Evaluating Sensitive Question Techniques
An Approach that Detects False Positives

Marc Höglinger ¹  Andreas Diekmann ²

¹University of Bern, Institute of Sociology, marc.hoeglinger@soz.unibe.ch
²ETH Zurich, Chair of Sociology, diekmann@soz.gess.ethz.ch

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Background and Motivation Misreporting in Self-Reports

Have you ever provided misleading or incorrect information on your tax return?
- Yes
- No

Did you vote in the 2012 US presidential election?
- Yes
- No

Have you ever intentionally taken something from a store without paying for it?
- Yes
- No
Substantial Underreporting of Sensitive Behavior

Proportion of confirmed norm-breakers with truthful self-report (true rate = 100%)

- Face to face
  - had penal conviction
  - committed welfare benefit fraud
  - went bankrupt
  - charged for drunk driving

- Paper and pencil
  - failed course during studies

- Online
  - had poor GPA (<2.5) during studies

Results from validation studies:

2. van der Heijden et al. (2000)
3. Locander, Sudman, and Bradburn (1976)
The Randomized Response Technique (RRT)

- The RRT (Warner 1965) protects individual’s answers with a randomization procedure.
  - random error is introduced in respondents’ answers
  - no inference possible from an individual’s survey response to her actual answer to the sensitive question
- in turn, respondents should answer (more) honestly

To analyze RRT data the systematic error is taken into account by adjusting the response variable accordingly.
The Crosswise-Model RRT (CM)

A recently proposed and seemingly promising new RRT variant (Yu, Tian, and Tang 2008)

Question A:
Is your mother’s birthday in January or February?
(If you do not know, please use the birth date of someone else you know.)

Question B:
Have you ever received a donated organ (kidney, heart, part of a lung or liver, pancreas)?

Compare your responses to question A & B. Are they identical or different?

- identical
- different
But, Does it Work? Validation Approaches

- **Comparative validation**
  - Prevalence estimates are compared under the *more-is-better assumption*: higher estimates are interpreted as more valid estimates
  - Tenable, if under-reporting, i.e. false negatives, is the only type of misreporting
  - Not tenable, if *false positives* occur, i.e. if respondents falsely admit sensitive behavior

- **Aggregate validation**
  - Prevalence estimates are compared to a known aggregate criterion such as official turnout rates (Rosenfeld, Imai, and Shapiro 2015)
  - No DQ as benchmark needed, but also relies on on-sided-lying assumption

- **Individual-level validation**
  - Self-reports are compared to observed/known behavior or traits at the individual level
  - Preferable, as it can identify false positives as well as false negatives
  - Very difficult to carry out.
CM Judged Favorably in Many Comparative Validations:

- Adrian Hoffmann and Jochen Musch. 2015. “Assessing the Validity of Two Indirect Questioning Techniques: A Stochastic Lie Detector versus the Crosswise Model”. *Behavior Research Methods* (online first)


- Daniel W. Gingerich et al. 2015. “When to protect? Using the crosswise model to integrate protected and direct responses in surveys of sensitive behavior”. *Political Analysis*: online first
An Enhanced Comparative Validation Design

- Simple design, able to detect systematic false positives without the need of an individual-level criterion.
- Test for false positives with (near) zero-prevalence items:
  - *Have you ever received a donated organ (kidney, heart, part of a lung or liver, pancreas)?*
  - *Have you ever suffered from Chagas disease (Trypanosomiasis)?*
- If a sensitive question technique produces a non-zero estimate → false positives, “more-is-better” must be refuted
- Implemented in an online survey on organ donation and health in Germany (*N* = 1,685)
Higher CM Estimates, But More-Is-Better Not Tenable

Crosswise-model produced clearly incorrect estimates for the two zero-prevalence items.
Conclusions

- An up-and-coming implementation of the crosswise-model RRT produced false positives to a non-ignorable extent.
- The crosswise-model’s defect could not have been revealed by several previous validations which points to a serious weakness in past research.
- Conclusive assessments of RRT implementations are only possible with validation designs considering false negatives as well as false positives.
- This has also implications for other sensitive question techniques (e.g., Item Count) that so far have been only validated with the same flawed strategies that rely on the “more-is-better” assumption.
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Appendix

References I


Hoffmann, Adrian, and Jochen Musch. 2015. “Assessing the Validity of Two Indirect Questioning Techniques: A Stochastic Lie Detector versus the Crosswise Model”. Behavior Research Methods (online first).


References II


Analyzing RRT Data

- To analyze RRT data the systematic error is taken into account by using the adjusted response variable $\tilde{Y}$.
- For the crosswise-model:

$$\tilde{Y} = \Pr(S = 1) = \frac{Y + p_{yes,u} - 1}{(2p_{yes,u} - 1)}$$

$Y$ = observed response variable with $Y = 1$ for “identical”
$S$ = actual answer to the sensitive item with $S = 1$ for “yes”
$p_{yes,u}$ = known probability of a “yes” answer to the unrelated question

- This follows from solving the probability of the response “identical” for $\Pr(S = 1)$

$$\Pr(Y = 1) = \Pr(S = 1) \cdot p_{yes,u} + (1 - \Pr(S = 1)) \cdot (1 - p_{yes,u})$$
Analyzing RRT Data

To analyze RRT data the systematic error is taken into account by using the adjusted response variable \( \tilde{Y} \).

For the crosswise-model:

\[
\tilde{Y} = \Pr(S = 1) = \frac{Y + p^{yes,u} - 1}{2p^{yes,u} - 1} 
\]

- \( Y \) = observed response variable with \( Y = 1 \) for “identical”
- \( S \) = actual answer to the sensitive item with \( S = 1 \) for “yes”
- \( p^{yes,u} \) = known probability of a “yes” answer to the unrelated question

This follows from solving the probability of the response “identical” for \( \Pr(S = 1) \)

\[
\Pr(Y = 1) = \Pr(S = 1) \cdot p^{yes,u} + (1 - \Pr(S = 1)) \cdot (1 - p^{yes,u})
\]

<table>
<thead>
<tr>
<th>unrelated question</th>
<th>no</th>
<th>yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>identical</td>
<td>different</td>
</tr>
<tr>
<td>yes</td>
<td>different</td>
<td>identical</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>sensitive item</th>
<th>no</th>
<th>yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>identical</td>
<td>different</td>
</tr>
<tr>
<td>yes</td>
<td>different</td>
<td>identical</td>
</tr>
</tbody>
</table>
# Sensitive Items Surveyed

<table>
<thead>
<tr>
<th>Item</th>
<th>Wording</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copying from other students in exam</td>
<td>In your studies, have you ever copied from other students during an exam?</td>
</tr>
<tr>
<td>Using crib notes in exam</td>
<td>In your studies, have you ever used illicit crib notes in an exam (including notes on mobile phones, calculators or similar)?</td>
</tr>
<tr>
<td>Taking drugs to enhance exam performance</td>
<td>In your studies, have you ever used prescription drugs to enhance your performance in an exam?</td>
</tr>
<tr>
<td>Including plagiarism in paper</td>
<td>In your studies, have you ever handed in a paper containing a passage intentionally adopted from someone else’s work without citing the original?</td>
</tr>
<tr>
<td>Handing in someone else’s paper</td>
<td>In your studies, have you ever had someone else write a large part of a submitted paper for you or have you handed in someone else’s paper as your own?</td>
</tr>
</tbody>
</table>
Estimates as displayed in the figure (SE in parenthesis)

<table>
<thead>
<tr>
<th>Levels</th>
<th>Never donated blood</th>
<th>Unwilling to donate organs</th>
<th>Excessive drinking</th>
<th>Received a donated organ</th>
<th>Suffered from Chagas disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct questioning (DQ)</td>
<td>48.82</td>
<td>22.01</td>
<td>20.58</td>
<td>0.00</td>
<td>0.37</td>
</tr>
<tr>
<td></td>
<td>(2.14)</td>
<td>(1.82)</td>
<td>(1.73)</td>
<td>(.)</td>
<td>(0.26)</td>
</tr>
<tr>
<td>Crosswise model (CM)</td>
<td>51.58</td>
<td>27.30</td>
<td>32.71</td>
<td>7.60</td>
<td>4.77</td>
</tr>
<tr>
<td></td>
<td>(2.33)</td>
<td>(2.23)</td>
<td>(2.28)</td>
<td>(1.95)</td>
<td>(1.91)</td>
</tr>
<tr>
<td>Difference</td>
<td>CM – DQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CM – DQ</td>
<td>2.76</td>
<td>5.29</td>
<td>12.13</td>
<td>7.60</td>
<td>4.40</td>
</tr>
<tr>
<td></td>
<td>(3.16)</td>
<td>(2.88)</td>
<td>(2.86)</td>
<td>(1.95)</td>
<td>(1.92)</td>
</tr>
<tr>
<td>N</td>
<td>1669</td>
<td>1641</td>
<td>1672</td>
<td>1669</td>
<td>1669</td>
</tr>
</tbody>
</table>
Individual-Level Validation of Abitur-Item

results are corroborated: the crosswise-model implemented produced false positives
Effect of random answering and unrelated question bias on false positive rate for zero-prevalence items

Dashed lines indicate false positive rates found and the corresponding extent of error necessary to generate them.

Notes: With an expected “yes”-probability for the unrelated questions of 0.18 as in the CM implemented. If the “yes”-probability is inverted to 0.82 (half the sample) random answering has the same effect, but the effect of the unrelated question bias goes in the opposite direction.
Exploring Causes of False Positives
Not clearly related to any of our experimental manipulations.

Effects of CM implementation details on false positive rate

<table>
<thead>
<tr>
<th></th>
<th>Percentage points change</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>With “don’t know” response option</td>
<td>-4.48</td>
<td>(2.79)</td>
</tr>
<tr>
<td>Response order different - identical (vs. inverse)</td>
<td>-1.18</td>
<td>(2.79)</td>
</tr>
<tr>
<td>Unrelated question on father (vs. mother)</td>
<td>-2.82</td>
<td>(2.87)</td>
</tr>
<tr>
<td>Unrelated question on acquaintance (vs. mother)</td>
<td>2.69</td>
<td>(2.91)</td>
</tr>
<tr>
<td>Unrelated question on birthday (vs. birth month)</td>
<td>2.04</td>
<td>(2.73)</td>
</tr>
<tr>
<td>Yes-probability unrelated question .82 (vs. .18)</td>
<td>-2.10</td>
<td>(2.79)</td>
</tr>
<tr>
<td>Item position (linear)</td>
<td>0.09</td>
<td>(0.96)</td>
</tr>
<tr>
<td>Item position 1st or 2nd (vs. 4th or 5th)</td>
<td>-1.54</td>
<td>(3.77)</td>
</tr>
</tbody>
</table>

Notes: Bivariate regressions on pooled responses to zero-prevalence items. Standard errors corrected for clustering in respondents. \( N = 2,243. \) *\( p < 0.05 \)
Exploring Correlates of False Positives

Positively associated with speeding through the CM explanation and with socially desirable responding (MC-scale).

Bivariate associations between respondents’ behavior and personal characteristics and false positive rate

<table>
<thead>
<tr>
<th></th>
<th>Percentage points change</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among fastest 10% on CM introduction screen</td>
<td>9.05</td>
<td>(4.87)</td>
</tr>
<tr>
<td>Among fastest 10% answering sensitive items (without intro)</td>
<td>-4.33</td>
<td>(4.46)</td>
</tr>
<tr>
<td>Clicked button referring to RRT Wikipedia link</td>
<td>6.05</td>
<td>(3.90)</td>
</tr>
<tr>
<td>Social desirability (Crown-Marlowe scale)</td>
<td>1.62*</td>
<td>(0.80)</td>
</tr>
<tr>
<td>Accomplished the university entrance qualification</td>
<td>-5.17</td>
<td>(3.53)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.03</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Female</td>
<td>-1.73</td>
<td>(2.95)</td>
</tr>
</tbody>
</table>

Notes: Bivariate regression on pooled zero-prevalence items. Standard errors corrected for clustering in respondents. N from 2,208 to 2,243. *p < 0.05