Multiverse Analysis Reveals Stronger Correlations When Removing All Careless Responders

Audrey Filonczuk, Teresa Ober, PhD., Daniella Rebouças, Ying Cheng, PhD.
Learning Analytics and Measurement in Behavioral Sciences Lab
Department of Psychology, University of Notre Dame

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 minority groups
2. Such minorities are not removed disproportionately

**Demographics**
- **Gender**: Female = 214, Male = 268, Other = 16
- **Age**: 12yrs=315, 13yrs=158, 14yrs=18
- **First Language Spoken**: English=226, Other = 161
- **Race/Ethnicity**: 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

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

<table>
<thead>
<tr>
<th>User ID</th>
<th>Validity Item</th>
<th>IRV</th>
<th>Longest String</th>
<th>Mahalanobis D</th>
<th>Synonyms</th>
</tr>
</thead>
<tbody>
<tr>
<td>p508</td>
<td>1</td>
<td>1.24</td>
<td>7</td>
<td>68.79</td>
<td>-0.324</td>
</tr>
<tr>
<td>p509</td>
<td>0</td>
<td>0.14</td>
<td>24</td>
<td>23.7</td>
<td>0.067</td>
</tr>
<tr>
<td>p510</td>
<td>0</td>
<td>0.78</td>
<td>4</td>
<td>31.29</td>
<td>0.75</td>
</tr>
<tr>
<td>p511</td>
<td>0</td>
<td>0.36</td>
<td>24</td>
<td>14.68</td>
<td>-0.29</td>
</tr>
<tr>
<td>p512</td>
<td>0</td>
<td>1.4</td>
<td>6</td>
<td>98.93</td>
<td>0.11</td>
</tr>
</tbody>
</table>

**Multiverse Analysis**: 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

<table>
<thead>
<tr>
<th>Results</th>
<th>Number of times student was flagged</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td></td>
<td>304</td>
<td>134</td>
<td>84</td>
<td>27</td>
<td>2</td>
</tr>
</tbody>
</table>

**RQ1**: One data set obtained significantly stronger correlations:
1. Removing all students indicated as careless at least once

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/Latino 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 matters4 (such as STEM engagement, attitudes, and stereotypes).

No Association
- **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

Association
- **Older children**: may feel less of an affect, or more defiant/mischievous5
- **Hispanic/Latino students**: unclear – may occur due to differences in culture, language, or other aspects of study administration

References

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