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Abstract

Stereotype threat and solo status have both been found to negatively affect the academic performance of African-Americans. However studies have not simultaneously investigated the potential deleterious effects of both factors. This experiment tested for the potential accumulative effects of both factors and posits that the combined effect if stereotype threat and solo status is greater than either factor alone. Results supported this hypothesis. Black students' performance was lowest when both factors were present compared to the performance of Black students in either condition as well as the control condition. White students' performance was relatively stable across all the conditions.

Introduction

There is a persistent disparity in academic test performance between African-American and white students. Even after controlling for backgrounds and education, the achievement gap still persists (Jenks & Philips, 1998; Massey, Charles, Lundy, & Fischer, 2003). Several reasons for these differences have been postulated, such as socioeconomic disadvantages (Bereiter & Engelmann, 1966; White 1982), cultural differences (Boykin 1986; Ogbu 1986), and genetic differences in intelligence (Benbow & Stanley, 1980; Hernstein & Murray, 1994), but one that deserves considerable attention is *stereotype threat* (Steele & Aronson, 1995), a pattern of internalizing negative stereotypes of performance inferiority; which adversely affects actual performance on a particular task.

Stereotype threat is a psychological dynamic that is related to negative stereotypes about a particular group's performance in a certain domain. Steele & Aronson (1995) found that African-American students did not perform as well as their white peers on a task that was described as indicative of intellectual ability. However, when the task was not described as indicative of intellectual ability, African-American students performed better than those in the previous condition and performed well as their white peers, thus invalidating the stereotype of intellectual inferiority of African-Americans. The researchers believed that this was due to the fact that African-American participants under the diagnostic condition were worried that they would confirm a negative stereotype of intellectual inferiority, and this "anxiety" caused them to underperform, thus confirming the negative stereotype. Anxiety of underperformance, thus, becomes a self-fulfilling prophecy supporting the negative stereotype.

Stereotype threat is a negative and pervasive self-fulfilling prophecy that has been

documented for a myriad of groups in a multitude of domains. For example, stereotype threat can affect the academic performance of Hispanics (Gonzales, Blanton, & Williams, 2002), white men in sports (Stone, Lynch, Sjomerling & Darley, 1999), women in negotiation (Kray, Galinsky, & Thompson, 2002), and homosexuals in providing childcare (Bosson, Haymovitz, & Pinel, 2004). Stereotype threat not only hampers performance but also reduces an individual's sense of belonging within a particular domain (Good, Rattan, & Dweck, 2008) and reduces how much an individual values a domain (Steele, 1997). Essentially, stereotype threat can have negative effects for an individual in a situation in which a stereotype of poor performance is expected.

Currently, researchers have turned their attention toward creating methods and interventions to reduce the effects of stereotype threat. Such approaches include informing an individual about stereotype threat before starting a task (Johns, Schmader, & Martens, 2005), emphasizing an incremental view of intelligence (Aronson, Fried, & Good, 2002; Good, Aronson, & Inzlicht, 2003), and encouraging self-affirmation (Schimel, Arndt, Banko, & Cook, 2004; Walton & Cohen, 2011). These studies have gained attention because they aim to reduce the achievement gap between disadvantaged minorities and their white peers and the gender gap in math-and-science related tasks. This claim, however, has been met with criticism and skepticism. For example, Sackett et al. (2004) found that in Steele and Aronson's initial experiment, an achievement gap still persisted in the non-stereotype threat conditions, thereby demonstrating that simply focusing on reducing stereotype threat will not eliminate the achievement gap. Furthermore, Steele and Aronson even said that it is a misinterpretation that the results from their initial study demonstrate that reducing stereotype threat eliminates the achievement gap between African-Americans and whites (Sackett et al., 2004).

A second factor that has shown to affect minority performance is *solo status* (Sekaquaptewa & Thompson, 2002; Lord & Saenz, 1985), which occurs when an individual is the only representative, or perceives him or herself to be, the only representative of his or her race and gender in an otherwise homogenous group (Lord & Saenz, 1985; Murphy, Steele, & Gross, 2007). For example, being the only woman in a predominately male engineering firm, or being the only African-American in a predominately white classroom. The term *solo status* was coined by sociologist Rosabeth Kanter, whose research found that women in predominately male occupations had lower job performance and often felt isolated (Kanter, 1977). Solo status decreases performance because individuals feel highly scrutinized and ostracized (Lord & Saenz, 1985) and tokenized (Niemman & Dovidio, 1998). Furthermore, research has shown that solo status has negative effects on individuals of disadvantaged groups (Yoder & Sinnett, 1985; Sekaquaptewa & Thompson, 2002). For example, a study found that solo women were less likely than solo men to participate in a group task and more likely to report low expectations about performance (Cohen & Swin, 1995; Stangor, Carr, & King 1998). Thus, experiencing solo status may be detrimental to disadvantaged groups such as women and racial minorities. However, solo status seems to have a negative impact only if an individual is performing a task in public. One study found that solo status did not adversely affect women's performance on a task when it was performed in private (Inzlicht & Ben-Zeev, 2000). In contrast, solo status did have an effect when female participants performed a task in front of an audience (Sekaquaptwea & Thompson, 2002). Though one may speculate that stereotype threat may stem from solo status, research has shown that they are both distinct, independent dynamics (Sekaqueaptewa & Thompson 2003; Steele & Aronson, 1995). Little research has focused on the dual impact of solo status and stereotype threat, although, there is some evidence that solo status can exacerbate the effects of

stereotype threat (Sekaqueptewa & Thompson, 2003). However, solo status has been found to have adverse effects even in stereotype-irrelevant domains (Sekaqueptewa & Thompson, 2002), so simply reducing stereotype threat may not eliminate the achievement disparity.

This study seeks to test the dual impact of stereotype threat and solo status on African-Americans. Indeed, African-Americans tend to be hyperaware of the negative expectations about their group, and to considerably overestimate the extent to which mainstream society sees them as less intelligent (Sigelman & Tuch, 1997). Consequently, when African-American students are in an evaluative situation such as in an academic setting, they are likely to experience an additional degree of risk not experienced by non-stereotyped students (Aronson, 2004). Furthermore, being the sole member of socially disadvantaged group in particular contexts can be a negative experience, and studies have found that African-Americans underperform in otherwise all-white groups compared to same race groups (Sekaquaptewa & Thompson, 2002). Similar effects have been found for African-Americans in work and academic settings where they are the only person of their race (Sackett, DuBois, & Noe, 1991; Niemman & Dovidio, 1998). Although the dual impact of stereotype threat and solo status has been found in women (Sekaquaptewa & Thomspson, 2003), no research has examined the dual effects on African-Americans despite the literature suggesting this possibility. I hypothesize that the combined effects of stereotype threat and solo status will have a greater negative impact on African-American participants' intellectual performance than either stereotype threat or solo status alone.

Method

Sample

A total of 82 black and white students from Southern Methodist University participated in this study in exchange for course credit or monetary compensation. 40 participants were African-American (29 Females, 11 Males) and 42 of the participants were White (37 Females, 5 Males). 80% of all participants were female. All 82 participants were randomly assigned to the four experimental conditions.

Design

The experiment used a 2 x 2 x 2 factorial design. The first independent variable was stereotype threat. Participants were administered a test that was presented as either diagnostic of intellectual ability (stereotype threat condition) or as a laboratory tool for studying "psychological processes" (non-stereotype threat condition). The second independent was solo status. Participants were shown two photos indicating that they were the only African-American/White participant in their test group (solo status condition) or that they are one of several African-American/White participants in their test group (non-solo status condition). The third was the race of the participant. Responses on items drawn from the Verbal GRE and 5 difficult anagram problems were utilized to measure the dependent variable, test performance.

Procedure

The participants were recruited through the human subject pool of the Department of Psychology at Southern Methodist University, campus advertisements targeting student groups, social media outlets, and referrals. Participants were given a choice of receiving extra credit in a psychology class or monetary compensation. All participants will be told that the purpose of the study was to assess the cognitive processes of verbal reasoning. Before participants arrive at the lab, they were sent a series of demographic questions as well as questions assessing their verbal ability and enjoyment of verbal oriented classes. This restriction was imposed because we wanted participants who identified with being "verbally competent" and valued their verbal ability. This distinction is important because previous research suggests that the effects of stereotype threat are limited to individuals who value their ability in a particular domain (Steele, 1997). Furthermore, participants were asked if they are familiar with GRE and whether they took the GRE. This restriction was set to lower the chance that a participant in the sample will have a particular advantage.

When the participants reported to the lab, they were greeted by an experimenter. First, the experimenter asked the participants to complete a consent form. Soon after they read and signed the consent form, the participants were asked to have their photo taken. They had a choice to decline, and their choice was not contingent on whether they were excluded from the experiment. However, whether they agreed to have their photo or not, the participants were shown two other photos of people whom the experimenter told the participants were two other participants

involved in the study. In this way, participants learned of his or her status, either as a solo (shown opposite-race photo) or non-solo (shown same-race photo). The experimenter further explained that the participant's scores would be compared to the other two participants in order to compute a percentile score in comparison to their peers. This creates a formal evaluative setting, a necessary requirement for solo status (Sekaquaptewa & Thomspson, 2002). Participants were then administered a series of questionnaires. First, participants were asked to complete a 5-item questionnaire designed to measure whether they had low or high expectations about the task, as the effect of solo status on performance has been found to be mediated by low performance expectations (Stangor, Carr & Kiang, 1998; Sekaquaptewa & Thompson, 2002).

Second, participants were asked to fill out a demographics form designed to manipulate stereotype threat. In the stereotype threat condition, participants were asked a question to indicate their race while in the non-stereotype threat condition such a question was absent.

After the initial questionnaires, the experimenter told the participants about the verbal reasoning task. The description of the task the participants were given differed depending on the experimental condition. In the diagnostic condition, the experimenter told the participants in that the study was concerned with verbal reasoning ability and the test is a genuine measure of verbal ability, intelligence, and competency. The participants were further told that the score on the task will also reflect how well they would on the actual GRE as well as other standardized tests. In the non-diagnostic condition, the experimenter told the participants that the purpose of the study is to understand the psychological processes involved in solving verbal problems and the results of the task will not reflect their actual verbal ability.

However, in both conditions, the experimenter stressed that the test will be very difficult and they should not expect to get many questions correct. This will be done because in order for

stereotype threat to occur the task has to be perceived as difficult (O'Brien and Crandall, 2003; Ben-Zeev et al. 2004; Keller, 2007).

Participants were then given 15 minutes to complete a challenging verbal reasoning test consisting of 10 multiple choice items taken from the verbal section of the Graduate Record Examination (GRE) as well as 5 difficult anagrams.   They were informed when they had 5 minutes left. Sample questions from the GRE have been used in a variety of studies involving stereotype threat (Steele & Aronson, 1995; Spencer, Steele, & Quinn, 1999; Brown & Josephs, 1999) and the GRE has been found to be a valid predictor of academic performance (Kuncel, Hezlett, & Ones, 2004).

Participants then completed a post-experimental word-fragment completion task in order to measure the activation of stereotype threat (Steele & Arosnon, 1995). Finally, participants were probed for suspicion and debriefed.

Measures

Test Performance. The primary dependent measure is participants' performance on 10 verbal items taken from GRE study guides as well as 5 anagram problems constructed by the primary investigator. The test consisted of five item multiple choice sentence equivalency and five text completion questions. Both the total number correct over the number attempted will be analyzed (Steele & Aronson, 1995). A preliminary version of the verbal reasoning test was given to a small group of undergraduates (n = 10) in order to assess the difficulty of it. Unlike the version used for the study, this did not contain any anagram questions. The students correctly answered an average portion of .52 of the items correctly. The student also rated the difficulty of the verbal reasoning task on a scale from 1-10. The students found the test to be very difficult, (M = 7.7)

Stereotype activation. Participants performed a word fragment completion task. The task will be made of 15-20 word fragments with missing letter specified as blank spaces (e.g. _ _ C E). Participants were asked to add letters to complete the word. The fragments had one possible solution reflecting a race related construct associated with African-Americans. Participants were told to work quickly and spend no more than 15 seconds per word-fragment. This task has shown to measure the cognitive activation of racial constructs that are recently primed (Steele & Aronson, 1995; Spencer et al., 1998; Stone, 2002).

Performance Expectations. Participants completed a questionnaire that measured whether they had low or high expectations about the task. Participants indicated on a 5 point Likert scale to the following statements: "I expect this test will be difficult" "I feel stressed about this test" "I wish I had a chance to take a practice test" "I believe this test will be biased"

Results

Test Performance

Participants' performance on verbal task was determined by calculating how many questions they answered correctly over how many they attempted. The overall performance scores were analyzed in a 2 (stereotype threat condition) x 2 (solo status condition) x 2 (race) ANOVA (Analysis of Variance). Gender and age were controlled. Examining the two ANOVA subsets for white and black students revealed systematic differences in how the experimental conditions affect test performance. As was predicted, there was a significant effect for participants race and stereotype threat (F=84.58, p=<.0001).   Black students in the stereotype threat condition performed significantly worse (M = 0.319, SD = 0.061) than Blacks in the no-

threat condition (M = 0.597, SD = 0.042), while the performance of white students did not differ by stereotype threat (F=0.19, p=0.6687).

In regards to solo status, analysis showed that there was significant effect between participants race and solo status (F=56.05, p=<.0001) Blacks performed more poorly as solos (M = 0.358, SD = 0.123) than as non-solos even when stereotype threat was not present. Conversely, for whites there was an effect between race and solo status (F= 4.29, p=0.0452). For whites, performance actually improved under solo status (M = 0.565, SD = 0.125) compared to whites in the control group (M = 0.452, SD = 0.109) although this is slightly significant.

Black students under both stereotype threat and solo status condition performed worse than Black students in either condition (M = 0.175, SD = 0.079). This shows that the combination of these two factors leads to an additive effect on Black students' performance (F=3.17, p=0.0837). When both factors were absent, Black students performed better than black students in the three other conditions, and actually performed better in comparison to white students in all four conditions including the control group (see table 4 and 5). Overall, white students performed better (M = 0.495, SD = 0.154) than black students (M = 0.361, SD = 0.172). However, this was to be expected given the experiment was designed to elicit such differences between races.

Table 1

Source	DF	Anova SS	Mean Square	F Value	Pr > F
African-Americans	1	0.36781366	0.36781366	24.93	<.0001
Whites (Solo Status)	1	0.03243021	0.03243021	2.20	0.1424
African-American (Solo_Status)	1	0.42424990	0.42424990	28.76	<.0001
Whites (Stereotype Threat)	1	0.38205000	0.38205000	25.90	<.0001

Source	DF	Anova SS	Mean Square	F Value	Pr > F
African-American (Stereotype Threat)	1	0.16450750	0.16450750	11.15	0.0013
Whites (Solo Status and Stereotype Threat)	1	0.00000000	0.00000000	0.00	1.0000
African-American (Solo Status and Stereotype Threat)	1	0.03483013	0.03483013	2.36	0.1287

Table 2

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Solo Status	1	0.09715238	0.09715238	4.29	0.0452
Stereotype	1	0.00405734	0.00405734	0.18	0.6745
Solo Status and Stereotype	1	0.00724690	0.00724690	0.32	0.5750

Table 3

| Source	DF	Anova SS	Mean Square	F Value	Pr > F
Solo Status	1	0.35952773	0.35952773	56.05	<.0001
Stereotype Threat	1	0.54250016	0.54250016	84.58	<.0001
Solo Status and Stereotype Threat	1	0.02030315	0.02030315	3.17	0.0837

Table 4
Performance score means and standard deviations showing the interaction between solo status, stereotype threat and race

Race	Solo and Stereotype Threat	Stereotype Threat	Solo Status	Control
Black	0.175 S.D. 0.079 (10)	0.319 S.D. 0.061 (11)	0.358 S.D. 0.123 (9)	**0.597** S.D. 0.042 (10)
White	0.520 S.D. 0.158 (10)	0.439 S.D. 0.220 (8)	0.565 S.D. 0.125 (11)	**0.452** S.D. 0.109 (13)

Note : Sample size appears in parentheses

Table 5

Test Scores by Race and Experimental Condition
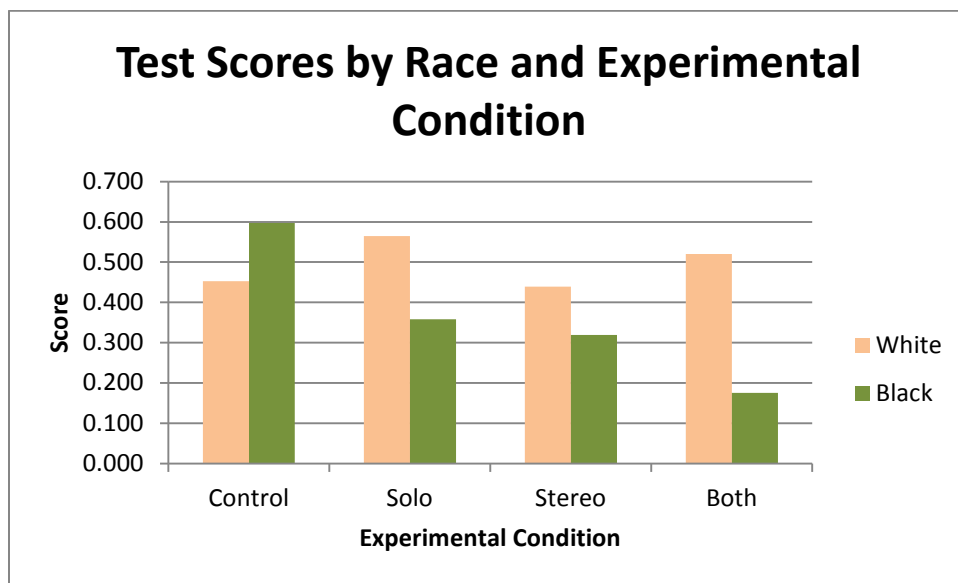
Pre-Test Expectations

We conducted several regression analyses on individual questions (difficulty, stress, bias, and tricky) of the pre-test expectations questionnaire to see if there was an interaction between any of the questions and the experimental condition solo status. We then conducted whether the overall score of performance expectations was meaningful predictor.

Difficulty

Results showed that there was no significant interaction between the variable difficulty and solo status (F=0.17, p=0.6844). Although there was trending evidence that perceived difficulty was affected by stereotype threat for both whites (F=5.14, p=0.0263) and African-Americans (F=5.35, p=0.0235), but they both miss the cut off for statistical significance.

Table 6

Source	DF	Type III SS	Mean Square	F Value	Pr > F
RACE	1	0.93946488	0.93946488	1.36	0.2466
Solo_Status	1	0.00000689	0.00000689	0.00	0.9975
Stereotype	1	3.53921984	3.53921984	5.14	0.0263
RACE*Solo_Status	1	0.11468590	0.11468590	0.17	0.6844
RACE*Stereotype	1	3.68493843	3.68493843	5.35	0.0235
Solo_Stat*Stereotype	1	0.90215268	0.90215268	1.31	0.2561
RACE*Solo_St*Stereot	1	0.43347882	0.43347882	0.63	0.4301

Stress

From the analysis, we did not find any evidence that stress was meaningful predictor for African-Americans under solo status (F= 0.15, p=0.6960).

Table 7

Source	DF	Type III SS	Mean Square	F Value	Pr > F
RACE	1	0.22608696	0.22608696	0.26	0.6102
Solo_Status	1	0.12630977	0.12630977	0.15	0.7031
Stereotype	1	0.00235914	0.00235914	0.00	0.9584
RACE*Solo_Status	1	0.13269708	0.13269708	0.15	0.6960
RACE*Stereotype	1	0.11372436	0.11372436	0.13	0.7176
Solo_Stat*Stereotype	1	0.08394957	0.08394957	0.10	0.7559
RACE*Solo_St*Stereot	1	0.12315889	0.12315889	0.14	0.7066

Tricky

We found no evidence that whether participants perceived the task was tricky was a meaningful predictor for African-Americans under solo status (F=0.52, p=0.47475).

Table 8

RACE	1	0.28127090	0.28127090	0.24	0.6231
Solo_Status	1	0.43619340	0.43619340	0.38	0.5407
Stereotype	1	0.00122846	0.00122846	0.00	0.9741
RACE*Solo_Status	1	0.59691632	0.59691632	0.52	0.4745
RACE*Stereotype	1	0.01785139	0.01785139	0.02	0.9014
Solo_Stat*Stereotype	1	0.07060115	0.07060115	0.06	0.8054
RACE*Solo_St*Stereot	1	0.00595235	0.00595235	0.01	0.9430

Biased

We concluded that there is no evidence that perception of bias was meaningful predictor for

African-Americans under solo status (F=0.12, p=0.7346).

Table 9

Source	DF	Type III SS	Mean Square	F Value	Pr > F
RACE	1	0.00133779	0.00133779	0.00	0.9719
Solo_Status	1	0.34939816	0.34939816	0.33	0.5699
Stereotype	1	0.34033903	0.34033903	0.32	0.5749
RACE*Solo_Status	1	0.12419369	0.12419369	0.12	0.7346
RACE*Stereotype	1	0.11073420	0.11073420	0.10	0.7489
Solo_Stat*Stereotype	1	0.19004016	0.19004016	0.18	0.6750
RACE*Solo_St*Stereot	1	0.57533309	0.57533309	0.54	0.4662

Overall Score

We did not find that performance-expectations measure was a meaningful predictor. The

correlation between score and pre-test expectations was -0.09 (p = 0.41). We have no evidence

there was a significant relationship between a participants score and the participant's pre-test

expectations. With this, we conclude the pre-test expectations measure was not sensitive to the

experimental conditions.

Table 10

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Difficulty	4	0.08780498	0.02195124	0.69	0.6022
Stress	3	0.05070721	0.01690240	0.53	0.6629
Tricky	4	0.03168864	0.00792216	0.25	0.9095
Biased	5	0.34775216	0.06955043	2.18	0.0667

Discussion

This experiment investigated whether or not African-Americans exposed to both solo status and stereotype threat would have lower performance compared to African-Americans who were exposed to only one of the factors. As predicted, both factors were found to negatively impact the performance of African-Americans, but when both factors were activated, they had an additive negative effect on the performance of African-Americans. In sum, performance was lowest for African-Americans when both factors were activated.

The results show that both factors are indeed distinct in regards to the performance of African-Americans. Furthermore, the results also showed that the performance of African-Americans could still be negatively impacted even when negative stereotypes were not made relevant. However, it could be argued that because participants were in a testing situation that stereotypes were made relevant regardless. A study done by Johnson & Richeson (2009) found that racial minorities who were solos did not differ in persistence on a cognitive task from racial minorities who were not solos. However, the authors speculated this most likely occurred because the task did not activate negative stereotypes. Perhaps, in this experiment, the evaluative situation of the task led negative stereotypes to be activated, but the negative effect was transmitted through the conduit of solo status. Additionally, although participants were in a evaluative situation, the situation was not necessarily public, which is another requirement for solo status (Sekaquaptewa & Thompson, 2002).

Even though performance expectations have been found to be mediating factor for solo status (Sekaquaptewa & Thompson, 2002), the pre-test expectations form that was designed for this study did not find that African-Americans under solo status were more likely to have low expectations concerning the task. However, the same study also found that although pre-test

expectations were a mediating factor, its effect was not statistically significant. In fact, the experimenters surmised it could actually be one of many factors that mediate solo status. Moreover, the self-report made for this current study was not standardized and was not tested to determine validity. Additionally, our stereotype threat activation measure was not sensitive to any of our experimental conditions. A similar measure has been found to measure stereotype threat (Steele & Aronson, 1995). However, it might be the case, that if race was made more salient for participants in the stereotype threat condition, the results might have differed. For example, if in addition to telling participants that the verbal task was aimed to be diagnostic, participants were told that the verbal task was concerned with the racial differences in verbal reasoning.   Another limitation to address is that the sample size was relatively small and therefore the results are not appropriate for generalizing.

In spite of the limitations, the additive effect of solo status and stereotype threat on performance has important implications. First, both situational factors are likely to occur in academic settings where performance is of course important. However, interventions aimed to lessen the effects of stereotype threat are not designed to lessen the negative effects of solo status. This means even when an intervention aimed to alleviate the negative effects of stereotype threat is implemented stigmatized minorities such as African-Americans are still likely to underperform due other situational factors, because reducing the deleterious effect one factor many not ameliorate the negative effects of another factor. Indeed, this study showed that African-American's performance can be impaired by solo status even when stereotypes were not made relevant, and moreover the fact there was no interaction effect between the two factors does indicate that they affect performance using independent methods. Therefore, investigators who aim to improve academic outcomes for stigmatized minorities such as African-Americans

should look for multiple environmental factors that can impair performance. Future study needs

to be done to further investigate the relation between the two factors and current interventions

should be modified in order to alleviate the negative effects of stereotype threat as well as solo

status.

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