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A SOCIAL IMPACT TREND IN THE EFFECTS OF ROLE MODELS ON ALLEVIATING WOMEN'S MATHEMATICS STEREOTYPE THREAT

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ABSTRACT

The present research examined the relationship between number of successful role models and alleviation of performance deficits that women suffer under mathematics stereotype threat. Men and women were reminded of the stereotype, read brief biographies of 0-4 successful women, and took a difficult math test. Women who read no biographies scored worse than men; women who read 4 biographies scored as well as men. Increases in women's performance across the number of role models were consistent with a power function trend predicted by social impact theory (Latane, 1981). This relationship with social impact theory suggests new directions in understanding how role models alleviate stereotype threat.

INTRODUCTION

Stereotype threat has been defined as "the social-psychological threat that arises when one is in a situation or doing something for which a negative stereotype about one's group applies" (Steele, 1997, p. 614). When a situation creates stereotype threat, members of the negatively stereotyped group perform poorly relative to their actual level of competence (Steele, 1997, 1998). Performance deficits from stereotype threat have been found for African-Americans on verbal tests (Steele & Aronson, 1995), people of lower income on verbal tests (Croizet & Claire, 1998), Latino students on spatial ability tasks (Gonzales, Blanton, & Williams, 2002), athletes on sports-related tasks (Stone, Lynch, Sjomeling, & Darley, 1999), and women on mathematics tests (Inzlicht & Ben-Zeev, 2000; Keller & Dauenheimer, 2003; Quinn & Spencer, 2001; Schmader, Johns, & Barquissau, 2004; Spencer, Steele, & Quinn, 1999).

Researchers have discovered techniques that effectively alleviate the performance deficits associated with stereotype threat. These techniques include lessening the importance of the task (Croizet & Claire, 1998; Steele & Aronson, 1995), reducing the salience of the stereotype (Spencer et al., 1999), providing excuses for poor performance (Brown & Josephs, 1999; Stone, et al., 1999), claiming the test is not susceptible to the stereotype (Walsh, Hickey, & Duffy, 1999), altering ability conceptions from static to fluid (Aronson, Fried, & Good, 2002), and presenting people with successful role models from their own group (Marx & Roman, 2002; McIntyre, Paulson, & Lord, 2003).

Using successful role models to alleviate women's mathematics stereotype threat, Marx and Roman (2002, Study 1) had the experimenter, who was either a man or a woman, give a difficult math test to college men and women. The experimenter claimed to have written the test, and thus to be highly competent in math. When a man created and administered the test women scored worse than men, but when a woman created and administered the test they scored as well as men and significantly better than women taking the test for a man. In a second experiment (Marx & Roman, 2002), women scored worse than men when a woman of relatively low math competence was the experimenter, but scored significantly better (and as well as men) when a woman of relatively high math competence was the experimenter, even though the "experimenter" was someone they only read about and was not physically present. Marx and Roman (2002) thus showed that one role model who was competent in the relevant domain could alleviate the performance deficits that usually affect the members of stereotyped groups when they are in a situation that induces stereotype threat.

McIntyre, Paulson, and Lord (2003, Study 2) demonstrated similar role model effects by having participants read biographical essays of fictitious successful women immediately before taking a difficult math test. A male experimenter told students that they would be participating in two unrelated experiments: one to develop stimulus materials for subsequent research, and the other to help standardize items for the math section of the Graduate Record Examination (GRE). To insure that all participants were aware of and had recently been reminded of the stereotype that women do not perform as well as men on math tests, the experimenter stated the stereotype explicitly. Then he had the students read and critique either four brief biographies of a highly successful woman architect, lawyer, physician, and inventor; or four very similar essays, in which the same accomplishments were attributed to four corporations. He then left the room and a female experimenter, blind to condition, administered a difficult math test drawn from sample GRE items.

As predicted on the math test, women scored worse than men in the no successful women role models condition, but scored significantly better (and as well as men) in the four successful women role models condition. McIntyre et al. (2003) noted that using role models to alleviate women's mathematics stereotype threat might depend on the domain in which the role models had succeeded and on mechanisms entirely different from other effective alleviation techniques such as downplaying the test's diagnostic importance (Croizet & Claire, 1998; Steele & Aronson, 1995), claiming that the test was impervious to the stereotype (Spencer et al., 1999), or providing an opportunity to misattribute arousal (Brown & Josephs, 1999). McIntyre et al. (2003) did not, however, address one important aspect of their procedure. They used four successful women biographies rather than some other number of successful women. With their two-condition procedure, it was impossible to examine the trend that might have occurred for alleviating women's performance deficits with different numbers of role models. At least three possible trends seem plausible: a counter-example trend, an additive trend, and a social impact trend. Each would cast the role model alleviation technique in a different light.

Counter-Example Trend

Marx and Roman (2002) alleviated women's performance deficits under stereotype threat by using just one successful role model, a competent female experimenter. Perhaps McIntyre et al. (2003) did not need to provide women with four biographies of successful women. One biography might have been enough. Perhaps all it takes is one salient counter-example role model to undo the negative effects of stereotype threat. This "counter-example" hypothesis, however, fails to take into account several important differences between Marx and Roman's (2002) procedure and McIntyre et al.'s (2003) procedure. First, Marx and Roman's (2002) role model was presented as very successful in the exact domain (mathematics) that was the topic of the relevant stereotype, whereas McIntyre et al.'s (2003) role models were successful in professional careers that did not necessarily require high levels of math competence. Second, Marx and Roman's (2002) role model was physically present in Study 1, and phenomenologically present (participants expected to meet and interact with her after the test) in Study 2, whereas McIntyre et al.'s (2003) role models were complete strangers (described in a few paragraphs) that the participants would probably never meet. It may be more feasible for participants to use a personally relevant woman who excels at math to counter-argue the stereotype than to use just one story about a complete stranger who happened to be talented at architecture, brain surgery, or law as a counter-example. When it comes to reading biographies of successful but otherwise unknown members within one's own group as an antidote for stereotype threat, one exemplar might easily be dismissed as an exception (Lockwood & Kunda, 1999), and it may take some larger number of such role models to have the desired alleviation effect. By including conditions with 0-4 role models, as was done in the present experiment, one can test the possibility of a counter-example trend, in which any one role model improves women's performance under stereotype threat, and additional role models do not add to the improvement.

Additive Trend

Furthermore, it is impossible from McIntyre et al.'s (2003) results to know which part of their intervention caused the alleviation effects that they reported. Not only might it not have been necessary to use four role models, but their procedure left open the possibility that their alleviation effects were caused by a specific one of their fictitious biographies, and not by any of the other three. The domain of a role model's specific success might be so important that only certain types of success alleviate the performance deficits associated with stereotype threat. Women participants in McIntyre et al.'s (2003) study might have perceived, for instance, that successful architects must have extremely high spatial ability, which is known to be correlated with competence at math. Reading about that one successful woman architect might have been enough to dispel any negative effects of the stereotype, and reading about the successful physician, lawyer, and inventor might have added nothing of any importance. With McIntyre et al.'s (2003) procedure, all participants read about all four role models, so it was impossible to detect whether one was more effective than the others. In short, McIntyre et al. (2003) assumed that it was necessary to use four successful role models from four different professions to alleviate women's math performance deficits under stereotype threat, and that the biographies that they used had a cumulative and additive effect, but their procedure left open alternative explanations that would result in different types of advice to prospective test-takers.

The present experiment tested for an additive trend by varying the number of successful role models, of the type used by McIntyre et al. (2003), from 0 to 4. If a particular one of the role models was alone responsible for improving women's test performance under stereotype threat, then we would see high variance of scores in the 1 biography condition, and a straight linear trend in performance across conditions. With random assignment, each specific biography (e.g., the architect) would have a .25 probability of being included in the 1 biography condition, .5 with 2 biographies, .75 with 3, and 1.0 with 4. Thus if either one specific biography was producing the alleviation, or each additional biography added the same amount of alleviation to the cumulative effect, then we would observe a straight linear pattern of women's test score means, in which, for instance, 4 biographies work twice as well as 2.

Social Impact Trend

In the present experiment, however, we predicted a third possible pattern of means for women's performance under stereotype threat, consistent with other sources of social influence, as described by social impact theory (Latane, 1981). Steele (1997, 1998) has consistently described stereotype threat as exerting a psychological pressure or burden on members of the stereotyped group, a pressure that may be similar to the force fields described by Lewin (1943), Stevens (1975), and others. In social impact theory, stereotype threat can be seen as a source of psychological impact that can impinge on a target person or on several target persons. Role models may serve in part as a psychological cohort of other targets. When the source tries to influence several targets rather than just one, according to social impact theory (Latane, 1981), its influence on any one target is reduced in a power function, by an exponent (less than 1) of the number of targets. A social impact prediction for using 0-4 role models in McIntyre et al.'s (2003) alleviation technique, then, would be that stereotype threat would diminish, and performance would increase, less with each additional target, a data pattern different from either a counter-example trend or an additive trend. A social impact trend would also carry with it interesting theoretical implications for understanding how role models alleviate performance deficits under stereotype threat.

METHOD

Participants

Two hundred ninety-five college students (209 women and 86 men) participated for course credit, in mixed-sex groups.

Procedure

The procedure and materials were almost identical to those used by McIntyre et al. (2003, Study 2). All materials are included in appendices (Appendix D, containing the GRE items is available only in the PDF version of this paper). The first experimenter informed participants that they would be participating in two separate studies: one to develop stimulus materials for future experiments, and another to standardize quantitative GRE items. To be sure that the relevant stereotype had been recently activated for all participants the experimenter explicitly mentioned the stereotype that women perform worse than men on math tests (see Smith & White, 2002; Spencer et al., 1999).

The first experimenter then asked participants to read and critique brief essays that would be used as stimulus materials in future studies. The essays were supposedly abstracted from such popular publications as "Entrepreneur" or "Who's Who." Participants were randomly assigned to one of five conditions. Participants in the 0 successful women condition read the 4 corporation essays that McIntyre and his colleagues (2003, Experiment 2) had used as an appropriate control condition because it involved the same processing time and concepts as in the experimental conditions, but with no mention of successful women. In the four experimental conditions participants read a randomly selected 1, 2, 3, or 4 of McIntyre et al.'s (2003) successful women essays. When they read fewer than four, the relevant essays (about a successful woman architect, lawyer, doctor, or inventor) were randomly assigned.

A woman experimenter, who had no knowledge of how many biographical essays participants had received, then entered to conduct her "unrelated" study. Under the guise of helping to develop and standardize new questions for the GRE, she administered a mathematics test that consisted of 34 difficult quantitative items from sample GRE tests. Difficult questions were used because previous research indicated that women's mathematics stereotype threat interferes with performance primarily on difficult items (Spencer et al., 1999). The experimenter read aloud the usual test instructions that strongly advised against guessing or skipping items. She then gave participants 20 minutes to complete the test. She did not claim to have written the items or to have any special math competence. To the extent that a woman test administrator might have facilitated participant women's performance, it would have done so equally in all conditions. After taking the test, all participants rated their perceptions of the extent that reading the biographical essays led them to conclude that women could do well at mathematics and made them think that they could do well at mathematics (both on scales from 0 = not at all to 9 = very much). This measure was presented as part of a progressive debriefing, in which no participant guessed that reading the biographies was intended to change his or her test scores.

RESULTS

Table 1 shows the mean percentage of attempted items correct for men and women in each of the five experimental conditions. The primary goal of the present experiment was to examine performance trends for women across these five conditions (0, 1, 2, 3, and 4 role models). Before examining the women's performance trends across conditions, however, consider first the observed differences between men and women within the five conditions. As can be seen in Table 1, the first (0 biographies) column of means shows that when both men and women were reminded of the stereotype prior to the math test and read no biographies of successful women (i.e., read only biographies of successful corporations), women scored .78 standard deviations worse than men, $F(1, 59) = 8.26$, $p = .006$, replicating McIntyre et al.'s (2003) results. The difference in the 0 biographies condition may be taken as a manipulation check, showing that reminding participants of the stereotype had the intended effect of placing women under stereotype threat sufficient to impair their performance, relative to men's. Without this difference in the 0 biographies condition, there would be no performance impairment to alleviate, so attempts to do so by providing role models would be unnecessary.

Table 1: Mean Percentage of Attempted Items Correct for Men and Women Who Read 0-4 Biographies of Successful Women.

		Number of Biographies Read				
		0	1	2	3	4
Men						
	% Correct	57.99	59.63	59.06	57.41	59.40
	(SD)	(16.13)	(12.50)	(17.53)	(17.28)	(14.60)
	n	17	16	20	17	16
Women						
	% Correct	47.12	52.83	56.26	60.22	61.67
	(SD)	(11.99)	(14.86)	(17.48)	(16.06)	(13.36)
	n	44	45	42	41	37

When men and women were both reminded of the stereotype and read a randomly selected 1 biography of a successful woman, women scored .47 standard deviations worse than men, $F(1, 59) = 2.64$, $p = .110$. With 2 biographies, women scored .16 standard deviations worse than men, $F(1, 60) = .35$, $p = .559$. With 3 biographies, women scored .17 standard deviations better than men, $F(1, 56) = .35$, $p = .555$. Finally, with 4 biographies of successful women, women scored .17 standard deviations better than men, $F(1, 51) = .31$, $p = .583$. The first (0) and last (4) columns, which represent the only two conditions in McIntyre et al.'s (2003) experimental design, produced a pattern of performance means very similar to those found by McIntyre et al. (2003), and suggest a similar conclusion to theirs. When women are reminded of the stereotype and given no information about successful role models, they perform poorly relative to men, but when they are given information about 4 successful women role models, that performance deficit is alleviated. It is important to note also that the 0 biographies condition did not produce especially high variance among women's math scores, as would have happened had only one particular biography (e.g., that of the architect) been responsible for McIntyre et al.'s (2003) reported effects. The novel contribution of the present experiment, however, rests in including the intermediate conditions (1, 2, and 3 role models) necessary to test performance trends for women across 0-4 role models.

The present experiment made no predictions about men's performance, because the men had no reason to perceive any stereotype threat. To assess trends in women's performance across the 5 conditions, we used the least-squares criterion to predict the women's mean percent correct on the math test (Y) from the number of biographies read (X) with: 1) a counter-example model, 2) an additive (linear) model, and 3) a social impact power model. The resulting equations were:
1) Y = 47.12 + 14.55 D; 2) Y = 48.32 + 3.65 X; and 3) Y = 47.02 ((X+1) exp .17); where D = 0 when number of biographies = 0; otherwise D = 1; exp = exponent.

From each equation, we noted the mean percentage correct predicted in each of the 5 conditions. Those predicted means are shown in Table 2, along with the observed means for women's percent correct on the math test. The F, p, and ES(r) columns, respectively, show the F test that the row of predicted values matched the observed values, the probability level, and the effect size (ES) as a Pearson product-moment correlation coefficient between predicted and observed values. As can be seen, the means predicted from a social impact power curve, in which each additional role model adds to the performance alleviation, but to a lesser degree, fit the women's mean percent correct scores extremely well (r = .997).

By examining the observed and predicted rows of Table 2, readers can see that reading about just one successful role model did not have an especially large increase in performance followed by no increase after that, as would be predicted if one salient counter-example were sufficient to alleviate women's performance deficits under stereotype threat. Nor was the best fit to the data a straight linear increase in performance with increasing number of role models, as would be predicted if one of the role models were the only potent exemplar, or each additional role model exerted the same impact. Instead, the effect of additional role models increased until 3-4, and then leveled off, just as has been found in previous research described by the social impact power function (Latane, 1981). The fit to an exact power function was not perfect, but a power function consistent with Latane's (1981) descriptions provided the most compelling fit to the means, consistent with the idea that successful women role models exert social impact on women's mathematics performance under stereotype threat.

Table 2. Means Predicted from Counter-Example, Additive (Linear), and Social Impact Models of Alleviation Effects for Women's Performance Under Stereotype Threat.

		Number of Biographies Read							
		0	1	2	3	4	F(1,3)	p	ES(r)
Predicted									
	Counter-Example	47.12	61.67	61.67	61.67	61.67	6.66	.08	.808
	Additive (Linear)	48.32	51.97	55.62	59.27	62.92	79.03	.003	.982
	Social-Impact	47.02	52.92	56.71	59.56	61.87	695.96	.0001	.997
Observed		47.12	52.83	56.26	60.22	61.67			

Recall that participants were also asked, after the math test had ended, to rate the extent that reading the biographies led them to conclude that women (and they) could do well at math. These retrospective ratings were included as possible mediators of the math performance trends. The ratings, however, were highly skewed. More than one-quarter of both men and women participants reported that reading the biographies had no effect on their perceptions (0, on a 0-9 scale). The mean ratings are shown in Table 3. These means did not follow the same pattern as the test performance means, nor were the ratings highly correlated with test scores. In addition, the means did not increase monotonically, but decreased (for women, though not for men) with four rather than three biographies. It is unclear what might have caused this decrease, except to note that it differed from the pattern of math test performance means, which did increase monotonically as additional biographies were read. A reasonable conclusion to draw from this finding is that participants' retrospective ratings of the extent that they were affected by reading the biographies did not mediate the social impact trend of reading 0-4 biographies on women's math performance.

Table 3. Participants' Mean Retrospective Ratings of the Extent that Reading the Biographies Led Participants to Conclude that Women (and They) Could Score Well at Math.

		Number of Biographies Read				
		0	1	2	3	4
Men						
	Women can do well	1.94	3.06	4.15	3.59	4.38
	(SD)	(2.77)	(2.93)	(2.85)	(3.02	2.55)
	I can do well	2.44	2.19	2.30	1.59	2.75
	(SD)	(2.76)	(2.71)	(3.10)	(2.37)	(2.44)
Women						
	Women can do well	2.00	3.85	5.14	5.70	3.70
	(SD)	(2.50)	(2.81)	(2.89)	(2.62)	(2.61)
	I can do well	1.86	3.63	4.05	4.38	2.95
	(SD)	(2.34)	(2.57)	(2.96)	(2.38)	(2.22)

DISCUSSION

The primary goal of the present experiment was to answer the question "What trends occur in women's performance under stereotype threat with increasing number of successful women role models?" The answer to this question seemed important from both a theoretical and a practical perspective.

Based on the present research, each successive role model increases the alleviation by less than the previous one, with alleviation increasing by a power function of the number of successful role models. Men's performance on the math test did not differ across conditions. After being placed under explicit stereotype threat, however, women who read no biographies of successful women scored worse than men, women who read a biography of one successful woman scored a little better, women who read biographies of two successful women scored better than that, women who read biographies of three successful women scored better still (and as well as men), and reading a fourth biography added little compared to reading three. Although we did not include groups of women who read about more than four successful role models, further performance improvements seem unlikely or negligible beyond three or four biographies.

These results matched a social impact model of how successful role models affect performance under stereotype threat better than they matched other plausible models. First, there was not a large increase in performance simply by reading about any one successful role model that could be used as a counter-example, followed by no further benefits from reading about two, three, or four potential counter-examples. Second, there was not the straight linear effect or large variance in the 1 biography condition that would be expected if a specific one of McIntyre et al.'s (2003) biographies had caused the entire effect and the others been nothing more than placebos, or if each additional biography contributed equally to the cumulative alleviation effect. Instead, women's mean performance on the math test followed approximately the type of power function described by social impact theory (Latane, 1981).

Admittedly, participants' retrospective ratings of the impact that reading the biographies had on their beliefs about women's (and their own) math ability (see Table 3) did not follow a social impact trend. The different pattern of means found on this retrospective measure might be dismissed as a bias in hindsight (Fischhoff, 1982) or as another case of participants failing to recognize the actual impact of a manipulation on their thoughts (Nisbett & Wilson, 1977). In addition, means on the more immediate and important measure of math test performance did follow a social impact trend across increasing numbers of biographies. Nonetheless, given the failure of these retrospective ratings to follow the same social impact trend as the math performance means, the following observations about applying social impact theory to future research on stereotype threat should be viewed with caution.

Latane (1981; Latane & Wolf, 1981) had previously reported this type of power function for sources of influence in social behaviors as diverse as conformity, imitation, embarrassment, bystander intervention, responding to requests for help, tipping in restaurants, stuttering, stage fright, and social loafing. This new finding, that the social impact curve offers an excellent description of the influence that successful role models have in alleviating women's mean performance under mathematics stereotype threat, adds to the phenomena described by social impact theory and invites renewed speculation as to what all these phenomena might have in common. Perhaps the nearest analogy to the present findings, albeit counterintuitive, occurs in research on social loafing (Karau, Williams, & Bourgeois, 1993).

Social loafing occurs when a task is distributed among many rather than few "workers," and each worker exerts less effort than had he or she been working alone. The social impact theory account of social loafing is that the pressure that one source (the task) exerts on each target (or worker) decreases in a power function of the number of targets. In the present experiment, stereotype threat might be conceptualized as a source of influence that impairs each woman's performance, so the more "company" a woman has, at least phenomenologically, the less impact the source of influence (the stereotype) has on her. The effect of role models on performance under stereotype threat might be similar to the effect of what Latane (1981) called "pseudogroups" (imagined others who are not physically present) on reducing the pressure that a situation exerts on an individual. The larger the number of imagined others who share the burden, the less the pressure on any one target person (Latane, Williams, & Harkins, 1979); perhaps because of perceived diffusion of responsibility or freedom from making a fool of oneself (Darley & Latane, 1968), which can occur even when the other people are only imagined (Garcia, Weaver, Moskowitz, & Darley, 2002).

Steele (1997; Steele, Spencer, & Aronson, 2002) has consistently portrayed stereotype threat as a situational pressure on members of the stereotyped group. When the stereotype is salient, they suffer both the usual anxiety that a testing situation would elicit and an additional burden of not wanting to embarrass both themselves and the group by performing poorly. It is this extra burden or additional pressure that impairs performance. In alleviating stereotype threat, then, the present results suggest that when women are under mathematics stereotype threat, a little social loafing, or at least being more relaxed about potential embarrassment to themselves and to the group, might improve performance.

Before drawing such a conclusion, one would want to replicate the present experiment's social impact curve with other groups and other stereotypes. One would need empirical evidence, for instance, that African Americans who are reminded of the stereotype (and are thus placed under stereotype threat) can significantly improve their performance on standardized tests of the type used by Steele and Aronson (1995), by reading about the accomplishments of three or four successful African American role models, and that the alleviation effect of successful African American role models increases in a power function of the number of role models. One would also want to know whether having 2, 3, or 4 female math mavens present in the experiment adds incrementally to the alleviation results reported by Marx and Roman (2003). It may be that the social impact trend applies only to reading biographies of successful women, and not to other types of role models, or to role models who are physically or psychologically present. One would also want to include questions about the extent to which participants felt that the role models falsified the stereotype itself, as a different type of potential mediator (Spencer, et al., 1999).

Integrating research on role model alleviation from stereotype threat with research on social impact theory, however, suggests several interesting new research directions. In social impact theory, for instance, the basic descriptive formula is that I = f(SIN), or social impact (I) is a function of the strength (S), immediacy (I), and number (N) of either sources (in the case of several sources influencing one target) or targets (in the case of one source influencing several targets). In terms of social impact theory, the present experiment investigated the effects of varying the number of targets (or the number in a pseudogroup) on the impact that one source (the stereotype) has on a target (a woman participant). Taking a social impact theory perspective on role model alleviation of stereotype threat, then, suggests future studies that vary either the perceived strength or the perceived immediacy of the role models, or both. There are obviously many ways to operationalize "strength" and "immediacy," each of which may have different implications, but one very informative clue to possible results comes from Tesser's (1988) self-evaluation maintenance theory, which provides a solid theoretical framework and a history of empirical findings that suggest interesting predictions. From Tesser's (1988) theory, for instance, one might predict that psychologically distant role models (like the previously unknown architect, lawyer, doctor, and inventor in the present experiment, who were only read about) might increase performance under stereotype threat to the extent that they are perceived as strong, whereas psychologically close and immediate role models (like a roommate with whom one competes) might serve as relatively ineffective role models if their credentials are perceived as too strong and the domain is important to the individual (Tesser, & Campbell,1980).

Thinking about role models and stereotype threat alleviation in terms of social impact theory suggests also new research directions that embrace dynamic social impact theory (Latane, 2000; Latane & L'Herrou, 1996; Latane, Nowak, & Liu, 1994), which examines emergent products of dynamically interacting sources of social influence. Dynamic social impact theory has identified processes such as consolidation and clustering that emerge reliably from the cumulative give-and-take among several sources of influence across time. The present experiment examined performance at one point in time, but, just as stereotype threat can presumably have a cumulative impact on women's performance at and withdrawal from math-related tasks (Steele, 1997), so successful role models can presumably have a cumulative effect, especially when women who are made aware of such role models perform so well that they become role models themselves.

Until further studies examine strength, immediacy, number, their interactions and cumulative effects in greater depth, we can offer only tentative advice to members of negatively stereotyped groups when they approach a threatening situation such as an important standardized test. "The research is at best only preliminary," we might say, "but our initial results lead us to recommend that just before the test, you read three or four brief biographies of other members from your own group who have been successful. One biography probably won't have the full effect, but reading dozens of them is not necessary. Three or four will do."

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APPENDIX A

Correlation Matrix of Relevant Variables

Men (n = 86)			
	# Biographies Read	Percent Correct	Women Can Do Well
Percent Correct	.005		
Women Can Do Well	.251	.029	
Self Can Do Well	-.001	-.01	.455
Women (n = 209)			
	# Biographies Read	Percent Correct	Women Can Do Well
Percent Correct	.329		
Women Can Do Well	.266	.140	
Self Can Do Well	.167	.198	.763

APPENDIX B

Essays

Successful Woman Essay 1

Janet Haley is a highly successful architect who lives and works in London, England. Born in Houston, Texas, she received an undergraduate degree in art history from the University of Houston and a Master's degree in architecture from the Minnesota School of Design. She was the only woman among nine males in her entering class at MSD and feels that she "had to prove myself" to the faculty, most of whom were male. In her graduate courses in architecture, however, Janet was more frequently the top student in her class. On graduating with her master's degree, she worked briefly for the well-known Houghton and associates architectural firm, which has its corporate headquarters in New York City and London, England. Although the firm made Janet responsible for designing a few small structures in the west counties of England, she began to notice that the most prestigious contracts were invariable awarded to her male counterparts in the "old boy network."

Taking a chance, Janet resigned from the firm to start her own architectural consulting business. For the first two years, she was unable to secure a contract. Almost out of money, she briefly considered quitting and retraining for a new career. In 1996, however, the Tate Museum asked Janet Haley to design their modern sculpture facility in Bradford-on-Avon, which recently opened to enormous critical acclaim. Since the opening of that art facility, Janet has been showered with offers, many of them from clients who used to take all their business to Houghton. According to a recent review in the London Times, "Janet Haley's architectural designs constitute a significant creative step forward from the old-school Houghton approach, which is so mired in past ideas that it has lost its utility and appeal."

Who does the selection describe?
What is the person’s occupation?
How successful has the person been?
What obstacles did the person have to overcome?

Successful Woman Essay 2
Silvia O'Connell is the first female attorney contracted by more than six of the top ten Fortune 500 companies. She was born in El Paso, Texas, on March 26, 1930, and educated at Stanford University. While at Stanford, Silvia was at the top of her law school class. She was the first of only two women to attend the law school at Stanford from 1962-65. It wasn't until her third application to the Stanford law program that the director of the law school approved the acceptance of female students. Of her classmates, two males were also considered outstanding students, but are now no longer practicing law because of the severe pressure related to being an attorney. O'Connell first entered public office as an assistant attorney general in Arizona (1965-69). In 1969 she was appointed to the Arizona Court of Appeals. She was the first woman to be appointed to any judiciary position in the state of Arizona.

Although she benefited from her keen legal skill, Silvia still felt that sexist politics played a role in how long it took her to gain position. Also she felt these same sexist politics stalled her further advancement in civil law. Feeling disenchanted with being a token she resigned from her position with the state of Arizona and went into private industry. Soon after her resignation, she served as a legal analyst for Ford Motor Company(1969-95). Her tenure at Ford was a difficult battle. Working for a company run under the strict dogma of male chauvinism in the auto industry Silvia needed to prove herself as more than just an able female attorney, but as a powerful legal analyst. Her earlier experiences as a state official proved useful to her. Thus, her previous experiences with sexism in the legal field provided her with the means and motivation to overcome sex driven obstacles.

Who does the selection describe?
What is the person's occupation?
How successful has the person been?
What obstacles did the person have to overcome?

Successful Woman Essay 3
Siamese Twins, is the name popularly applied to twins congenitally united in a manner not incompatible with life or activity. The name is derived from the famous twins Eng and Chang, born of Chinese parents in Siam (now Thailand). Eng and Chang were joined together at the sternum by a thick, muscular ligament and remained united throughout life.

Joined twins are always identical. Surgical separation is sometimes possible. An operation was successfully performed in 1953 on twins who were joined near the base of the spine and shared the lower intestinal tract, and in 1979 on twins joined at the skull. However the surgery involved in separating two cranial Siamese twins is an intricate operation requiring only the most exceptional surgeons in this field.

Of these surgeons, Kari Hunter is world renown for her skill in performing such a difficult surgery. Dr. Kari Hunter is the only surgeon who has successfully separated twins sharing brain matter.

After obtaining her M.D. from Johns Hopkins in 1974, Kari immediately sought a post-doc at the Geneva Institute for Micro-Neuro-surgery. While in Geneva, she was the only female student and yet was still able to rise above each of her male classmates. She also greatly impressed her advisor Dr. Hans Schloegel, the leading micro-surgeon of his day, who is also considered to be somewhat chauvinistic.

After her schooling Kari found it difficult to find placement in clinics or institutes specializing in micro or neuro-surgery. The field seemed to be dominated by old guard male surgeons who believed that women did not have what it takes to perform such operations correctly. It wasn't until the University of Michigan opened its micro-surgery unit in 1983 that Kari was able to begin performing such specialized surgery. Recently, the unit at U of M hospital has appointed her head of neuro-surgery, and under Kari the clinic has become the leading clinic for neuro-surgery. Today the clinic she heads performs 90% of the world's micro-surgery involving the separation of Siamese twins.

Who does the selection describe?
What is the person's occupation?
How successful has the person been?
What obstacles did the person have to overcome?

Successful Woman Essay 4
Born in rural Louisiana, LaSonne Dore was accustom to hardships. Being the only daughter of five children, LaSonne was often left to care for her family when her mother was away at work. Starting school at a late age, she often felt intimidated by the ability of the other children. Upon completing school at 19, LaSonne soon married and was happy to leave her rural surroundings.

Relocating to Tampa, FL., LaSonne and her new husband were eager to start a family.
Five years and three children later, LaSonne and her family were happy and doing well in their new home. Her husband was an established and rather specialized contractor installing environmentally friendly power and cooling systems. LaSonne's husband admits if not for her encouragement and support he would never have entered into such a small and specialized field. Not only did LaSonne provide him with the support to enter the field but she was also a creative consultant for solving design problems with some of the solar systems. Although not having any formal education or training in the area, LaSonne had what some called a "natural talent" for understanding and retrofitting systems.

However, tragedy soon struck LaSonne's family. Returning from a family vacation, their sport utility vehicle was broad-sided by a drunk driver. Her family was killed in an instant. LaSonne spent several months in physical therapy and two long and dark years recovering from depression. With her family gone and little training to do much of anything other than service occupations, LaSonne used up the majority of her insurance money.

Fortunately, LaSonne had a successful recovery from her depression and felt a renewed motivation for going on. Her experiences with helping her late husband with designing the environmentally based power and thermal systems inspired her to carry on the family business. At first her efforts seemed thwarted. However, a close friend of her husband's, who also was a contractor, offered her some contracts for environmental systems for some of the local businesses. This opportunity spurred LaSonne's business and reputation. She is now regarded as one of the best small contractors installing and designing thermal regulation units from homes and businesses in the South. Moreover, her designs using the natural cooling properties of the soil have earned her various awards from both the building industry and conservation societies. The system she invented is now regarded as perhaps the most effective, reliable, and cost-efficient method of cooling a structure in warm climates.

Who does the selection describe?
What is the person's occupation?
How successful has the person been?
What obstacles did the person have to overcome?

Corporation Essay 1
ART-itectural Associates is a highly successful architectural firm based in London, England. In fact the success of the firm is so great that high pressures have been placed upon other firms to live up to the philosophy of "quality before everything else" that ART-itectural has. ART-itectural only hires people who are the best at what they do, and approach their designs and endeavors with the attitude that "Quality is Pride-and Pride is Everything". This attitude is sought after because it is the same attitude that ART-itectural had when the firm was first established. In fact, the founder of ART-itectural was originally employed by the renowned
Houghton and associates architectural firm, which has its corporate headquarters in New York City and London, England. Although the Houghton made the ART-itectural's founder responsible for designing the newest structures in England, their attitude for quality was second to making money which was a disappointment.

Taking a chance, ART-itectural Associates-architectural consulting business was formed. For the first two years, ART-itectural Associates was unable to secure a contract. Almost out of money, in 1996, however, the Tate Museum asked ART-itectural to design their modern sculpture facility in Bradford-on-Avon, which recently opened to enormous critical acclaim. Since the opening of that art facility, the firm has been showered with offers, many of them from clients who used to take all their business to Houghton. According to a recent review in the London Times, "ART-itectural designs constitute a significant creative step forward from the old-school Houghton approach, which is so mired in past ideas that it has lost its utility and appeal."

What profession does the selection describe?
What philosophy is highlighted?
How successful has the philosophy been?
What obstacles stand in the way of this philosophy?

Corporation Essay 2
Ford Motor Company has at its aid a team of strong and power legal analysts. Many of whom have been the first attorneys to be contracted by many of the top Fortune 500 companies. These attorneys advise Ford in affairs with the United-Auto-Workers (UAW), liabilities of their products, environmental issues, copyright regulations, and advertising content.

Ford made the switch from their old philosophy of only consulting legal advice after problems, to a renewed philosophy of preventative maintenance. This new philosophy has lead Ford to remain as a leader in the auto-industry despite lagging international sales. Many executives at Ford regard the swift and prudent advice of these new analysts at having a hand in this great success. In the company's recent problems with certain rollover accidents of their SUV's, the analysts were quick to advise Ford to force Firestone to replace all existing tires on these SUV's.

Many analysts admit that the tenure at Ford is a difficult battle. Working for a company run under the strict dogma of the auto industry and needing the people skills to also work the auto unions is thought by many to be a juggling act. Unlike many large corporations, Ford cannot simply rely on only the legality of opening new plants or in the hiring and firing of their employees, but must also fulfill the demands of the UAW. Much mediation is required between Ford executives and UAW officials in just about everything from contract negotiations to mandating coffee breaks. These pressures present many of these analysts with somewhat of a restriction on their time at Ford. Although there is a high turn-over of these analysts, Ford has been successful at maintaining the large team of consultants.

What profession does the selection describe?
What philosophy is highlighted?
How successful has the philosophy been?
What obstacles stand in the way of this philosophy?

Corporation Essay 3
Siamese Twins is the name popularly applied to twins congenitally united in a manner not incompatible with life or activity. The name is derived from the famous twins Eng and Chang, born of Chinese parents in Siam (now Thailand). Eng and Chang were joined together at the sternum by a thick, muscular ligament and remained united throughout life.

Joined twins are always identical. Surgical separation is sometimes possible. An operation was successfully performed in 1953 on twins who were joined near the base of the spine and shared the lower intestinal tract, and in 1979 on twins joined at the skull. However the surgery involved in separating two cranial Siamese twins is an intricate operation requiring only the most exceptional surgeons in this field.

Only the world's most renowned surgeons perform these difficult surgeries. Often, the point where the twins are joined can further complicate the delicate process. When they share an organ the surgery becomes extremely high risk and usually results in one of the twins dying. In fact, only one set of twins have been successfully separated when they shared brain matter.

The field is dominated by only the most famous surgeons who are progressively aging but do not wish to give up their positions. It wasn't until the University of Michigan opened its micro-surgery unit in 1983 that younger and upcoming surgeons were able to begin performing such specialized surgery. Recently, the unit at U of M hospital has become the leading clinic for neuro-surgery. Today the clinic performs 90% of the world's micro-surgery involving the separation of Siamese twins.

What profession does the selection describe?
What philosophy is highlighted?
How successful has the philosophy been?
What obstacles stand in the way of this philosophy?

Corporation Essay 4

Recent advances in building and designing environmentally friendly systems for providing power and thermal regulation for homes and buildings have provided contractors with an array methods for designing "Green Structures." These structures usually consist of 60-0 % recycled materials and usually incorporate solar or wind powered systems used to produce electricity. One cooling system, in particular, has contractors of "green structures" talking. The use of the natural cooling properties of the soil have recently been harnessed in order to provide perhaps the most effective, reliable, and cost-efficient method of cooling a structure.

This system requires the contractor to dig a trench ten feet below the structure and have a pipe running thirty feet away from the center of the structure. At the end of the pipe a dry well or stone vault is placed. This well or vault, consists of an eight cubic foot hole filled with stones. The stones in the well work to absorb the cool temperatures of the deep soil. At the top of the well is a pump which pushes air into the pipe and eventually into the structure. Although the pump is often electric, many contractors have also used windmills to power the pump, thus creating a truly natural (and free) basis of air conditioning.

Another advance in thermal regulation which has increased the use of environmental methods in building is the use of heat and direction of the sunlight to heat a structure. By having a glass walled empty room on the south half (in the northern hemisphere) of the upper portion of a structure lined with black granite can often produce enough heat to completely shut off conventional means of heating during the day. Although not perfect, these heat systems have been shown to reduce power consumption by up to 60 % in homes in the Midwest.

What profession does the selection describe?
What philosophy is highlighted?
How successful has the philosophy been?
What obstacles stand in the way of this philosophy?

APPENDIX C

Math Ability Questions

Please indicate the choice that best fits your feelings to the following questions.
(0 = not at all; 9 = very much)

To what extent did reading the essays lead you to conclude that women in general might be able to score well on math tests?

To what extent did reading the essays lead you to conclude that you might be able to score well on math tests?

APPENDIX D
Quantitative Section

1. if 3n <500, which of the following is the greatest possible value of n?
a. 2
b. 4
c. 5
d. 6
e. 7

2. $\frac{mn+m}{m}-n=$
a. $\frac{mn}{m-n}$
b. $\frac{m}{m(m-n}$
c. $\frac{m-n}{m}$
d. 1
e. -1

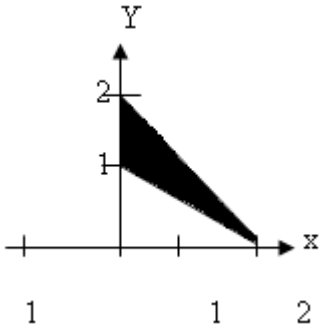
3. In deciding the asking price for a piece of property, a real estate broker determines that the market value of the lot is 1/7 the market value of the building on it. If the total value of the property is set at $140,000, then what is the total value of the lot?
a. $10,000
b. $17,500
c. $20,000
d. $120,000
e. $122,500

4. Company A manufactures paper plates at a rate of 1,000K per hour, while company B manufactures plates at a rate of 1,000L per hour. If both companies work simultaneously, how many hours will it take them to manufacture 100,000 plates?
a. 100/(K+L)
b. 1/(K+L)
c. K+L/100
d. 100 (K+L)
e. 1000 (K+L)

5. John has 4 ties, 12 shirts, and 3 belts. If each day he wears exactly one tie, one shirt and one belt, what is the maximum number of days he can go without repeating a particular combination?
a. 12
b. 21
c. 84
d. 108
e. 144

6. If y= 2x-1, what is the value of x in terms of y?
a. (y/2) -
b. (y/2) – (1/2)
c. ((y/2) + (1/2)
d. (y/2) + 1
e. y + 1/2

7.



In the figure above what is the area of the shaded region?
a. 1
b. 2
c. 2√2
d. 3
e. 4

8. If a = 2, b = 4, and c = 5, then [(a+b)/c] – [c/(a-b)] =
a. 1
b. 37/10
c. 0
d. -11/30
e. -1

9. Which of the following is the greatest?
a. .00003/.0007
b. .008/.005
c. .007/.0008
d. .006/.0005
e. .01/.008

10. If (p-q)/p = 2/7, then q/p =
a. 2/5
b. 5/7
c. 1
d. 7/5
e. 7/2

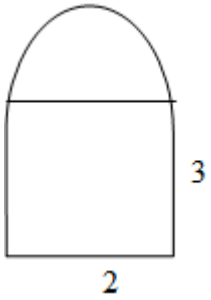
11. If integer x were divided by 7, the quotient would be 12 with a remainder or 1. Therefore, x =
a. 91
b. 90
c. 88
d. 85
e. 83

12. If y is not 0 and 2x + y = 12, then which of the following is NOT a possible value of x?
a. 12
b. 10
c. 8
d. 6
e. 4

13. Two tanks, X and Y, are filled to capacity with jet fuel. Tank X holds 600 gallons more than tank Y. If 100 gallons of fuel were to be pumped from each tank, tank X would then contain 3 times as much fuel as tank Y. What is the total number of gallons of fuel in the two full tanks?
a. 1,400
b. 1,200
c. 1,000
d. 900
e. 800

14. If 4x + 3y = 8 and x/2 = 1/4, what is the value of y?
a. 4/3
b. 2
c. 7/3
d. 3
e. 10/3

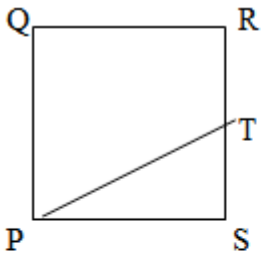
15. Two people were hired to mow a lawn for a total of $45. They completed the job with one person working for 1 hour and 20 minutes and the other working 40 minutes. If they split the $45 in proportion to the amount of time each spent working on the job, how much did the person who worked longer receive?
a. $33.75
b. $30.00
c. $27.50
d. $25.00
e. $22.50



16. A rectangular window with dimensions 2 meters by 3 meters is to be enlarged by cutting out a semicircular region in the wall as shown above. What is the area, in square meters, of this semicircular region?
a. π/4
b. π/2
c. π
d. 2π
e. 4π

17. [102 (108 +108)] / 104
a. 2(104)
b. 2(106)
c. 108
d. 2(108)
e. 1010

18. If n = 15 x 28 x 26, which of the following is NOT an integer?
a. n/15
b. n/21
c. n/32
d. n/35
e. n/39



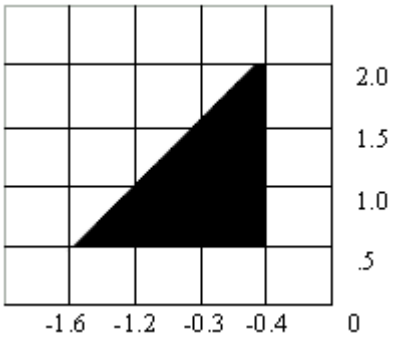
In square PQRS above, T is the midpoint of side RS. If PT = $8\sqrt{5}$, what is the length of a side of the square?
A. 16
B. $6\sqrt{5}$
C. $4\sqrt{5}$
D. 8
E. $2\sqrt{6}$

19.

20. If q is not 0 and k = qr/2 – s, then what is r in terms of k, q, and s?
a. (2k + s) /q
b. (2sk)/q
c. [2(k-s)]/q
d. [(2k) + (sq)]/q
e. [2(k + s)]/q

21. |3| + |-4| + |3-4|
a. 14
b. 8
c. 7
d. 2
e. 0

22.



What is the area of the shaded region in the figure above?
a. 0.5
b. 0.7
c. 0.9
d. 7
e. 4.5

23. A computer can perform 30 identical tasks in 6 hours. At that rate, what is the minimum number of computers that should be assigned to complete 80 of the tasks within 3 hours?
a. 6
b. 7
c. 8
d. 12
e. 16

24. Which of the following is 850 percent greater than 8 x 103?
a. 8.5 x 103
b. 6.4 x 104
c. 6.8 x 104
d. 7.6 x 104
e. 1.6 x 105

25.

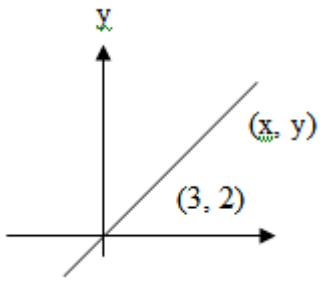
$$\frac{9^2 - 6^2}{3} =$$

a. 1
b. 15/9
c. 5
d. 8
e. 15

26. What is 0.423658 rounded to the nearest thousandth?
a. 0.42
b. 0.423
c. 0.424
d. 0.4236
e. 0.4237

27. If 3(x +2) = x-4, then x =
a. -5
b. -3
c. 1
d. 3
e. 5

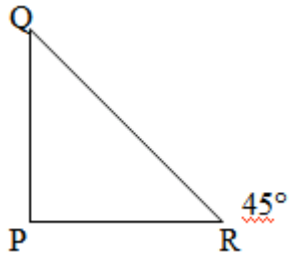
26. If x2 + 2xy + y2 = 9, then (x + y)4 =
a. 3
b. 18
c. 27
d. 36
e. 81



29. In the rectangular coordinate system above, if x = 4.8, then y =
a. 3.0
b. 3.2
c. 3.4
d. 3.6
e. 3.8

30. If the sum of two numbers is 14 and their difference is 2, what is the product of the two numbers?
a. 24
b. 28
c. 40
d. 45
e. 48

31. A secretary typed 6 letters, each of which had either 1 or 2 pages. If the secretary typed 10 pages in all, how many of the letters had 2 pages?
a. 1
b. 2
c. 3
d. 4
e. 5



32. If the area of triangle PQR is 32, what is the length of PR?
a. 2
b. 7
c. 8
d. 16
e. 32

33. If $3/x + 4/3x = 1/3$, then x =
a. 7
b. 9
c. 11
d. 13
e. 15

34. $$\frac{4/9 + 4/9 + 4/9 + 4/9 + 4/9 + 4/9}{6}$$
a. 2/27
b. 4/9
c. 2/3
d. 8/3
e. 6

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