# Mixed-mode Survey Estimation and Inference

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# Mixed-Mode “Systems” (DeLeeuw, Hox and Dillman, 2008)

- Mix modes at
  - contact phase
  - follow-up phase
  - response phase

DeLeeuw, Hox, and Dillman. 2008. Mixed mode surveys: When and why. International Handbook of Survey Methodology.

# Mixed-mode at contact phase

- Advance notification in different mode than data collection
  - Rationale for implementation
    - Correct sampling frame
    - Raise response rate
      - Enhance credibility/trust
      - Evoke social norms (Groves, Cialdini and Couper, 1992)
        - Reciprocation (prepaid incentive)
        - Authority
  - Reduces coverage and nonresponse error
  - No effect on measurement error if single mode data collection


Photo credit: Hansi Lo Wang/NPR


- Examples:
  - de Leeuw, E. D., Callegaro, M., Hox, J., Korendijk, E., & Lensvelt-Mulders, G. (2007). The influence of advance letters on response in telephone surveys a Meta-Analysis. Public Opinion Quarterly, 71(3), 413–443.
  - Hembroff, L. A., Rusz, D., Rafferty, A., McGee, H., & Ehrlich, N. (2005). The Cost-effectiveness of alternative advance mailings in a telephone survey. Public Opinion Quarterly, 69(2), 232–245.

# Mixed-mode at contact phase

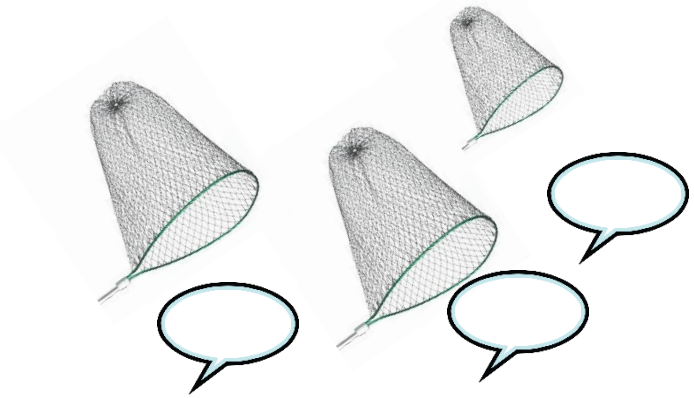
- Recruitment/ screening/ selection in different mode than data collection
  - Rationale for implementation
    - Reduce cost per interview
    - Enhance efficiency
    - Update/ expand contact information for main code
  - Timeliness improved
  - No effect on measurement error if single mode data collection

- Examples:
  - Link, M. W., & Lai, J. W. (2011). Cell-Phone-Only Households and Problems of Differential Nonresponse Using an Address-Based Sampling Design. Public Opinion Quarterly, 75(4), 613–635.

# Mixed-mode at follow-up phase

- Reminders in different modes from mode in which all respondents are asked to complete questionnaire
  - Reduce nonresponse error
  - Although potentially you may bringing respondents with different measurement error qualities based on a single instrument, varying qualities are based on respondent behavior (considering all essential survey conditions to be constant over the survey period)
  - If reminder plus part data collection in other response mode, there is a risk for nonignorable mode effects

# Mixed-mode at response phase



- Different (sample) persons by different modes when surveying one sample at one time period with one questionnaire
  - Different estimation considerations conditioned on the sampling frame characteristics
    - Single-frame vs. Multi-frame
    - Probability vs. Nonprobability
  - Rationale for implementation
    - Reduce cost per interview (start with a less expensive mode and follow-up with more expensive modes that have better coverage and nonresponse qualities.)
    - Improve coverage
    - Improve response
  - **Potentially nonignorable mode effects**

# Examples


- Cobben, F., Schouten, B., & Bethlehem, J. (2006). A Model for Statistical Inference based on Mixed Mode Interviewing. In European Conference on Quality in Survey Statistics. Retrieved from http://www.statistics.gov.uk/events/q2006/downloads/T10_Cobben.doc
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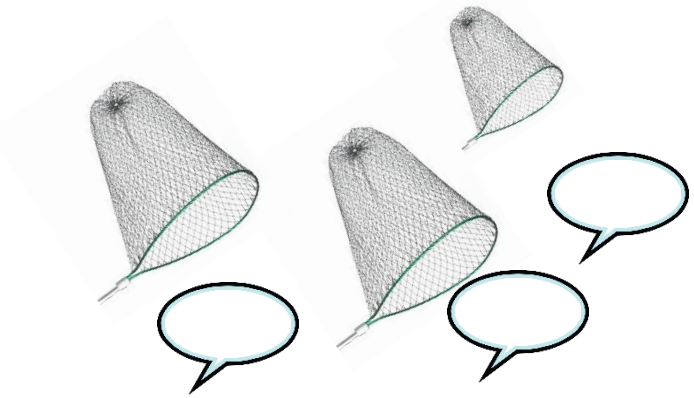
- Millar, M. M., & Dillman, D. A. (2011). Improving Response to Web and Mixed-Mode Surveys. Public Opinion Quarterly, 75(2), 249–269.
- Peytchev A., (2012), “Multiple Imputation for Unit Nonresponse and Measurement Error,” Public Opinion Quarterly, 76(2), 214–237.

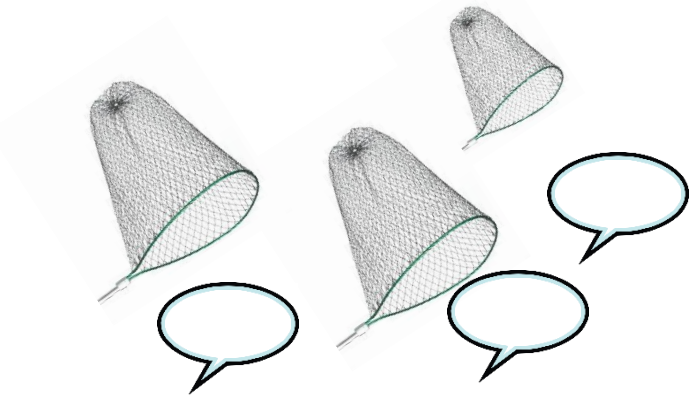
# Mixed-mode at response phase



- Different parts of a questionnaire by different modes when surveying one sample at one time point
  - Improve privacy of measurement
  - Reduce social desirability
  - **Mode effects** are desirable with the assumption that one mode provides superior quality data

- Examples:
  - Jones, R. K., & Kost, K. (2007). Underreporting of Induced and Spontaneous Abortion in the United States: An Analysis of the 2002 National Survey of Family Growth, 187–197.
  - Tourangeau, R., & Smith, T. W. (1996). Asking Sensitive Questions the Impact of Data Collection Mode, Question Format, and Question Context. Public Opinion Quarterly, 60, 275–304.

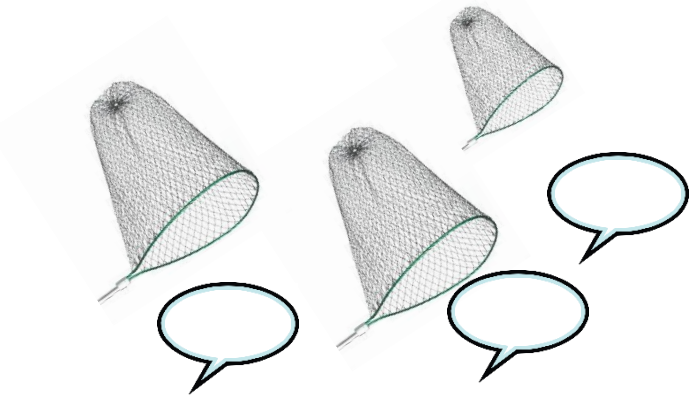
# Mixed-mode at response phase



- Same person with different modes at multiple time points (panel)
  - Reduce cost per interview
- Measurement differences causing confounding of time and mode effects

- Examples:
  - Peracchi, F., & Welch, F. (1995). How representative are matched cross-sections? Evidence from the Current Population Survey. Journal of Econometrics, 68, 153–179.

# Mixed-mode at response phase



- Different (whole) samples by different modes, often at different times with different questionnaires
  - Comparative research
  - Different research traditions
  - Different coverage
  - Different cost structure

- Examples:
  - Martin, P. (2011). What makes a good mix? Chances and challenges of mixed mode data collection in the ESS (No. 2). Retrieved from https://www.city.ac.uk/__data/assets/pdf_file/0015/125133/CCSS-Working-Paper-No-02.pdf
  - HaileMichael, G. W. (2013). Quality assurance and quality control in multinational and multicultural surveys. Stockholm University.

# Measurement error

- **Measurement error:** Departure of the response to a measure from the true value of the measure for the respondent

  $E_t(y_{it}) \neq Y_i$, where

  $t$ indexes repeated measurements

  $y_{it}$ is a response collected from person $i$ person at time $t$

  $Y_i$ is the "true value" of person $i$ for the quantity of interest

For example, $Y_i$ is the total number of hospital emergency visits in the last 12 months for person $i$.

- **Question effects:** question and device variations influence survey responses (Schuman and Presser, 1996)
- **Respondent characteristics and behavior:** memory capacity, education, technology use
- **Interviewer characteristics and behavior:** behavior in administering questions and recording responses, characteristics perceived as part of a social context

- Univariate or marginal distributions

# Differential measurement error

$y_{ipt} = Y_i + M_p + \varepsilon_i$, where

$t$ indexes repeated measurements

$y_{ipt}$ is a response collected from person $i$ at time $t$ at response mode $p$

$Y_i$ is the "true value" of person $i$ for the quantity of interest

$M_p$ mode effect for a given response mode

$\varepsilon_i$: random error with a zero mean and some variance for person *i*

# Total number of hospital emergency visits in the last 12 months for person *i* (https://www.cdc.gov/nchs/nhis/2020nhis.htm)

**Question Text:**

Is there a place that you USUALLY go to if you are sick and need health care?

**Response:**

| | |
|---|---|
| 1 | Yes |
| 2 | There is NO place |
| 3 | There is MORE THAN ONE place |
| 7 | Refused |
| 9 | Don't Know |

**Universe:**

Sample Adults 18+

**Question Text:**

What kind of place ^ISITGOMSTOFT - a doctor's office or health center; an urgent care center, a clinic in a drug store or grocery store; a hospital emergency room; a VA Medical Center or VA outpatient clinic; or some other place?

**Read if necessary:** *A doctor's office or health center is a place where you see the same doctor or the same group of doctors every visit, where you usually need to make an appointment ahead of time, and where your medical records are on file.*

**Read if necessary:** *Urgent care centers and clinics in a drug store or grocery store are places where you do not need to make an appointment ahead of time, and do not usually see the same health care provider at each visit.*

**Fills:**

| | | |
|---|---|---|
| ^ISITGOMSTOFT | Description | is it/do you go to most often |
| | Instruction | If USUALPL_A=1 fill "is it";<br>else fill "do you go to most often" |

**Response:**

| | |
|---|---|
| 1 | A doctor's office or health center |
| 2 | Walk-in clinic, urgent care center, or retail clinic in a pharmacy or grocery store |
| 3 | Emergency room |
| 4 | A VA Medical Center or VA outpatient clinic |
| 5 | Some other place |
| 6 | Does not go to one place most often |
| 7 | Refused |
| 9 | Don't Know |

**Universe:**

Sample Adults 18+ with 1+ usual place of care or who don't know or refused to answer if they have a usual place of care

**Question Text:**

During the past 12 months, how many times have you gone to a hospital emergency room about your health?

**Read if necessary:** *This includes emergency room visits that resulted in a hospital admission.*

**Enter 96 if number of times is 96 or more.**

# Differential measurement error

- Inference methods for single mode surveys have largely ignored measurement errors, including creating weights and estimating appropriate design-based standard errors (e.g., Groves and Lepkowski, 1985; Lavrakas, et al. 2017; Peytchev, 2012)
- The most prevailing assumption is that measurement biases are **constant** (Schuman and Presser, 1996)
- Mixing responses from various survey modes present both validity and reliability issues even under this assumption
- Survey statisticians mostly have investigated differential measurement error as a whole while effects of question, respondent characteristics and behavior, and interviewer characteristics and behavior are required to be studied individually for design decisions

# Diagnosing and adjusting differential selection and measurement errors

- Nonignorable mode effects is threat to comparability over time and/or across subgroups
  - Subgroups with differential coverage and/or response behavior ~Differential selection error
  - Differential measurement error
  - Both differential selection and measurement errors
- Quantifying differential measurement error is difficult
- Analytical approaches
  - Model assumptions
  - Data availability
  - A list of review papers is provided at the end

# Diagnosing and adjusting differential selection and measurement errors

- The answer to “Ignorable vs. nonignorable?” paves the way for the estimation method

- Diagnosing
  - “Gold standard” or administrative data record systems for the target population members
  - Benchmark surveys, conducted in different modes on different respondents,
  - Repeated measurements on the same respondents, in different modes,
- Diagnosing and adjusting
  - Statistical modeling and analysis approaches

# Take-aways

- Despite diagnosing differential selection and measurement error literature is well-developed and applications are still scarce
- Design and estimation strategies go hand in hand
- Existing repeated cross-sectional surveys need to plan and budget for additional data collection

# References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