Pre-Analysis Plan: Inspiring the Next Generation of Students in Higher Learning

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Working Abstract

This research employs an artefactual framed-field experiment with current students at the investigating University to assess how representation affects individuals' perceptions of their ability to and/or likelihood to pursue higher education. The experiment also investigates participants' perceptions of the academic aptitude of their peers. Participation is open to current University students at the investigating University across all degree levels and academic fields.

Participants will view a video depicting a panel of notable academics from the fields of physiology and medicine, physics, chemistry, and economics. Treatments will vary across the panel depicted with regards to the gender diversity of the academics shown. Participants will be asked a series of questions both before and after the video to compare treatment effects. Specifically, we assess the impact of representation in academia on students' perceptions of their own academic aptitude, their likelihood of pursuing further education, and the likelihood their male and female peers will pursue further education. Expert predictions will also be elicited and compared to experimental outcomes.

STEM (i.e. Science, Technology, Engineering and Mathematics) and economics are fields that have been historically underrepresented by women. For example, the government of Canada reports that, although progress has been made in the past several decades with regards to women entering historically male-dominated STEM fields, progress has been relatively stagnant in recent years (Statistics Canada, 2019). Similarly, stalled progress in narrowing the gender gap in the field of economics has been evidenced (Lundberg & Stearns, 2019). This research therefore seeks to understand how representation and social identity affect student perceptions of higher learning and academic ability.

References

Statistics Canada. (2019) "Persistence and Representation of Women in STEM Programs". Retrieved from https://www150.statcan.gc.ca/n1/pub/75-006-x/2019001/article/00006-eng.htm

Lundberg, S., & Stearns, J. (2019). "Women in Economics: Stalled Progress". Journal of Economic Perspectives, 33(1): 3-22.

Treatment Information

Treatments are administered between groups at the session-level. Each treatment and control group will view one of four different videos depicting a panel of Nobel Prize Laureates from the fields of physiology and medicine, physics, chemistry, and economics. Two videos depict all-

male Nobel Prize Laureates, while the other two include some female presentation. Participants will be asked a series of questions both before and after the video is shown to compare treatment effects. Participants will also respond to binding questions which ask their perception of both their male and female peers' likelihood to pursue further education.

Participants will respond to pre- and post-video questionnaires, which include providing the following information:

- Current field of study (pre-video)
- Estimated GPA (pre-video)
- Likelihood of pursuing advanced degrees (pre- and post-video)
- Perceived academic ability compared to peers (pre- and post-video)
- Perceived future career success compared to peers (pre- and post-video)
- Binding questions[1]:
  - Estimated likelihood their male peers will pursue further education (pre- and post-video)
  - Estimated likelihood their female peers will pursue further education (pre- and post-video)
- Perceived effect their social identity will have on their job market success (post-video)
- Parental levels of education and fields of study (post-video)
- Standard demographic questions (post-video)

[1]Note that for the binding questions participants view the following message:

"If you guess closest (compared to the other participants) to the true value, you have the opportunity to receive [a financial incentive] (Note: This is in addition to and separate from the gift card draw for participating in this experiment).

Among all questions of this format, one question will be randomly chosen to be binding by the computer when all experimental session concludes (i.e. the binding question is the one for which a winner will be selected to receive the gift card). The participant who answers closest to the true value among the study sample for this chosen question will be the winner. If you are selected as the winner you will be contacted once all sessions for this experiment concludes."

The treatments and control are summarized below:

Control

After responding to pre-video questions participants in control sessions will view video 1 or video 2. Both videos feature an all-male panel of Nobel Prize Laureates in the videos from the fields of physics, chemistry, economics and physiology/medicine (i.e. no gender diversity depicted). Participants will then respond to post-video questions and provide demographic information.

Treatments

After responding to pre-video questions participants in control sessions will view video 3 or video 4. As in the control, the panels depicted in the videos feature of panel of Nobel Prize Laureates from the fields of physics, chemistry, economics, and physiology/medicine. Video 3 and video 4 both feature some gender diversity amongst the panel. Videos 3 and 4 vary with respect to the academic fields from which female Nobel Prize Laureates are represented.

Timeline and Sample

Data collection is intended to take place in Summer-Fall 2022 at the investigating University. Experimental sessions will take place in-person and potentially online (via a session-wide zoom meeting). For completing the experiment participants are entered into a draw to win 1 of 50 $25 gift cards. Additionally, the participant who guesses closest to the true value for the selected binding question will receive a $25 gift card (separate to the draw). Recruitment will be undertaken at the investigating University. Only participants with valid University emails will be able to register to ensure participants are students.

Ex-ante power analysis was conducted to determine the required sample size shown in the table below. Information on enrollment in undergraduate and graduate-degree programs provided by the Common University Data of Ontario (Council of Ontario Universities[1]) was utilized to determine the expected proportion of undergraduate students who will pursue graduate-level qualifications for the purpose of determining required sample size (i.e. control group proportion).

Statistical Power Analysis – Sample Size Determination

Significance level	Power	Delta	p1	p2	N
0.1	0.8	0.2	0.12	0.32	104
0.05	0.8	0.2	0.12	0.32	134
0.1	0.8	0.15	0.12	0.27	172
0.05	0.8	0.15	0.12	0.27	218
0.1	0.8	0.1	0.12	0.22	348
0.05	0.8	0.1	0.12	0.22	442
0.1	0.8	0.05	0.12	0.17	1,226
0.05	0.8	0.05	0.12	0.17	1,556

Results from two-sample Pearson's chi-squared test comparing proportions (p2 = p1 versus Ha: p2 != p1). N2/N1 = 1; where p1 is control group proportion, p2 is treatment (experimental) group. Note that sample size determination relates to the minimum sample size required to test *H1* (described below).

[1]https://cudo.ouac.on.ca/. Enrollment data from 2018.

Experts Prediction Survey

A separate survey will be conducted online hosted by the Social Science Prediction Platform (https://socialscienceprediction.org/). This survey elicits field experts' predictions for the effect of the treatment on students' likelihood of pursing further education, by gender.

Hypotheses

Hypotheses

With the common null hypothesis being that a treatment does not influence any outcome, testable alternative hypotheses are listed below:

> Primary Outcomes:

H1: Female representation in higher learning will increase reporting of female students' likelihood to pursue further education.

H2: Female representation in higher learning will affect male participants' perceptions of their own ability differently than female participants.

H3: Female representation in higher learning will affect participants' stated likelihood that their male peers will pursue further education differently than it will affect participants' stated likelihood that their female peers will pursue further education.

> Secondary Outcomes:

H4: Social identity will impact perceptions of students' own ability.

H5: Treatment outcomes will differ from expert predictions.

Data Analysis

Dependent Variables:

Key dependent variables include:

- *Further Education$_i$*: Difference in stated likelihood to pursue further education (before vs. after treatment)[2]

- *Academic Ability$_i$* & *Future ability$_i$*: Difference in students' perceptions of their own ability (i.e. academic ability and future career performance) compared to their peers (before vs. after treatment)[3]

- *Peer Ability Difference$_i$*: Difference in male/(female) students' perceptions of their female peers' likelihood to pursue further education (before vs. after treatment)

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[2]Participants respond to a 5-point Likert scale regarding their likelihood to pursue further education. The dependent variable can then be constructed by categorizing responses into less likely/no change/more likely to pursue further education before and after the treatment.

[3]As for above, perceptions of own ability are measured on a 5-point Likert scale. The dependent variable can then be constructed by categorizing responses into less confident/no change/more confident with regards to participants' stated ability compared to peers before and after the treatment.

We will combine ordinary least square and logistic models, along with visualization tools, to analyze the data. The effect of gender representation (treatment) on the variance of responses, by gender, will also be explored.

Explanatory Variables:

Key explanatory variables to be included are as follows:

- *Treatment$_i$*: Binary indicator if shown Video 1 (control), Video 2 (control), Video 3 (treatment) or Video 4 (treatment)
- *Gender$_i$*: Participant gender (binary indicator)
- *Gender$_i$* X *Treatment$_i$*: Interaction between participant gender and treatment (video shown)
- *GPA$_i$*: Student's current stated GPA

Note that regressions will be conducted with and without demographic variables as a robustness check.

IRB Approval Details

This project is approved by the University of Guelph's Research Ethics Boards (REB 21-12-016).