Multiverse Analysis Reveals Stronger Correlations When Removing All Careless Responders

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Introduction

- **Curated Pathways to Innovation (CPI)** is a web-based app that guides and motivates students as they select activities which engage them in the possibility of pursuing a STEM+C career. The app is specifically designed to set women and underrepresented minorities on a path towards STEM careers.[1]
- **Careless Responding**: Survey participants are inattentive or do not properly read the item questions

Why does this matter? To ensure:

(1) We obtain honest perceptions from minorities groups

(2) Such minorities are not removed disproportionately

Demographics

- <u>Gender:</u> Female = 214, Male = 268, Other = 16
- <u>Age:</u> 12yrs=315, 13yrs=158, 14yrs=18
- <u>First Language Spoken:</u> English=226, Other = 161
- <u>Race/Ethnicity:</u> American Indian/Alaska Native=11, White=8 Asian/Asian American=54, Hispanic/Latino/Mexican=291, Native Hawaiian/Pacific Islander=14, Multiracial=66, Black/African American=12, Other=41

Research Questions

RQ1: Does removing careless responders affect the inter-item correlations between the gender stereotype items?

RQ2: Is careless responding associated with one's demographic background?

Methods

Longstring: Selecting one answer repeatedly & consecutively

Intra-individual response variability: Selecting answers randomly (high IRV), or repeatedly and the same (low IRV)

Validity Item: Responding differently to the same question

Mahalanobis Distance: Detects response vectors that differ greatly from the average distribution of responses

Psychometric Synonyms: Detects low correlations between item pairs that are well correlated within the scale

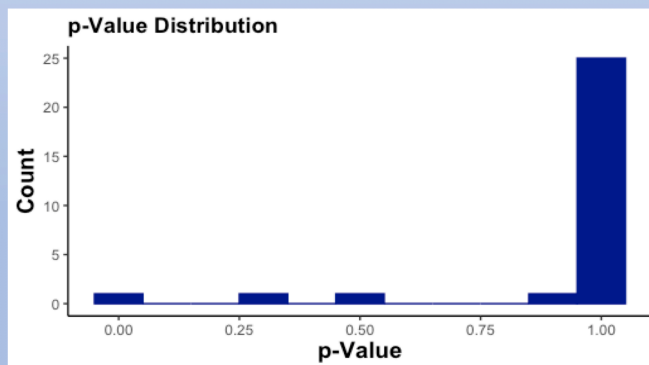| User IDs	Validity Item	IRV	Longest String	Mahalanobis D	Synonyms
p508	1	1.24	7	68.79	-0.324
p509	0	0.14	47	23.7	0.067
p510	0	0.87	4	31.29	0.75
p511	0	0.36	24	14.68	-0.29
p512	1	1.4	6	98.92	0.11

Sample Output: Cells in red indicate that method flagged a student as careless.

Multiverse Analysis[2]: 29 data sets utilize different combinations of removal based on careless methods.

Jennrich's Chi-Squared Test for Correlation Matrices

Chi-Squared Test for Independence

Results

Number of times student was flagged	0	1	2	3	4
n	304	134	84	27	2

RQ1: One data set obtained significantly stronger correlations:

    1. Removing **all** students indicated as careless **at least once**

Distribution of p-values generated from the multiverse analysis. Only one is significant (p<0.05).

However, removing every flagged person removes 44.8% of our sample

- Recommended range: 3-10%. [3]
- For RQ2, we removed those flagged by 3+ methods (5.3%)

RQ2:

- Chi-squared analyses reveal statistically significant (p<0.05) association between carelessness and:
  - **Age:** Older children = more carelessness
  - **Race/Ethnicity:** Hispanic/Latinx students = more carelessness

Discussion

Careless responding can highlight participants who may neither be interested in the survey matters nor feel responsible to report truthfully, which may imply they feel less affected by such matters [4] (such as STEM engagement, attitudes, and stereotypes).

<u>No Association:</u>

- **Female, male, and gender minorities:** may equally feel the need to report on their perceptions toward the STEM field
- **English not spoken as a first language:** remained just as vigilant

<u>Association:</u>

- **Older children:** may feel less of an affect, or more defiant/mischievous[5]
- **Hispanic/Latinx students:** unclear – may occur due to differences in culture, language, or other aspects of study administration

References

[1] https://ywca-sv.org/curated-pathways-to-innovation/

[2] Steegen, Sara, Francis Tuerlinckx, Andrew Gelman, and Wolf Vanpaemel. 2016. "Increasing Transparency through a Multiverse Analysis." *Perspectives on Psychological Science* 11 (5): 702-712. doi:10.1177/1745691616658637.

[3] Grau, Ina, Christine Ebbeler, and Rainer Banse. 2019. "Cultural Differences in Careless Responding." *Journal of Cross-Cultural Psychology* 50 (3): 336-357. doi:10.1177/0022022119827379.

[4] Ward, M. K. and Adam W. Meade. 2018. "Applying Social Psychology to Prevent Careless Responding during Online Surveys." *Applied Psychology* 67 (2): 231-263. doi:10.1111/apps.12118.

[5] Joseph P. Robinson-Cimpian. 2014. "Inaccurate Estimation of Disparities due to Mischievous Responders: Several Suggestions to Assess Conclusions." *Educational Researcher* 43 (4): 171-185. doi:10.3102/0013189X14534297

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