

# Sensitive Questions in Online Surveys: Experimental Results for the Randomized Response Technique (RRT) and the Unmatched Count Technique (UCT)

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# Sensitive Questions in Survey Research

- Sensitive questions: questions pertaining to private, socially frowned upon or illegal behavior.
- Gaining valid answers to sensitive questions is difficult. People typically underreport sensitive behavior (while overreporting socially desirable behaviors).
- Various techniques have been developed to guarantee anonymity and minimize the respondent's feelings of jeopardy, so that more honest answers can be expected.
- Two such techniques are the randomized response technique (RRT) and the unmatched count technique (UCT; also called item count technique, unmatched block design, or block total response).

# The Randomized Response Technique (RRT)

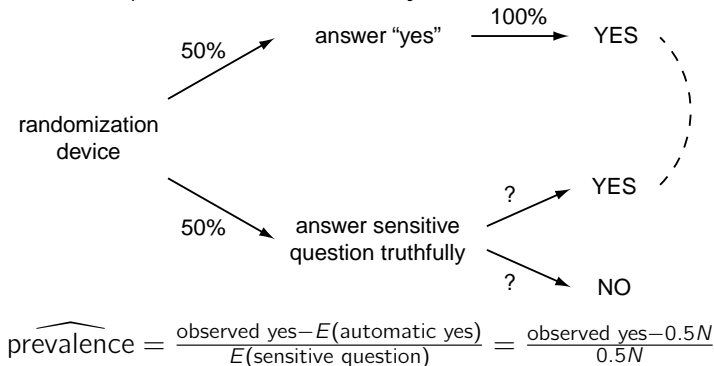
(Warner 1965; also see, e.g., Fox and Tracy 1986)

- Basic idea: **anonymity through randomization.**
- Depending on the outcome of a randomization device (e.g. roll a dice), the respondent has to answer the sensitive question or give an automatic “yes” or “no” answer (or answer an unthreatening question of which the distribution is known).
- Since only the respondent knows the outcome of the randomization device, a “yes” answer cannot be interpreted as an admission of guilt.
- However, the proportion of the sample that has engaged in the behavior of interest can be calculated with knowledge of the properties of the randomizing device.

# The Randomized Response Technique (RRT)

(Warner 1965; also see, e.g., Fox and Tracy 1986)

- Example (forced-response design): Toss a coin and, if heads, answer the sensitive question, else answer “yes” .



- **Critical assumption:** Respondents closely follow the instructions.

# The Unmatched Count Technique (UCT)

(see, e.g., Dalton et al. 1994, Raghavarao and Federer 1979)

- Given a list of statements, respondents report how many of them are true, but not which ones. For some respondents the list contains the sensitive item, for others not.
- Example: “How many of the following statements apply to you?”

Group A	Group B
I have a cat.	I have a cat.
I have blue eyes.	I have blue eyes.
I like country music.	I like country music.
	I use drugs.

- Prevalence estimate = mean difference
- Advantage: Requires no randomization device.
- BTW: Analysis of effects of covariates on prevalence is possible for both RRT and UCT.

# Our Study

- “. . . 35 years of research have not led to a consensus or a description of best practices” (Lensvelt-Mulders et al. 2005: 323).
- This is even truer for RRTs in **self-administered modes** (and computer-assisted modes in particular).
- Our study is an exploration of the effectiveness of different implementations of RRT in the setting of an **online survey**.
- We also compare the use of the RRT to that of the UCT.

# Measurement Techniques in our Study

- 1 Direct questioning (DQ).
- 2 Five variants of the randomized response technique (RRT).
  - ▶ All variants employ a forced-response design (answer truthfully or simply say “yes” depending on the outcome of the randomization device).
  - ▶ Different randomization devices.
- 3 Unmatched count technique (UCT).



# The Five RRT Variants

- 1 **Manual coin toss:** Respondents were instructed to get a coin, toss the coin six times, and note the results on a sheet of paper.
  - 2 **Electronic coin toss:** A “Toss Coin” button was displayed next to each of the sensitive questions.
  - 3 **Banknotes:** Respondents were instructed to get two Euro bills and write down the last three digits of their serial numbers.
  - 4 **Phone numbers:** Respondents were instructed write down the last three digits of two telephone numbers of their choice.
  - 5 **Banknotes or phone numbers:** Similar to (3), but with the option to use telephone numbers if no banknote were available.
- With all variants but the second, the random numbers had to be generated before seeing the questions.

# The Sensitive Questions

- 1 **Keeping too much change:** “Have you ever received too much change and knowingly kept it?”
- 2 **Freeriding:** “Have you ever knowingly used public transportation without buying a ticket?”
- 3 **Shoplifting:** “Have you ever deliberately taken an article from a store without paying for it?”
- 4 **Marihuana use:** “Have you used marihuana in the past month?”
- 5 **Driving under influence (DUI):** “Have you ever driven a car although your blood alcohol was almost certainly over the legal limit?”
- 6 **Infidelity:** “Have you ever cheated on your partner?”

# Data Collection I

- Online survey implemented using the Unipark platform by Globalpark GmbH.
- Respondents recruited from the German “Sozioland” access panel by Respondi AG ( $N = 2075$ ).
- Data collection: August/September 2007
- Compared to the general population, female respondents are overrepresented and the respondents are relatively young and well educated.
- Questionnaire structure: (1) basic demographic questions, (2) living conditions and neighborhoods, (3) item battery measuring personality trait, (4) sensitive questions, (5) attitudes towards the sensitive behaviors, (6) perception of the used technique (RRT/UCT).

## Data Collection II

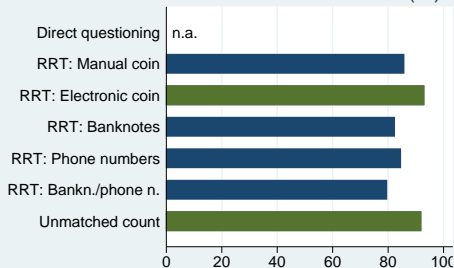
- Respondents were randomly assigned to one of ten experimental groups

Group	Count	Percent
Direct questioning 1	193	9.30
Direct questioning 2	232	11.18
Direct questioning 3	218	10.51
RRT: Manual coin toss	185	8.92
RRT: Electronic coin toss	201	9.69
RRT: Banknotes	194	9.35
RRT: Phone numbers	218	10.51
RRT: Banknotes or phone numbers	236	11.37
Unmatched count 1	210	10.12
Unmatched count 2	188	9.06
Total	2075	100.00

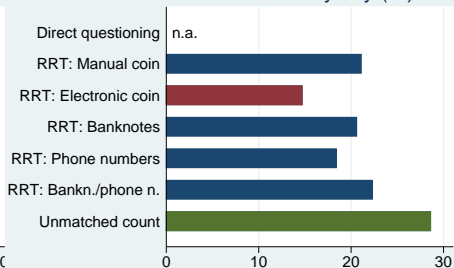
# Results

# Quality Measures for the Different Techniques

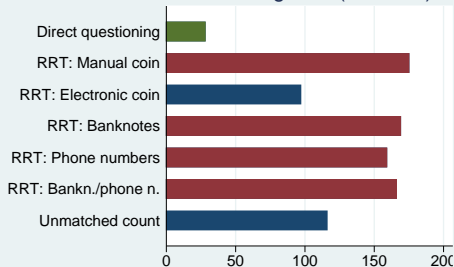
understood instructions (%)



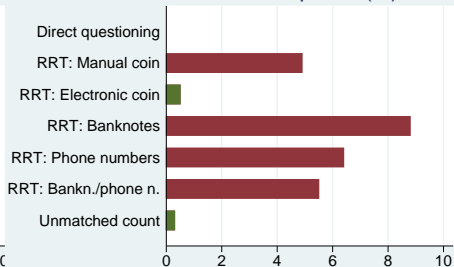
trust in anonymity (%)



answering time (seconds)



non-response (%)



## Quality Measures for the Different Techniques

Experimental condition	N	Under- stood (in %)	Trust (in %)	Time (in sec.)	Non- response (in %)
Direct questioning	643	n.a.	n.a.	28	0.0
RRT: Manual coin	185	85.7	21.1	175	4.9
RRT: Electronic coin	201	92.9	14.7	97	0.5
RRT: Banknotes	194	82.3	20.6	169	8.8
RRT: Phone numbers	218	84.5	18.4	159	6.4
RRT: Bankn./phone n.	236	79.5	22.3	166	5.5
Unmatched count	398	91.8	28.6	116	0.3

Understood: completely understood the instructions

Trust: believes that the technique guaranteed the anonymity

Time: total time spent answering the sensitive questions (median)

Non-response: did not answer any of the sensitive questions

## Quality Measures: Summary

- The **manual RRTs** (manual coin toss, banknotes, and telephone numbers) were problematic with respect to several domains. Many respondents did not understand the procedures and both answer times and levels of non-response were considerable.
- The **electronic coin** toss RRT, although easier to use and better understood by the respondents, is problematic because it induces less trust.
- The **unmatched count** technique (UCT), however, performed well compared to the RRTs on all of these measures.



## Prevalence Estimates (Std. Err. in Parentheses)

	Keeping too much change	Free- riding	Shop- lifting	Mari- huana use	DUI	Infi- delity
Direct questioning	56.1 (2.0)	61.8 (1.9)	23.4 (1.7)	4.7 (0.8)	29.0 (1.8)	26.2 (1.7)
RRT	58.3 (2.6)	56.7 (2.6)	9.2 (3.2)	-31.1 (3.1)	1.9 (3.2)	4.4 (3.2)
RRT: Electronic coin	59.0 (5.7)	67.8 (5.2)	22.0 (6.9)	-7.0 (7.1)	8.0 (7.0)	20.0 (6.9)
Unmatched count	43.5 (11.1)	76.5 (10.1)	17.5 (10.3)	32.5 (11.3)	19.0 (9.3)	35.9 (9.1)
Question sensitivity	20.4	22.0	79.2	42.6	52.7	72.8
RRT: "false no"	0.0	5.1	14.2	35.7	27.0	21.8

Sensitivity: proportions of respondents who think that the behavior is not alright and that admitting it would be uncomfortable for most.

"false no": Estimated proportion of respondents who answered "no" although they were instructed to give an automatic "yes".

## Prevalence Estimates: Summary

- The **RRT estimates** seem unreliable due to strong false “no” biases. Apparently, many respondents were reluctant to give an automatic “yes” answer.
- Interestingly, the **electronic coin** toss RRT seems to be the least biased. Possibly, the thought that the electronic coin flips could be recorded disciplined the respondents to follow the instructions.
- The **unmatched count** technique (UCT) provides more reasonable estimates.
- However, standard errors are high for the UCT.

# Conclusions

- The **UCT is a promising alternative to RRT** in self-administered surveys (also see the results by Tsuchiya et al. 2007). It was superior to the (forced-response) RRT in our study along several dimensions.
  - ▶ Easier to understand, higher trust rates.
  - ▶ Shorter response times, less non-response.
  - ▶ UCT does not suffer from the negative biases observed for RRT.
- Respondents are reluctant to give an automatic “yes” answer. This is a **strong argument against the forced-response RRT** in self-administered settings.
- Outlook
  - ▶ How does UCT compare to non-forced-response RRT?
  - ▶ How can the statistical efficiency of UCT be improved?
  - ▶ How do generalizations of UCT to non-binary variables perform?

# Proportion of False “No” Answers: Estimation I

The expected proportion of “yes” answers in the RRT design can be written as

$$\lambda = p \cdot \pi_x + (1 - p)(1 - \gamma)\pi_y$$

where

- $p$ : probability of being directed to the sensitive question ( $p = 0.5$  in our design)
- $\pi_x$ : (unknown) probability of answering “yes” to the sensitive question
- $\pi_y$ : (known) probability of answering “yes” to the innocuous question ( $\pi_y = 1$  in our design)
- $\gamma$ : probability of cheating (i.e. giving a “no” answer although an automatic “yes” would have been indicated by the procedure)

## Proportion of False “No” Answers: Estimation II

If we assume that  $\pi_x$  is at least as high as the observed proportion of “yes” answers using direct questioning, the proportion of cheaters (false “no” answers) in the RRT design can be estimated as

$$\hat{\gamma} \geq 1 - \frac{1}{(1 - \rho)\pi_y} (\hat{\lambda} - \rho \cdot \hat{\pi}_x^{\text{DQ}})$$

where

- $\hat{\lambda}$  observed proportion of “yes” answers in the RRT design
- $\hat{\pi}_x^{\text{DQ}}$  observed proportion of “yes” answers using direct questioning

Note that the boundary of the above solution is equivalent to the maximum-likelihood estimate for the proportion of cheaters proposed by Clark and Desharnais (1998).

# UCT Statements I

- Set 1:

- ▶ I have been to Spain.
- ▶ I have read the book “Perfume”.
- ▶ I have one or more cats as pets.
- ▶ I am an active, playing member of a soccer club.
- ▶ I have received too much change and knowingly kept it at least once.
- ▶ I have a brother.

- Set 2:

- ▶ I have a cell phone.
- ▶ I have more than one sister.
- ▶ I read a newspaper every day or nearly every day.
- ▶ I use an electronic planner to schedule my appointments.
- ▶ I own a digital camera.
- ▶ I have knowingly used public transportation without having a valid ticket at least once

# UCT Statements II

- Set 3:

- ▶ I have ordered an item online at least once.
- ▶ I own a dog.
- ▶ I have my own car.
- ▶ My shoe size is larger than  $10\frac{1}{2}$ .
- ▶ I have lived in another country for longer than a month.
- ▶ I have deliberately taken an article from a store without paying for it at least once

- Set 4:

- ▶ I have been to America.
- ▶ I have one or more children.
- ▶ I drink coffee every morning or nearly every morning.
- ▶ I wear glasses to correct my vision..
- ▶ I have used marijuana in the past month.
- ▶ I have a television set in my bedroom.

# UCT Statements III

- Set 5:

- ▶ I work on a computer every day or nearly every day.
- ▶ I am self employed.
- ▶ I live in an apartment building.
- ▶ I can drive a motorcycle.
- ▶ I have driven a car although my blood alcohol was almost certainly over the legal limit at least once.
- ▶ In my free time I go jogging at least once a week.

- Set 6:

- ▶ I have a dishwasher in my kitchen.
- ▶ I go shopping more than once a week.
- ▶ In my free time I listen to music at least once a week.
- ▶ I have cheated on a partner at least once.
- ▶ I eat only vegetarian dishes.
- ▶ In winter I go skiing or snowboarding at least once.



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