

# Nudge away the Gap!

The effect of norm nudge messaging  
on competition preference

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# Executive Summary

The greatest achievements of history often come through the pressure of competition. While people are naturally inclined to have different attributes toward competition, prior research has shown that there is a significant gap between genders in choosing competitive payment schemes (Niederle & Vesterlund, 2011).

Many approaches have been taken to close the gender competition gap, none of which have included the effects of norm nudge messaging. In the present report, our team explores the research question of how different type of norm messages, moderated by gender of who is delivering the message, may increase willingness to compete. Our study uses a 2 (norm message type) x 2 (messenger gender) between-subject design given to 143 participants on MTurk. We test the effectiveness of different interventions to increase the number of participants choosing to enter into a competitive math environment. As STEM industries often have high gender imbalances (Cheryan et al., 2017), our design focuses on math with the intention to be more applicable beyond the experiment.

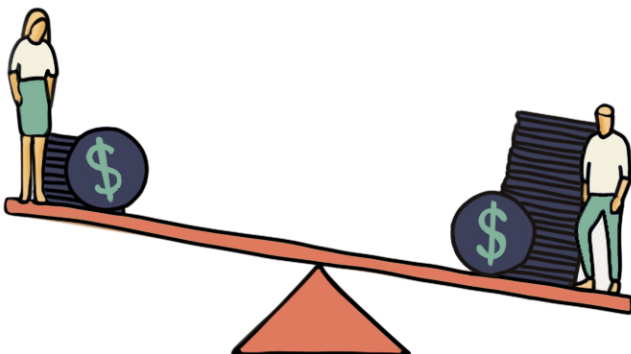
## Research Question

Can norm nudge messages increase entry into math-like competitive environments?

Is the effect of the message dependent on the messenger?

We predicted that norm nudging will increase tournament entry for all participants, but particularly women, moderated by messenger gender. Further, we hypothesized that egalitarian norm nudges would be more effective than empirical ones. Analyzing results using both OLS regression and mean comparison tests, we do not find statistical evidence to support our hypotheses. However, as our study is underpowered, we believe the results approaching significance warrant further research into nudge messages, especially focused on dynamic egalitarian norms.

Many practical implications can arise from these results to increase competition beyond the lab particularly within workplace environments. Nudge messaging could be an effective tool for targeting gender disparities by boosting applications for open roles or even increasing female participation in jobs with competitive pay structures. There may be broader application to quasi-competitive tasks (e.g., performance reviews).



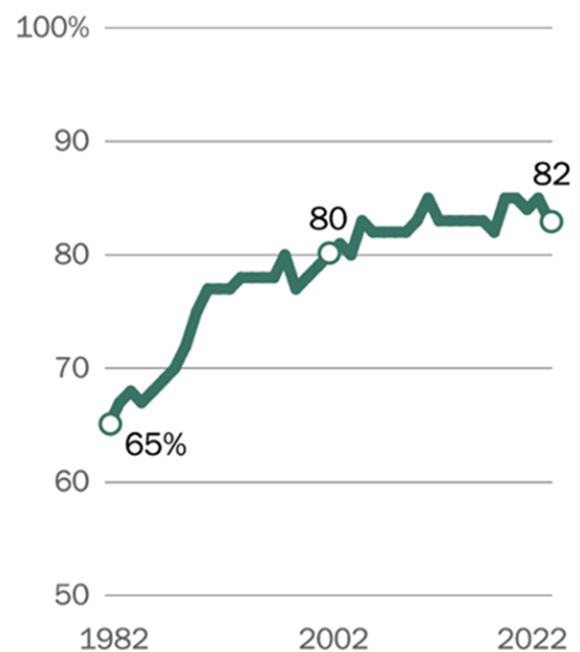
# Introduction & Literature Review

The Fortune 500 is a list of the largest companies, ranked by revenues, that epitomizes the nature of competitiveness within the public and private sector (Fortune Editors, 2023). In 2023, there were 52 female CEOs, saturating 10% of the market (Catalyst, 2023). Fortune's list is an ongoing benchmark of a competitive environment of the top 500 companies worldwide, and also highlights the gender gap across all business industries. Despite attempts at narrowing the gender gap between men and women in the 1980s and early 2000s, progress has seemingly slowed down from the 2000s to today (Pew Research Center, 2023). In addition to systemic factors, research suggests that a gender gap in competitiveness exacerbates existing inequities (Markowsky, 2022).

Social scientists have explored ideas to close the gender gap in willingness to compete. In a seminal lab experiment, Niederle and Vesterlund (2007) demonstrated a significant difference in preference for tournament entry (i.e., competition) between men and women. The leading result was that men were more willing than women to enter competition. A meta-analysis of gender differences in competition (Markowsky, 2022) examined moderators such as same-sex tournaments, teams, prize magnitude, time

## Gender pay gap narrowed in the 1980s and '90s, but progress has stalled since

*Women's median hourly earnings in the U.S. as a % of men's median hourly earnings*



Note: Samples include employed workers ages 16 or older with positive earnings, working full time or part time, excluding the self-employed.

Source: Pew Research Center analysis of the Current Population Survey outgoing rotation group files (IPUMS).

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pressure, and others. Power priming (Balafoutas, 2018) and advice (Brandts, 2012) also show promise in increasing women's participation in competition. Shastry et al. (2020) specifically explored the role of attribution of feedback in this process and, interestingly, found that additional feedback did not materially boost the tournament entry of women but rather decreased the entry of low-performing men.

Another study by Kessel et al. (2021) used a design where participants solved addition problems and chose between receiving tournament or piece-rate pay. Before the participants' final decision to compete or not, they received advice/information regarding the existence of a gender gap in willingness to compete. Participants were also prompted with framed messages about higher earnings potential. The results showed that advice intervention decreased the gender gap in willingness to compete. However, to our knowledge, researchers have not yet explored the use of norm nudge messages to close the competition gap.

Norm nudging involves informing individuals about what others do in similar circumstances using social comparison to induce behavior (Bicchieri, 2023). For our experiment, we plan to test two message types to increase the willingness to compete. The first will be an egalitarian norm message tapping into a sense of fairness and desire for equal treatment that has been tested in various settings (Bennett & Sekaquaptewa 2014; Schuster et al., 2023). We take the dynamic egalitarian message utilized by Schuster et al. in a study on boosting salary offers to female candidates as our base because of its focus on gender gaps. The second message is an empirical norm message that highlights how a high percentage of even low performing individuals will willingly enter a competition in lab settings. This message utilizes a descriptive norm with a clear reference network of other experiment participants (Bicchieri, 2023). Though there is promise in utilizing both egalitarian and empirical nudging, there is also a warning noting the limitations it has in promoting real behavioral change (Bicchieri & Dimant, 2019). We tested both types to see if one norm message is more applicable within this context.

**“Empirical expectations, which refer to individuals' beliefs about what others actually do, and normative expectations, which refer to beliefs about what others believe is the right thing to do, are the two types of social expectations that norm-nudges rely on.” (Bicchieri & Dimant 2023)**

In addition to the message, we also tested whether an associated messenger gender has an effect. Prior research has suggested that the messenger of information can make an impact on behavior (Dolan et al., 2010). Messenger gender has been shown to be salient in contexts pertinent to gender equity showing that men were more likely to listen to a male messenger compared to a female one (Williams et al., 2021). Given potential power dynamics in the workplace, and with women still underrepresented in managerial and executive positions like Fortune 500, understanding any moderation by messenger gender could be important.

Finally, we recognize there are additional factors outside of gender that influence willingness to compete. Hunziker et al. (2011) found that students with more negative emotions about team competition

had higher rates of stress and poorer performance. This demonstrates that perceived views of competitiveness and levels of stress may affect competition entry. However, Liu et al. (2021) found that social comparison orientation may lead to higher competitiveness and lower risk aversion. For this reason, we have added validated attitudinal surveys to assess stress, risk, and competitiveness for the purposes of controls.

The existing literature led us to predict that normative nudging will increase tournament entry for all participants but particularly women and this effect will be moderated by messenger gender. We believe it is especially important to test this using a math context for application to STEM, where gender inequities are highest. This is the basis of our research question and key hypotheses covered next.



# Research Question

Can norm nudge messages increase entry into math-like competitive environments for participants

Is the effect of the message dependent on the messenger?

## Hypothesis

## Motivation

**H1a.**

Norm nudge messages will increase tournament entry for all participants.

Research in a variety of contexts has shown this to be an effective intervention

**H1b.**

The egalitarian norm nudge will be more effective than the empirical norm nudge at increasing tournament entry

Prior research has shown higher effect sizes for egalitarian norm nudge; moreover, we expect this norm to be more salient given the context

**H2**

Norm nudge messages will increase tournament entry for female participants more than male participants.

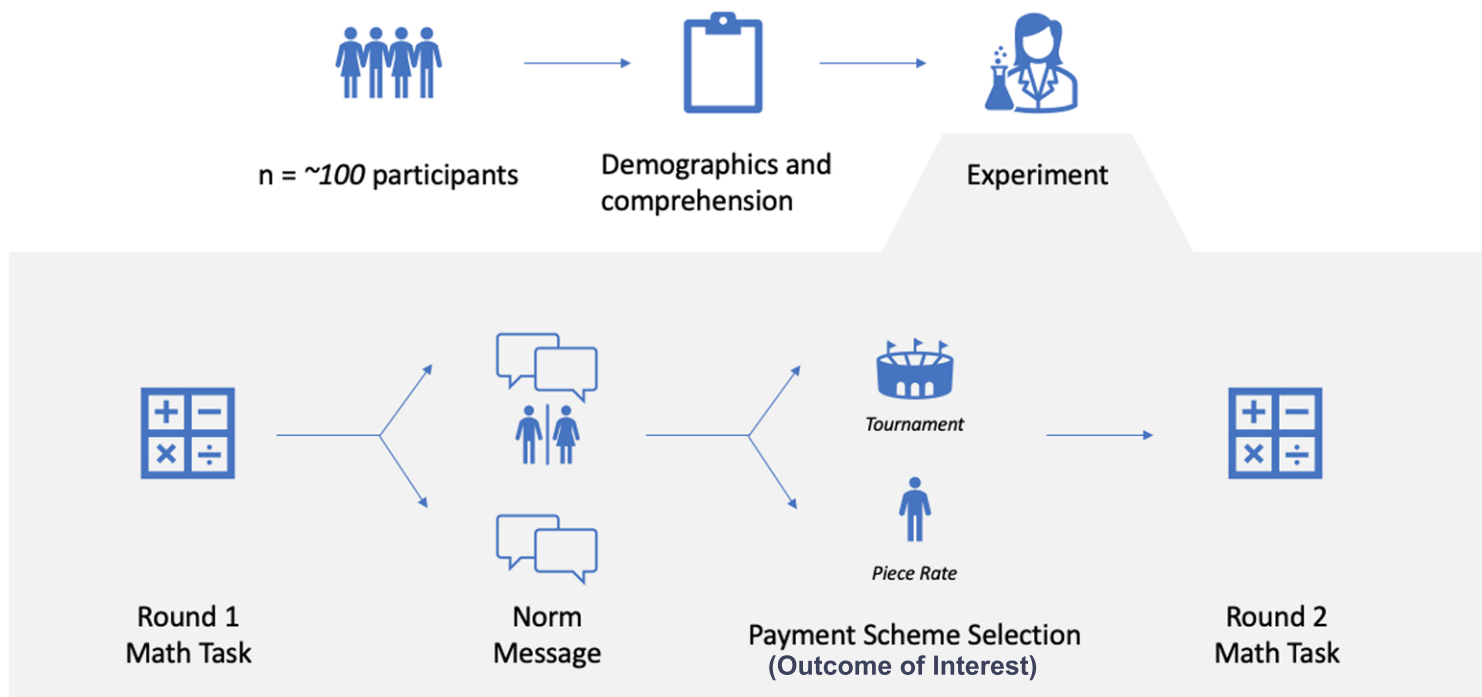
Because women choose competition less frequently (at least in documented lab settings), we expect the messages to have a large effect for them

**H3**

Norm nudge messages will be moderated by the gender of the messenger

The messenger matters and given the gender differential in competition preference, male and female messengers could change how the nudge is received

# Experimental Design



We tested our research question online as a between-subject design using multiple rounds of a math task similar to Shastry et al (2020). Niederle and Vesterlund (2007) tested gender differences in competitiveness with a two-digit addition task that has been found to have equal ability across genders. After completing a practice, unscored round, participants were sorted randomly into treatment groups and received a message intended to encourage tournament entry, the primary dependent variable. The experiment used a 2 (norm nudge messages: egalitarian or empirical) x 2 (messenger: male or female) structure with a separate control group.

We recruited participants using MTurk and provided participation and task-related compensation. We recruited 144 participants, and excluded one participant due to failing three attention checks. (covered in detail in the “Results” section). To meet our feasibility requirements, we modified Niederle and Vesterlund’s math task to include three rather than five two-digit numbers, with a time requirement of 1 minute and thirty seconds to complete 10 questions.



# Egalitarian Norm Message

In cognition tasks, competition gaps have reduced significantly between genders over the years. That means more and more people are willing to compete head-to-head with other participants to potentially earn more payment.

# Empirical Norm Message

In a previous study, over 50% of individuals, despite scoring the lowest on a mental cognition task, opted for head-to-head competition with other participants to potentially earn more payment.

After round 1, participants received a norm message coming from a male/female messenger. The egalitarian norm message focused on the increased willingness of men and women to enter competitive environments. The empirical norm message highlighted how even

low performing individuals willingly enter into competition. The messages were presented with an image of a man or a woman as the “messenger.” Both messages and images were validated in a pilot test. Those in the control group did not receive a message.

After completing round 1 (the unscored, practice round), participants were then be asked what payment scheme they would like to use for round 2:

## Tournament Payment Option



If they score higher than a randomly matched participant, they will be compensated with higher payout.

## Piece Rate Payment Option



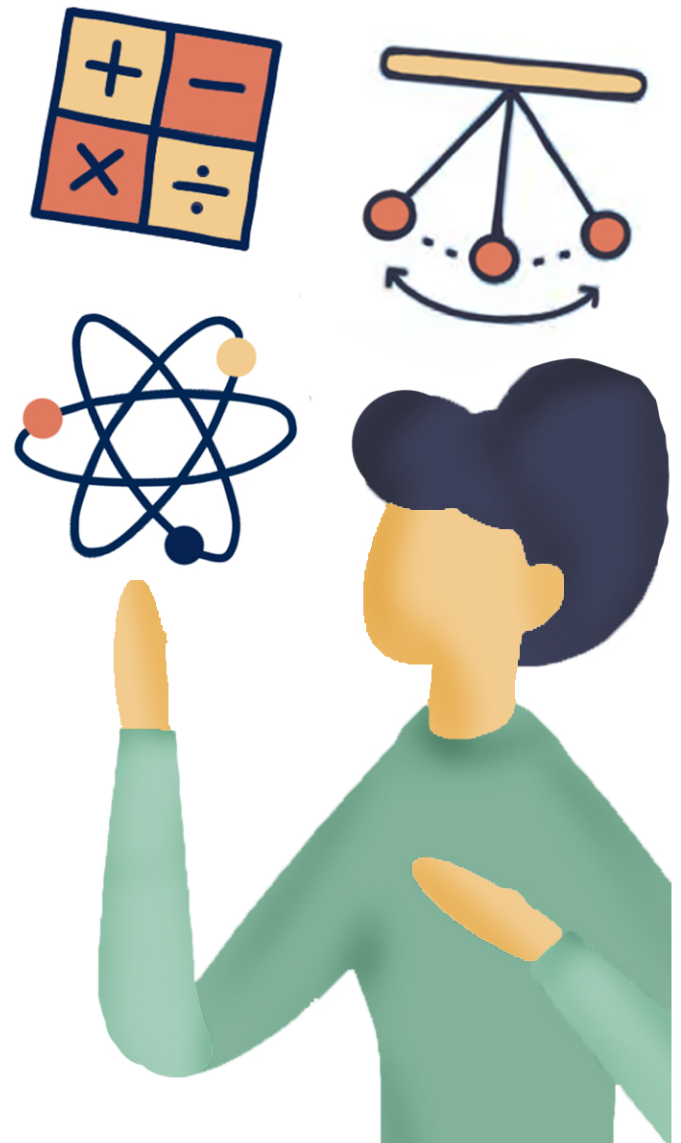
Participants were compensated per correct question answered



		Normative Message	
		Egalitarian	Empirical
Messenger Gender	Male	Male Egalitarian Norm Messaging	Male Empirical Norm Messaging
	Female	Female Egalitarian Norm Messaging	Female Empirical Norm Messaging

After choosing, participants completed round 2. After completing round 2, we had individuals complete attitudinal surveys on anxiety and risk-taking behavior to control for potential confounds. We measured scores and payouts for all rounds along with the key binary variable of tournament entry.

Participants received \$0.70 for participating and earned raffle tickets based on performance. Tickets will be used in a lottery for one \$50 gift card. Participants received four tickets for each correct answer in the piece rate scheme and two or six raffle tickets per correct answer in the tournament scheme (if below/above the score of their match). This should meet incentive compatibility (Lecture 3, Slide 21), but we recognize that there are limitations (covered in more detail in the “Results” section).



# Results & Discussion

In conducting our research, we were concerned with one key result for each participant (our primary dependent variable): the decision to choose a competitive payment scheme. Because this is a binary outcome, we evaluated and compared the percentage of individuals choosing to “compete” across different groups. Against our specific hypotheses, we evaluated the influence of the different norm nudge messages (our independent variable) using both mean comparison tests and linear regression. In our linear probability model regression, we controlled for certain personality traits (our covariates) strongly correlated with competitiveness. The hypotheses and key results are summarized below; a more detailed review can be found in the appendix.



Hypothesis	Key Result	✓	Meaning
<b>H<sub>1A</sub>: Norm nudge messages will increase tournament entry for all participants.</b>	<b>Approaching significance!</b> p-value = 0.16 ( <i>Wilcoxon</i> )	✓	Given smaller sample size, further research can confirm this approach.
<b>H<sub>1B</sub>: The egalitarian norm nudge will be more effective than the empirical at increasing tournament entry</b>	<b>Approaching significance!</b> p-value = 0.09 ( <i>Wilcoxon</i> )	✓	This result suggests further research could narrow on egalitarian norms.
<b>H<sub>2</sub>: Norm nudge messages will increase tournament entry more for female participants.</b>	Interaction term was <b>not</b> significant	✗	This approach is not more effective for females.
<b>H<sub>3</sub>: Norm nudge messages will be moderated by messenger gender.</b>	Interaction term was <b>not</b> significant	✗	The messenger gender does not appear to change effectiveness.

Table 1: Validation of hypothesis and implications

Our primary hypothesis stated that the norm nudges would increase preference for competition across all participants. Participants in the control chose to compete 14% of the time while those who received the norm nudge messages chose to compete 27% of the time. These results were not statistically significant in either of our two tests (Mann-Whitney U test and LPM), but this was likely due to our low sample size. Taking a more detailed look at

the different types of norm nudge messaging, the egalitarian norm (35.4%) outperformed the empirical norm (20.9%). While this differential supports our hypothesis, the results were not statistically significant (using a Mann-Whitney U test) due to our sample size. It is our contention that these are promising data and could be a sign of opportunity for future research.

## Competition by Treatment

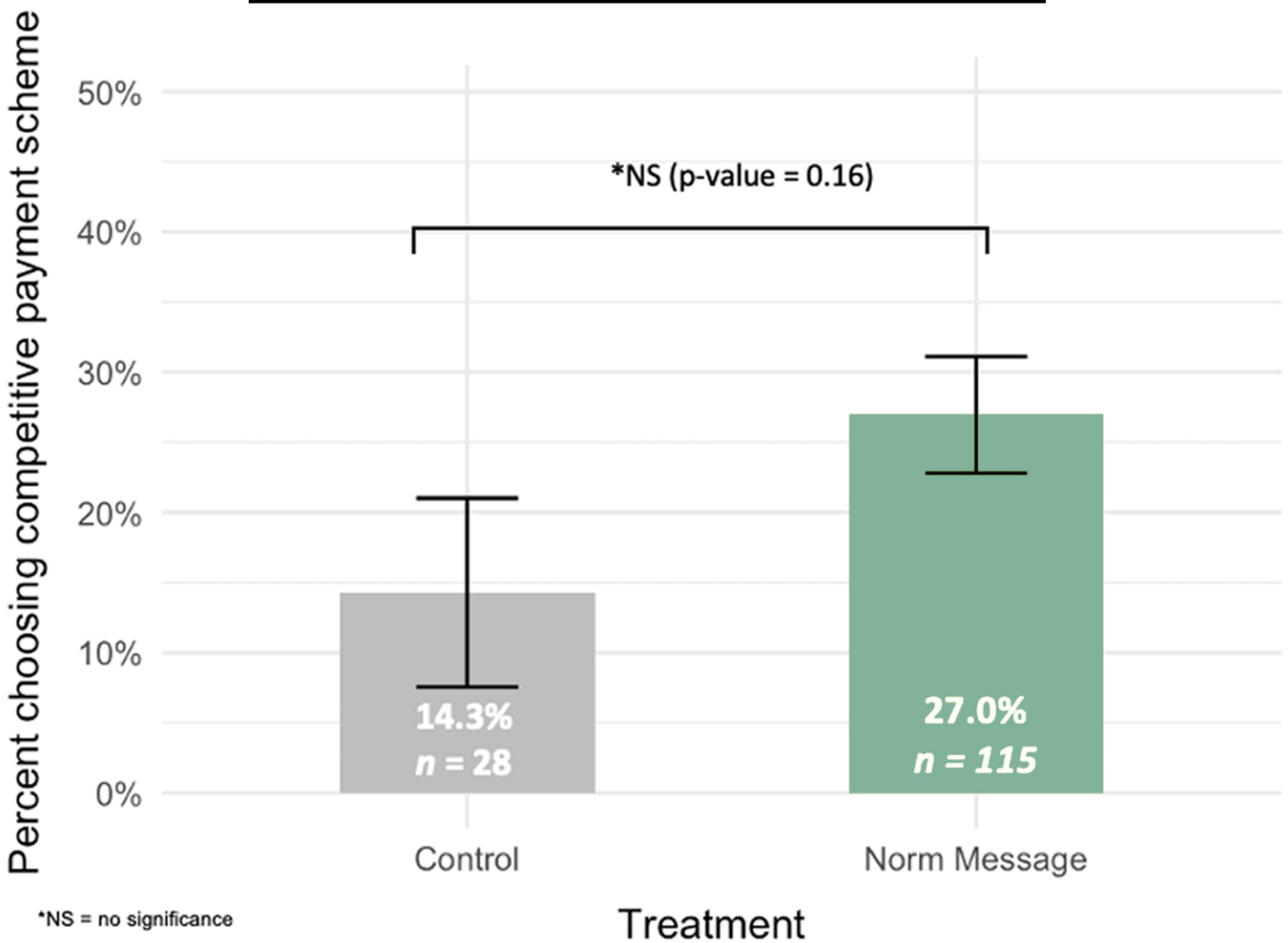


Figure 1: Comparing control and all treatment groups pooled

As covered in the summary table above, our other hypotheses were not supported by the data. Regression analysis did not find evidence to show that the messages were more effective at increasing competition for female participants. Similarly, the data did not support the hypothesis that the messenger gender would moderate the influence of the

message. (For both of these hypotheses, we looked at interaction terms and the coefficients were not statistically significant). Given the high p-values observed, we are more inclined to reject these hypotheses and not attribute the results to our sample size (and thus not recommend these for further research).

## Competition by Treatment

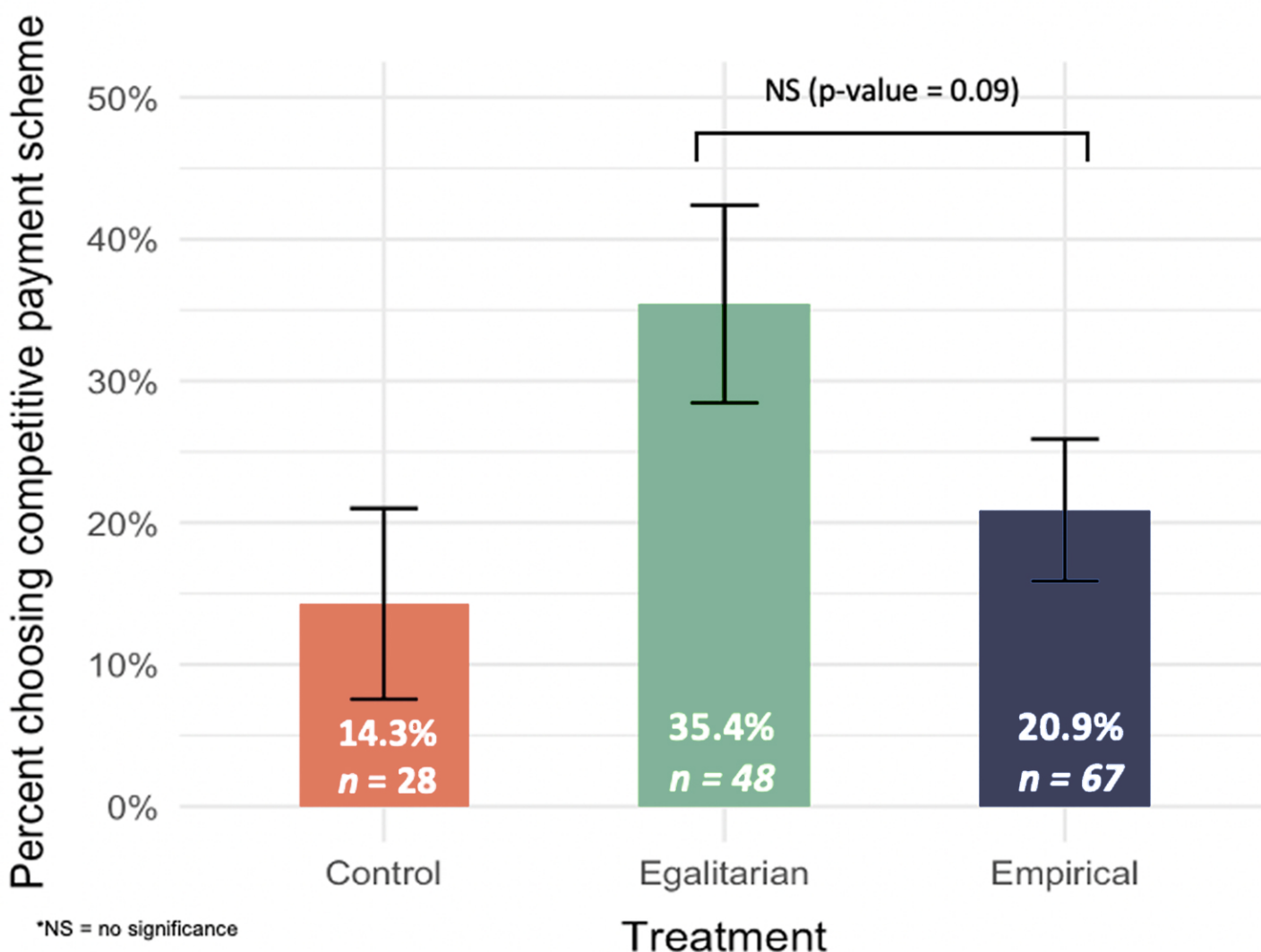
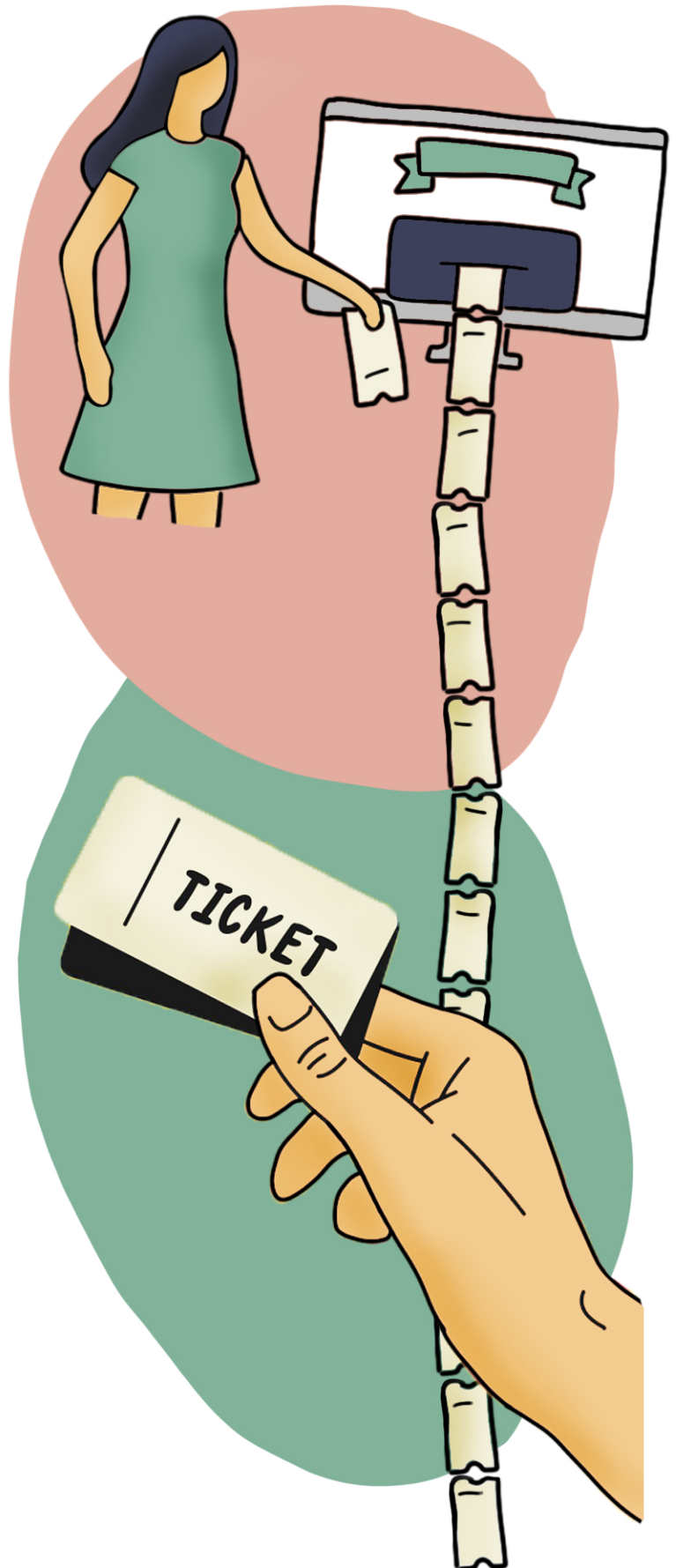


Figure 2: Comparing control and different message types

Highlighted by our many references to it, sample size is key to understanding our results. Our experiment had 143 participants with ~30 individuals per condition. A power analysis conducted before the experiment suggested we would need at least 520 participants to see our predicted effect size. We calculated this from both prior research on norm nudge messaging and data from a pilot test that we ran. Unfortunately, due to budget constraints, we were not able to recruit this number of participants for this experiment. A post hoc power analysis confirmed that we were indeed underpowered (power of 31% compared to the usual behavioral science threshold of 80%). As such, there is uncertainty in the interpretation of our findings.

For the purposes of transparency, we want to highlight other limitations beyond sample size that may have affected our results. Our budget required a participation fee combined with a raffle scheme instead of having a pure pay for performance model. While lotteries are cost effective, we recognize that it may be less motivating to some participants because they know that either all or none of their decisions will count toward payment. This ultimately reduces IVT compatibility for those participants. Separately, we recognize that it is difficult to rely on gender reporting on MTurk. We asked for gender identification in our demographic questions (for the purposes of Hypothesis 2), but we cannot validate its accuracy. The results using participant gender were not meaningful in any case.



# Policy Implications

As covered previously, prior research has shown men have a higher preference for competition than women (Niederle and Vesterlund, 2007). This may be a factor contributing to gender disparities in earning power in workplace settings, including those in STEM. Our experiment has the potential to suggest new strategies for nudging competition that could help to address disparities for females and other underrepresented groups in professional contexts.

While our intervention did not lead to statistically significant results, we believe it is directionally close enough to warrant further research. Particularly, the overall increase in competitive entry for participants in the egalitarian norm nudge treatment is promising. With the support of additional research in a high-powered sample, results could have many practical applications in competitive workplace environments. Nudge messaging could boost applications for open roles and potentially increase female participation in jobs with competitive pay structures (such as commission-based sales roles). Messaging could further be implemented in quasi-competitive activities such as encouraging strong self-evaluation in performance reviews (competing against peers). Moreover, insights about the influence of the messenger gender could help determine how organizations deliver these nudges to ensure maximum effectiveness.

Until existing systems change, head-to-head competition will remain a core element of workplaces and could disadvantage underrepresented employees such as females in STEM. Understanding low-touch approaches that can effectively tighten the competition gap will help to combat observed gender inequities. Given the urgent need for parity in the most powerful fields and the documented success of social norms in driving behavior, we recommend future researchers continue to explore the relationship between social norms and competition preference.



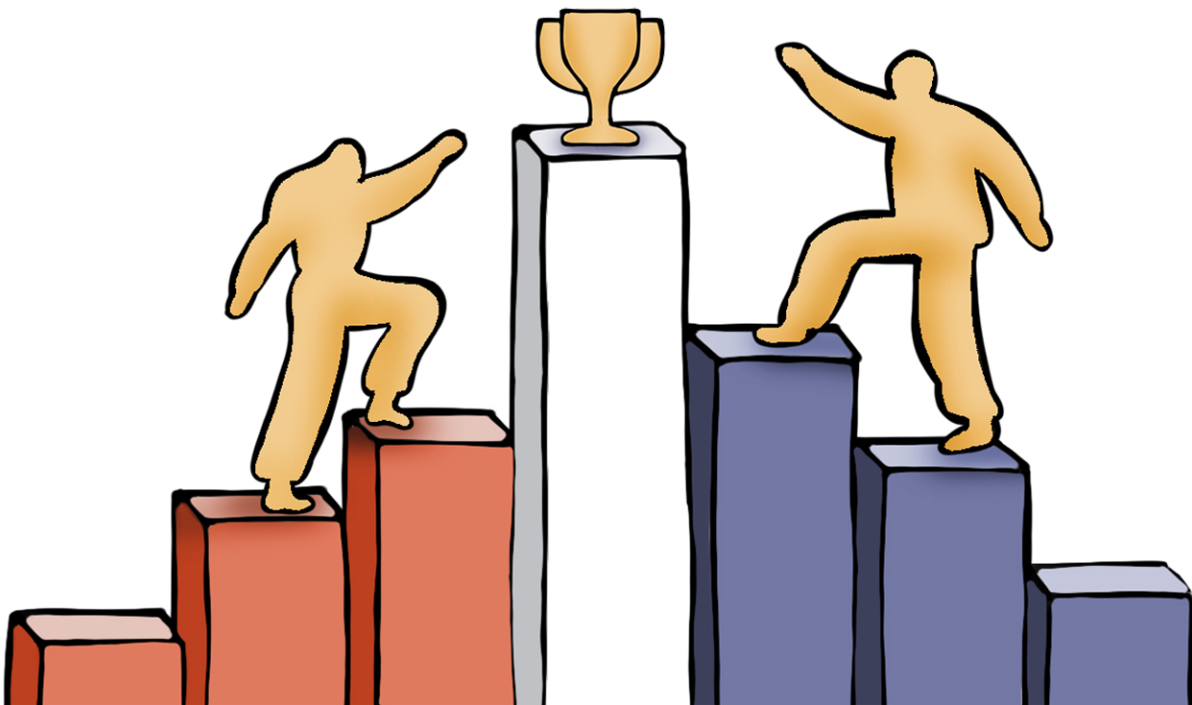
# Appendix A - Power Analysis

## *A priori*

In conducting our power analysis, we looked at both prior research and results from our pilot tests. Prior research on norm nudge messaging shows a range from Cohen's  $d = 0.2$  to  $0.5$ :

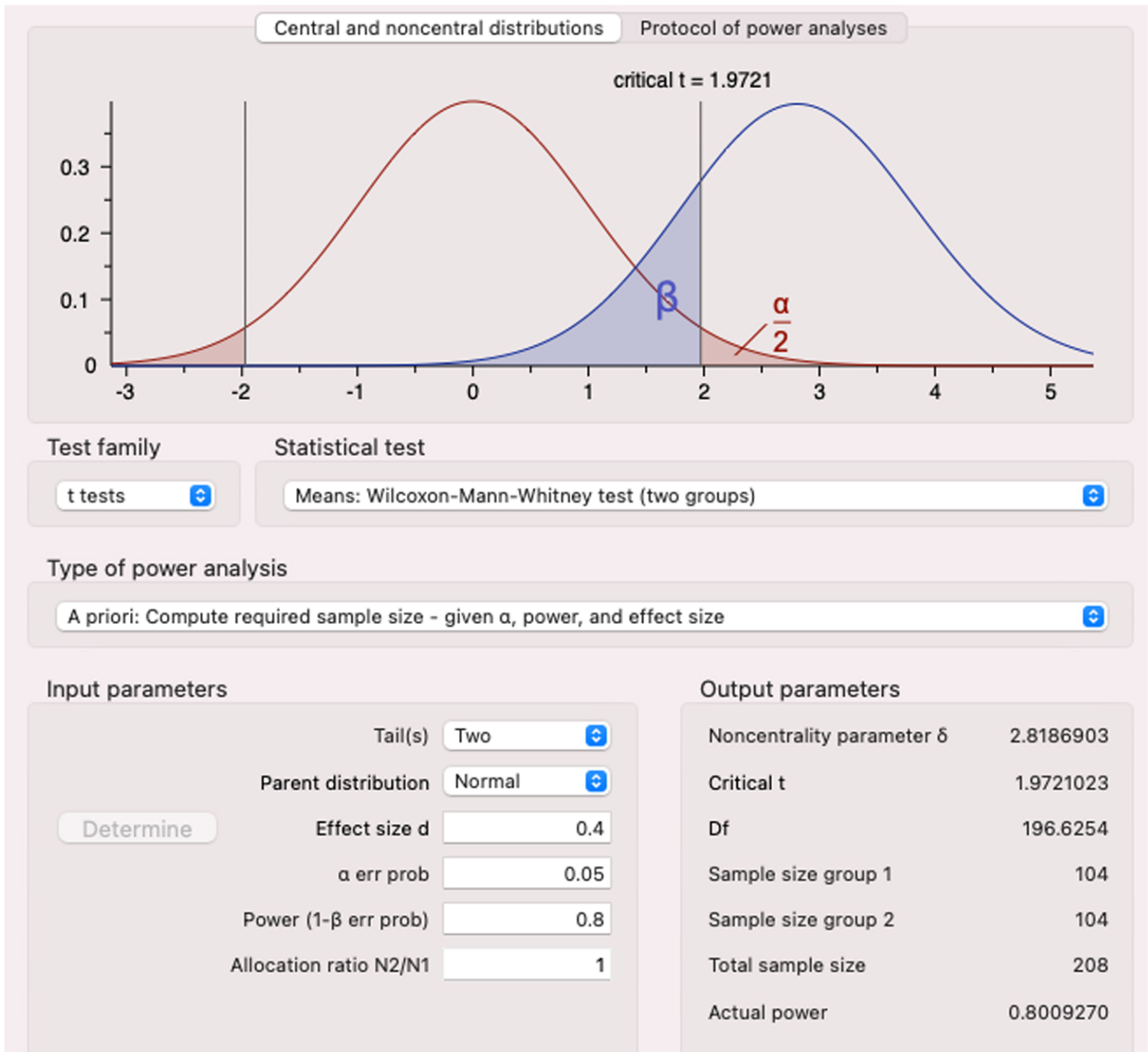
- Egalitarian norm nudge – Dynamic egalitarian norm demonstrated an effect size of  $0.38$  to  $0.40$  in prior research (Schuster et al., 2023)
- Empirical norm nudge – Using an empirical descriptive norm (“3 out of 4 did...”) in a physical activity context showed an effect size of  $0.19$  to  $0.49$  (Priebe and Spink, 2015).

In our pilot study, we saw an effect size of  $0.48$  when looking at our treatment groups pooled compared to the control. Overall message effect size ranged from Cohen's  $d = 0.13$  to  $0.99$  when looking at individual treatment groups compared to the control. To be conservative, we anticipated an effect size of  $0.4$  which is more in line with prior literature. For an alpha of  $0.05$  and power of  $80\%$ , this would require  $104$  participants per treatment group (with an equal control this would require  $n = 520$ ). Of note, we expected to recruit  $\sim 100$  participants and thus our experiment was underpowered.





# Appendix A - Power Analysis

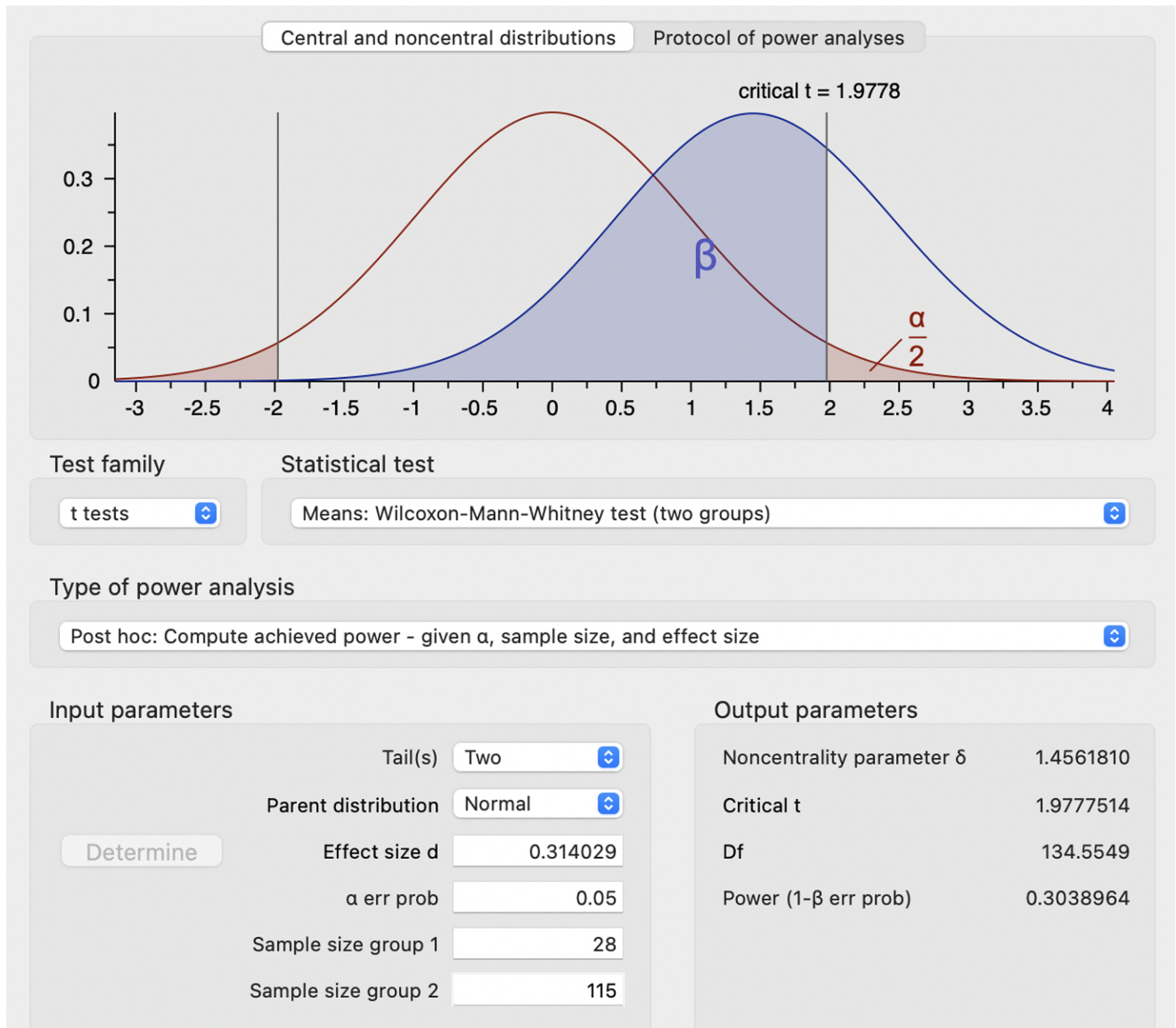


**Figure 3 - G\*Power calculation used for sample size**

# Appendix A - Power Analysis

## Post Hoc

We conducted a post-hoc power analysis based on the results of our experiment (shared below). Our experimental data suggested an effect size of  $d = 0.314$ , which was below our estimate based on the pilot and literature review. For an alpha of 0.05 and our sample size collected ( $n = 143$ ), the predicted power was 0.303. This is substantially below the 0.8 level sought in behavioral science. Thus while our results against H1A and H1B are promising, we cannot be certain of the findings and future research is required.



# Appendix B - Detailed Statistical Analysis

Treatment	Participants (n=)	Compete (%)	St. Deviation
Control	28	14.2%	35.6%
Female Egalitarian	21	28.6%	46.3%
Female Empirical	37	16.2%	37.3%
Male Egalitarian	27	40.7%	50.1%
Male Empirical	30	26.7%	45.0%

Table 2 : Summary statistics from the experiment

**Hypothesis 1A: Norm nudge messages will increase tournament entry for all participants.**

Group means relevant for hypothesis:

- Control = 14.3% (n = 28)
- Norm Nudge (all intervention groups pooled) = 27.0% (n = 115)

For the on the next page, the statistical tests that we are approaching significance at the 95% level but are not quite there. We believe this is likely due to being underpowered.

*Comparison of means test:*

- Wilcoxon rank sum test: p = 0.16
- Two Sample t-test: p = 0.12

*OLS Regression (Linear Probability Model):*

See Figure 4 for the full regression, coefficient on binary variable for receiving norm nudge message was not significant (p = 0.229)

### Testing Hypothesis 1

		<i>Dependent variable:</i>
		Compete
Norm Nudge	0.112 (0.093)	<b>Note</b> p-value = 0.229
Stress	0.099 (0.101)	
Risk	0.011 (0.015)	
Competitiveness	-0.094 (0.095)	
Constant	0.089 (0.262)	
Observations	143	
R <sup>2</sup>	0.026	
Adjusted R <sup>2</sup>	-0.002	
Residual Std. Error	0.432 (df = 138)	
F Statistic	0.937 (df = 4; 138)	
<i>Note:</i>		*p<0.05

Figure 5 : Linear probability model assessing treatment with covariates

**Hypothesis 1B: The egalitarian norm nudge will be more effective than the empirical norm nudge at increasing tournament entry**

Group means relevant for hypothesis:

- Egalitarian = 35.4% (n = 48)
- Norm\_Nudge (all intervention groups pooled) = 20.9% (n = 67)

For the below statistical tests we are approaching significance at the 95% level but are not quite there. We believe this is likely due to being underpowered.

*Comparison of means test:* Wilcoxon rank sum test was not significant (p = 0.09)

*OLS Regression with Post-Test Estimation:* Egalitarian and empirical norm nudge messages were not significantly different (p = 0.09).

We ran a set of pairwise comparison tests to evaluate whether the egalitarian norm nudge was statistically significant compared to the control. This was an extension of Hypothesis 1 that was not pre-registered. Again the results were not significant but informative.

- Pairwise Wilcoxon (with Holm adjustment):  $p = 0$ .
- Pairwise t-test (with Holm adjustment):  $p = 0.15$

**Hypothesis 2: Norm nudge messages will increase tournament entry for female participants more than male participants.**

Running an LPM with an interaction term between participant gender and treatment as a binary (i.e., receiving intervention) did not yield a significant result ( $p = 0.75$ ). This does not support our hypothesis. The full regression is below in Figure 6.

<b>Testing Hypothesis 2</b>	
	<i>Dependent variable:</i>
	Compete
Norm Nudge	0.095 (0.114)
Female	-0.189 (0.173)
Stress	0.096 (0.101)
Risk-Taking	0.006 (0.015)
Competitiveness	-0.090 (0.095)
Nudge * Female (Interaction)	0.062 (0.192)
Constant	0.171 (0.269)
Observations	143
R <sup>2</sup>	0.050
Adjusted R <sup>2</sup>	0.009
Residual Std. Error	0.430 (df = 136)
F Statistic	1.205 (df = 6; 136)
<i>Note:</i>	* $p < 0.05$

Figure 6 : Linear probability model assessing interaction between treatment and participant gender

**Hypothesis 3: Norm nudge messages will be moderated by the gender of the messenger with a different effect coming from a male messenger than from a female messenger (we do not hypothesize about direction).**

Running an LPM with an interaction term between message type and messenger gender did not yield a significant result ( $p = 0.98$ ). Note here that the reference for both variables is empirical (for norm nudge message) and male (for gender). This result does not support our hypothesis. Full regression is below in Figure 7.

<b>Testing Hypothesis 3</b>	
	<i>Dependent variable:</i>
	Compete
Egalitarian Norm Nudge (Binary)	0.127 (0.120)
Female Messenger (Binary)	-0.120 (0.112)
Stress	0.063 (0.117)
Risk	0.009 (0.017)
Competitiveness	-0.080 (0.109)
Egalitarian * Female (Interaction)	0.005 (0.172)
Constant	0.293 (0.312)
Observations	115
R <sup>2</sup>	0.049
Adjusted R <sup>2</sup>	-0.004
Residual Std. Error	0.447 (df = 108)
F Statistic	0.918 (df = 6; 108)
<i>Note:</i>	* $p < 0.05$

Figure 6 : Linear probability model assessing interaction between treatment and messenger gender

# Appendix C - Norm Nudge Message x Gender of Messenger

Q2

Please read the following information found in a paper written by the researcher below.



*In cognition tasks, competition gaps have reduced significantly between genders over the years. That means more and more people are willing to compete head-to-head with other participants to potentially earn more payment.*

Figure 7 : Treatment condition: Egalitarian norm message x female messenger

□ Q3

Please read the following information found in a paper written by the researcher below.



In cognition tasks, competition gaps have reduced significantly between genders over the years. That means more and more people are willing to compete head-to-head with other participants to potentially earn more payment.

Figure 8 : Treatment condition: Egalitarian norm message x male messenger



Q4

Please read the following information found in a paper written by the researcher below.



In a previous study, over 50% of individuals who scored the lowest on a mental cognition task opted for head-to-head competition with other participants to potentially earn more payment.

Figure 9 : Treatment condition: Empirical norm message x male messenger

Q5

Please read the following information found in a paper written by the researcher below.



In a previous study, over 50% of individuals who scored the lowest on a mental cognition task opted for head-to-head competition with other participants to potentially earn more payment.

Figure 10 : Treatment condition: Egalitarian norm message x female messenger

# Appendix D - Competitive Math Task

Round 2 Instructions: Please add up the numbers shown in the boxes below and enter your answer in the text entry box. You may not use a calculator, but you may use scratch paper. You have 1 minute and 30 seconds to complete as many questions as you can. Time will run out automatically.

Q26



62      60      78

Q27



56      19      60

Q28



54      46      32

Q29



74      31      67

Q30



89      15      46

Q31



24      83      87

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