Comparing Errors from Non-coverage to Other Errors in a Mobile Web Survey

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- Fred Conrad, Brady West, Pedja Klasnja

Context

- Focus is on mobile Web surveys that require a smartphone to participate
  - necessary if want to use an app or other mobile-only feature
  - following Fuchs and Busse (2009) analysis of coverage errors in mobile-only Web surveys

Smartphone surveys

- Offer several advantages over PC Web data collection:
  - Auxiliary data collection opportunities
    - GPS; Bluetooth medical devices (De Nazell et al. 2013)
  - App with prompts
    - TV viewing; EMA; time-use (Sonck & Fernee 2013)
  - Sampling
    - RDD sample of mobile-Web users; send invite using text messaging

Smartphone surveys

- But not everyone has their own smartphone which is necessary to participate
  - At least 20% of U.S. adults don't own a smartphone
  - Owners are younger and better educated than non-owners (Smith, 2012)
  - Survey variables related to smartphone ownership may be biased due to non-coverage
- Owning a smartphone is necessary but not sufficient -- one also has to use (and know how to use) mobile browsers, etc.

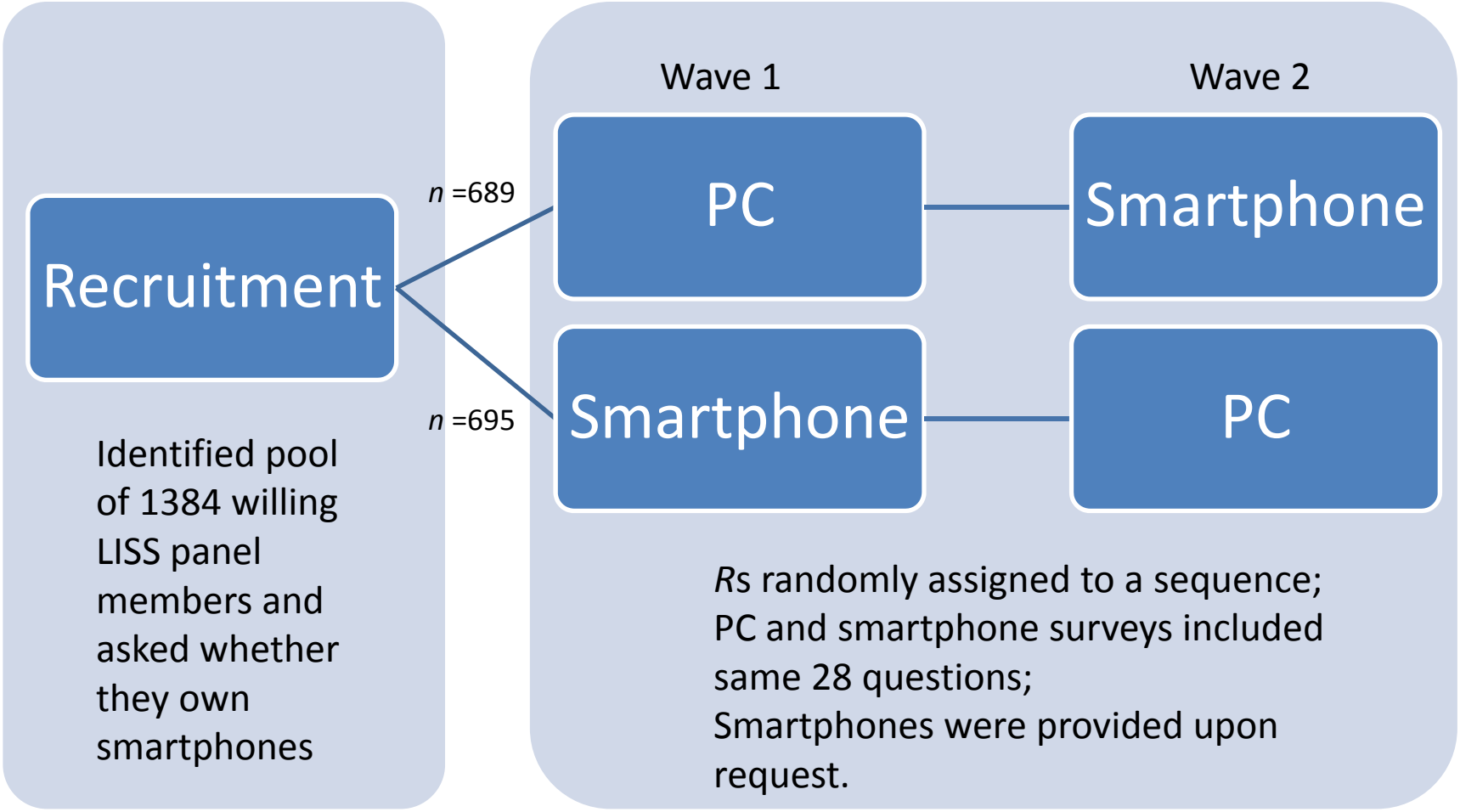
Current Study

- Estimates non-coverage bias in a mobile Web survey for a selected group of survey variables
  - Usually don't know about uncovered population
  - Overcame this by conducting parallel PC Web survey
  - Know about those with and without smartphones; consider those without their own smartphones to be uncovered
- Compares non-coverage bias relative to other sources of error – nonresponse and measurement
- Considers the impact on nonresponse and measurement errors of providing phones to all respondents

Mode Experiment

July – December 2013

LISS panel: probability Web panel in the Netherlands



Implementation

- Sent two emails to panel members
  - instructions about device to use
  - “normal” invitation email with URL
- To start mobile survey
  - could click URL in email
  - Or if received smartphone for study, then could click on bookmark on the phone’s home screen
- Two email reminders near the end of month
- Normal cash incentive

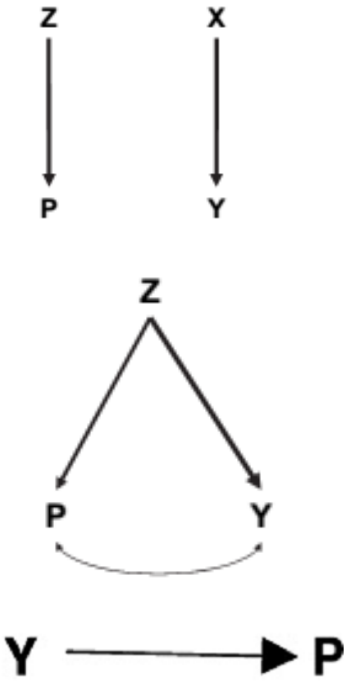
Items

- Several measures that one might want to measure in smartphone survey:
  - health: exercise; social life; binge drinking
  - technology: tablet use; TV viewing
  - travel: drunk driving; eating out
- These variables lend themselves to passive measurement or apps with prompts
  - E.g., health survey + Bluetooth monitoring; TV viewing app; travel survey + GPS

Predictions: Non-coverage

Y: survey variable of interest
P: propensity to be covered
Z: other survey variables

- Relation between survey variable and coverage can be represented by 3 models
  1) separate causes
     - Travel
  2) common cause
     - Health (affected by age, which affects smartphone adoption)
  3) Survey variable cause
     - Technology (social media use directly affects smartphone adoption)



Source: Groves (2006)

Assumptions

- No carryover effects: response in wave 2 not affected by wave 1
- Benchmark is full population of panel members who agreed to participate in the experiment and completed the PC Web survey; deviations from benchmark regarded as error
  - *relative* biases

Estimating Non-coverage Bias

- Compare mean based on benchmark ($\bar{y}_{\text{benchmark}}$) to mean based on those with smartphone ($\bar{y}_{\text{covered}}$)
  - Coverage deviation: $B_{cov} = \bar{y}_{\text{benchmark}} - \bar{y}_{\text{covered}}$
  - Assumes self-reported ownership is accurate and smartphones are not shared

Estimating Nonresponse Bias

- Compare mean based on those with smartphone ($\bar{y}_{\text{covered}}$) to mean based on those with completed smartphone survey ($\bar{y}_{\text{respond}}$)
  - Nonresponse deviation: $B_{nr} = \bar{y}_{\text{covered}} - \bar{y}_{\text{respond}}$

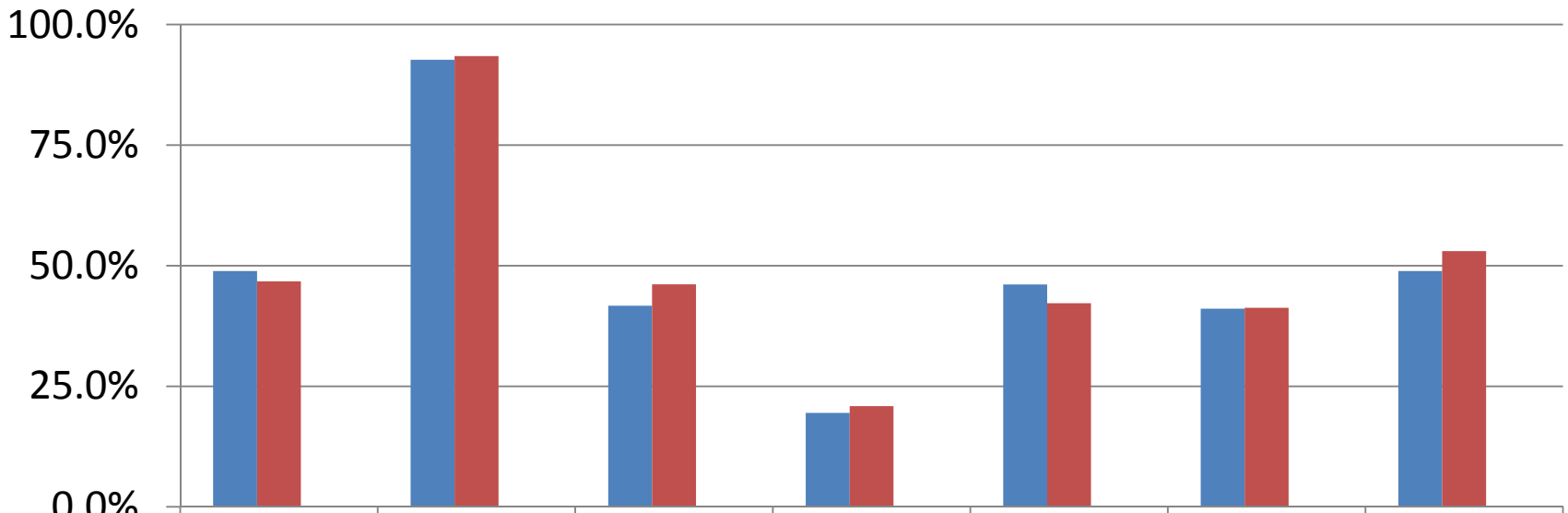
Estimating Measurement Bias

- Difference between means based on PC Web responses ($\bar{y}_{respond}$) and means based on smartphone survey responses ($\bar{y}_{smartphone}$) for the same respondents
  - Measurement deviation: $B_{meas} = \bar{y}_{respond} - \bar{y}_{smartphone}$

Subgroups

	Sample Size	Rate
Benchmark	1180	--
Covered	843	71.4%
Respond	614	72.8%
Respond (smartphone answers)	614	--

Results: Non-coverage errors



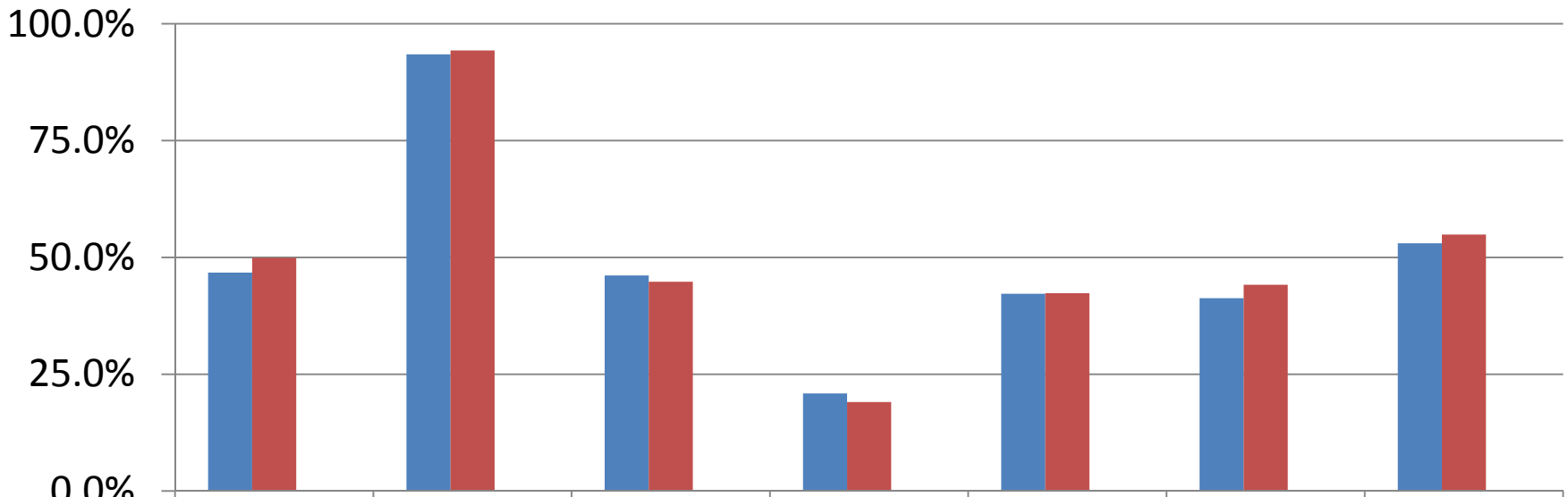
	Exercise (>2 times per week)	Satisfied with social life	Binge drank in past month	Prefer tablet for going online	Hours watching TV (> 3.0 per day)	Ever drink and drive	Eating in restaurants (>6 times per year)
Benchmark	48.9%	92.7%	41.7%	19.5%	46.1%	41.1%	48.9%
Covered	46.7%	93.5%	46.1%	20.9%	42.2%	41.3%	53.0%
|Bcov|	2.2%	0.8%	4.4%	1.4%	3.9%	0.2%	4.1%

Average absolute B_{cov} = 2.4%

Logistic regression to predict non-coverage

- DV: covered vs. not covered
- IVs: demographics commonly used for weighting adjustments (age, gender, education, marital status, and urbanicity); survey variables of interest
- Results: two survey variables are significant predictors
  - Tablet use; eating out
  - Appear to fall under Groves's "survey variable cause" model

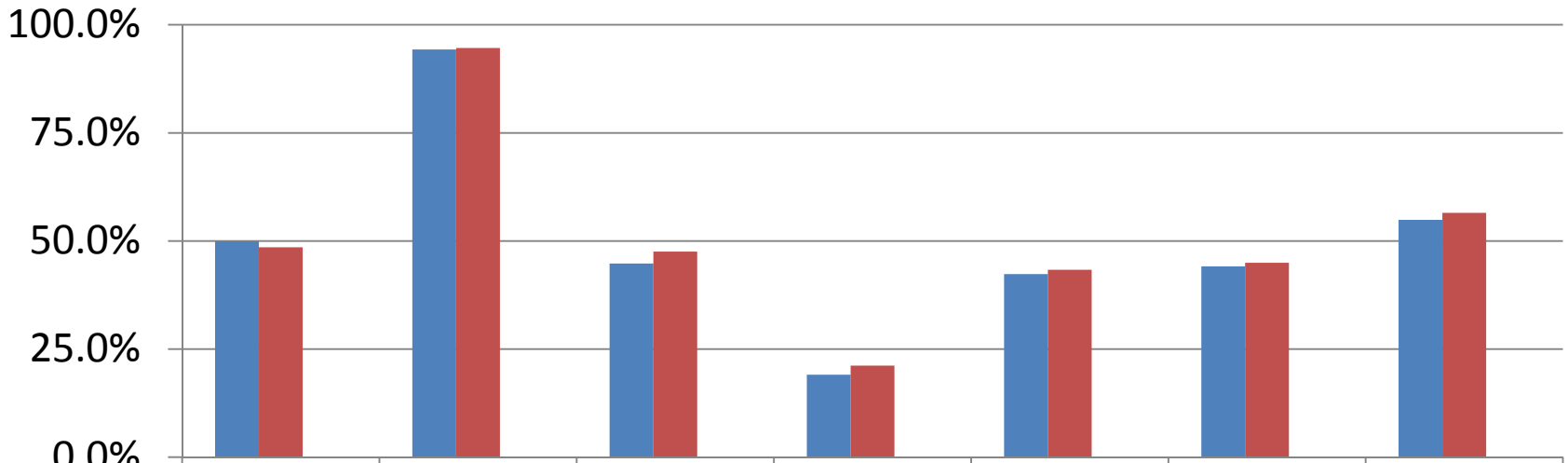
Nonresponse Errors



	Exercise (>2 times per week)	Satisfied with social life	Binge drank in past month	Prefer tablet for going online	Hours watching TV (> 3.0 per day)	Ever drink and drive	Eating in restaurants (>6 times per year)
Covered	46.7%	93.5%	46.1%	20.9%	42.2%	41.3%	53.0%
Respond	49.9%	94.3%	44.8%	19.1%	42.3%	44.1%	54.9%
|Bnr|	3.2%	0.8%	1.4%	1.8%	0.1%	2.9%	1.9%

Average absolute B_{nr} = 1.7%

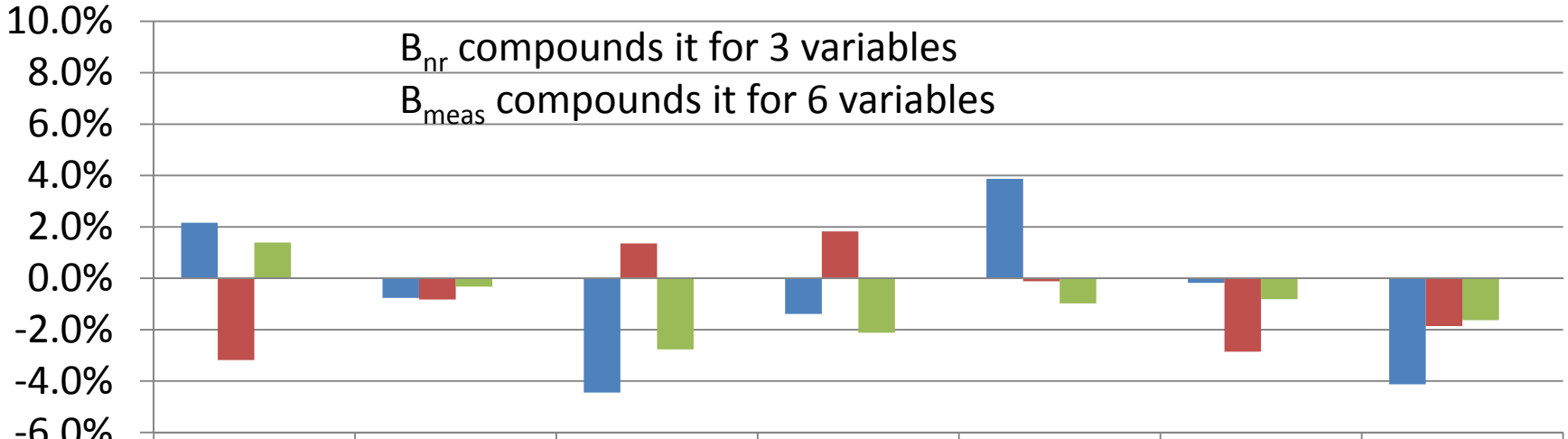
Measurement Errors



	Exercise (>2 times per week)	Satisfied with social life	Binge drank in past month	Prefer tablet for going online	Hours watching TV (> 3.0 per day)	Ever drink and drive	Eating in restaurants (>6 times per year)
Respond	49.9%	94.3%	44.8%	19.1%	42.3%	44.1%	54.9%
Respond: smartphone	48.5%	94.6%	47.6%	21.2%	43.3%	45.0%	56.5%
|Bmeas|	1.4%	0.3%	2.8%	2.1%	1.0%	0.8%	1.6%

Average absolute B_{meas} = 1.4%

Non-coverage errors not consistently offset by other sources of errors



	Exercise (>2 times per week)	Satisfied with social life	Binge drank in past month	Prefer tablet for going online	Hours watching TV (> 3.0 per day)	Ever drink and drive	Eating in restaurants (>6 times per year)
Bcov	2.2%	-0.8%	-4.4%	-1.4%	3.9%	-0.2%	-4.1%
Bnr	-3.2%	-0.8%	1.4%	1.8%	-0.1%	-2.9%	-1.9%
Bmeas	1.4%	-0.3%	-2.8%	-2.1%	-1.0%	-0.8%	-1.6%
|Btotal|	0.4%	1.9%	5.9%	1.7%	2.8%	3.8%	7.6%

Average absolute B_{total}= 3.4%

Summary so far

- Absolute non-coverage bias larger than absolute nonresponse or measurement biases
  - 2.4% vs. 1.7% vs. 1.4% on average
- Two survey variables directly related to non-coverage
- Other errors don't consistently offset it

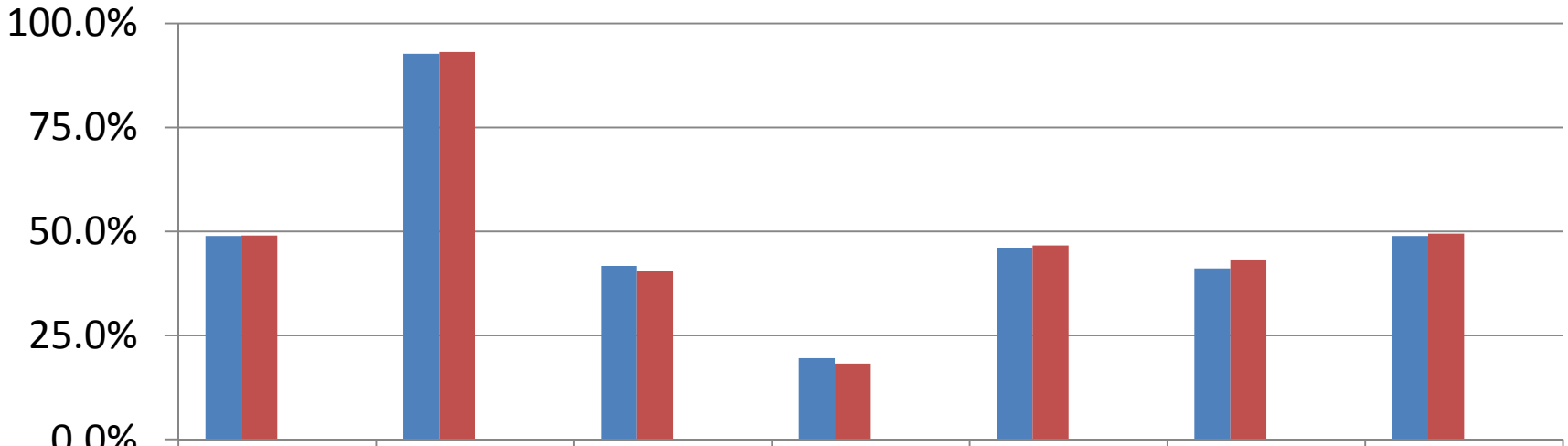
Estimating errors when phones are provided

- Coverage issues are (by definition) eliminated
  - But additional respondents using unfamiliar phones could inflate other errors
    - unwillingness to accept or use loaner phone may increase nonresponse error

Subgroups (With Phones Provided)

	Old Sample Size	Old Rate	New Sample Size	New Rate
Benchmark	1180	--	1180	--
Covered	843	71.4%	1180	--
Respond	614	72.8%	918	77.8%
Respond (smartphone answers)	614	--	918	--

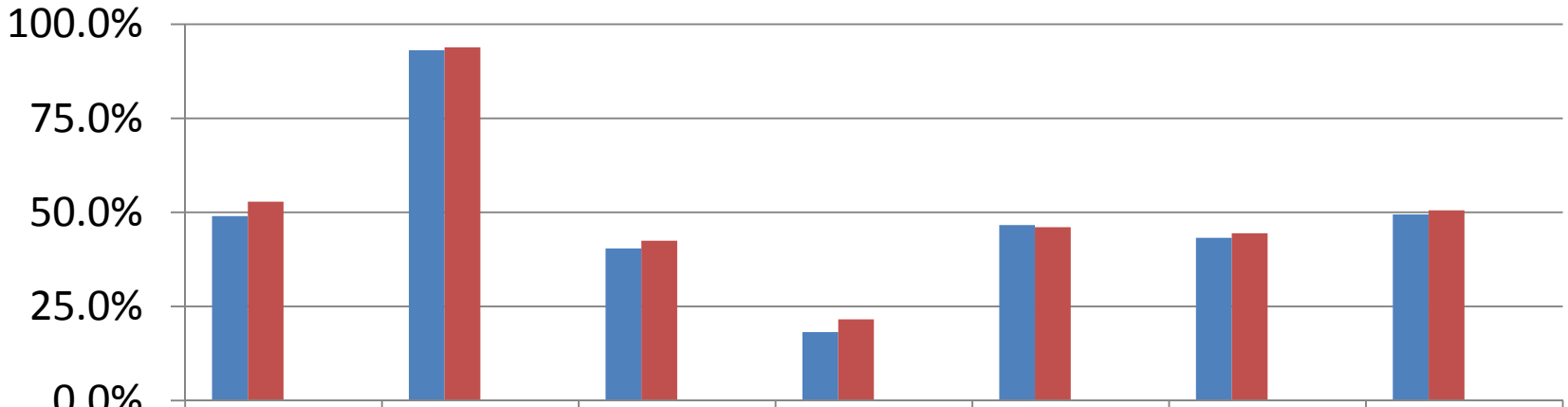
No negative effect on nonresponse errors



	Exercise (>2 times per week)	Satisfied with social life	Binge drank in past month	Prefer tablet for going online	Hours watching TV (> 3.0 per day)	Ever drink and drive	Eating in restaurants (>6 times per year)
Sample	48.9%	92.7%	41.7%	19.5%	46.1%	41.1%	48.9%
Respond	49.0%	93.1%	40.4%	18.2%	46.6%	43.2%	49.5%
|Bnr old|	3.2%	0.8%	1.4%	1.8%	0.1%	2.9%	1.9%
|Bnr new|	0.1%	0.4%	1.3%	1.3%	0.5%	2.1%	0.6%

Average absolute B_{nr} old= 1.7%; **Average absolute B_{nr} new= 0.9%**

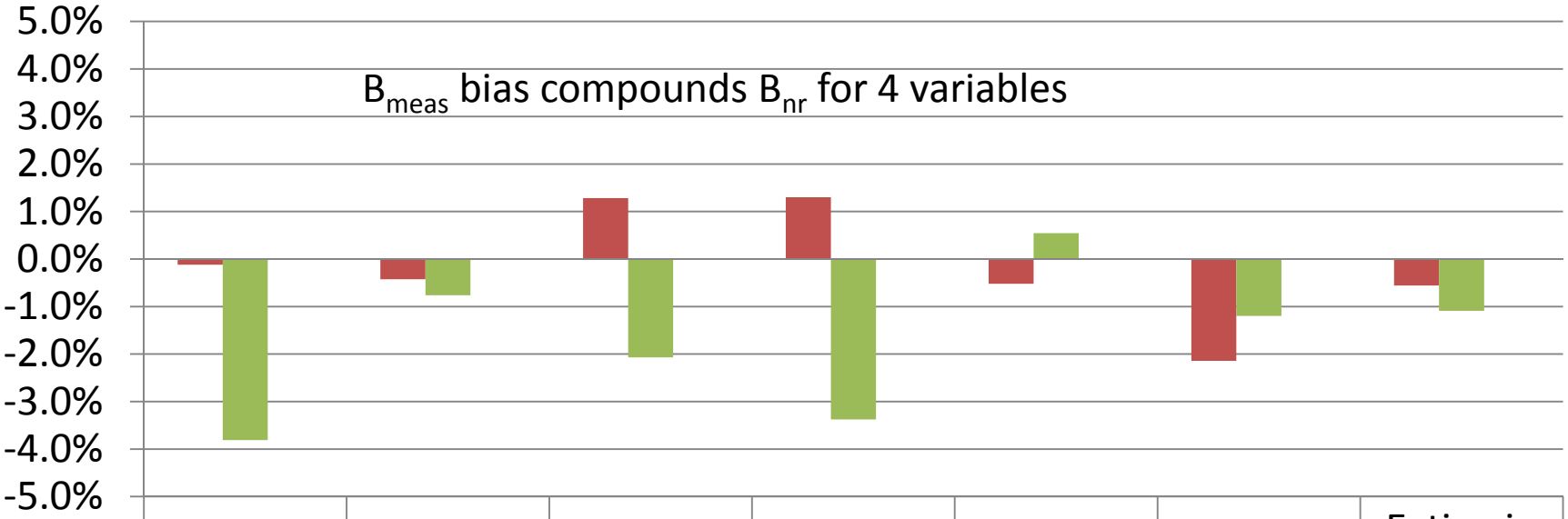
Modest increase in measurement errors



	Exercise (>2 times per week)	Satisfied with social life	Binge drank in past month	Prefer tablet for going online	Hours watching TV (> 3.0 per day)	Ever drink and drive	Eating in restaurants (>6 times per year)
Respond	49.0%	93.1%	40.4%	18.2%	46.6%	43.2%	49.5%
Respond: smartphone	52.8%	93.9%	42.5%	21.6%	46.1%	44.4%	50.5%
|Bmeas old|	1.4%	0.3%	2.8%	2.1%	1.0%	0.8%	1.6%
|Bmeas new|	3.8%	0.8%	2.1%	3.4%	0.5%	1.2%	1.1%

Average B_{meas} old= 1.4; **Average B_{meas} new= 1.8%**

As before, biases don't consistently cancel out



	Exercise (>2 times per week)	Satisfied with social life	Binge drank in past month	Prefer tablet for going online	Hours watching TV (> 3.0 per day)	Ever drink and drive	Eating in restaurants (>6 times per year)
Bnr	-0.1%	-0.4%	1.3%	1.3%	-0.5%	-2.1%	-0.6%
Bmeas	-3.8%	-0.8%	-2.1%	-3.4%	0.5%	-1.2%	-1.1%
|Btotal|	3.9%	1.2%	0.8%	2.1%	0.0%	3.3%	1.6%

Average B_{total} old= 3.4% ; **Average B_{total} new= 1.9%**

Summary

- Large non-coverage error biases relative to other sources of error
  - Cannot be eliminated by weighting
    - Two survey variables directly related to non-coverage
  - Furthermore, non-coverage errors not consistently offset by other errors
- Suggests that limiting Web surveys to mobile Web users only is risky for general population surveys
- Unless phones are provided
  - Eliminates coverage issues without large effect on other sources of error

Remaining Questions

- For this analysis:
  - Are bias estimates statistically significant?
    - Plan is to use bootstrapping to add confidence intervals around bias estimates
  - Present results for more survey variables
- For future work:
  - error in a cross sectional survey
  - mean square error (MSE)
  - weighting adjustments
- Biases have different causes. What are they?
  - E.g., are the observed measurement errors due to socially desirable reporting, satisficing, or what?

THANK YOU!