# Testing Interventions to Reduce Math Anxiety in Practice Canadian Forces Aptitude Test (PCFAT) Examinees

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# Preparing for the Canadian Forces Aptitude Test (CFAT)

- The Practice Canadian Forces Aptitude Test (PCFAT) was created to replicate the length, difficulty, and time restrictions of the CFAT completed during the recruiting and selection process.

- The PCFAT platform also provides the CAF with a mechanism to collect data and examine sub-group differences.

- Academic literature shows gender-based differences on test performance can occur as a result of math anxiety (Hart & Ganley, 2019).

- Specifically, math anxiety may artificially lower scores for women (compared to men; Hart & Ganley, 2019), which could effect scores on the problem solving section of the CFAT.

# Reducing Anxiety

- In addition to examining gender differences in math anxiety, there is an opportunity to try to reduce any potential gap, which would level the playing field for examinees.

- Brief psychological interventions hold promise for efficiently and cost-effectively reducing anxiety (e.g., Cohen & Sherman, 2014; Jackson et al., 2017).

# Mechanisms to Reduce Anxiety

- Inoculation: Resistance is hypothesized to form as a result of being exposed to information that counters negative thoughts triggered by threat (McGuire, 1964).

- Self-Affirmation: People have a basic need to maintain the integrity of the self (i.e., a global sense of personal adequacy; Cohen & Sherman, 2014).

# Purpose

In the current study, we aimed to:

1. Assess gender differences in math anxiety.
2. Determine whether performance differs on the problem solving portion of the PCFAT, by gender.
3. Determine whether women's problem solving test scores can be improved through brief interventions designed to mitigate math anxiety.

# Methods

- A randomized controlled trial was created to examine whether a brief pre-emptive message or writing intervention effectively reduce math anxiety and improve test-taking performance.

- Participants were randomized to one of five conditions and subsequently asked to complete demographic questions, an intervention activity (or not), a measure of math anxiety, and the PCFAT.

# Methods

- The five conditions included:
  1. Inoculation Message (IM).
  2. Self-Affirmation (SA).
  3. Combined IM+SA.
  4. Control condition with a writing activity to equalize factors like time, cognitive effort, and fatigue.
  5. Control condition with no manipulation message or writing activity.

- The sampling frame included prospective CAF personnel.

# Example Inoculation Message

"I'm nervous the PCFAT is going to be very difficult"

- Consistent with the CFAT, the degree of difficulty of the PCFAT was designed to be appropriate for those with a Grade 10 level of education.  If you have successfully completed Grade 10, you have the knowledge and capability to do well on the PCFAT.

- Most people who take the PCFAT are able to complete the questions in the allotted time.

# Outline of Self-Affirmation Message

- In the following task, you are asked to provide written responses to questions about your ideas, your beliefs, and your life.

- Please rank the following characteristics and values (1-12) in order of your personal importance.

- Look at the value you picked as most important to you.  Briefly describe why your selected characteristic/value (the item ranked “1”) is personally important to you, and describe a time when it was particularly important to you.

# Results

- Participants in the trial (*N* = 5,814), predominantly:

- Identified as men (*n* = 3,997; 69%)
- Completed the English version of the PCFAT (*n* = 4,848; 83%)
- Were between 15 and 24 years of age (*n* = 3,121; 54%)
- Did not identify as a visible minority (*n* = 4,243; 73%)
- Did not identify as Indigenous (*n* = 5,411; 94%)
- Did not identify as a person with a disability (*n* = 5,380; 93%)
- Completed at least high school (*n* = 4,753; 84%)
- Completed the PCFAT for the first time (*n* = 4,827; 83%)

# Results

- Those allocated to the control group received no intervention and there was no difference in math anxiety scores between men and women.

- After including those who received an intervention, we found that women experienced more math anxiety than men before completing the PCFAT (*d* = .25).

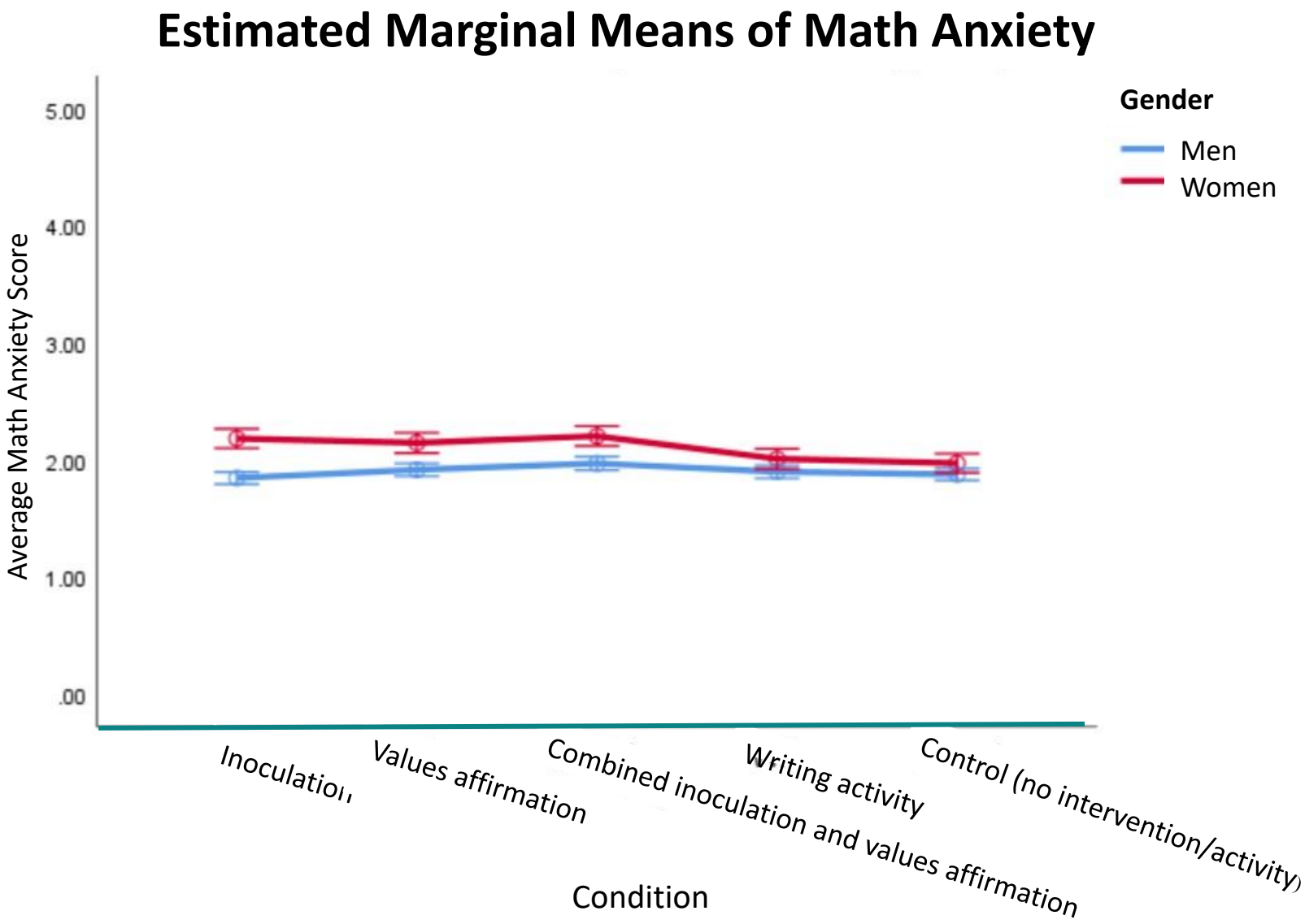
- Men scored higher than women on the problem solving section of the PCFAT in all conditions (*d* = .25).

# Results- Gender differences in math anxiety scores

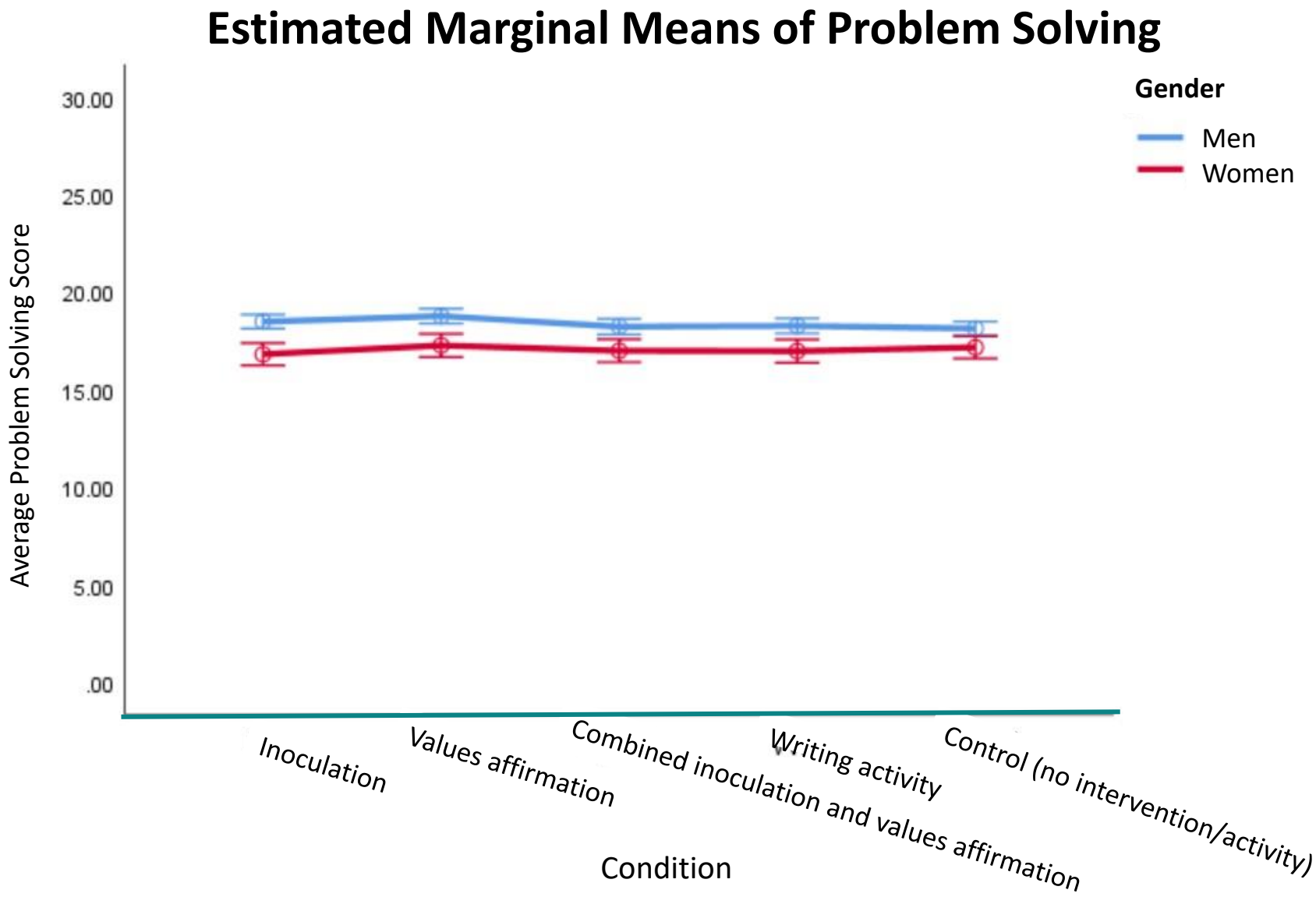
| | Inoculation Condition | Self-Affirmation (SA) Condition | Inoculation + SA Condition | Writing Activity Condition | Control Condition |
|---|---|---|---|---|---|
| Men | 1.88* | 1.97* | 2.00* | 1.91* | 1.91 |
| Women | **2.23*** | **2.25*** | **2.25*** | **2.05*** | 1.99 |
| Effect Size ($\eta p^2$) | .008 | .003 | .004 | .001 | .001 |

* denotes statistically significant difference between men and women. However, none of these differences were practically significant.
Scores are average scores on a scale of 1 to 5. Higher scores represent higher levels of math anxiety. Statistically significant interaction effect between gender and condition ($p$ = .03; $\eta p^2$ = .003)

# Results


Estimated Marginal Means of Math Anxiety
Gender
Men
Women
Average Math Anxiety Score
5.00
4.00
3.00
2.00
1.00
.00
Inoculation
Values affirmation
Combined inoculation and values affirmation
Writing activity
Control (no intervention/activity)
Condition

# Results


Estimated Marginal Means of Problem Solving
Gender
Men
Women
Average Problem Solving Score
30.00
25.00
20.00
15.00
10.00
5.00
.00
Inoculation
Values affirmation
Combined inoculation and values affirmation
Writing activity
Control (no intervention/activity)
Condition

# Results

- The interventions had a negligible *negative* effect (i.e., 0.4% explained variance overall) on math anxiety, and no effect on problem solving scores.

- Math anxiety had a moderate negative relationship with problem solving scores ($r$ = -.30), and this relationship was not different for men and women.

- There was a small positive relationship between how many times participants had previously completed the PCFAT, and problem solving ($r$ = .08), and math anxiety ($r$ = .07).

# Discussion

Overall, we sought to examine gender differences in

- (a) math anxiety and
- (b) problem solving scores on the PCFAT, and
- (c) the effectiveness of two brief interventions at mitigating math anxiety and differences in problem solving scores.

# Discussion

- There was no gender difference in anxiety between men and women in those who did not receive an intervention. The lack of difference in anxiety when writing the PCFAT, removed the requirement to close the gap.

- Despite not finding a difference in anxiety, there was a small gender difference between problem solving scores (women<men).

# Discussion

- The messages participants read before completing the PCFAT had a small negligible effect in the opposite direction than what we expected.

- Priming people to think, and tell a potential future employer, about their important personal values *immediately* before writing the PCFAT may have resulted in feelings of vulnerability, and elicited a slight anxious response in women compared to men.

# Discussion

- The low-stakes nature of the PCFAT may render the platform suboptimal for examining and mitigating anxiety.

- Writing the PCFAT more times was related to higher problem solving scores, and higher math anxiety scores.

- Since there is no evidence of bias in the CFAT (Berry, 2020), there may be factors other than anxiety causing the difference in problem solving scores.

# Key Takeaways

- Women do not experience more math anxiety than men prior to completing the (low-stakes) PCFAT.
- The interventions we tried did not have the desired effect.
- Despite the utility of the PCFAT platform, the low-stakes nature of the PCFAT may have limited the usefulness of using this platform to study anxiety.
- Since math anxiety is related to problem solving scores, it may be worth examining math anxiety in CFAT examinees, when the stakes (and likely anxiety) are higher.

# Questions/Discussion

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