GENDER BIAS IN SCIENCE FICTION FANTASY (SFF)

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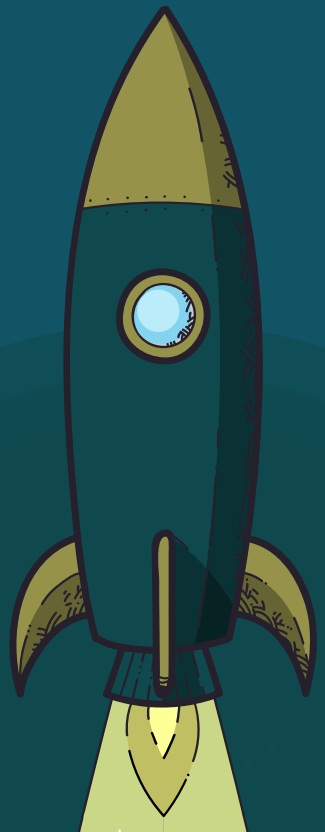
01

THE QUESTION

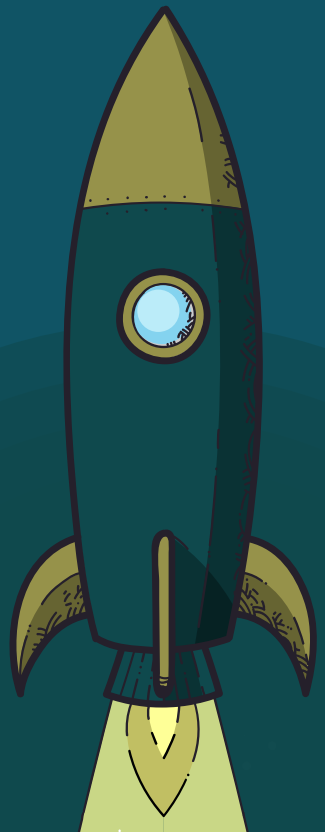
Our Research Question



The Question:
Based on a science fiction character's gender, are warmth and competence of the character and respect for them perceived differently?

Why an experiment is necessary:
We are posing a causal question; conducting a randomized controlled experiment would allow us to perform causal inference and answer whether there is strong evidence pointing to character gender affecting perception in this context.

Motivation



We are interested in gender bias as we have first-hand experience with its manifestation and effects in our day-to-day. Prior research has been done in this area, in which gender bias is evaluated through warmth and competence metrics. Key findings from prior research:

- "Housewives" and "business women" receive opposite scores on the Warmth-Competence scale (high-low vs. low-high)[1]
- For women in professional settings, correlation between perceived confidence and Competence seems to rely on Warmth[2]

We wanted to see if we would have similar findings when investigating gender bias in the context of science fiction fantasy literature. The answer to our question could be valuable to discover because the SFF genre in particular has been found to influence the perceptions and acceptance of science by the public.[3]

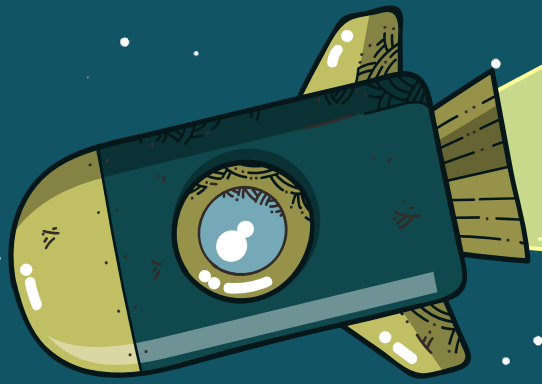
Our Hypothesis

Hypotheses to address our question

- Null hypothesis: There is no difference in perception between male and female versions of the character, in terms of warmth, competence, and respect.
- Alternative hypothesis: There is a difference in perception between male and female versions of the character, in terms of warmth, competence, and respect.

Our expectation

- We expect that perceived warmth will be higher for female version of character on average, perceived competence will be higher for male version of character on average, and respect will be higher for male version of character on average.



02 THE EXPERIMENT

Process of Constructing Treatments

Susan Calvin had been born in the year 1982, they said, which made her seventy-five now. Everyone knew that. Appropriately enough, U. S. Robot and Mechanical Men, Inc. was seventy-five also, since it had been in the year of Dr. Calvin's birth that Lawrence Robertson had first taken out incorporation papers for what eventually became the strangest industrial giant in man's history. Well, everyone knew that, too.

At the age of twenty, Susan Calvin had been part of the particular Psycho-Math seminar at which Dr. Alfred Lanning of U. S. Robots had demonstrated the first mobile robot to be equipped with a voice. It was a large, clumsy unbeautiful robot, smelling of machine-oil and destined for the projected mines on Mercury. But it could speak and make sense.

LEGEND

Blue box := indicates character name and/or gender

Green underline := indicates passage source

^ An excerpt of from the short story *I, Robot* by Isaac Asimov

Transformed the short story into our two treatment passages.

- Replaced indicators of literature source with less revealing words
- Replaced identifiers of gender with gender pronouns corresponding to each treatment

The Treatment

Treatment 1: Passage with Female Character

Gender indicated by pronouns

She had been born in the year 1982, they said, which made her seventy-five now. Everyone knew that. Appropriately enough, Robot, Inc. was seventy-five also, since it had been in the year of her birth that the CEO had first taken out incorporation papers for what eventually became the strangest industrial giant in human history. Well, everyone knew that, too.

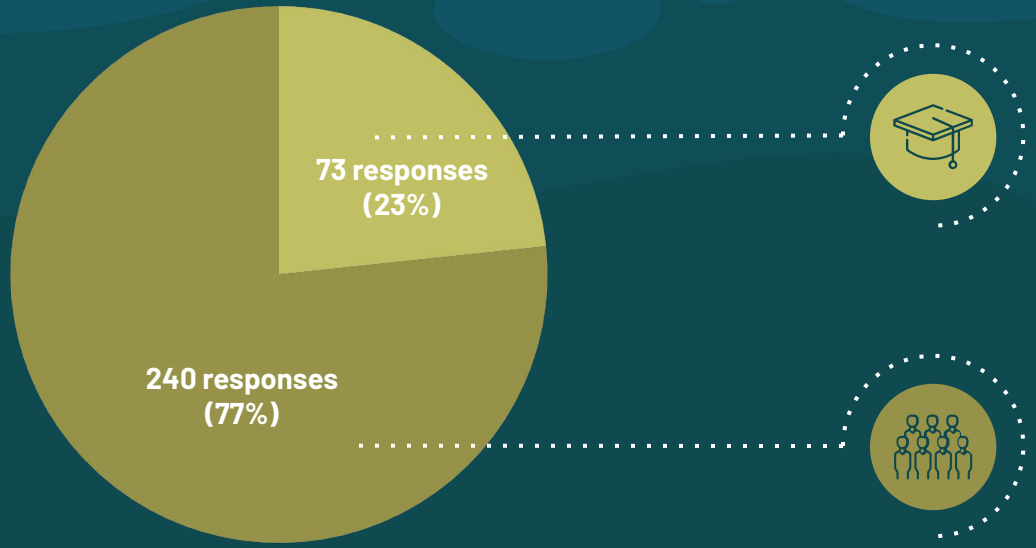
At the age of twenty, she had been part of the particular Psycho-Math seminar at which the director of research of Robot, Inc. had demonstrated the first mobile robot to be equipped with a voice. It was a large, clumsy unbeautiful robot, smelling of machine-oil and destined for the projected mines on Mercury. But it could speak and make sense.

Treatment 2: Passage with Male Character

He had been born in the year 1982, they said, which made him seventy-five now. Everyone knew that. Appropriately enough, Robot, Inc. was seventy-five also, since it had been in the year of his birth that the CEO had first taken out incorporation papers for what eventually became the strangest industrial giant in human history. Well, everyone knew that, too.

At the age of twenty, he had been part of the particular Psycho-Math seminar at which the director of research of Robot, Inc. had demonstrated the first mobile robot to be equipped with a voice. It was a large, clumsy unbeautiful robot, smelling of machine-oil and destined for the projected mines on Mercury. But it could speak and make sense.

Our Measurement Units



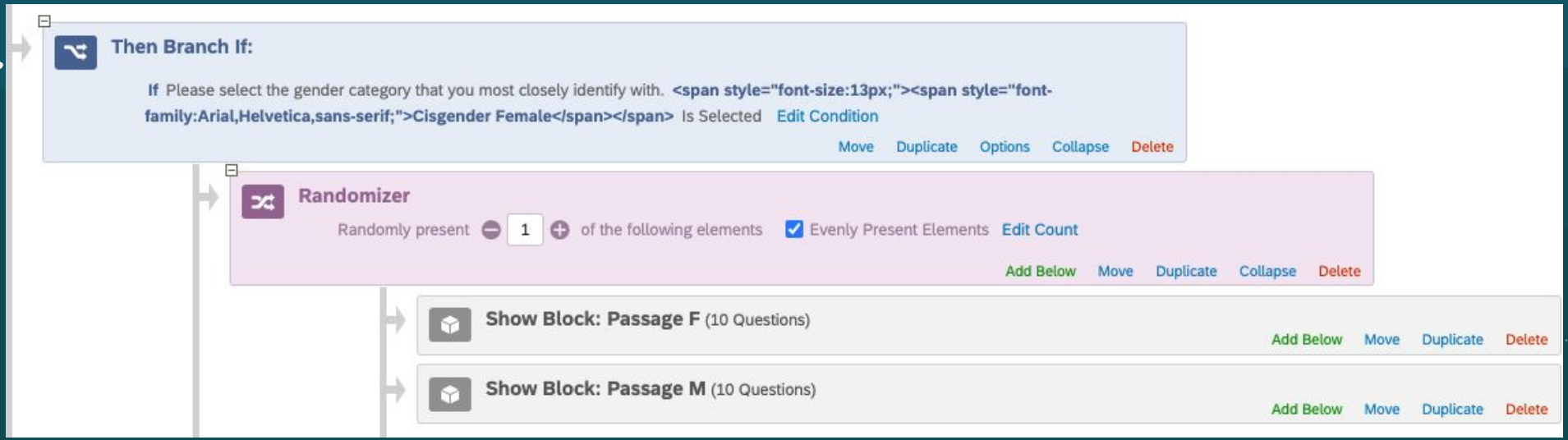
Peers & English Depts.

Fellow classmates on Slack & University English Department faculty/students

MTurk

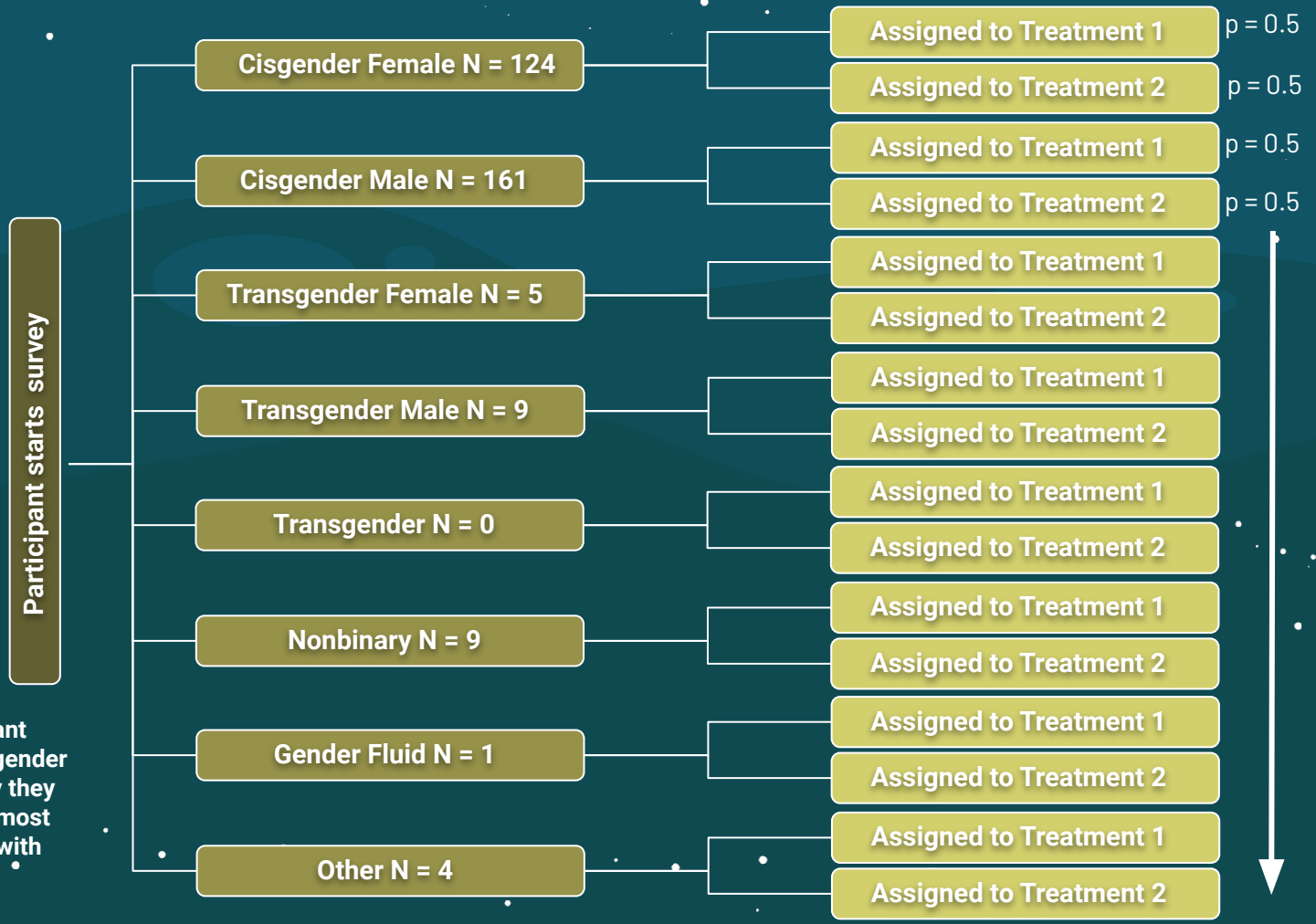
Paid MTurk workers

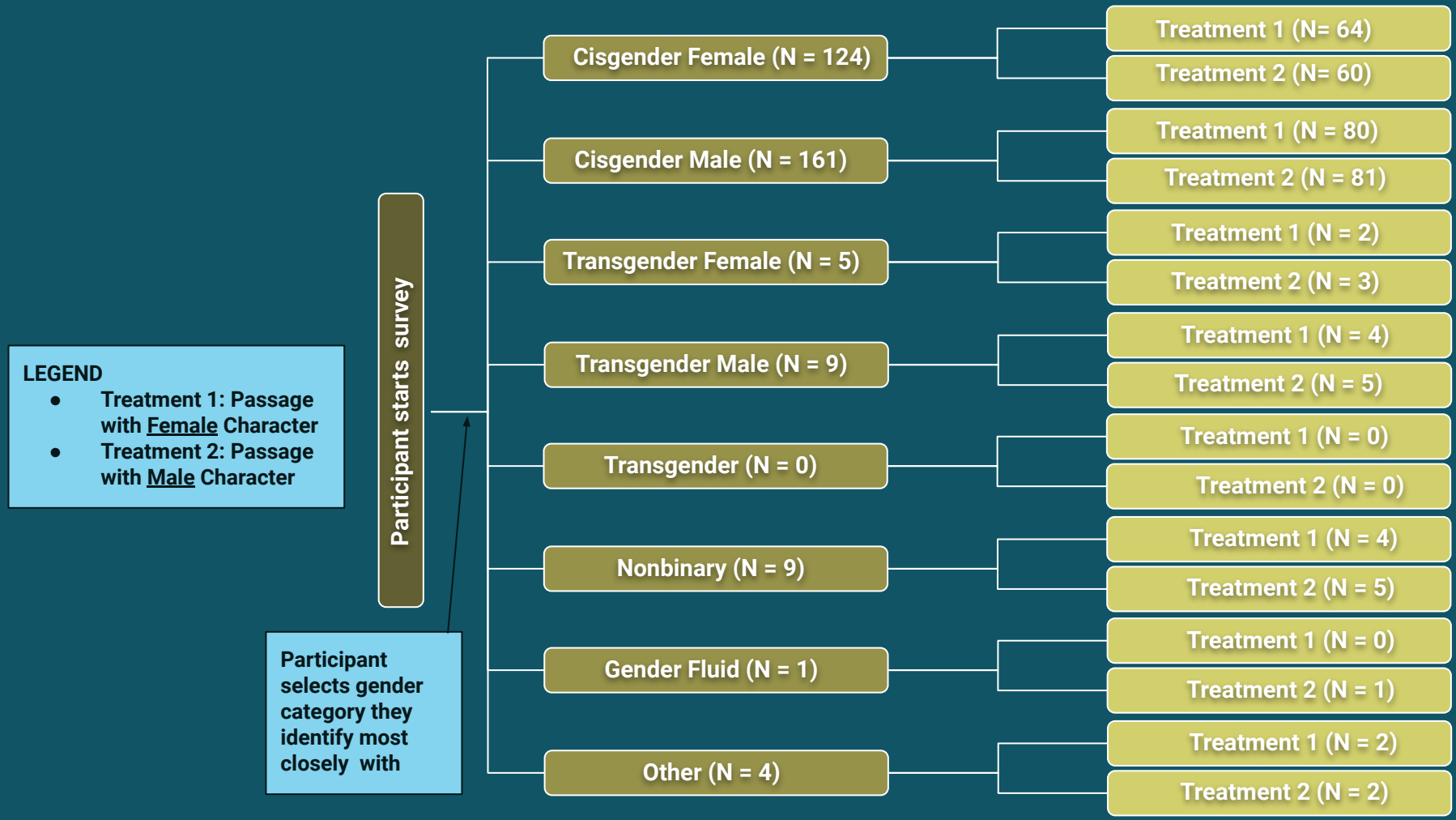
Block Random Assignment



^ In Survey Flow of our Qualtrics surveys, we included a conditional section like this for each of the following gender categories:
Cisgender Female, Cisgender Male, Transgender Female, Transgender Male, Transgender, Nonbinary, Gender Fluid, Other

Our Flow Document




LEGEND
Treatment 1: Passage with Female Character
Treatment 2: Passage with Male Character
Participant starts survey
Participant selects gender category they identify most closely with
Cisgender Female (N = 124)
Cisgender Male (N = 161)
Transgender Female (N = 5)
Transgender Male (N = 9)
Transgender (N = 0)
Nonbinary (N = 9)
Gender Fluid (N = 1)
Other (N = 4)
Treatment 1 (N= 64)
Treatment 2 (N= 60)
Treatment 1 (N = 80)
Treatment 2 (N = 81)
Treatment 1 (N = 2)
Treatment 2 (N = 3)
Treatment 1 (N = 4)
Treatment 2 (N = 5)
Treatment 1 (N = 0)
Treatment 2 (N = 0)
Treatment 1 (N = 4)
Treatment 2 (N = 5)
Treatment 1 (N = 0)
Treatment 2 (N = 1)
Treatment 1 (N = 2)
Treatment 2 (N = 2)

The Comparison We Want to Make

$R \; X_F \; O$
$R \; X_M \; O$

- Assignment to group (**R**): Randomized blocking on gender.

  Treatment (**X**):
  - X_F: Female Passage
  - X_M: Male Passage

  Observations (**O**): We only evaluate participants' perception of warmth, competence and respect after they have read the passage. This is because the outcome metrics we are measuring are based on the treatment where they can develop a perception of the character only after having read the passage.

  This is a between subjects comparison where we are comparing the difference between subjects who will only see one variation of the treatment.

Outcome Measures

In your opinion, how...

- Competent
- Warm
- Capable
- Well-Intentioned
- Respectable

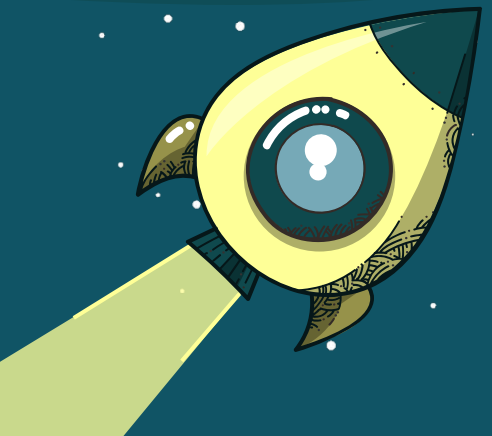
... is the interviewee in the passage?

Outcome Measures

In your opinion, how ***competent*** is the interviewee in the passage? Please move the slider to the number that most closely aligns with your opinion. 1 represents "not at all," 3 represents "somewhat," and 5 represents "extremely."

Not at all		Somewhat		Extremely
1	2	3	4	5

RESULTS & ANALYSIS 03



Final Measures

WARMTH

Average of the ratings for “warm” and “well-intentioned”

COMPETENCE

Average of the ratings for “competent” and “capable”

RESPECT

The rating for “respectable”

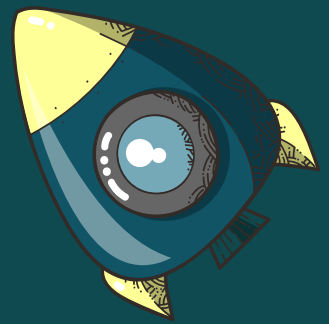
Power Calculations Using Pilot Study Data



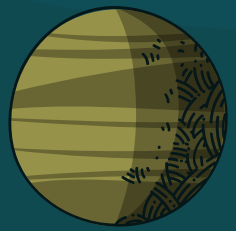
	WARMTH	COMPETENCE	RESPECT
POWER	0.8	0.8	0.8
EFFECT	0.088	0.019	0.571
ERROR	0.617	0.740	1.01
n size of each treatment group	775	23232	50

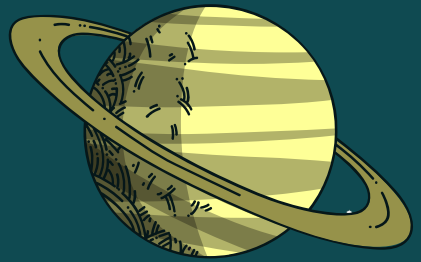
Changes From Pilot Study

- Blocked by participant gender
- Added a covariate question for education level
- Made one of the attention check questions less ambiguous
- Lowered the number of page breaks from 4 to 2
- Disabled back button
- Added clearer instructions, including approximately how long the survey should take & to take in one sitting

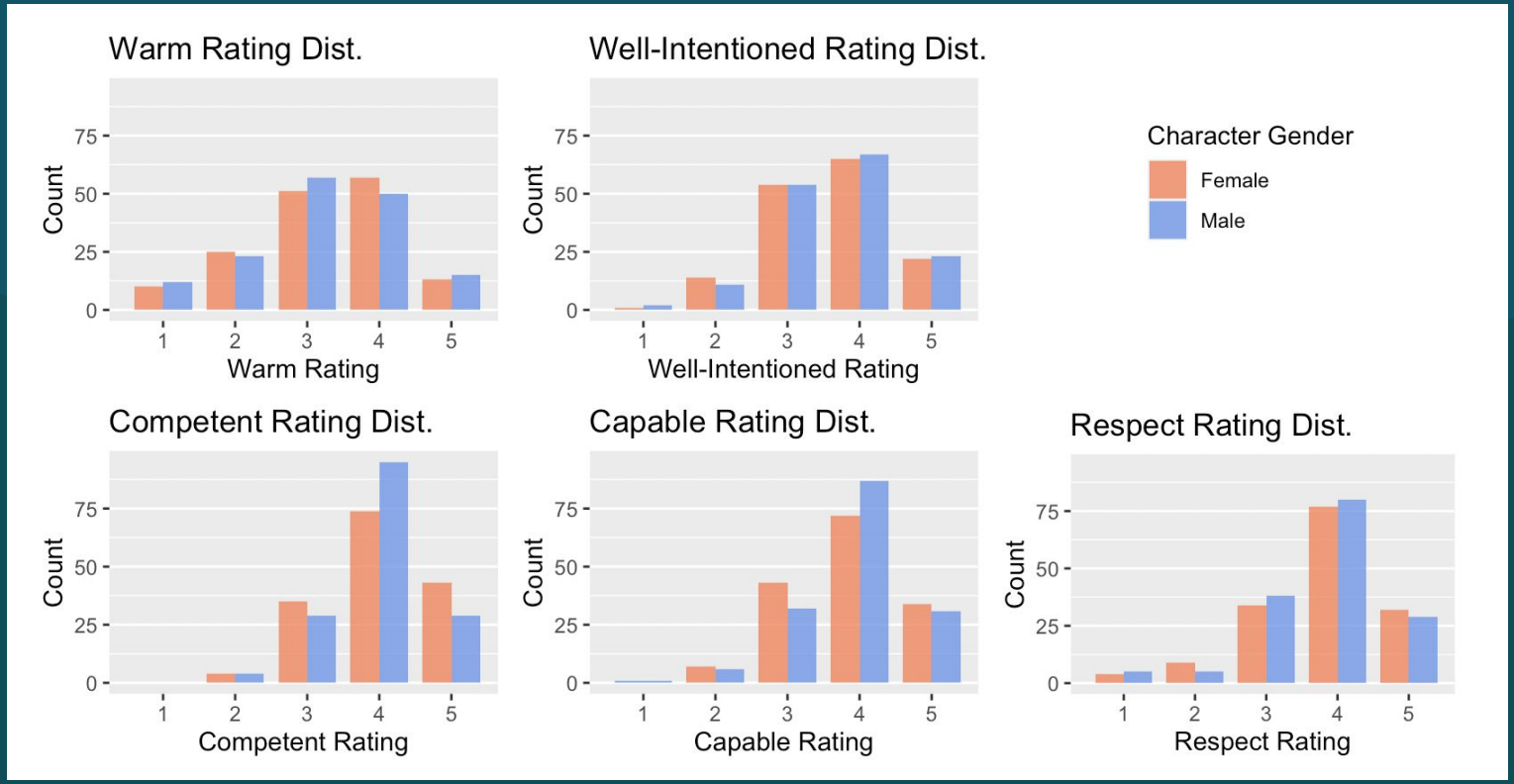


FINAL STUDY

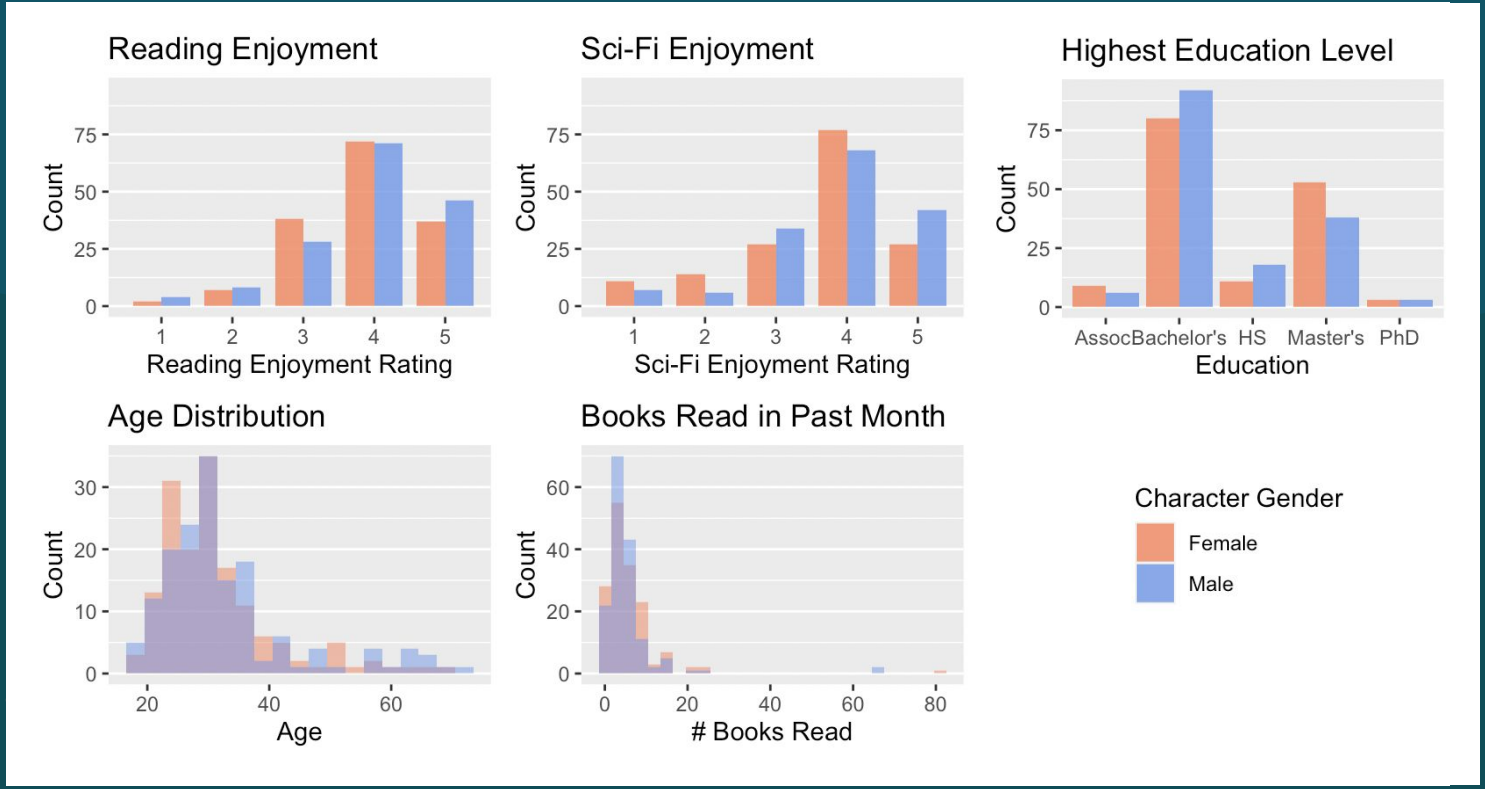




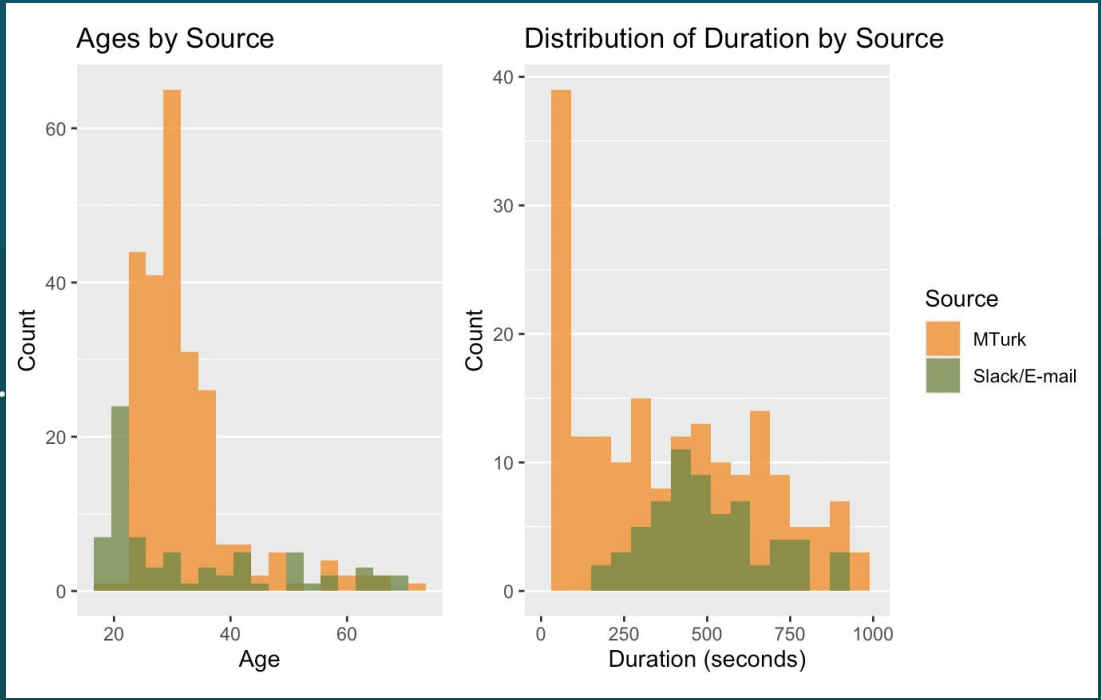
Distribution of Outcome Measures

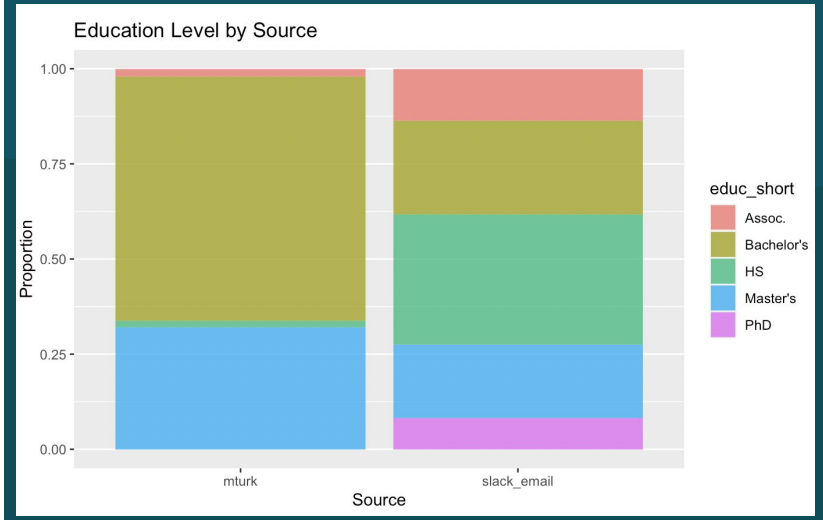


Distribution of Covariates



Distribution of Covariates By Source





Difference in Means Test Results

	WARMTH	COMPETENCE	RESPECT
EFFECT	0.028579	0.035412	0.11144
ERROR	0.09394247	0.07697408	0.102989
P-VALUE	0.9772	0.9718	0.9113

Regression Results: Warmth

Warmth ~ Passage Gender + Age + Education + Reading Enjoyment + Sci-fi Enjoyment + Books Read

```
Coefficients:
                                                                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                                                                     1.641773   0.269522   6.091 3.39e-09 ***
passage_genderPassageM                                                         -0.021652   0.079510  -0.272    0.786
age                                                                            -0.004804   0.004119  -1.166    0.244
educationBachelor's degree                                                      0.818013   0.187816   4.355 1.82e-05 ***
educationDoctorate degree                                                       0.353435   0.345037   1.024    0.306
educationHigh school graduate, diploma or the equivalent (for example: GED) -0.092739   0.219728  -0.422    0.673
educationMaster's degree                                                        0.905390   0.195740   4.625 5.54e-06 ***
enjoy_reading                                                                   0.075598   0.046545   1.624    0.105
books                                                                           0.004639   0.005211   0.890    0.374
sci_fi                                                                          0.244579   0.040444   6.047 4.33e-09 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6866 on 303 degrees of freedom
Multiple R-squared:  0.3298,    Adjusted R-squared:  0.3099
F-statistic: 16.57 on 9 and 303 DF,  p-value: < 2.2e-16
```

Regression Results: Competence

Comptence ~ Passage Gender + Age + Education + Reading Enjoyment + Sci-fi Enjoyment + Books Read

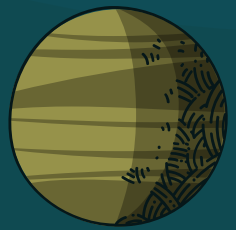
```
Coefficients:
                                                                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                                                                     3.284193   0.254434  12.908  < 2e-16 ***
passage_genderPassageM                                                         -0.064511   0.075059  -0.859   0.3908
age                                                                             0.006334   0.003889   1.629   0.1044
educationBachelor's degree                                                     -0.393008   0.177302  -2.217   0.0274 *
educationDoctorate degree                                                      -0.190268   0.325721  -0.584   0.5596
educationHigh school graduate, diploma or the equivalent (for example: GED)  0.123080   0.207427   0.593   0.5534
educationMaster's degree                                                       -0.380199   0.184782  -2.058   0.0405 *
enjoy_reading                                                                   0.052910   0.043940   1.204   0.2295
books                                                                           0.002737   0.004919   0.556   0.5784
sci_fi                                                                          0.152058   0.038180   3.983 8.54e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6482 on 303 degrees of freedom
Multiple R-squared:  0.1096,    Adjusted R-squared:  0.08316
F-statistic: 4.145 on 9 and 303 DF,  p-value: 4.709e-05
```

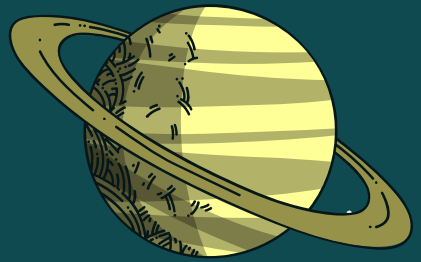
Regression Results: Respect

Respect ~ Passage Gender + Age + Education + Reading Enjoyment + Sci-fi Enjoyment + Books Read

```
Coefficients:
                                                                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                                                                     2.779355   0.334489   8.309 3.27e-15 ***
passage_genderPassageM                                                         -0.037719   0.098676  -0.382    0.703
age                                                                            -0.002087   0.005112  -0.408    0.683
educationBachelor's degree                                                      0.257705   0.233088   1.106    0.270
educationDoctorate degree                                                       0.269531   0.428206   0.629    0.530
educationHigh school graduate, diploma or the equivalent (for example: GED) -0.315238   0.272692  -1.156    0.249
educationMaster's degree                                                        0.298279   0.242922   1.228    0.220
enjoy_reading                                                                  -0.013544   0.057765  -0.234    0.815
books                                                                           0.004447   0.006467   0.688    0.492
sci_fi                                                                          0.246992   0.050193   4.921 1.42e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8522 on 303 degrees of freedom
Multiple R-squared:  0.1408,    Adjusted R-squared:  0.1153
F-statistic: 5.516 on 9 and 303 DF,  p-value: 4.869e-07
```

EXPLORATION





Exploratory Regression Results

Duration ~ Passage Gender + Age + Education + Reading Enjoyment + Sci-fi Enjoyment + Books Read

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	3711.76	3952.49	0.939	0.348	
passage_genderPassageM	-692.10	1166.00	-0.594	0.553	
age	99.33	60.41	1.644	0.101	
educationBachelor's degree	521.44	2754.30	0.189	0.850	
educationDoctorate degree	-2848.29	5059.91	-0.563	0.574	
educationHigh school graduate, diploma or the equivalent (for example: GED)	1156.98	3222.28	0.359	0.720	
educationMaster's degree	2006.14	2870.50	0.699	0.485	
enjoy_reading	-190.27	682.58	-0.279	0.781	
books	-35.44	76.41	-0.464	0.643	
sci_fi	-1365.98	593.11	-2.303	0.022	*

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

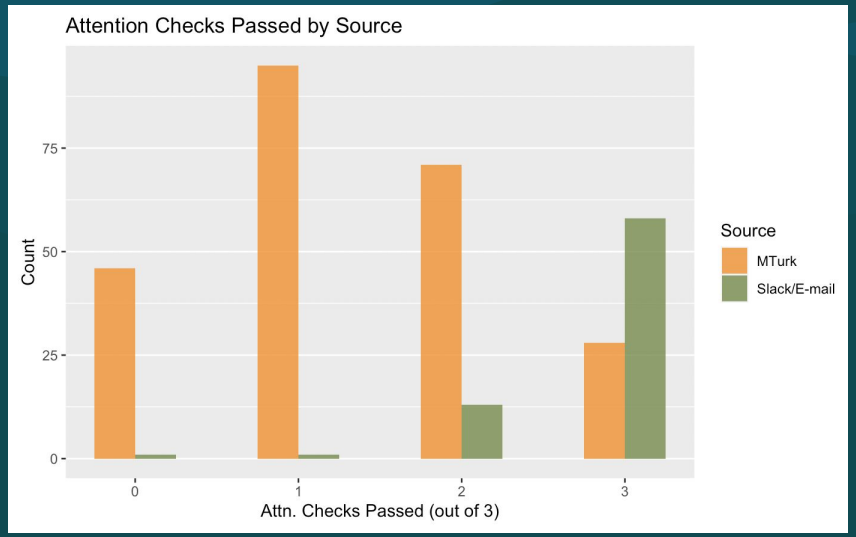
Residual standard error: 10070 on 303 degrees of freedom
Multiple R-squared: 0.03983, Adjusted R-squared: 0.01131
F-statistic: 1.397 on 9 and 303 DF, p-value: 0.1888

Exploratory Table of Means

passage_gender <fctr>	source <fctr>	mean_warmth <dbl>	mean_competence <dbl>	prop_recognized <dbl>
PassageF	mturk	3.642857	3.899160	0.7647059
PassageF	slack_email	2.702703	4.013514	0.1081081
PassageM	mturk	3.652893	3.884298	0.7190083
PassageM	slack_email	2.625000	4.055556	0.1111111


MORE EXPLORATION
ON FILTERED DATA
(FILTERED BY SOURCE)

Motivation



- Attention check performance varies by source

Exploratory Difference in Means on Filtered Data

	WARMTH	COMPETENCE	RESPECT
EFFECT	-1.2014	0.98343	-0.012912
ERROR	0.1401253	0.1150231	0.1627917
P-VALUE	0.2313	0.3269	0.9897

Exploratory Regression on Filtered Data

Warmth ~ Passage Gender + Age + Education + Reading Enjoyment + Sci-fi Enjoyment + Books Read

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	2.630547	0.429571	6.124	6.53e-08	***
passage_genderPassageM	-0.107250	0.193478	-0.554	0.5813	
age	0.007698	0.008094	0.951	0.3452	
educationBachelor's degree	0.371324	0.304795	1.218	0.2277	
educationDoctorate degree	0.254750	0.434585	0.586	0.5598	
educationHigh school graduate, diploma or the equivalent (for example: GED)	0.150304	0.295535	0.509	0.6128	
educationMaster's degree	0.233284	0.354819	0.657	0.5133	
enjoy_reading	-0.151086	0.081737	-1.848	0.0692	.
books	-0.002179	0.010149	-0.215	0.8307	
sci_fi	0.070792	0.066547	1.064	0.2915	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.7592 on 63 degrees of freedom
Multiple R-squared: 0.1148, Adjusted R-squared: -0.01161
F-statistic: 0.9082 on 9 and 63 DF, p-value: 0.5239

Exploratory Regression on Filtered Data

Competence ~ Passage Gender + Age + Education + Reading Enjoyment + Sci-fi Enjoyment + Books Read

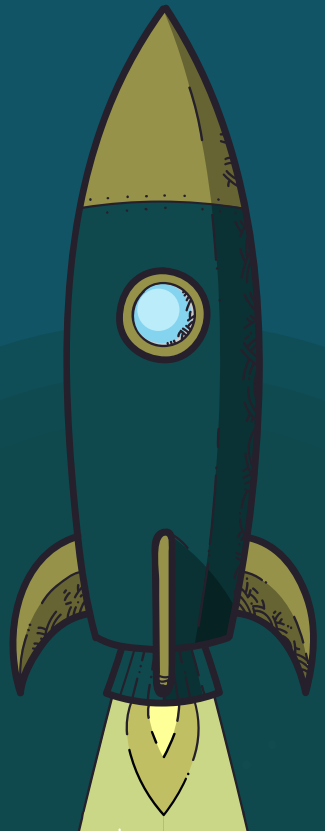
```
Coefficients:
                                                                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                                                                     4.143970   0.472674   8.767 1.64e-12 ***
passage_genderPassageM                                                         -0.050902   0.212891  -0.239  0.81181
age                                                                             0.016799   0.008906   1.886  0.06388 .
educationBachelor's degree                                                     -0.435305   0.335378  -1.298  0.19904
educationDoctorate degree                                                      -0.675731   0.478191  -1.413  0.16255
educationHigh school graduate, diploma or the equivalent (for example: GED) -0.205617   0.325189  -0.632  0.52948
educationMaster's degree                                                       -1.040799   0.390421  -2.666  0.00975 **
enjoy_reading                                                                  -0.128006   0.089939  -1.423  0.15959
books                                                                          -0.003092   0.011167  -0.277  0.78278
sci_fi                                                                          0.099158   0.073225   1.354  0.18052
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8354 on 63 degrees of freedom
Multiple R-squared:  0.1489,    Adjusted R-squared:  0.02737
F-statistic: 1.225 on 9 and 63 DF,  p-value: 0.2961
```

Exploratory Regression on Filtered Data

Respect ~ Passage Gender + Age + Education + Reading Enjoyment + Sci-fi Enjoyment + Books Read

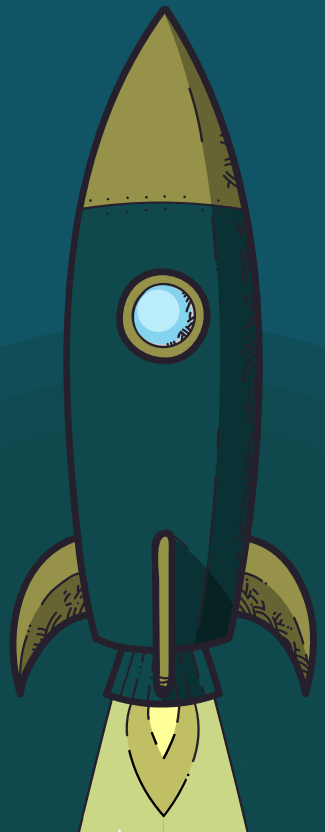
```
Coefficients:
                                                                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                                                                     4.262882   0.660760   6.451 1.79e-08 ***
passage_genderPassageM                                                         -0.247225   0.297605  -0.831    0.409
age                                                                            -0.004388   0.012451  -0.352    0.726
educationBachelor's degree                                                     -0.085172   0.468831  -0.182    0.856
educationDoctorate degree                                                       0.070247   0.668473   0.105    0.917
educationHigh school graduate, diploma or the equivalent (for example: GED) -0.540019   0.454587  -1.188    0.239
educationMaster's degree                                                       -0.234989   0.545777  -0.431    0.668
enjoy_reading                                                                  -0.196441   0.125727  -1.562    0.123
books                                                                          -0.004501   0.015611  -0.288    0.774
sci_fi                                                                          0.151179   0.102362   1.477    0.145
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.168 on 63 degrees of freedom
Multiple R-squared:  0.1047,    Adjusted R-squared:  -0.02319
F-statistic: 0.8187 on 9 and 63 DF,  p-value: 0.6011
```

Summary of Results



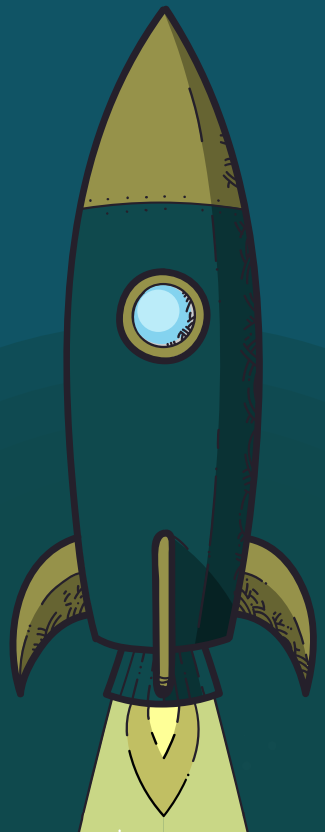
- **Main Results:**
  - There is a difference in perception of warmth, competence, and respect between female character and male character, but not statistically significant
- **Exploratory Results:**
  - Participants coming from Slack/Universities tended to perform better on the attention checks than those coming from MTurk
  - When filtering to only include those who came from Slack/Universities, there is again a difference, it is not statistically significant, but the effect size with this filtered data is larger than the effect size with the full data

Limitations



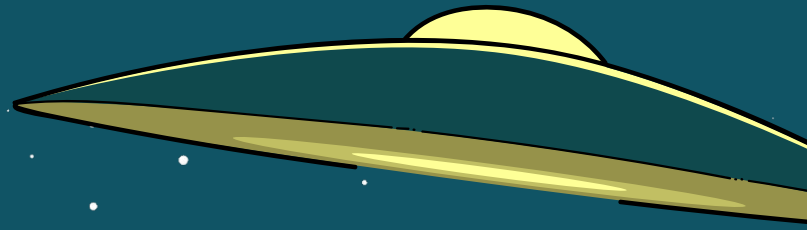
- The timeline and budget given for completing this project limited how much data and the quality of data we could collect
- Having to carry out the experiment remotely (as opposed to in-person) limited how we approached every step of the pipeline — how we recruit the participants, how we deliver the treatments, how we observe the outcomes
- Have yet to include characters of other gender categories (outside of the gender binary) when constructing treatment passages

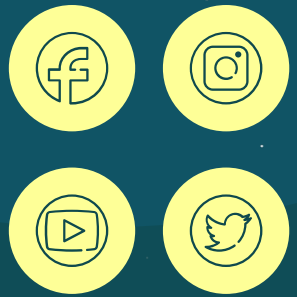
Questions for Audience



- How would you approach analysis on “noisy” data — MTurk responses not performing well on attention checks, indicating they might not be answering the *primary post-treatment questions accurately?
  (* := We get the outcome measures through these)
- How would you incentivize participants to finish a survey? (I.e. incentivize them to not stop midway)

Thank You





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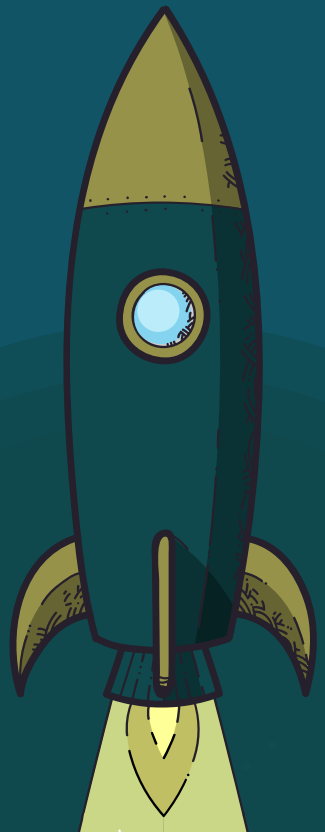
References



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