Is Stereotype Threat Always a Bad Thing? An Exploration of the Impact of Stereotype Threat on Math and Language Performance

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Approval

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Table of Contents

List of Tables and Figures

Abstract

Previous stereotype threat (ST) research has shown how it, and its interaction with participant gender, can impair performance in various areas including math and language. Although negative ST effects are influenced by task difficulty, potential task order effects have not been assessed. The current study explored the influence of task order and task difficulty on ST (versus control) effects measured on math- and language-based tasks. Results from sixty-eight participants (61 females: M_{age} = 22.93, *SD* = 8.45; 7 males: M_{age}= 34.71, *SD* = 17.03) showed that women in the ST condition performed significantly better in the math task than women in the control condition when controlling for the covariate of perceived competency in math. Further, a significant interaction between task type and threat condition suggested that when controlling for perceived competency, women in the ST condition performed better on math tasks compared to women in the control condition, while the opposite can be seen for the language tasks. These results suggested that the presence of ST may improve female math performance if they are comfortable with math. Future research is needed to explore the effects of comfort/perceived ability levels in math and language areas and how they impact performance in ST and control conditions.

Is Stereotype Threat Always a Bad Thing? An Exploration of the Impact of Stereotype Threat on Math and Language Performance

Societal stereotypes can have both profound and subtle impacts on many domains of life such as athletics, occupation choices, and academics (Kahalon et al., 2020; Kalokerinos et al., 2017; Nix et al., 2015). This is particularly true of gender stereotypes. For example, Heinze et al. (2017) examined how beliefs surrounding gender roles and norms influence a child's participation in athletic activities. In an online study, parents or legal guardians were asked about the cost of sports that their children were currently or previously enrolled in, their beliefs of the benefits of sports for different genders, and their different gender role beliefs. Results showed that in addition to the parents' ratings that sports benefitted boys more than girls, the parents who held strong, traditional gender role beliefs were more likely to consider sports a predominantly male-centered domain and were more supportive of their son(s)' participation than their daughter(s)' (Heinze et al., 2017). Gender stereotypes also impact individuals' occupation choice. In the Science, Technology, Engineering, and Mathematics (STEM) fields, most jobs are occupied by men while other fields, such as healthcare, early education, and domestic roles, are overly represented by women (Kahalon et al., 2020). It has been suggested that the gender gaps in some athletic and occupational domains is the result of negative gender stereotypes and the belief in, or identification with, these stereotypes (Kahalon et al., 2020).

Stereotype threat (ST) is a stereotype that is negative in nature and is supported by the actions or features (i.e., gender, race.) of an individual or a group of individuals (Steele & Aronson, 1995). This stereotype is acknowledged and confirmed by non-threatened and threatened individuals and often results in a negative evaluation of others

or a negative self-evaluation (Steele & Aronson, 1995). Research demonstrates the negative impact of ST on self-esteem (Casad et al., 2019), sense of belonging (Pietri et al., 2019), academic/occupational performance (Hutter et. al, 2019), and occupation selection (Schuster & Martiny, 2017). Since ST has been found to have such a profound impact on academic performance of both men and women in various academic areas (Pansu et al., 2016; Deemer et al., 2014; Shaffer et al., 2013), as will be discussed shortly, the current study will examine potential ST effects in an academic setting.

According to Watson et al. (2017), gender-based ST occurs from an incongruence between an individual's expected role and their actions/behaviours. These researchers examined why there were fewer male singers engaged in New Zealand school choirs compared to females. Watson et al. (2017) recruited 12 choirs across different schools in New Zealand (i.e., mixed choirs, all boy choirs, and all girl choirs) and randomly assigned the choirs to one of two conditions: the ST condition (i.e., performed in front of the whole school) or the non-ST condition (i.e., performed in front of a group of arts peers). Both groups were judged on their performance and choir members were asked to complete a self-evaluation questionnaire that assessed their perceived vocal competency, performance quality, self-worth, and cognitive interference (Watson et al., 2017). Women in both the ST and the control conditions reported that they were not concerned about what their peers, both men and women, may think about them being a woman in a school choir. However, men in the ST condition reported that they more concerned they would be judged by men who were not a part of the choir (Watson et al., 2017). There was no significant difference found in observed performance between genders (Watson et al., 2017). Therefore, it was concluded that the ST experienced by these young men was not

a result of the pressure received from the director to perform well, but from the perception of judgement from out-group male peers (Watson et al., 2017). Since this finding suggests that ST may be a result of conflicts with gender role conformity, it helps to explain the lack of men in helping professions since men are perceived to have less compassion for others than women (Kahalon et al., 2020).

There are other instances in which men have reported experiencing ST in domains that were predominantly female based. Kalokerinos et al. (2017) found that male primary-teachers reported experiencing significantly more ST than their female counterparts upon being exposed to the stereotype that men lack the traits (i.e., being nurturing and gentle) to succeed in such a job. As a result, men reported lower job satisfaction and commitment compared to their female coworkers who did not report experiencing such feelings. They also found that male child protection workers felt the impact of ST when they had to engage in an upward social comparison (i.e., comparing themselves to others who have higher authority) with another caseworker, leading to an increase in turnover rates for male child protection workers only (Kalokerinos et al., 2017). Lastly, these men also felt they were expected to perform more masculine duties which also resulted in an experience of ST (Kalokerinos et al., 2017).

As mentioned previously, ST effects also have negative implications academically. Specifically, ST negatively impacts academic performance for women in domains such as science (Deemer et al., 2014) and math (Nix et al., 2015), and negatively impacts reading ability in men (Pansu et al., 2016). Furthermore, it not only affects how an individual performs on a task, but also their perception of how they believe they will perform or have performed (Nix et al., 2015). In a longitudinal study, Nix et al. (2015)

showed that both men and women rated themselves as being similarly confident in their perceived ability to perform well on general and verbal challenges. However, females rated their perceived ability to perform well on math tasks significantly lower than that of their male peers (Nix et al., 2015). This finding suggested that the stereotype that women underperform compared to their male counterparts on various math tasks was accepted and believed by the women in this study, and resulted in a diminished belief in their abilities, despite how well they may be able to perform.

Although biology is considered a female-centered domain, physics is an area of science that is considered a male-centered domain (Sunny et al., 2017). This apparent gender gap in different areas of science may also be caused in part by the presence of ST. Deemer et al. (2014) conducted a study in which they asked students who were enrolled in a chemistry or physics lab course to complete an online questionnaire regarding their thoughts and perceived ability in the science courses they were enrolled in. Furthermore, the researchers asked women about their intentions to pursue a career in science (Deemer et al., 2014). The researchers told participants that gender differences were found to be present in the field of physics, with men performing better than women. On the other hand, they also explained that no gender differences were found for chemistry related courses or labs. The results showed that female undergraduate students who were physics and chemistry majors experienced differential effects with regard to ST. Upon being questioned about their capabilities in the science course they were enrolled in, those enrolled as physics majors were indirectly negatively affected by ST when it came to deciding on a career in the science field (Deemer et al., 2014). Those enrolled as chemistry majors, however, showed no negative repercussions of ST when it came to

deciding on a career (Deemer et al., 2014). These findings are similar to those found by Sunny et al. (2017) which showed that the presence of ST had no significant impact on the performance of women who were enrolled in chemistry courses. Since academic ST regarding women is mainly centered around math performance, these findings may help explain the difference between physics, chemistry, and biology, since physics is more math-based than the latter.

Although ST effects can affect men as equally as women, many ST effects studied are surrounding women's underperformance on STEM-based tasks, specifically math. Shaffer et al. (2013) examined how women performed when exposed to positive and negative stereotypes relating to math performance among genders. They found that men in the control group performed significantly better on math related questions compared to their female counterparts (Shaffer et al., 2013). They also found that women performed significantly worse on math-based questions compared to men when told that women were significantly underrepresented in STEM fields and that success rates were unequal to that of men (Shaffer et al., 2013). On the other hand, when women were presented with the positive stereotype that stated women were able to succeed in STEM fields and that women were becoming more prominent in this field, they performed as well as men (Shaffer et al., 2013).

Previous research supports the notion that women perform more poorly than men in various academic fields. However, there are areas of academia where women are affected positively by stereotypes and the performance of men is negatively impacted by ST. Pansu et al. (2016) set up a study where they separated a class of third grade children into two groups; children who were told that a reading task was being treated as a test

(i.e. ST condition) and children who were told that a reading task was being treated as a game (i.e., control condition). They found that boys in the ST condition performed significantly worse than girls on an animal naming task. However, in the control condition, boys performed similar to girls (Pansu et al., 2016). Thus, in the absence of a ST, boys possess the ability to perform as well as girls on reading tasks. The current study will utilize math and language tasks to study the impact of stereotype threat on performance between men and women. Unfortunately, very little research has been conducted on the effects of ST on reading performance of adult males.

Task difficulty has also been found to have an impact on performance in the presence of ST. For example, Keller (2007) investigated the relationship between ST, domain identification (i.e., the degree to which one forms a relationship between themselves and a specific field or domain), and task difficulty on math-based tasks across gender. Specifically, the researcher asked high school students to complete a math test in the same format they would in any normal testing situation. Students were randomly assigned to either the ST condition or the control condition. Two weeks prior to testing, the researcher administered a personal questionnaire that asked students personal questions, including questions regarding their identification with mathematics. Upon completion of the math test, the researcher found that women who had a high domain identification with math who were placed in the ST condition performed significantly worse when given difficult math question as opposed to easy math questions while being compared to men (Keller, 2007). They also found that in the absence of ST, women with high domain identity performed better on difficult math questions than women in the ST

condition who were under the same conditions (i.e., high domain identification and difficult math questions) (Keller, 2007).

These findings were similar to those of Neuville and Croizet (2007), who conducted a similar study but with both males and females and used gender identity activation (i.e., bringing awareness to one's gender) as a variable. The researchers found that girls in the gender-identity activation condition performed better on an easy task than boys. However, girls in the gender-identity activation who were given a difficult task performed worse than boys in that same condition (Neuville & Croizet, 2007). These studies suggest that in some cases, ST may not play as crucial a role in determining success in math performance as task difficulty does.

Although previous studies (Petzel & Casad, 2020; Marx, 2019; Allison et al., 2017) examined the effects of ST, gender, and task difficulty on performance, they did not assess, or control for, the potential impact of order effects (i.e., the main effects and interaction of task and difficulty order of completion). In a review of the ST literature, Pennington et al. (2016) suggested that future research should counterbalance testing instruments to control for order effects. The current study will use task type (math versus language), task order (threat condition completed first or last), and task difficulty (easy versus difficult) to examine the potential impact(s) of ST across genders. To the best of my knowledge, this study will be one of the first to consider task order effects with regard to ST research.

Based on previous research, it was hypothesized that:

1. In the ST condition, men will perform better than women on math tasks and women will perform better than men on language tasks.
2. Task difficulty will modify the ST impact, with increasing difficulty interacting with ST effects to negatively impact performance.
3. Task difficulty and task order will interact to impact any ST effect and negatively impact performance.
4. Gender will impact interactions involving task type as men are predicted to outperform women on math tasks and vice versa for language tasks.

Method

Participants

Of the complete questionnaires received, there were a total of 73 responses recorded. However, some of these responses were eliminated due to their inability to be included in the analysis (i.e., 3 non-English speakers, 1 gender fluid individual, and one non-binary individual). Therefore, 68 participants (M_{age} = 24.16, *SD* = 10.17) from both Memorial University of Newfoundland's Grenfell Campus, and the general population, participated in this study. Of these participants, 61 identified as female (M_{age} = 22.93, *SD* = 8.45) and 7 identified as male (M_{age} = 34.71, *SD* = 17.03). However, due to an uneven gender split, we were unable to examine the effects of gendered ST on performance and therefore further excluded all male responses from our analyses. Therefore, the following analyses were conducted using the sample of 61 female participants only.

All participants were recruited through social networking sites (i.e., Facebook), posts made through Grenfell Campus's Psychology Majors and Minors page, the Participant Pool for psychology students (see Appendix A), and a poster that was posted online with the written posts (see Appendix B).

Materials

All participants completed an informed consent form, a questionnaire and received a debriefing form. All study materials were completed online via Qualtrics.

Informed Consent Process. All participants were required to complete a standard informed consent process (see Appendix C). However, language regarding ST or expected gender effects were not described to reduce any bias in responding.

Instructions (Stereotype Threat Manipulation). As is typical in similar experiments, participants who were randomly assigned to the stereotype threat condition were told that their performance on both math and language tasks would be compared to their male and female peers (Davies et al., 2016) (See Appendix F).

Questionnaire. The questionnaire consisted of 48 multiple-choice and fill-in-the-blank questions broken down into 3 parts: demographic, math, and language questions (See Appendix D). First, participants were asked a series of demographic questions, including gender, education level, and age. They were also asked about their math ability and perceived competency, and language ability and perceived competency. Next, participants were instructed to complete 20 math questions, divided into two sections: hard math questions (e.g., estimations, logic questions, and intuition questions) and easy math questions (e.g., formulae and algorithms) (Davies et al., 2016). Finally, participants were asked to complete 20 language questions. For the language questions, participants were given questions where they were asked to identify which two words out of a set of five words had the same meaning. Participants were given easy language-based questions (i.e., similar meanings were obvious, words were common) and hard language-based questions (i.e., similar meanings were less obvious, words were not ones used in everyday language).

Debriefing Form. The debriefing form (see Appendix E) thanked participants for their participation and then informed them that the researchers had withheld information from them to obtain true results. It then listed the information that was withheld. Next, participants were provided with a definition of what ST was and different strategies to avoid experiencing stereotype threat. The contact information was listed for the main

researcher in case there were any questions or concerns about the study. The information for the ethics committee was also included in case the participant had any ethical questions or concerns about the study. Lastly, it listed contact information of personnel at Counselling and Psychological Services (CPS) for Grenfell campus and listed mental health services for those in the general public in case the study raised some personal issues for some participants. The participants were asked not to disclose any information with individuals who may be interested in participating in the study.

Procedure

Participants were randomly assigned to either the stereotype threat condition or the control condition. All participants were given a questionnaire that contained any of the following combinations of questions:

First Completed	Second Completed	Third Completed	Fourth Completed
Hard math	Easy math	Easy language	Hard language
Easy math	Hard math	Hard language	Easy language
Hard language	Easy language	Easy math	Hard math
Easy language	Hard language	Hard math	Easy math
Hard math	Easy math	Hard language	Easy language
Easy math	Hard math	Easy language	Hard language
Hard language	Easy language	Hard math	Easy math
Easy language	Hard language	Easy math	Hard math

Results and Discussion

Hypothesis 1: Stereotype threat conditions will impact performance on the math and language tasks.

Table 1

Descriptive Statistics for Overall Performance on Math and Language Tasks across Control and ST Conditions

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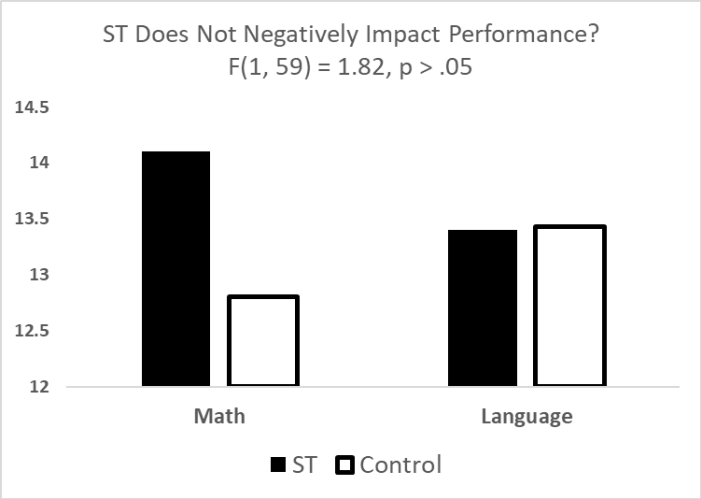
Task Type	*M*	*SD*	*n*	95% CI
Math				
Control	12.77	4.74	30	[11.17, 14.36]
ST	14.10	3.96	31	[12.53, 15.66]
Total	13.44	4.38	61	[12.31, 14.55]
Language				
Control	13.43	2.39	30	[12.56, 14.31]
ST	13.35	2.40	31	[12.49, 14.22]
Total	13.39	2.38	61	[12.78, 14.01]

A mixed 2 (task type; math vs. language) x 2 (condition; ST vs. control) ANOVA examined overall performance on math and language tasks across both conditions. There was no significant main effect of condition on performance, $F(1,59) = 1.82$, $p = .183$, $n^2 = .03$. As observed in Table 1, women in the ST condition performed better on math-based tasks compared to the women in the control condition. Although the findings were not significant, it is interesting to note that these findings are opposite of previous research, which suggests that in the absence of negative stereotypes, women perform better than they would if they had been presented with a negative stereotype pertaining to their ability to perform well on math-based tasks (Shaffer et al., 2013). Regarding performance on the language task, women in the ST condition performed worse than women in the control group. Again, although no significant main effect was found between condition and performance, $F(1,59) = 1.82$, $p = .183$, $n^2 = .03$, these differences in average performance on language tasks are opposite of previous research, which suggests that women hold strong beliefs in their ability to perform well on language and reading tasks, resulting in greater performance in the ST condition than the control condition (Muntoni et al., 2021).

Figure 1

Women's Overall Performance on Math and Language Tasks



In an effort to determine whether percieved competency levels played a role in the unexpected performance differences across conditions, a mixed 2 (task type; math vs. language) x 2 (threat condition; ST vs. control) ANCOVA was conducted, controlling for percieved competency of math ability. Table 2 presents the descriptive statistics overall math and language performance on related questions across ST and control conditions when controlling for perceived competency levels.

Table 2

Descriptive Statistics for Overall Performance on Math Tasks across Conditions when Controlling for the Covariate of Perceived Competency

Condition Type	*M*	*SD*	*n*	95% CI
Control	12.65	4.74	30	[11.35, 13.96]
Stereotype Threat	14.28	4.01	30	[12.98, 15.58]
Total	13.47	4.41	60	[12.55, 14.39]

The covariate, percieved compentency of performing math tasks, was significantly related to women's overall math performance, $F(1,56) = 38.54$, $p < .001$, $n^2 = .41$. A significant main effect of task type was also found, $F(1,56) = 11.07$, $p = .002$, $n^2 = .17$. The covariate, percieved competency of performing language tasks, was not significantly related to women's overall language performance, $F(1,56) = 0.03$, $p = .857$, $n^2 = .00$. This suggests that when controlling for the covariate of percieved competency of completing math tasks, women actually do better in the ST condition if they percieve their math ability to be high. To examine where the significant differences were within the ANCOVA, appropriate post-hoc tests were conducted. A *t*-test on the adjusted means

from the covariance analysis revealed a significant higher performance score for the ST group compared to the control group on overall math score, $t(58) = 2.32$, $p = .043$.

Hypothesis 2: Task difficulty will modify the ST impact, with increasing difficulty interacting with ST effects to negatively impact performance.

A mixed 2 (task type; math vs. language) x 2 (task difficulty; easy vs. hard) x 2 (condition; ST vs. control) ANOVA was conducted to examine whether task difficulty interacted with ST conditions to impact performance on both math and language tasks. There was no significant interaction between task difficulty, task type, and ST effects, $F(1,57) = 0.02$, $p = .898$, $n^2 = .00$. Participants in the ST condition performed better on the hard math task ($M = 6.71$, $SD = 2.12$) than participants completing the hard math task under control conditions ($M = 6.10$, $SD = 2.67$).

As presented in Table 3 and Figure 2 below, when women completed the hard math task, performance was better than when they completed the hard language task. However, the opposite can be seen for the easy difficulty. Task difficulty was significantly related to task type, $F(1,57) = 131.94$, $p < .001$, $n^2 = .70$. A significant main effect of task difficulty was also found, $F(1,57) = 193.54$, $p < .001$, $n^2 = .77$.

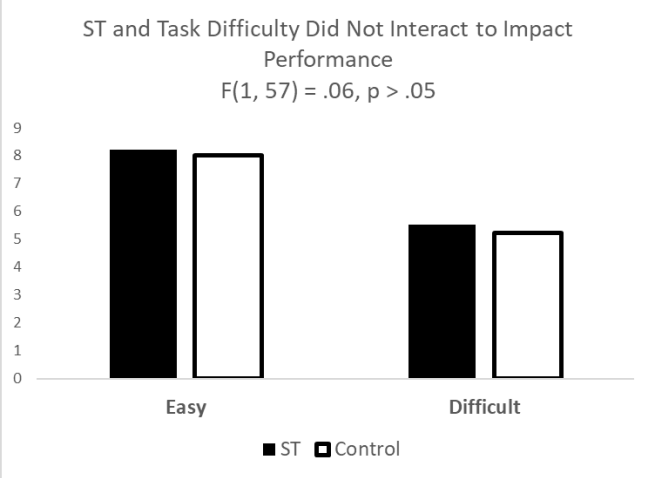
Table 3

Descriptive Statistics for Difficulty-Related Performance Differences across Conditions

Condition Type	Easy Math	Easy Language	Hard Math	Hard Language
Control				
M	6.67	9.17	6.10	4.27
SD	2.67	0.87	2.67	1.96
n	30	30	30	30
95% CI	[5.78, 7.55]	[8.86, 9.47]	[5.22, 6.98]	[3.53, 5.00]
ST				
M	7.39	9.10	6.71	4.26
SD	2.17	0.79	2.12	2.07
n	31	31	31	31
95% CI	[6.51, 8.26]	[8.80, 9.40]	[5.85, 7.57]	[3.53, 5.00]

Figure 2

Task Performance Based on Task Difficulty



Hypothesis 3: Task difficulty and task order will interact to impact any ST effect

A mixed 2 (task order; math first vs. language first) x 2 (task difficulty; hard vs. easy) x 2 (task type; math vs. language) x 2 (threat condition; ST vs. control) ANOVA was conducted to examine how task order interacts with ST, task difficulty, and task type, to see how performance is impacted. Tables 4 and 5 shown below present the descriptive statistics for the interactions of threat condition, task order, and task difficulty for math and language performance, respectively. There was no significant interaction found between task order, task difficulty, task type, and threat condition, $F(1,57) = 0.55$, $p = .462$, $n^2 = .01$. See appendix G for a complete list of F scores and their significance values.

Table 4

Descriptive Statistics for the Interactions of Threat Condition, Task Difficulty, and Task Order and Their Impact on Math Performance

Condition Type	Difficulty	Order	*M*	*SD*
	Easy			
	M = 7.39	**Math First**	7.63	1.98
Stereotype Threat	*SD* = 2.17	*n* = 19		
M = 14.10	*n* = 31	**Language First**	7.00	2.49
SD = 3.96	**Hard**	*n* = 12		
n = 31	*M* = 6.71	**Math First**	6.79	2.27
	SD = 2.12	*n* = 19		
	n = 31	**Language First**	6.58	1.93
	Easy	*n* = 12		
	M = 6.67	**Math First**	7.18	2.86
	SD = 2.67	*n* = 11		
Control	*n* = 30	**Language First**	6.37	2.59
M = 12.77	**Hard**	*n* = 19		
SD = 4.74	*M* = 6.10	**Math First**	6.09	2.81
n = 30	*SD* = 2.67	*n* = 11		
	n = 30	**Language First**	6.11	2.66
		n = 19		

Table 5

Descriptive Statistics for the Interactions of Threat Condition, Task Difficulty, and Task Order and Their Impact on Language Performance

Condition Type	Difficulty	Order	*M*	*SD*
	Easy			
	M = 9.10	**Math First**	9.00	0.88
Stereotype Threat	*SD* = 0.79	*n* = 19		
M = 13.35	*n* = 31	**Language First**	9.25	0.62
SD = 2.40	**Hard**	*n* = 12		
n = 31	*M* = 4.26	**Math First**	3.89	2.16
	SD = 2.07	*n* = 19		
	n = 31	**Language First**	4.83	1.85
	Easy	*n* = 12		
	M = 9.17	**Math First**	9.64	0.50
	SD = 0.87	*n* = 11		
Control	*n* = 30	**Language First**	8.89	0.94
M = 13.43	**Hard**	*n* = 19		
SD = 2.39	*M* = 4.27	**Math First**	4.73	1.68
n = 30	*SD* = 1.96	*n* = 11		
	n = 30	**Language First**	4.00	2.11
		n = 19		

General Discussion

Past research has found evidence to support that when faced with ST, women underperform on math tasks compared to men (Nix et al., 2015). It was also found that when given easy and hard tasks under ST, women underperform compared to men (Davies et al., 2016). However, research examining the positive effects of ST and its interaction with task difficulty to positively impact performance is limited. Furthermore, the role of task order within ST studies have no been considered in previous research. The purpose of this study was to explore the effects of ST, gender, task difficulty, and task order on performance of math- and language-based tasks. Unexpectedly, none of the four hypotheses were supported. The first hypothesis that ST conditions will impact performance on the math and language tasks, was not supported. The results of the first analysis found that there were no significant differences between women in the ST and control conditions. There was, however, an interesting difference in overall means between women in the control and ST conditions. Women in the ST condition performed better overall on the math task than women in the control condition. To understand why these results were found, an ANCOVA was conducted to control for the perceived competency levels of participants when completing math tasks. These results revealed that when controlling for competency levels, overall performance on the math task was significantly related to perceived competency levels. It was found that the ST mean was higher when controlling for perceived competency levels as opposed to not including perceived competency levels in the analysis, suggesting that perceived competency levels impact performance on math tasks for women in the ST condition.

The finding that perceived competence positively impacts performance under ST could be further explained by research conducted by Taillandier-Schmitt et al., (2012), where they found that by initiating self-affirmation (i.e., getting the students to write about their values and a time when they had displayed those values) in a group of female nursing students, they were able to perform better in the self-affirmation condition as opposed to the control condition on tasks involving dosage calculation tasks for medication. They also found that women who were placed in the self-affirmation group performed better in the threat condition (i.e., telling the students that an incorrect dosage could be life-threatening and that women are not as good as men at doing this type of calculation) as opposed to the women in the control condition (i.e., telling the students that an incorrect dosage could be life-threatening, however, it is a normal nursing practice) under the threat condition. This suggests that when a unique set of values are brought to their awareness, women will use those values as motivation to perform well in the face of adversity. Therefore, it is a possibility that the women in this study hold a unique set of values (e.g., intelligence, equality, hard work) and therefore use those values to motivate themselves to do better in the presence of ST.

Similar to the findings of Tailender-Schmitt et al., (2012), Leitner et al. (2013) conducted a study where they gave females positive feedback after completing a math task under ST conditions. These females were more likely to engage with future math tasks than females in the no-threat condition and those who received negative feedback (Leitner et al., 2013). Although previous research is limited regarding the use of positive test feedback in ST testing scenarios (Leitner et al., 2013), this finding suggests that

under ST conditions, if the correct answers are outlined opposed to the incorrect ones, this may motivate women to continue doing math, despite being told they cannot do it.

The second hypothesis that task difficulty will modify the ST impact, with increasing difficulty interacting with ST effects to negatively impact performance, was not supported. The results of this study found that there was no significant interaction between task difficulty, task type, and threat condition. Although it was not significant, women in the ST condition performed better on the hard math tasks than women completing hard language tasks under ST conditions. Further, women in the ST condition performed better than women in the control condition on the hard math questions. These results are not reflective of previous research, which suggests that completing more difficult math tasks will impact women's performance, resulting in them disproportionately suffering compared to their male peers (Neuville & Croizet, 2007).

On the other hand, these findings are supported by Pennington et al. (2019), where they conducted a study in which women were asked to participate in a working memory interference study. They found that women's accuracy, latencies, and math performance did not significantly differ as a result of task difficulty under the ST condition (Pennington et al., 2019). In fact, they found that ST improves performance on simple interference tasks. This suggests that ST may have positive impacts on performance in various academic areas, since it may help facilitate motivation to do well (Pennington at el., 2019).

The third hypothesis that task difficulty and task order will interact to impact any ST effect, was not supported. Since this is the first ST study known to incorporate the effects of task order on performance, it is unknown whether this finding was similar or

unlike previous studies. It is possible that task order has no effect on ST effects. This may be due to the differences of the tasks being studied. Since math and language have unique and separate skill sets, the performance of the task and thoughts associated with the perceived performance on one may not impact performance or thoughts on the other. However, it is important to continue research into this area since the effects may be present and more prominent in a larger, more focused study, examining solely the effects of task order on ST effects and their combined impact on overall performance.

The fourth hypothesis, that gender will impact interactions involving task type as men are predicted to outperform women on math tasks and vice versa for language tasks, was unable to be tested due to a largely unequal gender split, resulting in the exclusion of all male participants from the analysis. By doing so, the interaction of ST and gender could not be examined in a holistic view because research was not able to be conducted on how ST affects male performance on language tasks. Therefore, a full understanding of whether ST has the potential to be beneficial for males was not reached.

Having to carry out the study in an online atmosphere posed as another limitation. Since this study used testing scenarios in an online situation where participants were not being actively monitored, it runs the risk of cheating and therefore could provide unrealistic results. Students may have used answer websites, math notes, or asked others for help.

Conclusion

The current study examined how ST threat interacted with gender, task difficulty, and task order to impact performance on math and language tasks. Using a questionnaire

that contained math and language questions of varying difficulties and orders, the results showed that perceived competency levels may interact with ST to have a positive impact on performance. It was also found that task difficulty did not interact with ST on these tasks. If future research finds that ST impacts are reduced when one feels confident or competent, then education could be implemented in schools and/or workplaces to lessen the effects of ST on work or school performance.

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Appendix A

Honours Facebook Post/E-mail/Brightspace Post

Facebook

Hey everyone! As a part of my program requirements at Grenfell Campus, Memorial University of Newfoundland, I am conducting a study on the potential differences in performance between math-based and language-based tasks as a function of various demographic variables, including age, gender, level of education, and geographic location. This study is completely anonymous and voluntary. In order to participate, you must be 19 or older or considered a mature minor (e.g., a university student). This study has been approved by an ethics review process in the psychology program at Grenfell Campus, Memorial University of Newfoundland and has been found to be in compliance with Memorial University's ethics policy as well as Tri-council Policy on Ethics. If you have ethical concerns about the research, you may contact the chairperson of the GC-REB at gcethics@grenfell.mun.ca. If you are interested in participating in my study, you can click on the link below. Thank you so much!

INSERT LINK AND POSTER

E-mail

Hello everybody. My name is Kristen Seymoure and I am a 4th year Psychology (Hons) student here at Grenfell Campus. As a part of the program requirements for psychology, I am conducting a study on the potential differences in performance between math-based and language-based tasks as a function of various demographic variables, including age, gender, level of education, and geographic location. For participation in this study, Grenfell students will receive a 0.5% bonus mark in any participating psychology courses. This study is completely anonymous and voluntary. To participate, you must be 19 or older or considered a mature minor (i.e., a university student). If you are interested in participating in my study, you can click on the link below. If you have any questions you can contact me at ksseymoure@grenfell.mun.ca or my supervisor, Dr. Peter Stewart, at pstewart@grenfell.mun.ca. This study has been approved by an ethics review process in the psychology program at Grenfell Campus, Memorial University of Newfoundland and has been found to be in compliance with Memorial University's ethics policy as well as Tri-council Policy on Ethics. If you have ethical concerns about the research, you may contact the chairperson of the GC-REB at gcethics@grenfell.mun.ca. Thank you so much!

(INSERT LINK AND POSTER)

Brightspace

Same as e-mail

Appendix B

PARTICIPANTS NEEDED!

We are looking for volunteers to take part in an online study of *performance on math-based and language-based questions.*

As a participant in this study, you would be asked to: answer some math- and language-based questions, as well as some demographic questions.

Your participation is **entirely voluntary, anonymous,** and would take approximately 15-20 minutes of your time. By participating in this study, you will help us to identify any possible differences in math and language performances as they relate to certain demographic variables.

This study is open to anybody in the general public who is 19 or older or considered a mature minor (e.g., a university student). If you have any ethical questions or concerns, you may contact the GC-REB at gcethics@grenfell.mun.ca. This study has been approved by an ethics review process in the psychology program at Grenfell Campus, Memorial University of Newfoundland and has been found to be in compliance with Memorial University's ethics policy as well as Tri-council Policy on Ethics.

To learn more about this study please contact:
Kristen Seymoure
ksseymoure@grenfell.mun.ca

This study is supervised by: Dr. Peter Stewart (pstewart@grenfell.mun.ca)

Appendix C

Does Demographic Variables Determine Success? A Study of Math and Lexical Performance

Informed Consent Form

The purpose of this Informed Consent Form is to ensure you understand the nature of this study and your involvement in it. This consent form will provide information about the study, giving you the opportunity to decide if you want to participate.

Researchers: This study is being conducted by Kristen Seymoure as part of the course requirements for Psychology 4959: Honours Project in Psychology. I am under the supervision of Dr. Peter Stewart.

Purpose: This study is designed to investigate potential differences in performance between math-based and language-based tasks as a function of various demographic variables, including age, gender, level of education, and geographic location. The results will be used in the production of an honours thesis and may be presented and/or published in the future.

Task Requirements: You will first be asked some basic demographic questions. You will then be asked to complete 10 math-based questions and 10 language-based questions.

Credit: You will be given bonus marks (i.e., 0.5%) in any participating Psychology courses for the completion of this study.

Duration: The study will take approximately 15-20 minutes to complete.

Risks and Benefits: There are no obvious risks or benefits associated with this study.

Anonymity: Your responses are anonymous. Please do not answer questions using any identifying information. All information will be analyzed and reported on a group basis. Thus, individual responses cannot be identified by the researchers. All information will also be held on a password protected computer for a minimum of 5 years.

Right to Withdraw: Your participation in this research is totally voluntary and you are free to stop participating at any time. Once you complete and submit the questionnaire, data cannot be removed because there is no identifying information collected and therefore participants are not linked to their responses.

Contact Information: If you have any questions or concerns about the study, please feel free to contact me, Kristen Seymoure, ksseymoure@grenfell.mun.ca. You may also contact my supervisor, Dr. Peter Stewart, pstewart@grenfell.mun.ca. As well, if you are interested in knowing the results of the study, please contact me Kristen Seymoure, ksseymoure@grenfell.mun.ca or Dr. Peter Stewart, pstewart@grenfell.mun.ca after May 1st, 2021.

This study has been approved by an ethics review process in the psychology program at Grenfell Campus, Memorial University of Newfoundland and has been found to be in compliance with Memorial University's ethics policy as well as Tri-council Policy on Ethics. If you have ethical concerns about the research, you may contact the chairperson of the GC-REB at gcethics@grenfell.mun.ca.

By clicking continue, you verify that you are 19 years of age or over, or are considered a mature minor (e.g., a university student) and consent to participating in this study. You have the right to withdraw at any time throughout the study up until you submit your answers. Any answers that are submitted will not be able to be retrieved and removed since there is no identifying information on each response.

Appendix D

Questionnaire

DEMOGRAPHIC QUESTIONS

1) Is English your first language?

Yes ___ No___

2) Please indicate on the scale below your ability in the English language.

1 2 3 4 5 6 7

(Very Poor) (Adequate) (Very High)

3) How would you rate your math ability?

1 2 3 4 5 6 7

(Very Poor) (Adequate) (Very High)

4) How comfortable are you completing math problems?

1 2 3 4 5 6 7

(Not comfortable at all) (Somewhat comfortable) (Extremely comfortable)

5) How comfortable are you with completing language problems?

1 2 3 4 5 6 7

(Not comfortable at all) (Somewhat comfortable) (Extremely comfortable)

6) What is your gender?

_____

7) What is the highest level of education you have received?

a) Some high school
b) High school diploma
c) Some post-secondary
d) College diploma/certificate
e) Bachelor's degree
f) Master's degree
g) PhD

h) Other (please specify) _____

8) How old are you?

_____

MATH QUESTIONS

Solve Math Questions

1. Solve the following: (10 + 10) - 4 x 3
   a. 12
   b. 8
   c. 48
   d. - 12
2. Solve the following: x +17 = 24
   a. 41
   b. 408
   c. 7
   d. 1.4
3. If the total surface area of a cube is 54, what is the volume of that cube?
   a. 27
   b. 9
   c. 3
   d. 18
4. Evaluate the following: ½ + ⅓ + ⅙
   a. 1
   b. 3/11
   c. 3/6
   d. 1/6
5. Factor the following: x^2 - 7x +10
   a. (x-5) (x+2)
   b. (x-5) (x-2)
   c. (x+3) (x-10)
   d. (x-10) (x+3)

6. Evaluate the following: $(20 / 5)^2$ (10 - 12)
    a. -32
    b. -16
    c. -8
    d. 16
7. What is the value of $x^2 + 4x + 3$ when x = 2?
    a. 10
    b. 11
    c. 13
    d. 15

8. Use the rules of exponents to simplify the following expression: (a^7/a^4)

    a. 3
    b. $a^{1.75}$
    c. a^3
    d. a
9. The ages of 10 children in a youth group are as follows: 5, 7, 9, 5, 13, 6, 8, 7, 10, & 12. What is the mean age of the children in the youth group?
    a. 8
    b. 8.2
    c. 9
    d. 7.9
10. If the area of a square is 100, what is the perimeter?
    a. 20
    b. 10
    c. 1000
    d. 40

Comparison Math Questions

1. If there are a total of 36 strawberries and raspberries in a bucket and the ratio of strawberries to raspberries is 4:2, how many strawberries are there?
    a. 9
    b. 18
    c. 24
    d. 12
2. Which of the following statements are true?
    a. 0.01 > 0.02

b. ⅓ < ¼
c. -7 > -5
d. $-1^{13} = -1$

3. If integer a is even and integer b is odd, which answer will be even?
   a. ab
   b. b + a
   c. 2a - b
   d. b x b

4. Which of the following expressions correctly represents this sentence: Three times x is squared, and the result is divided by 7?
   a. $7 \div 3x^2$
   b. $3x^2 \div 7$
   c. $(3x)^2 \div 7$
   d. $7 \div (3x)^2$
5. The lengths of 2 sides of an isosceles triangle are 12 and 20. What are the possible values of the perimeter?
   a. 36 & 60
   b. 44 & 52
   c. 1728 & 8000
   d. 2880 & 4800
6. In how many ways can the letters in the word CAT be arranged without repeating the letters (i.e., CCC)?
   a. 7
   b. 6
   c. 9
   d. 5
7. Which of the following is a prime number?
   a. 2
   b. 6
   c. 9
   d. 21
8. In this equation, a and b are integers. Based on the given information, which is larger?

   Given that $a^2 = b^3$

   a. Variable a is larger
   b. Variable b is larger
   c. Variables a and b are equal
   d. Cannot be determined by the information provided

9. Order these numbers from least to greatest:

   -1, -5, 0.4, 0.05, 2, 2.34, -4.7, & -4.9

   a. 0.4, 0.05, -5, -4.9, -4.7, -1, 2, 2.34

   b. -5, -4.9, -4.7, -1, 0.05, 0.4, 2, 2.34

   c. 2.34, 2, 0.4, 0.05, -1, -4.7, -4.9, -5

   d. 0.05, 0.4, -1, 2, 2,34, -4.7, -4.9, -5

10. For a given 2-digit positive integer, the tens digit is 4 more than the ones digit. The sum of the digits is 14. What is the integer?
    a. 51
    b. 73
    c. 95
    d. 84

LANGUAGE QUESTIONS

For each of the following questions, select the two words that have the same meaning (EASY).

1) Tiny

Faded

New

Large

Big

2) Junk

Squeeze

Trash

Punch

Crack

3) Fly

Soar

Hop

Drink

Peer

4) Worldly

Solo

Inverted

Drunk

Alone

5) Silence

Rage

Anger

Victory

Love

6) Sector

Mean

Light

Harsh

Predator

7) Shovel

Spade

Needle

Oak

Club

8) Recall

Flex

Efface

Remember

Divest

9) Deal

Claim

Plea

Recoup

Sale

10) Entrapment

Partner

Fool

Companion

Mirror

For each of the following questions, select the two words that have the same meaning (Hard)

1) Finish

Embellish

Cap

Squeak

Talk

2) Mindful

Negligent

Neurotic

Lax

Delectable

3) Quash

Evade

Enumerate

Assist

Defeat

4) Disburse

Perplex

Muster

Convene

Feign

5) Related

Intrinsic

Alien

Steadfast

Pertinent

6) Noted

Subsidiary

Culinary

Illustrious

Begrudge

7) Influence

Power

Cauterize

Bizarre

Regular

8) Yearn

Reject

Hanker

Despair

Indolence

9) Depression

Despondency

Forswear

Hysteria

Integrity

10) Breach

Harmonize

Vehement

Rupture

Acquiesce

Appendix E

The Impacts of Stereotype Threat in Math and Lexical Settings: The Role of Task Order and Task Difficulty

Debriefing Form

Thank you for your participation in this research study. For this study, it was important that I withhold some information from you about some aspects of the study. Now that your participation is completed, I will describe the withheld information to you, why it was important, and answer any of your questions (contact me via email at ksseymoure@grenfell.mun.ca). This study has been approved by an ethics review process in the psychology program at Grenfell Campus, Memorial University of Newfoundland and has been found to be in compliance with Memorial University's ethics policy as well as Tri-council Policy on Ethics. If you have ethical concerns about the research, you may contact the chairperson of the GC-REB at gcethics@grenfell.mun.ca.

What you should know about this study

You were not told the exact purpose of this study. The main purpose of this study was to examine potential occurrences of stereotype threat in participants regarding performance on math- and language-based tasks.

Withholding this information was important for this study because if you had been aware that we were specifically studying stereotype threat then we may not have seen true results because you may have tried to correct for the stereotype threat.

Stereotyping occurs when a person is defined by their actions or their physical being which can often lead to a negative view of themselves and/or others (Steele & Aronson, 1995). When this negative self-view leads to a decrease in performance, stereotype threat is often a factor. That is, the threat of the stereotype leads to poorer performance on related tasks if you identify with the stereotype.

Given that two common stereotypes are that men are better at math and women are better with languages, the study examines whether there was a difference in performance between genders on the math and language tests. Furthermore, you may have noticed that some of the questions were harder than others. This too was intentional in order to determine if task difficulty interacted with stereotype threat to further negatively impact performance.

How to prevent stereotype threat

- Engage in activities that help promote positive self-esteem (Rydell & Boucher, 2010)
    - **https://www.skillsyouneed.com/ps/self-esteem.html**
    - **https://ideas.ted.com/5-ways-to-build-lasting-self-esteem/**

- Participate in programs/seminars that educate you about stereotype threat and its impacts or educate yourself on how to prevent stereotype threat (Hill & Augoustinos, 2001)
    - https://www.colorado.edu/center/teaching-learning/inclusivity/stereotype-threat
    - **https://digitalpromise.org/2018/08/16/recognize-avoid-stop-stereotype-threat-class-school-year/**

If you have questions
The researcher conducting this study is Kristen Seymoure, an undergraduate student at Grenfell Campus, Memorial University of Newfoundland's Psychology program. If you have questions, you may contact Kristen Seymoure at ksseymoure@grenfell.mun.ca or you can contact the study supervisor, Dr. Peter Stewart, at pstewart@grenfell.mun.ca. If you have any questions or concerns regarding your rights as a research participant in this study, you may contact the chairperson of the GC-REB at gcethics@grenfell.mun.ca. If you would like to receive a summary of the findings when it is completed, please feel free to contact the researcher.

Disclaimer
Please do not disclose research procedures and/or purpose to anyone who might participate in this study in the future as this could affect the results of the study.

Counselling services
If you feel upset after having completed the study or find that some questions or aspects of the study were distressing, talking with a qualified clinician or counselor may help. If you are a Grenfell student and feel you would like assistance, please contact health services reception at (709) 637-7919 to schedule a remote session with Veronica Hutchings (registered psychologist) or Jennifer Broadbent (Canadian certified counsellor). If you are a member of the general public and would like to seek assistance, you may contact Crisis Services Canada at 1-833-456-4566 or text 45645. It is also suggested that you see a professional in your area.

If you still wish to submit your data, please click the Submit button below. If you do not wish to submit your data, please close the window.

Thank you for your time.

Appendix F

Instructions (Stereotype Threat Manipulation)

Stereotype Threat Condition: Please answer all of the following questions. Since past research has shown that males outperform females on math tasks and females outperform males on language tasks, your performance will be compared to your male and female peers.

Control Condition: Please answer all of the following questions. Although your performance will be compared to your male and female peers, past research has shown no differences in performance between genders on these tasks.

Appendix G

Table 6

List of F Values from All Mixed ANOVA Analyses

Interaction/Main Effect	F-Value	Significance
Task	0.01	.943
Task*Threat Condition	1.82	.183
Task Difficulty	193.54	> .001
Task Difficulty*Task Order	1.54	.220
Task Difficulty*Threat Condition	0.57	.812
Task Difficulty*Task Order* Threat Condition	0.30	.864
Task Type	0.05	.823
Task Type*Task Order	0.40	.532
Task Type*Threat Condition	1.38	.244
Task Type*Task Order* Threat Condition	1.56	.217
Task Difficulty*Task Type	131.94	> .001
Task Difficulty*Task Type* Task Order	0.14	.707
Task Difficulty*Task Type* Threat Condition	0.02	.898
Task Difficulty*Task Type* Task Order*Threat Condition	0.55	.462

Table 7

List of F Values From all Mixed ANCOVA Analyses

Interaction/Main Effect	F-Value	Significance
Task*Question 5	38.54	> .001
Task*Question 6	0.03	.857
Task	11.07	.002
Task*Threat Condition	5.10	.028
Task Difficulty	15.47	> .001
Task Difficulty*Question 5	0.21	.649
Task Difficulty*Question 6	2.14	.149
Task Difficulty*Task Order	2.41	.127
Task Difficulty*Threat Condition	0.01	.912
Task Difficulty*Task Order* Threat Condition	0.12	.733
Task Type	10.05	.003
Task Type*Question 5	38.33	> .001
Task Type*Question 6	0.01	.927
Task Type*Task Order	1.31	.258
Task Type*Threat Condition	4.07	.049
Task Type*Task Order* Threat Condition	2.42	.126
Task Difficulty*Task Type	7.01	.011
Task Difficulty*Task Type* Question 5	0.00	.965
Task Difficulty*Task Type* Question 6	0.05	.832
Task Difficulty*Task Type*		

Task Order	0.08	.775
Task Difficulty*Task Type* Threat Condition	0.01	.938
Task Difficulty*Task Type* Task Order*Threat Condition	0.60	.440