the specific reasons they were selected for the study or the specific goal of the study, a phenomenon they called "diagnosis threat."

Steele (1997) suggested that stereotype threat calls up negative expectations for individual performance, leading to worse performance. Steele and colleagues (Steele, 1997; Steele & Aronson, 1995) have suggested that this effect is possibly mediated by increasing anxiety, causing distraction and/or less efficient cognitive processing, or by reducing effort provided on the cognitive tasks. There is evidence that anxiety and stress can lead to diminished cognitive performance (Baumeister & Showers, 1984; Gass, 2002; Gass et al., 1994; Gass & Daniel, 1990; Geen, 1991; Sarason, 1980). However, evidence for the relation of anxiety to cognitive performance under stereotype threat conditions is mixed at best, with several studies showing no relation (Aronson et al., 1999; Hess et al., 2003; Steele & Aronson, 1995), and others suggesting that anxiety may partially

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explain the effect (Osborne, 2001, Spencer et al., 1999). The role of motivation/effort in explaining the stereotype threat effect has been less frequently addressed. Given that recent neuropsychological studies have emphasized the role of decreased effort in cognitive test results of patients with head injury, depression, and chronic pain (Gervais et al., 2001; Green & Iverson, 2001; Green et al., 2001; Rohling et al., 2002; Suhr, 2003), effort is a variable worthy of more exploration. Within the stereotype threat literature, effort has been most commonly measured by self-report, with mixed findings. Steele and Aronson (1995) and Aronson et al. (1998) found no role for self-reported effort on testing in explaining the stereotype threat effect. However, Suhr and Gunstad (2002) found that self-reported effort was related to cognitive performance in individuals with a history of head injury who were exposed to "diagnosis threat." Results from studies inferring diminished effort based on qualitative patterns of performance also provide limited support of the role of effort in explaining stereotype threat. For example, Spencer et al. (1999) found that women subject to gender-based stereotype threat spent less time on individual math items, suggesting decreased effort. Hess et al. (2003) found that older adults who rated themselves as having personal investment in their memory and who were exposed to stereotype threat did less clustering on a verbal learning task, which they interpreted as consistent with either increased anxiety or decreased motivation/effort. To our knowledge, however, no studies in the stereotype threat literature have utilized cognitive tasks specifically designed to assess poor effort.

The present study presents a replication and extension of Suhr and Gunstad (2002), with a primary goal of examining the roles of anxiety and effort in explaining cognitive differences in persons exposed to diagnosis threat. Effort was assessed by both self-report and a cognitive measure of poor effort (the Word Memory Test; Green et al., 1996). We expected that individuals exposed to diagnosis threat would (1) perform more poorly on cognitive tasks; (2) rate themselves as being more anxious and providing less effort on cognitive tasks; and (3) perform more poorly on effort subtests of the Word Memory Test, relative to individuals exposed to neutral task instructions.

A second goal of this study was to examine the role of depressive symptoms in explaining diagnosis threat effects. Given the presence of negative cognitions in depressed persons (Clark, 2001; Clark et al., 1999; Gotlib & Neubauer, 2000), we hypothesized an interaction between depression and diagnosis threat, such that individuals with higher depressive symptoms subjected to diagnosis threat would perform worst on cognitive tests.

METHODS

Research Participants

Over 2000 undergraduates at a medium-sized Midwestern university completed a large screening evaluation. All participants received extra credit points in their psychology classes in exchange for their participation in the screening. The screening evaluation was approximately 60 min long and included a head injury history questionnaire. Participants with a history of self-reported mild head injury (with loss of consciousness of more than 1 min but less than 30 min), but without other self-reported history of neurological disease, current psychiatric diagnosis/treatment, learning disability, or attention deficit/hyperactivity disorder were selected from the larger sample. Approximately 17% of individuals from the larger sample met these criteria. A random sample of selected individuals were then contacted by phone with an invitation to participate in a study of undergraduate performance on various thinking and memory skills under different conditions. Approximately 81% of contacted individuals agreed to participate. Of the 53 undergraduates who participated, 28 were randomly assigned to the diagnosis threat group and 25 to the neutral group.

Measures

Psychological measures

Self-reported depression was assessed using the Beck Depression Inventory, Second Edition (BDI–II; Beck et al., 1996). Self-reported anxiety was assessed using the state version of the State Trait Anxiety Inventory (STAI; Spielberger, 1977). Self-reported anxiety was also assessed using a Likert-type scale asking individuals to rate how much pressure they experienced during testing, ranging from 1 (*no pressure*) to 9 (*very much pressure*). This item was also used in Suhr and Gunstad (2002).

Cognitive measures

Attention/working memory was assessed using the Digit Span, Letter Number Sequencing, and Mental Arithmetic subtests of the Wechsler Adult Intelligence Scale–III (WAIS–III; Wechsler, 1997). Psychomotor speed was assessed using the Digit Symbol subtest of the WAIS–III and the Trailmaking Test (TMT; Reitan, 1971) Part A. Memory was assessed using the Complex Figure Test recall trial (CFT; Rey, 1941) and the paired associates, free recall and delayed free recall subtests of the computerized version of the Word Memory Test (WMT; Green et al., 1996). Executive functioning was assessed using the Trailmaking Test Part B and the Wisconsin Card Sorting Test (WCST; Heaton et al., 1993) number of categories, number of failures to maintain set, and percent perseverative errors.

Effort measures

Effort was assessed in two ways: The first four subtests of the computerized version of the WMT were administered to objectively measure effort, and with a Likert-type scale asking individuals to rate how hard they tried on the cognitive tests, to measure self-reported effort, ranging from 1 (*not at all*) to 9 (*very hard*).

Procedure

The protocol was approved by the university's Institutional Review Board. Following informed consent, each participant completed the BDI–II. Then each person was randomly assigned to either the neutral or the diagnosis threat group, and each was given an envelope containing instructions appropriate to their group placement. See Appendix A for specific instructions for each group. All participants were instructed to read the contents of their envelope, return them to the envelope, and to keep the examiners unaware of what the instructions said. Thus, all examiners were unaware of group assignment at the time of testing.

After reading the instructions, participants participated in the neuropsychological battery, which included, in the following order, the WMT learning and immediate recognition trials, CFT copy trial, the TMT, the WAIS–III subtests, the WMT delay subtests, the WCST, CFT recall trial, and the long delay WMT subtest. Following neuropsychological testing, participants rated their effort during tasks and their sense of pressure during tasks. Finally, they completed the state version of the STAI.

Participants were then debriefed by providing information about the purpose of the experiment and more comprehensive information about the effects of mild head injury on cognitive performance. In addition, each participant was offered feedback about his/her individual performance if interested. Participants received extra credit points in their undergraduate psychology courses for their participation in the study.

RESULTS

Groups were different in age ($t(51) = 2.1$, $p < .05$), but were not different in years of schooling ($t(51) = 1.68$, *n.s.*). Although the age difference was significant, the range of ages in the participant population (see Table 1) was not large, and age did not correlate significantly with any of the neuropsychological measures. Sex distribution was not different among groups [$\chi^2(1) = 0.04$, *n.s.*], and groups were equally distributed with regard to handedness [$\chi^2(1) = 0.89$, *n.s.*]. The two groups were not different in baseline depression ($t(51) = 0.08$, *n.s.*; see Table 1). Based on study inclusion and exclusion criteria, all participants reported a history of one mild head injury, with greater than 1 but less than 20 min loss of consciousness, and greater than 1 but less than 30 minutes posttraumatic amnesia. None had a history of more than emergency room treatment for their head injury, and none had positive neuroradiological findings. The vast majority reported either no official diagnosis or diagnosis with concussion following their injury. None were currently involved in treatment or litigation related to their head injury. All experienced the injury at least 1 year prior to participation in the study. There was no difference in requests for feedback between the two groups; of the individuals exposed to diagnosis threat, 39.2% requested feedback about their results; 32% of the control group participants also requested feedback [$\chi^2(1) < 1$].

Prior to analysis, dependent variables were examined for assumptions of normality. Variables that violated these assumptions were transformed as follows: removal of outliers (CFT recall, TMT Part B), square root transformation (TMT Part A), and log transformation (STAI). Several variables could not be normalized by transformation (WCST number of categories and failure to maintain set; WMT effort subtests).

Table 1. Demographic characteristics of the study groups

Variable	Diagnosis threat $N = 28$	Neutral $N = 25$
Age (years; *M*, *SD*)	18.8 (0.7)	19.3 (0.9)
Education (years; *M*, *SD*)	13.3 (0.5)	13.9 (0.2)
Male (%)	43	40
Right Handed (%)	89	80

Performance on Neuropsychological Tests

Based on past studies, we predicted the diagnosis threat group would perform worse on memory, psychomotor speed, attention, and executive function tasks, relative to controls. This hypothesis was tested with a series of four MANOVAs, one for each cognitive domain (executive domain also included nonparametric tests to assess non-normal WCST variables). Follow-up one-tailed ANOVAs were conducted to clarify significant omnibus tests. Table 2 shows the mean and standard deviations for all neuropsychological variables for both groups.

Consistent with expectations, the MANOVA for memory showed a significant effect, [Wilks's lambda $F(4,46) = 2.34$, $p < .05$], with the diagnosis threat group performing worse on CFT delayed recall [$F(1,50) = 6.60$, $p < .01$], and WMT Paired Associates [$F(1,50) = 3.47$, $p < .05$]. Also consistent with expectations, the MANOVA for psychomotor speed showed a significant between-groups effect [Wilks's lambda $F(2,48) = 3.06$, $p < .05$], as the diagnosis threat group performed worse on the Digit Symbol test ($F(1,50) = 4.84$, $p < .05$). Between group differences also emerged for attention/working memory [Wilks's lambda $F(3,48) = 4.46$, $p < .005$], with the diagnosis threat group performing worse on all three tests ($p < .05$ to $p < .01$). No group differences emerged for executive functioning tasks (TMT Part B and WCST percent perseverative errors) [Wilks lambda $F(2,47) = 1.12$, *n.s.*]. Neither WCST number of categories (Mann-Whitney $U = 312.5$, $p = .10$), nor WCST failures to maintain set (Mann-Whitney $U = 337.0$, *n.s.*), were significantly different between groups.

Clinical Significance of Findings

In addition to statistical significance, we sought to determine whether diagnosis threat effects reach the level of

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Table 2. Performance on neuropsychological tests by study groups

Neuropsychological tests by domain	Diagnosis threat $N = 28$ M (SD)	Neutral $N = 25$ M (SD)
Memory		
CFT delayed recall[2]	18.8 (7.1)	23.2 (4.5)
WMT Paired Associates Subtest (percent)[1]	95.7 (6.2)	98.2 (3.5)
WMT Free Recall Subtest (percent)	68.4 (12.3)	70.1 (13.5)
WMT Delayed Recall Subtest (percent)	72.4 (11.9)	74.7 (14.0)
Psychomotor speed		
TMT speed to complete Part A	24.9 (9.1)	22.8 (6.6)
WAIS–III Digit Symbol ACSS[1]	11.6 (1.7)	12.8 (2.1)
Attention		
WAIS–III Digit Span ACSS[2]	9.8 (2.1)	11.4 (2.2)
WAIS–III Letter Number Sequencing ACSS[3]	10.3 (2.1)	12.2 (2.1)
WAIS–III Mental Arithmetic ACSS[2]	10.2 (2.2)	11.6 (2.1)
Executive functioning		
TMT speed to complete Part B	47.5 (9.9)	44.2 (12.0)
WCST number categories	5.8 (0.6)	6.0 (0.0)
WCST failure to maintain set	0.5 (0.8)	0.4 (0.7)
WCST percent perseverative errors	20.0 (8.8)	17.7 (6.4)

Note. CFT = Complex Figure Test. WAIS–III = Wechsler Adult Intelligence Test–III. ACSS = age corrected scaled score. TMT = Trailmaking Test. WCST = Wisconsin Card Sorting Test.
[1]$p < .05$ (one-tailed), [2]$p < .01$ (one-tailed) [3]$p < .005$ (one-tailed).

clinical significance. A task performance was considered clinically impaired if it fell greater than 1.5 standard deviations below the mean based on published norms for the task. Groups differed in the number of impaired performances [$\chi^2(1) = 7.43$, $p < .01$]; 46% of diagnosis threat and only 12% of control participants exhibited an impaired performance on at least one task.

Effort As a Mediator?

Contrary to predictions, no differences emerged between diagnosis threat and control groups on objective or subjective measures of effort. See Table 3. Due to significant non-normality of the first four subtests of the WMT, each was tested using Mann-Whitney *U*. None were significantly different between groups. ANOVA using the self-rating of effort as a DV was also failed to reach significance [$F(1,49) = 1.80$, *n.s.*].

The relationship between effort and cognitive test performance was examined independently for each group, using only those neuropsychological tests for which there were significant group differences. In the diagnosis threat group, self-rated effort was significantly correlated with CFT delayed recall ($r = -.54$, $p < .005$), while in the control group, self-rated effort was not significantly correlated with this test ($r = .19$). No other neuropsychological variable significantly related to effort ratings in either group. The only variable related to WMT effort measures was WMT paired associates, and these variables were highly correlated in both groups.

Anxiety As a Mediator?

Also contrary to predictions, no differences emerged in state anxiety or subjective pressure during testing [Wilks's lambda $F(2,50) < 1$; see Table 3]. No relationship emerged between anxiety/pressure and performance on tests in either group.

Interaction With Depression?

To examine whether depression interacted with diagnosis threat, we conducted two 2 × 2 MANOVAS (one for mem-

Table 3. Performance on effort and anxiety measures by study groups

Tests by domain	Diagnosis threat $N = 28$ M (SD)	Neutral $N = 25$ M (SD)
Anxiety measures		
STAI	33.8 (9.2)	34.6 (8.7)
Self-rated pressure during testing	4.9 (1.9)	4.9 (2.1)
Effort measures		
Self-rated effort during testing	7.6 (1.5)	8.1 (1.0)
WMT Immediate Recall percent	99.3 (1.6)	99.5 (1.6)
WMT Delayed Recall percent	99.0 (1.6)	99.3 (1.4)
WMT Consistency Percent	98.7 (2.2)	99.0 (1.9)
WMT Consistency 2	95.9 (5.8)	97.8 (3.8)
WMT Paired Associates consistency	95.9 (6.7)	98.4 (4.3)

Note. STAI = State Trait Anxiety Inventory (state version). WMT = Word Memory Test.

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ory, one for attention), using both group status and depression (median split on the BDI) as between subjects factors. For the memory MANOVA, there was no main effect for depression [Wilks's lambda $F(4,46) < 1$], and no significant interaction between Depression × Group Status [Wilks's lambda $F(4,46) = 1.03$, *n.s.*]. For the attention/working memory MANOVA, there was no main effect for depression [Wilks's lambda $F(3,48) = 1.29$, *n.s.*], nor was the depression/group status interaction significant [Wilks's lambda $F(3,48) < 1$].

To further test the possible contribution of depression to diagnosis threat effects, a logistic regression analysis was conducted. Neuropsychological impairment (as defined above) was employed as the dependent variable, and group status, depression (high *vs.* low as defined above) and the Group by Depression interaction were independently entered on successive steps. Results showed no significant effect for depression or the group by depression interaction. Within the control group, 25% of the participants with low depressive symptoms met the definition of impairment, while none of the participants with high depressive symptoms did. Within the diagnosis threat group, 44% of the participants with low depressive symptoms met the definition of impairment, while 50% of the participants with high depressive symptoms did.

Finally, BDI scores were correlated with neuropsychological test performance (on only those measures showing significant differences between groups), separately by group. Depression did not correlate with any variables in either group.

DISCUSSION

The present results support the basic finding from Suhr and Gunstad (2002) that expectations regarding diagnosis can influence neuropsychological test performance. Consistent with prior findings, participants exposed to diagnosis threat performed worse on memory measures than participants given neutral test directions. Participants exposed to diagnosis threat also performed worse on measures of attention/working memory and psychomotor speed compared to controls, suggesting diagnosis threat effects may not be limited to memory tasks. These findings are consistent with Steele's (Steele, 1997; Steele & Aronson, 1995) suggestion that stereotype threat can lead to distractibility and poor cognitive efficiency.

Contrary to the findings of Suhr and Gunstad (2002), no difference in self-reported effort emerged between diagnosis threat and control groups. Furthermore, no differences emerged on objectively-measured effort, and effort was unrelated to cognitive performance in both diagnosis threat and control groups. These findings suggest that effort does not account for the between-group differences seen in the present sample. Future studies should continue to examine the role of effort in diagnosis threat effects using both subjective and objective measures, as ruling out suboptimal effort is crucial in understanding the causes of individual's poor test performance.

Our findings also offer no support for anxiety in explaining the diagnosis threat effect. Diagnosis threat and control groups did not differ in self-reported anxiety or test-related pressure, and these measures did not correlate with cognitive test performance in either group. However, the study may be limited by the absence of a baseline measure of state anxiety. High levels of state anxiety at the onset of testing, particularly test-related anxiety, may be expected to adversely impact test performance. In addition to assessing baseline anxiety and utilizing measures specific to test-related anxiety, future studies should also consider measuring anxiety using physiological measures (e.g., blood pressure, electrodermal responding) rather than relying on self-report. For example, Blascovich and colleagues (2001) found African Americans under stereotype threat conditions performed worse on a cognitive task and showed higher blood pressure readings, suggesting increased physiological arousal during cognitive testing.

Finally, the present study found no synergistic effect in depressed persons exposed to diagnosis threat information. However, the study was limited in its assessment of depression by using only a self-report measure of depressive symptoms and further limited by using participants specifically screened for the presence of psychological disorders. Although there was adequate range in scores on the BDI–II (0–17), scores did go above the mild depression range in the present sample. It is possible that depression plays a role in diagnosis threat when present at clinically significant levels; additional studies should be conducted to test this possibility.

The present study is limited in its generalizability. Participants were attending college and were relatively healthy. No participants were receiving clinical or legal services for their head injury, which were based on self-report and were specifically selected to be mild and chronic injuries. None were currently diagnosed with or receiving treatment for any psychological disorders. It would be important to attempt to replicate this study in a community sample, with a broader range of socioeconomic status, cognitive abilities, depression/anxiety symptoms, and life experiences, and perhaps to include participants with more significant head injuries (providing that the data was gathered outside of the clinical context, for ethical reasons).

Despite these possible limitations, the present study raises some interesting questions about the way individuals use clinical information. First and foremost, what causes diagnosis threat? In the present study, head-injured persons exposed to diagnosis threat performed more poorly on cognitive testing than matched controls, despite no differences in effort, anxiety, or depression, variables often raised as potential mediators of the stereotype threat effect. However, Wheeler and Petty (2001) make a strong argument that activation of automatic cognitive/ behavioral schemas related to a stereotype may explain much of the stereotype threat effect, rather than affect/motivational changes due to experience of a personal threat. Their argument is consistent with literature showing that stereotype threat effects are often seen even in individuals who are not members of the stereotyped group (see Wheeler & Petty, 2001, for a comprehensive review). Their explanation suggests that individuals *without* a personal history of head injury may also respond with diminished cognitive performance after exposure to the diagnosis threat information; future studies should examine whether individuals without head injury history are indeed susceptible to activation of a head injury stereotype in such a manner. However, this theory does not preclude a larger diagnosis threat effect in those with head injury history, as the information may be more accessible to those with personal experience with head injury, and such individuals may place more importance on the behavioral outcomes in a cognitive evaluation. Indeed, Steele (1997) argues that, for stereotype threat to be activated, the threat must be personally salient and meaningful. In addition to including control groups with no head injury history, future studies may employ a prospective design, allowing researchers to gather information before and after exposure to diagnosis threat, or expose individuals to positive as well as negative stereotypes about head injury.

Second, what are the clinical implications of diagnosis threat? In our sample, nearly one-half of head-injured persons exposed to diagnosis threat exhibited at least one clinically-impaired test performance, despite their high level of current functioning. Although the present findings do not indicate that diagnosis threat alone can explain fully the presence of cognitive impairments in these individuals, the findings do suggest that health care providers need to consider a patient's premorbid knowledge and expectancies about head injury and its cognitive consequences, and the role they may play in evaluation.

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Appendix A

DIRECTIONS GIVEN TO PARTICIPANTS IN EACH GROUP

Neutral Group

"When the experimenter returns to the room, he/she will ask you to complete a brief collection of common neuropsychological tests. These tests will assess skills such as attention, memory, speed of information processing, problem solving skills, etc. Some of the tests are easy, and some are more difficult. Please give your best effort on all tests. Questions about individual tests can be answered following the testing."

Diagnosis Threat Group

"You have been invited to participate in this study because of your responses to one of the questionnaires included in the mass screening at the beginning of the quarter. Your responses indicated a history of head injury/concussion. A growing number of neuropsychological studies find many individuals with head injuries/concussions show cognitive deficits on neuropsychological tests. Deficits in areas such as attention, memory, and speed of information processing are common—though other deficits sometimes emerge. This study examines the role that head injury may play in these cognitive areas to better understand the nature of the disorder. When the experimenter returns to the room, he/she will ask you to complete a brief collection of common neuropsychological tests. These tests will assess skills such as attention, memory, speed of information processing, problem solving skills, etc. Some of the tests are easy, and some are more difficult. Please give your best effort on all tests. Questions about individual tests can be answered following the testing."