



**Report of the AAPOR Task Force on Transitions from Telephone Surveys
to Self-Administered and Mixed-Mode Surveys**

SUMMARY

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1. Introduction

Since the 1970s, telephone methods have been a ubiquitous way of collecting large scale surveys. This has been especially true for studies with complex questionnaires, surveys requiring screening for special populations, and those requiring smaller area geographic estimates. With the changing environment for telephone surveys, an increasing number of surveys are transitioning from telephone to self-administration or combinations of modes for both recruitment and survey administration, where phone may be only one of a number of modes that are used, if at all. Survey organizations are conducting these transitions from telephone to mixed modes with only limited guidance from existing empirical literature and best practices. This Task Force aimed to help the survey research field navigate these challenges by examining what surveys have done in this transition, what is known, and where areas are open for additional insights and research.

We gathered information for this report through three approaches. First, we conducted an extensive review of the literature, examining published articles, technical reports, conference presentations, and internal reports conducted by members of the Task Force or their organizations. Second, we reached out to the greater AAPOR community via AAPORNet and asked for any description, papers, or documentation about surveys that had transitioned from telephone to self-administered or mixed-mode approaches or were thinking about making this transition. Finally, we conducted a convenience sample survey of the AAPOR community to get more general insights into survey organizations' reasons behind making these transitions.

The AAPOR Task Force Report on Transitions from Telephone to Self-Administered and Mixed-Mode Surveys contains 11 chapters. Each chapter focuses on various design features that need to be considered when transitioning from telephone to a self-administered or mixed-mode

survey. In doing so, we review issues related to coverage and sample designs (Chapter 2), within-household selection (Chapter 3), questionnaire design (Chapter 4), testing of questionnaires and other materials (Chapter 5), recruitment methods, nonresponse, and operations (Chapter 6), data preparation and processing (Chapter 7), and survey estimation (Chapter 8). We also address what is known about survey costs when transitioning from telephone to different modes (Chapter 9), human subjects issues that change when transitioning modes (Chapter 10), and communicating the impact of the change of modes to sponsors, stakeholders, and users (Chapter 11). The report focuses on issues related to *transitioning* from telephone to other modes; we cite relevant more general mixed-mode survey literature where appropriate. This summary focuses on of the major findings of the report; details for multiple additional individual design decisions not discussed here are available in the corresponding report chapter. We provide illustrative examples of surveys that made a transition or have considered transitioning to self-administered or mixed modes throughout; additional examples are in the report.

2. Why are surveys transitioning away from telephone to self-administered and mixed modes?

Traditional telephone surveys have provided valid and reliable survey data for decades, but they are now facing serious challenges (e.g., Lavrakas, et al. 2017). The growth of cellphone-only households has required significant changes in sample design and has generally reduced operational efficiency. Although the percentage of adults and children with no telephone service at home has remained relatively steady since 2003, the percentage of adults and children in households with access only through a cellular number has skyrocketed from about 3% in the

early 2000s to 56.7% of adults and 67.5% of children in late 2018 (Blumberg and Luke 2019). To ensure adequate population coverage, telephone surveys now typically use a mix of landline random digit dial (RDD) and cellphone RDD samples. This adaptation by researchers extended the life of telephone surveys, but two other challenges arose.

Perhaps the most serious challenge for telephone surveys is the precipitous drop in response rates for both landline and cellphone frames (Lavrakas, et al. 2017). Another challenge is that geographic targeting of RDD telephone surveys has become much more difficult.

Traditional landline RDD frames permitted geographic targeting of small areas because of how telephone companies assigned banks of telephone numbers to specified geographic areas. The efficiency and accuracy of geographic targeting of telephone surveys is less viable due to number portability (Federal Communications Commission 2016) and because cellular numbers do not have the same geographical associations as landline numbers (Skalland and Khare 2013; Pew Research Center 2015). At the same time, a new sample frame providing good coverage of US addresses, the Delivery Sequence File (DSF) based off of the list of addresses that receive mail from United States Postal Service, is now available, facilitating a method known widely as Address-Based Sampling (ABS) (Harter, et al. 2016). These multiple simultaneous changes to the landline and cellular telephone frames and declining response rates have created significant challenges for survey researchers attempting to measure the household population in the US and elsewhere in the world. In reaction, multiple surveys have transitioned their surveys from a single-mode telephone administration to a self-administered and/or mixed-mode survey, or are considering doing so.

3. What kind of surveys are transitioning?

General population surveys started examining the possibility of transitioning away from interviewer-administered modes (whether they did or not) in the early 2000s (e.g., Cantor, et al. 2005; Link, et al. 2008; Bailey, Grabowski, and Link 2010; DiSogra, Dennis, and Fahimi 2010), coinciding with the advent of ABS sampling (Iannacchione 2011; Harter, et al. 2016). Surveys examined in this report that have transitioned or are studying transitioning from interviewer-administered to self-administered or mixed modes encompass smaller community-based surveys and large scale, national surveys covering a wide variety of topical domains. These surveys cover multiple topics and target both general and special populations.

The AAPOR Mixed Mode Task Force conducted a survey using a convenience sample of organizations that have transitioned one or more surveys across modes, or are planning such a transition in the near future. Participation was solicited on AAPORnet and by personal contacts from members of the Task Force. Data collection began May 10, 2018 and concluded on July 2, 2018. Representatives of 21 organizations responded to the survey, providing data about a total of at least 25 different data collection efforts, including both named studies and broader shifts in the standard data collection mode for the organization.

Although we have no benchmark to compare this convenience sample to, the range of studies cited by respondents reflects the range of surveys seen in our review of the literature. Some of the transitioned studies involve national samples but many are geographically focused or target special populations rather than the general public. This survey includes responses from researchers in government, academia, nonprofit organizations and commercial firms, though at least half of the studies are sponsored by government agencies. Most but not all are surveys of populations in the U.S. Nearly all are household rather than establishment surveys. Most are

cross-sectional rather than longitudinal surveys. The survey transitions reported in the study began as early as 2004 and about half of them are still ongoing.

4. What is the priority goal of the transition?

Transitions from a telephone to a self-administered or mixed-mode survey are motivated by a desire to control costs, to maintain or improve data quality, or a combination of both, according to our survey of a convenience sample of organizations that have transitioned or are in the process of doing so. While controlling costs is a relatively straightforward goal, the issue of data quality is more nuanced. Survey designers may aim to (1) minimize mean squared error (MSE) of the self-administered survey estimates, independent of existing telephone survey estimates, or (2) minimize the MSE of the self-administered survey estimates with respect to existing telephone survey estimates. This decision depends on what the design will be for the survey into the future. That is, will the future survey design be a single mode (only web, only mail), a mix of web and mail modes, or a mix of web, mail, and telephone methods of data collection? Other organizations with surveys that have not had a telephone survey administration for many years may prioritize maximizing the quality of data from the self-administered or mixed-mode administration, whereas organizations with ongoing telephone survey administrations may prioritize consistency in the survey estimates over time or minimizing the difference in the quality of estimates between the two administrations. For example, an expert panel for the National Household Travel Survey (NHTS) recommended prioritizing data quality for the 2017 NHTS mixed-mode administration, stating that dramatic changes in the survey landscape since the 2009 administration rendered over-time comparisons not useful (Transportation Research Board, 2016; p. 26). The University of Michigan's Survey of

Consumers is evaluating methods for combining data from telephone, web, and mail modes to minimize the effect of a future potential mode transition from solely telephone data collection on estimates of change in economic conditions (Elkasabi, et al. 2014). Other organizations and survey sponsors may have other goals.

In our survey of organizations that transitioned, data quality topped the list of reasons for implementing the transition of modes (Table 1). A large majority (17 of 22 responding) said that response rates in the interviewer-administered survey were either “extremely” or “very” important in making a decision to transition. Anticipated response rates in the new modes closely followed (15 selecting “extremely” or “very” important of 23 responding). Anticipated frame coverage for the new modes matched this level of importance (15). Ten organizations said that demands for greater precision, such as lower standard errors at the same level of cost, were either extremely or very important.

Table 1 Why transition?
Number of respondents choosing each response

	Extremely important	Very important	Somewhat important	A little/not at all important
Response rates to the interviewer administered survey	12	5	2	3
Anticipated response rates to the self-administered of mixed-mode survey	10	5	4	4
Anticipated coverage for the self-administered or mixed-mode studies	9	6	3	6
Costs for interviewer administered survey	9	2	3	5
Coverage of the frame of the interviewer administered survey	8	3	5	6
Anticipated costs for the self-administered or mixed-mode survey	8	2	4	6
Desire for greater precision/ lower standard errors / different estimation strategy at lower or same costs	6	4	4	7
Client demands	4	9	3	5
Sponsor or funding agency demands	3	6	3	7

Source: AAPOR Mixed Mode Task Force survey of organizations that have transitioned a survey across modes

5. Is telephone still part of the mix in mixed-mode surveys?

Many surveys that transitioned included telephone as part of the mixed-mode approach. In many early studies, phone numbers were matched to addresses selected from the DSF to facilitate telephone attempts, and mail was used to request telephone numbers from those who were not successfully matched (e.g., Montaquila et al. 2013; Jans, et al. 2013; Allison, Stevenson, and Kniss 2014; Kali and Flores Cervantes 2016). For the 2012 Wisconsin Family Health Survey, Allison, Stevenson, and Kniss (2014) sent a one-page mail questionnaire requesting a telephone number to an address-based sample of Wisconsin households that could not be reverse directory list-matched to a telephone number. Forty-three percent of unmatched households returned the questionnaire, 91.6% of which had a valid telephone number to be called for a telephone interview.

Some studies using list samples with available telephone numbers, or those with matched telephone numbers, may also include telephone or face-to-face interviews as one of the modes, possibly for nonresponse follow-up (Murphy, Harter, and Xia 2010; LeClere, et al. 2012; Lien 2015; Mayfield et al. 2015; Sterrett, et al. 2015; Klausch, Hox and Schouten 2015; Mathews, et al. 2017; Federal Highway Administration and Westat 2018; Wells, et al. 2018; Amaya, et al. 2018; Axinn, et al. 2018). For instance, the Racial and Ethnic Approaches to Community Health across the US Risk Factor Survey (REACH US) randomly assigned addresses matched to a telephone number to be initially contacted in a telephone mode and then nonrespondents followed up with a mailed paper questionnaire (the phone-first approach), or to be initially contacted with a mail questionnaire and then nonrespondents followed up with telephone (the mail-first approach) (Amaya, et al. 2015). Thus, transitioning to a self-administered or mixed-

mode survey does not necessarily mean that telephone or other interviewer-administered modes are abandoned.

6. What modes are being using in mixed-mode surveys?

As surveys transition from telephone to self-administered and mixed-mode surveys, the mode for initially contacting the sampled household and the mode of data collection may differ. Table 2 describes combinations of recruitment modes and survey administration modes used in several surveys that transitioned to self-administered or mixed modes. The most common recruitment mode among surveys that have transitioned to self-administered or mixed modes is mail, including only a letter and questionnaire or a URL to complete the survey online; others with available contact information use email. As shown in Table 2, there are a variety of strategies used for initial contact and data collection. Many surveys that transitioned from telephone to self-administered surveys used only mail for both contact and data collection mode (e.g., Montaquila, et al. 2013; Brick, Andrews, and Mathiowetz 2016; Breidt, et al. 2018). Recent mixed-mode studies use mail to recruit sampled individuals, but use only web as a data collection mode (e.g., Bosa, Gagnon, and Caron 2017; Federal Highway Administration and Westat 2018; American National Election Studies 2018). Others use a mailed contact letter to recruit respondents to complete either a mail or web questionnaire (e.g., Marlar, et al. 2017; Ghandour, et al. 2018; McPhee, et al. 2018). Still other surveys use web surveys, obtained from probability-based web panels or nonprobability opt-in panels, as the self-administered mode replacing the telephone survey (e.g., Breton, et al. 2017; American National Election Studies 2018; Brown, et al. 2018; Ghandour, et al. 2018; Penn State Harrisburg, 2019a).

Table 2 Examples of Modes of Contact and Modes of Administration for Surveys that Transitioned or Examined Transitioning to Self-Administered or Mixed Modes

Example Surveys	
Contact Mode: Mailed letter	
Administration mode: Mail survey	2005 Behavioral Risk Factor Surveillance System pilot; 2007 Health Information National Trends Survey; 2006-2014 ODOT surveys; Dutch Crime Victimization Survey mode experiment; National Household Education Survey: 2011 Field Test; Survey of Consumer Attitudes; Coastal Household Telephone Survey; Gallup Sharecare Well-Being Surveys; CAHPS Hospice Survey; National Survey of Fishing, Hunting, and Wildlife-Associated Recreation; Racial and Ethnic Approaches to Community Health (REACH) U.S. Risk Factor Survey, Phase 1-3
Administration mode: Web survey	2016 American National Election Studies Time Series Study; Canada National Travel Survey pilot; 2018 California Health Interview Survey Push-to-web pilot (three counties); National Immunization Survey; 2015 Residential Energy Consumption Survey National Pilot study; Dutch Crime Victimization Survey mode experiment
Administration mode: Concurrent mail and web survey	Survey of Consumer Attitudes; 2015 Residential Energy Consumption Survey National Pilot study; National Longitudinal Survey of Adolescent to Adult Health Wave V pilot; Gallup Sharecare Well-Being Surveys
Administration mode: Sequential mail survey followed by web survey	2015 New York Adult Tobacco Survey; Gallup Sharecare Well-Being Surveys
Administration mode: Sequential mail followed by telephone	National Household Education Survey: 2009 Pilot Study; CAHPS Hospice Survey; Racial and Ethnic Approaches to Community Health (REACH) U.S. Risk Factor Survey
Administration mode: Sequential web survey followed by mail survey	Survey of Consumer Attitudes; 2015 Residential Energy Consumption Survey National Pilot study; 2015 New York Adult Tobacco Survey; 2006-2014 ODOT surveys; 2016 National Survey of Children's Health; 2016 National Household Education Survey; Gallup Sharecare Well-Being Surveys
Administration mode: Sequential web followed by telephone	2018 California Health Interview Survey Push-to-web pilot (three counties)
Administration mode: Sequential web followed by mail followed by telephone	German Health Update 2.0 (GEDA) pilot study; 2017 National Survey of College Graduates
Contact mode: Mailed screener	
Administration mode: Telephone topical Survey	Wisconsin Family Health Survey; 2013-2014 California Health Interview Survey ABS pilot (one county); Brick, et al. (2013)
Administration mode: Mail topical survey	National Household Education Survey: 2011 Field Test; 2016 National Household Education Survey; National Survey of Veterans;
Administration mode: Web topical survey	2017 National Household Travel Survey
Contact mode: Mailed letter, Multiple modes screener and topical survey	

Table 2 Examples of Modes of Contact and Modes of Administration for Surveys that Transitioned or Examined Transitioning to Self-Administered or Mixed Modes

	Example Surveys
Administration mode: Sequential: Mail topical survey followed by phone	National Household Education Survey: 2009 Pilot Study
Administration mode: Sequential: Web screener and/or topical survey followed by mail	2016 National Household Education Survey; National Longitudinal Survey of Adolescent to Adult Health Wave V
Contact mode: Email	
Administration mode: Web survey	American National Election Studies 2012 Time Series Study; 2015 Canada Election Study; Rutgers-Eagleton Poll 2019; American Trends Panel; Penn State Harrisburg Lion Poll
Administration mode: Sequential web survey followed by telephone and face-to-face	University of Michigan 2015 Campus Climate Survey
Contact mode: Telephone	
Administration mode: Concurrent phone and web	2005 Health Information National Trends Survey (HINTS)
Administration mode: Sequential telephone followed by mail	Racial and Ethnic Approaches to Community Health (REACH) U.S. Risk Factor Survey

7. What benefits can be realized when surveys transition?

As noted above, survey organizations anticipated many opportunities for improvement when transitioning from telephone to self-administered modes. We describe some of the major opportunities below; the report details additional benefits, as well as additional examples for each of these benefits.

Improved frame coverage and geographic targeting. Many studies that transitioned from telephone to self-administered or mixed modes also transitioned from Random Digit Dialing (RDD) sampling to ABS sampling using the DSF as the frame, covering households with and without telephones. Because addresses are linked to geography, targeting small geographic areas such as states, cities, or even neighborhoods is easily accomplished (Harter, et al. 2016). These studies may use the DSF as-is or append information for stratification purposes or to target a rare

population (e.g., Brick, Andrews, and Mathiowetz 2016). For instance, addresses with household members who may speak a particular language (e.g., Spanish, Korean) may be identified through a compiled surname listing (e.g., Zuckerberg and Mamedova 2012; Brick, et al. 2013; Wells, et al. 2018). In a field test to transition the California Health Interview Survey from dual frame RDD to a mixed-mode web+phone ABS sample, Wells, et al. (2018) used Spanish, Korean, and Vietnamese surname lists to potentially identify non-English speaking households in three counties in California.

Improved response rates. Figure 1 displays response rates from a set of surveys conducted in the US that have examined transitioning from interviewer-administered modes to self-administered modes, ordered by the year of the transition study. Concurrent mixed-mode designs, sequential mixed-mode designs, and single mode designs (either mail only or web only) are presented separately. Some of these comparisons are experimental (interviewer- and self-administered modes mounted at the same time) whereas others are observational (self-administered mounted at a different time, limited here to those with no more than two years between the interviewer- and self-administered surveys, or one mode used as a follow-up mode for another mode). The response rates are taken directly from the available reports or articles, and thus some are AAPOR Response Rates (RR1 and RR3 are common) whereas others are CASRO Response Rates. Many factors vary across the studies. Yet patterns can be easily observed. In the one-stage surveys conducted between 2001 and 2012, response rates to the telephone mode tend to be higher or at about the same level as response rates to the self-administered or mixed modes. After about 2013, response rates to the self-administered or mixed modes tend to exceed those for the telephone mode.

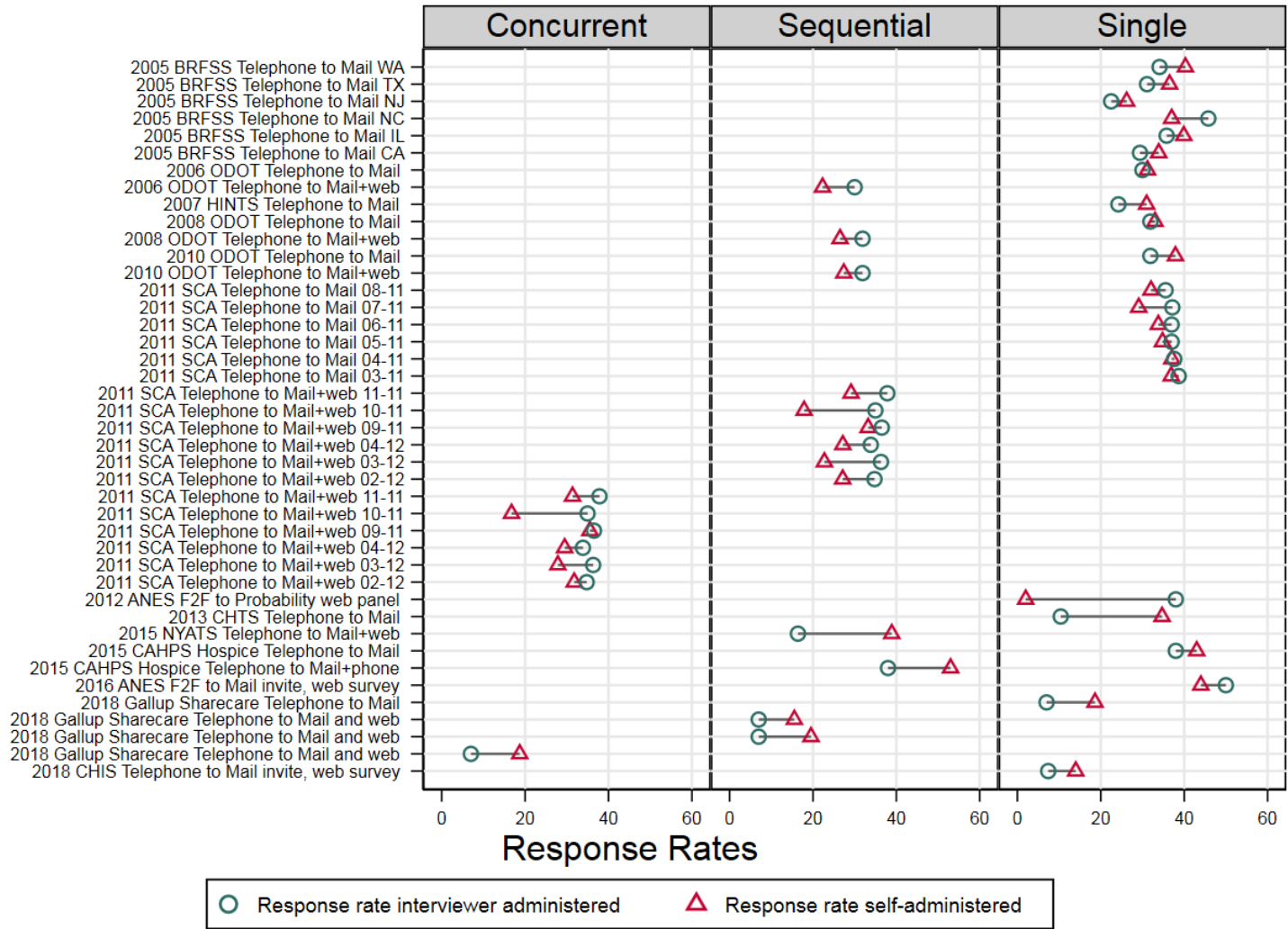


Figure 1: Response Rates for Surveys Conducted in Both Interviewer-Administered and Self-Administered or Mixed-Mode Data Collection Modes, Only US Surveys with Interviewer-Administered Mode Conducted within Two Years of Self-Administered Mode

Increased flexibility in the use of incentives. In mailed invitations to a mail or web survey, prepaid incentives are highly effective in increasing participation rates. Table 3 contains an overview of monetary incentive levels that have been offered in surveys that have transitioned to self-administered or mixed modes of data collection. Looking across surveys, prepaid incentives of \$2 and \$5 are common. Promised incentives are less commonly used, but when used, tend to be larger in value than prepaid incentives. In mixed-mode surveys, a combination of prepaid and promised incentives can be effective in pushing respondents to a new mode. For instance, the proportion of respondents who complete via a web instrument in a web survey with mail follow-up can be increased when a small prepaid incentive is followed by a larger promised incentive paid to those who respond by web (Biemer et al. 2018). Non-monetary incentives can also be delivered in a mixed-mode survey, although with more limited effectiveness. For example, the 2014 National Household Education Survey-Feasibility Test included a Department of Education magnet in the screener questionnaire. There was no statistically significant benefit to including this non-monetary incentive on response rates or eligibility rates (McQuiggan, et al. 2015).

Table 3: Summary of monetary incentive levels and example studies using the incentive amount

Incentive Amount	Example Studies
Prepaid	
\$1	Andrews, Brick, and Mathiowetz (2013); Skalland, et al. (2017); Williams, Edwards, Giambo, and Kena (2018)
\$2	Cantor, et al. (2009); Brick Williams, Montaquila (2011); Montaquila, et al. (2013); Jans, et al. (2013); Allison, Stevenson, and Kniss (2014); Ghandour, et al. (2018); Federal Highway Administration and Westat (2018); Wells, et al. (2018); Williams, Edwards, Giambo, and Kena (2018); Jackson, McPhee, and Lavrakas (2019)
\$5	Murphy, Harter, and Xia (2010); LeClere, et al. (2012); Montaquila, et al. (2013); Elkasabi, et al. (2014); Amaya, et al. (2015); Ghandour, et al. (2018); Federal Highway Administration and Westat (2018); Brown, et al. (2018)
\$10	Jackson, McPhee, and Lavrakas (2019)
\$20	American National Election Studies (2018)
\$30	National Academies of Sciences, Engineering and Medicine (2018)

Promised	
\$5	Cantor, et al. (2005); Brick Williams, Montaquila (2011); Montaquila, et al. (2013)
\$10	Montaquila, et al. (2013); Biemer, et al. (2017);
\$15	Cantor, et al. (2005); Brick Williams, Montaquila (2011); Montaquila, et al. (2013)
\$20	Allison, Stevenson, and Kniss (2014); Biemer, et al. (2017); Montaquila, et al. (2013); Federal Highway Administration and Westat (2018)
Promised >\$20	American National Election Studies (2015); American National Election Studies (2018); Harris (2019)

Innovative measurement possibilities. One advantage of web and mail modes is that researchers can take advantage of visual design to more effectively communicate with respondents. Visual self-administered surveys allow for the use of graphics such as maps, ladders, smiley faces, or thermometers to try to help respondents understand questions that are not possible or very difficult to implement in telephone surveys. For example, in the National Household Transportation Survey transition, researchers were able to capitalize on the visual and dynamic nature of the web by integrating mapping functions (using Google Maps API) for the origin, destination, and shortest path distances of respondent reported trips (Federal Highway Administration and Westat 2018). Likewise, in the Residential Energy Consumption Survey, pictures of modern cooktops and images of CFL, LED, and incandescent light bulbs were included to improve reporting (Murphy, et al. 2015). Both of these surveys were able to use the visual communication channel of self-administered modes to improve their data collection.

Potentially lower costs. Little data are available that compares costs directly for a previously administered telephone survey to a newly administered self-administered or mixed-mode survey. In our survey, 13 out of 23 organizations reported that the surveys were redesigned in an attempt to reduce total survey costs, but 6 organizations reported that costs were not part of the decision

process. Thirteen survey respondents indicated that both the total survey costs and cost per completed interview were reduced compared to the interviewer-administered mode. There are examples of surveys that have reduced costs by transitioning to self-administered modes. In an early study, Link, et al. (2008) compared costs for the traditional telephone-administered Behavioral Risk Factor Surveillance System to a mail version of this survey. They found that the mail survey reduced costs by about 12%, from \$79,578 per 1000 completes for the telephone survey to \$70,969 per 1000 completes for the mail survey. The main driver of the difference was the reduced interviewer time, which offset the increased costs for printing and other mail materials.

8. What are the big challenges in transitioning to self-administered and mixed modes?

Myriad challenges exist when transitioning a survey from telephone to self-administered or mixed modes. We describe some of the larger challenges here; the report details additional challenges.

Within-household selection may be problematic. How to select a respondent within a household is an important decision. In some surveys, the traditional process of rostering and selecting an individual is separated into two steps – after transitioning, the household completes a roster, sends it back to the survey organization, and the survey organization selects the sampled person. For example, Brick, Williams and Montaquila (2011) and Montaquila, et al. (2013) used a two-phase approach to selecting persons within a household in the mail survey version of the National Household Education Survey (NHES). Selected households completed a screener

questionnaire, including the presence and number of children in the household, including a full roster of children (name, age, sex, type of school, and year in school).

Because these methods increase the length of the survey field period, resulting in higher survey costs and potentially lower response rates, other methods put the within-household selection decision into the hands of the sampled household via instructions in a cover letter or survey instrument. Methods used in self-administered and mixed-mode surveys reflect the range of methods used in telephone surveys, ranging from asking any knowledgeable reporter or all adults in the household to report for the household (e.g., Battaglia, et al. 2008; Elkasabi, et al. 2014; Brick, Andrews, and Mathiowetz 2016; Biemer, et al. 2018) to the oldest or youngest person in the household to report (e.g., Bosa, Gagnon, and Caron 2017; DeBell, et al. 2017; Wells, et al. 2018; Smyth, Olson, and Stange forthcoming) to the adult in the household with the next or most recent birthday (e.g., Battaglia, et al. 2008; Hicks and Cantor 2012; Westat 2013; Olson and Smyth 2017; Wells, et al. 2018, 2019). The methods selected may affect response rates and the accuracy of the selections. For example, in the California Health Interview Survey web pilot, Wells, et al. (2018) included an experimental comparison of the next birthday method and the next birthday method with a verification question (Olson and Smyth 2017). The next birthday method with the verification question yielded the highest response rate of the three methods (15%, compared to 13.9% for next birthday and 13.6% for age-order) and a substantial improvement in selection accuracy (10% inaccurately selected, compared to 30% inaccurately selected for the other methods).

Long questionnaires may be shortened. Many surveys that transition shorten the questionnaire.

For example, the RECS transition shortened a 40 minute face-to-face survey to a 20 to 30 minute

web and paper questionnaire by focusing on only the most critical content and asking for less detail in the self-administered modes (Murphy, Biemer, and Berry 2018). Similarly, the 2007 Health Information National Trends Survey (HINTS) introduced a mail instrument to the existing RDD telephone survey, reducing the length of both from a 40 minute interview to a 30 minute interview (Cantor, et al. 2009). Others have attempted to deal with questionnaire length issues for a transition by offering the new version in two separate modules versus one longer survey (Peytchev, et al. 2019). The National Longitudinal Survey of Adult to Adolescent Health, however, found offering multiple modules to be an ineffective strategy as it decreased response rates and increased data collection time and costs (Liao, et al. 2019).

Computerization may affect data collection decisions. When transitions involve mail surveys, survey designers lose the ability to use a package of automation methods to assist respondents. As such, the questionnaire may need to be simplified, abbreviated, or redesigned to avoid complex skip patterns (Berktd, et al. 2018). The NHES simplified or removed many complex skip patterns that had been built into the telephone questionnaire for mail administration, including moving a set of questions about homeschooling, a topic that applies to about 3% of school-age children, into a separate questionnaire to avoid complicated skip patterns (Chapman and Hagedorn 2009).

Computerization also opens up possibilities for customizing and personalizing the questionnaire such as by using prior information to create personalized routing and/or question wording. A mail version of a survey requires more generic item wording, or construction of a version for each fill, which greatly complicates survey production and management. For instance, in the transitioned National Survey of Children's Health, computerization is used for

skip patterns, range checks, “pick lists,” fills, required responses for screening questions, soft edit prompts, and online help screens in the web mode. On the mail questionnaire, researchers were able to include identifying information taken from the screener about the sampled child (name, initials, or nickname; age, and sex), but were unable to use any of the other automation tools (U.S. Census Bureau 2018b).

Loss of benefits of interviewer administration. Self-administered surveys do not have the benefits of having an interviewer for administration, clarification, motivation, or order of presentation of items. For instance, in interviewer-administered questionnaires, “don’t know” and “refused” options are available for respondents without explicitly offering them aloud. In a web or paper questionnaire, when interviewer presence is not possible, offering a “don’t know” or “refused” response as an explicit response option is the only way to communicate to the respondent that the response is a valid one. Since self-administered modes are typically more prone to item-nonresponse than interviewer-administered modes (Nicolaas and Tipping 2006; Heerwegh and Loosveldt 2008; Heerwegh 2009; Klausch, Hox and Schouten 2013; Breton, et al. 2017), surveys experience slightly higher item nonresponse rates when transitioning to self-administered modes, sometimes on different types of items than experienced higher item nonresponse rates in the interviewer-administered modes. Figure 2 shows examples of average (mean or median) item nonresponse rates before and after mode transitions for the NHES and RECS surveys.

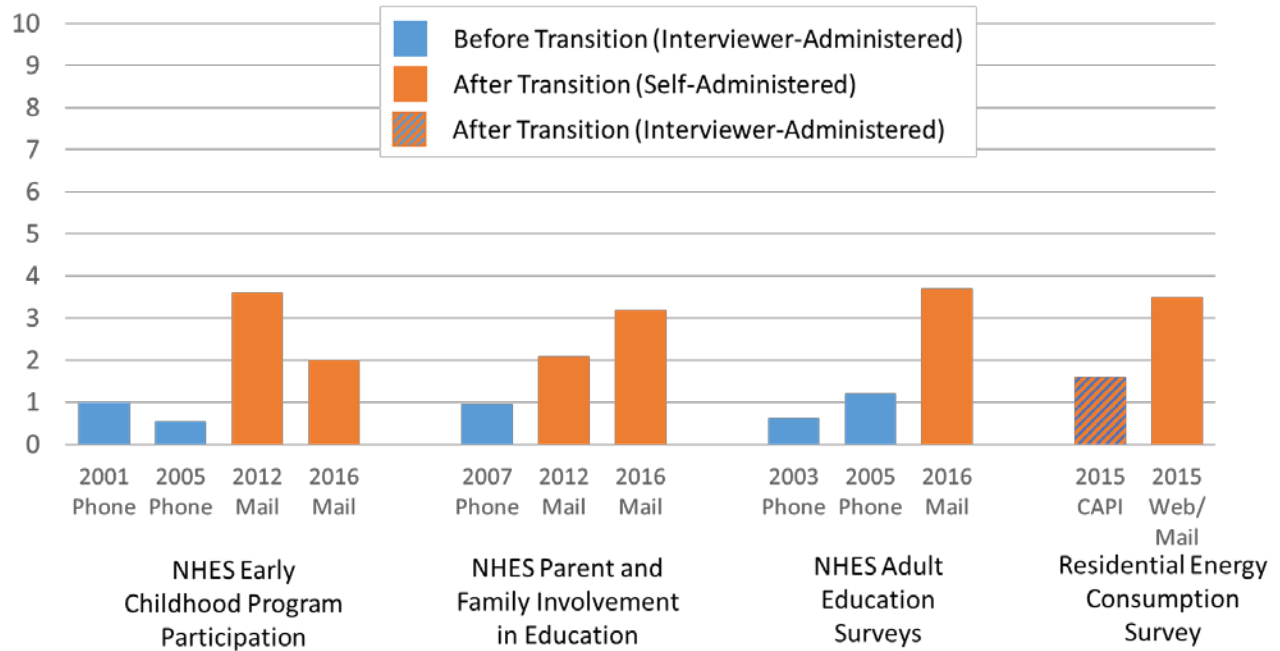


Figure 2: Item nonresponse rates by survey mode before and after transitions

Surveys that transition from telephone to self-administered or mixed modes may see changes in their survey estimates related to knowledge questions, socially (un)desirable issues, topics that are subject to acquiescence, or ordinal attitudinal items, all possibly related to loss of interviewer-control, to the absence of interviewer characteristics cueing the respondents to a response, or to the transition from aural processing with interviewers’ reading questions to visual processing of self-administered questionnaires. For example, respondents to web surveys may be able to look up answers and thus, transitioning to a web-based mode may have unintended consequences on knowledge items. Multiple studies have found higher levels of political knowledge (Liu and Wang 2014; Chang and Krosnick 2009; Ansolabehere and Schaffner 2014; Clifford and Jerit 2016; Gooch and Vavreck 2019), science knowledge (Fricker, et al. 2005), and health knowledge (Domnich, et al. 2015) in web modes than interviewer-administered modes. Self-administered modes may generate more accurate reporting of sensitive autobiographical information contained in records than interviewer-administered modes (Tourangeau and Yan

2007; Kreuter, et al. 2008; Preisendorfer and Wolter 2014). There is also evidence that non-sensitive autobiographical information is more accurately reported in self-administered surveys because of the ability to use records (Seeskin 2016; McGonagle, et al. 2017), although more research is needed here. Additionally, several studies have found that respondents are more likely to agree with items in interviewer-administered than self-administered modes (Dillman and Tarnai 1991; Greene, Speizer, and Wiitala 2008) and shifts in attitudes on race-related topics (Liu and Wang 2015; Abrajano and Alvarez 2019; Keeter, et al. 2015), including in surveys that transitioned modes (Cernat, Couper, and Ofstedal 2016; Sinozich, et al. 2019). Finally, one persistent mode effect is that ordinal scale attitude/opinion items produce more extreme positive responses in interviewer-administered modes, especially telephone, than in self-administered modes (e.g., Tarnai and Dillman 1992; Krysan, et al. 1994; Christian, Dillman, and Smyth 2008; Dillman, et al. 2009; Ye, Fulton, and Tourangeau 2011), including in surveys that transitioned (Liu 2018; Keeter, et al. 2015).

Additional decisions related to language of administration. When transitioning, surveys that use multiple languages must decide whether to translate all self-administered materials into all possible languages or to attempt to use language-specific interviewers. In the surveys that transitioned from telephone to self-administered or mixed modes, most were administered in only English or only English and Spanish. Self-administered and mixed-mode surveys conducted in multiple languages often include cover letters and survey questionnaires in these multiple languages from the initial mailing (Zuckerberg and Mamedova 2012; Montaquila, et al. 2013; Brick, et al. 2012; Brick, et al. 2013; Jans, et al. 2013; US Census Bureau 2018a,b; Ghandour, et al. 2018). For instance, the National Survey of Children's Health provided English and Spanish

versions of the screening materials and survey because of the rare occurrence of other language interviews in previous interviewer-based administrations. Spanish-language translations were printed on the back on the invitation letters, and respondents could request a Spanish-language paper screener and topical questionnaire. The web survey included an option to switch between English- and Spanish-language instruments (Ghandour, et al. 2018; US Census Bureau 2018a,b). Asking non-English-speaking respondents to call into a language-specific telephone survey is less successful (e.g., Cantor, et al. 2009; Wells, et al. 2018). The California Health Interview Survey recently tested a transition from phone to a web-push/phone survey, in which English language questionnaires are initially attempted via the web, and speakers of other languages are asked to call into a phone line to talk with an interviewer who speaks Spanish, Chinese, Korean, Vietnamese, or Tagalog; only 11 of 667 interviews were conducted in a language other than English (Wells, et al. 2018). In surveys where respondents can switch between languages, data users who want to know which language was used to complete the questionnaire may need item-specific flags; alternatively, the survey organization may need to make a decision on how to assign language used. For example, in the 2016 National Household Education Survey web experiment, language of interview in the web surveys was identified as the language used for the last item completed in the questionnaire (McPhee, et al. 2018).

Increased difficulty in interviewing children and teens. Transitioning an existing phone survey to a self-administered mode for research to screen and identify minors faces a unique set of challenges. One important decision is whether parents/guardians provide proxy reports for all of their children, a single child, or the child is asked to report for themselves. For example, in the redesigned web and mail-based National Survey of Children's Health (NSCH), household

informants completed a screener questionnaire to identify whether there were any children in the home, including those who met particular survey criteria of having special health care needs or being young. Focal children in the household were then randomly selected from the screening questions, and the adult household informant completed a survey about the child (Ghandour, et al. 2018; US Census Bureau 2018a,b). Difficulties associated with transitioning to a self-administered mode increase substantially when the minor is a teen who is requested to answer survey questions for themselves. Here, the parent must provide permission both to contact and interview the teen. The California Health Interview Study pilot collected data from teens on the web by first asking parents for permission and contact information for a selected teen respondent, and then following up with the teens. Parents provided permission for only 38 out of the 125 eligible teens, and completed interviews were obtained from only 12 of them, yielding about a 10% cumulative response rate among the eligible teens (Wells, et al. 2018).

Increased difficulty in collection of nonsurvey data. Transitioning away from interviewer-administered to self-administered modes raises challenges if interviewer observations, biological measurements, environmental samples, and consent to link to administrative records are required as part of data collection. Some studies send a separate observational team to collect the assessments, but consent rates may decrease substantially and more research is needed to minimize the losses. For example, in wave 5 of the National Longitudinal Survey of Adolescent to Adult Health, the survey transitioned to a mixed-mode design that started with web and mail data collection followed by telephone non-response follow-up. Researchers sought consent for the physical and biomarker collection during the initial web, mail, or phone survey and then had a biomarker subcontractor visit respondents for actual collection. Using this two-step process,

consent rates were considerably lower than prior in-person interviewer administration, with only 66% consenting for the biomarker visit (Harris 2018). Others have used self-administration to collect biological samples, with typically lower participation rates than those using interviewers (Sakshaug, et al. 2015). Transitioning from interviewer-to self-administered modes also can be problematic for record linkage, with lower consent rates and higher nonconsent bias in self-administered than interviewer-administered modes (Fulton 2012; Sakshaug, et al. 2017).

No single approach to measuring or adjusting for mode differences. A major challenge for surveys that want to account for potential “mode effects” in estimation is that it is a difficult-to-quantify bias, potentially resulting from differences in coverage, nonresponse, or measurement. Additionally, each variable collected in the initial telephone survey and the transitioned self-administered or mixed-mode survey yields a different bias term. There is no single method for evaluating differences in estimates across multiple modes, nor is there a single method for accounting for these differences in estimates analytically.

To evaluate and diagnose differential sources of selection and measurement errors in mixed-mode surveys, data need to be gathered through (1) “gold standard” or administrative data record systems (e.g., Hox, de Leeuw, and Klausch 2017; Sakshaug, Cernat, and Raghunathan 2019), (2) parallel surveys, conducted in different modes on different respondents, sometimes called “benchmark” or “bridge” surveys (e.g., Peytchev, Ridenhour, and Krotki 2010; Klausch, Schouten, and Hox 2017), or (3) repeated measurements on the same respondents in different modes (e.g., Klausch, Schouten, Buelens, and van den Brakel 2017), and in a variety of statistical modeling and analysis approaches. Multiple analytic approaches to statistically account for differential measurement errors across modes exist, including regression models, propensity

score adjustments and imputation, each of which relies on auxiliary or reference data (e.g., Kolenikov and Kennedy 2014; Suzer-Gurtekin, Valliant, Heeringa, and de Leeuw 2018; Hox, de Leeuw, and Klausch 2017; Peytchev, Ridenhour and Krotki, 2010). Different methods often do not produce differences in conclusions, although some may be more suited for different problems than others.

Deciding whether to transition using bridge surveys. One of many decisions made in the transition include whether to simultaneously field the survey in the new modes and the old mode to evaluate how estimates change with the change in design, an expensive but potentially important testing decision. For example, according to the Transition Plan for the Fishing Effort Survey (Marine Recreational Information Program 2015), during the bridge survey time, both the telephone mode Coastal Household Telephone Survey (CHTS) and the mail mode Fishing Effort Survey (FES) were fielded. The cost for conducting the telephone-based CHTS was \$1.8 million per year, and the mail-based FES was estimated to cost roughly \$1.3 million per year, costs considered important to incur while calibrating estimates across the two modes. As an alternative, some surveys compare a field test in the new self-administered or mixed modes with the most recent implementation of the survey in the interviewer-administered mode. For instance, the Panel Survey of Income Dynamics (PSID) compared the implementation of a web instrument in 2016 with the most recent (2015) telephone administration (McGonagle, Freedman, Griffin, and Dascola 2017).

9. What design decisions have had limited empirical attention?

Data processing. A review of the current literature regarding transitions from single mode data collection efforts to mixed-mode data collection provides little experimental or empirical data with respect to how such transitions affect data processing. In our survey, eight of the respondents said that data editing for their project varies by mode; 11 said it did not.

Transparency and documentation of data processing steps are critical, including identification of a data source (e.g., survey mode; administrative or survey data or other source) and identification of alterations to data, such that analysts can make informed decisions as to the pooling of data across modes. Organizations engage in many data processing steps; these decisions should be made *a priori*, including whether processing procedures will vary across modes. This may include what constitutes a complete case, rules concerning deduplication, the use of single vs. parallel review, clerical and/or automatic editing, and imputation. For example, one of many decisions made for data processing in mixed-mode surveys has to do with deduplication of completed cases. When one mode is used sequentially for nonrespondents, a sampled case may participate in a survey using the first mode offered and inadvertently also complete the survey in another mode while the survey organization is processing the initial response. The National Survey of Children's Health (US Census Bureau 2018a,b) prioritized a completed questionnaire in any mode, but selected the completed web questionnaires if both web and mail questionnaires were returned and completely filled out. Other processing, coding, and editing decisions abound.

Human subjects issues. When considering a transition of modes, one important consideration to take into account regarding protection of human subjects is obtaining informed consent. In interviewer-administered modes, the informed consent process is administered verbally. When transitioning to a self-administered mode such as a web or paper survey, a few considerations

arise. First, the respondent must be sufficiently literate to read and understand the consent form, although in a web survey, there is the possibility to have an audio feature read the consent language aloud. Second, there is no single mechanism or guarantee to ensure that respondents in self-administered environment read the entire consent document. Finally, there is also no clear way to check for understanding of the informed consent document in self-administered surveys. As such, surveys that transition from telephone to self-administered modes would benefit from conducting experiments that vary the display, attention, or comprehension attributes of informed consent information between interviewer-administered to self-administered surveys. Issues related to protection of personally identifiable information (PII) and handling respondent distress also require future attention.

10. What new reporting requirements may be needed in a self-administered, mixed-mode survey setting?

Standard survey documentation reports contain information on the survey's target population; the frame; the sample design, including stratification variables; and information on the data collection, including the mode of recruitment, and response modes and the order/timing they are offered. Some surveys also indicate changes from previous data collection cycles and the potential impact of this change on estimates, which is particularly important when switching from a telephone survey to a self-administered survey or mixed-mode survey. As surveys for which over time comparisons are important transition to self-administered or mixed modes, we recommend that all survey documentation identify any changes to the sampling frame from the previous administration and how the data collection procedures differ.

We were surprised to find that, at the time that we started writing this report, no surveys included screenshots of questionnaires of each question in the electronic modes, including differences in displays for PC web and mobile web questionnaires. Yet small differences in visual displays can yield large changes in responses. Thus, as surveys transition from aural to visual modes, a clear documentation of all questionnaires, including web, mobile, and mail versions, is critical for understanding how visual layout and design may affect data quality.

To go a step further in helping data users understand the impact of change in mode, we believe that organizations can add information to data files that would be beneficial. First, we recommend that data files contain information on the new data collection modes and specify how they are different from the previous survey cycles. In particular, survey response data files should contain flags for the response mode when multiple modes are available to respondents so users can subset by mode or compare across modes. We also recommend that files include more detailed information, particularly for web surveys, including the devices used to respond (smartphone, tablet, or PC). Many surveys also did not provide summary tables that reported the percentage of cases that responded by each mode. Presence of these flags on data files will facilitate users examining the impact of the change of mode of data collection.

Furthermore, we found it surprisingly hard to compare response rates across the telephone and self-administered or mixed modes of data collection for many surveys. Some of this had to do with differences in how response rates were reported – self-administered surveys with two stages of response (screener and main survey questionnaires) often reported each separately, but not an “overall” response rate. There are also substantial differences across modes in identification of ineligible sample units. Finally, many surveys reported response rates for each mode or frame used (e.g., separately for mail and web; separately for an ABS frame and a

list frame), but did not combine to provide an overall response rate. Understanding the differences in how response rates are calculated across studies and modes will be critical to the field for understanding the effect these transitions have had on survey participation and other outcomes.

11. What organization-level shifts are occurring as surveys transition from telephone to self-administered and mixed modes?

The shifts now occurring in data collection mode are affecting not only surveys, but also survey organizations more generally. Organizations have had to develop new data collection systems that effectively track what contacts cases have received and ensure interventions are properly employed. Having systems that talk to each other across multiple modes and also permit real-time analysis of data collection may be challenging or require significant infrastructure development at survey organizations. As such, smaller survey organizations may manage and evaluate the mailings and web-based contacts in different files, using Excel, SPSS, SAS, or other spreadsheet-style programs for analysis and reporting. Larger organizations may build in-house mixed-mode data collection systems, requiring substantial commitment of resources, planning, and extensive use of field managers, researchers, and IT professionals, requiring multiple years of planning and integration (e.g., Cheung and Maher 2015, Wernimont and Snowden 2015, Edwards, Maitland, and Connor 2017, Bonhomme 2018).

Additionally, many survey organizations are developing models for predicting the sample size for cost effectiveness of a mixed-mode survey (e.g., web and mail combined) over a single mode survey (e.g., mail only, web only). Previous studies find mixed conclusions about the sample size “tipping point,” depending on the mix of modes and assumed cost structure (e.g.,

Fricker and Schonlau 2002; Griffis, Goldsby, and Cooper 2003; Lien 2015; Lesser, et al. 2017; Kaminska and Lynn 2017) . Individual surveys that transition from telephone to self-administered or mixed-mode surveys will experience different fixed and variable costs of modes. For some studies, it will be more cost effective to data enter mail questionnaires than to program a web survey. In other instances, there may be costs that have already been sunk into developing a complicated telephone instrument that are more easily ported into a web survey than the cost for developing an easily-administered mail survey (e.g., Wells, et al. 2018; 2019). Similarly, some survey organizations may not have the capacity for data entry, and thus need to outsource that cost to a different organization. Each of these issues must be considered when examining survey costs related to transitioning from one mode to another.

12. Conclusion

The transitions described in this report reflect the adaptability of the survey research profession as it confronts the profound challenges of growing nonresponse and costs, along with the opportunities provided by new technologies and databases. One clear conclusion of the report is that there is no single way that a survey is transitioned from telephone to self-administered or mixed modes of data collection. Each survey transition requires a package of decisions that affect all survey error sources. Some survey researchers prioritize comparability of survey estimates with the telephone modes of data collection, and thus make decisions to minimize any potential differences that may arise. Others prioritize maximizing the quality of the survey data collected in the new mode, and thus make decisions to optimize a design for the current set of modes. Which of these decisions is optimal is survey- and estimate-specific.

Clearly communicating these decisions, and how they may affect survey estimates, is key. If changes in estimates are expected, plans should be made and procedures for how to address the break in the time series should also be communicated. These plans and procedures may include reporting on a parallel or bridge study or statistical modeling to help smooth the changes in estimates. The plans may simply be that the new set of modes starts the beginning of a new time series. Results from experimentation and related literature can be used to explain what the organization can expect to see from the survey moving forward, including costs, response rates and any changes in estimates. We hope this report helps survey organizations consider, plan, and inform users about the important issues related to these transitions.

13. References

- Abrajano, M., Alvarez, R. M. (2019), “Answering Questions About Race: How Racial and Ethnic Identities Influence Survey Response.” *American Politics Research*, 47(2), 250–274.
- Allison C. M., Stevenson J., Kniss C. (2014), “Address Based Sampling as a Method of Tackling the ‘Cell Phone Problem’: Examples from the Wisconsin Family Health Survey,” Paper presented at 18th Minnesota Health Services Research Conference, Minnesota, MN.
- Amaya A., Leclere F., Carris K., Liao Y. (2015), “Where to Start: An Evaluation of Primary Data-Collection Modes in an Address-Based Sampling Design,” *Public Opinion Quarterly*, 79(2), 420-442.
- American National Election Studies (2018), “User’s Guide and Codebook for the ANES 2016 Time Series Study,” Ann Arbor, MI and Palo Alto, CA: the University of Michigan and

Stanford University. Retrieved from

https://electionstudies.org/anes_timeseries_2016_userguidecodebook/.

Andrews R., Brick J. M., Mathiowetz N. (2013), "Continued Development and Testing of Dual-Frame Surveys of Fishing Effort: Testing a Dual-Frame, Mixed-Mode Survey Design--Final Report," National Oceanic and Atmospheric Administration, Fisheries Statistics. Retrieved from

<https://www.st.nmfs.noaa.gov/mdms/public/finalReport.jsp?ReportID=831>

Ansolabehere S., Schaffner B. F. (2014), "Does Survey Mode Still Matter? Findings from a 2010 Multi-Mode Comparison," *Political Analysis*, 22(3), 285-303.

Axinn W. G., Wagner J., Couper M. P., Crawford S. (2018), "Campus Climate Surveys of Sexual Misconduct: Limiting the Risk of Nonresponse Bias," University of Michigan: Ann Arbor, MI, PSC Research Report No. 18-887.

Bailey J. T., Grabowski G., Link M. W. (2010), "Your Home Was Specially Selected: Using Address Based Sampling as a Recruitment Technique," Proceedings of the 65th Annual Conference for the American Association for Public Opinion Research, Chicago, IL.

Battaglia M. P., Link M. W., Frankel M. R., Osborn L., Mokdad A. H. (2008), "An Evaluation of Respondent Selection Methods for Household Mail Surveys," *Public Opinion Quarterly*, 72(3), 459-469.

Berktold, J. (2018), "Conducting a Mail-Push-to-Web Survey with a US General Population Audience: Lessons Learned from the Field," Paper presented at the Annual Meeting of the American Association for Public Opinion Research, Denver, CO.

- Biemer P. P., Murphy J., Zimmer S., Berry C., Deng G., Lewis K. (2018), "Using Bonus Monetary Incentives to Encourage Web Response in Mixed-Mode Household Surveys," *Journal of Survey Statistics and Methodology*, 6(2), 240-261.
- Blumberg S. J., Luke J. V. (2019), "Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, July-December 2018," *US Department of Health and Human Services, Centers for Disease Control and Prevention*, retrieved 8/13/2019 from <https://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201906.pdf>.
- Bonhomme S. (2018), "Active Management Framework to Monitor and Manage Data Collection," Paper presented at the 2018 Federal Computer Assisted Survey Information Collection Workshops, Suitland, MD.
- Bosa K., Gagnon F., Caron P. (2017), "Comparison of Three Methods to Select a Respondent for Household Online Surveys Using Mailed Invitations," Paper presented at the 72nd Annual Conference of the American Association for Public Opinion Research, New Orleans, LA.
- Breidt J., Kreuter F., Lesser V., Moore D. L., Smyth J. D. (2018), *Comparison and Assessment of Vendor Results for the 2016 National Survey of Hunting, Fishing, and Wildlife-Associated Recreation: Evaluation Team Report*, Washington, DC: Association of Fish and Wildlife Agencies.
- Breton C., Cutler F., Lachance S., Mierke-Zatwarnicki A. (2017), "Telephone Versus Online Survey Modes for Election Studies: Comparing Canadian Public Opinion and Vote Choice in the 2015 Federal Election," *Canadian Journal of Political Science*, 50(4), 1005-1036.

- Brick J. M., Andrews W. R., Mathiowetz N. A. (2016), "Single-Phase Mail Survey Design for Rare Population Subgroups," *Field Methods*, 28(4), 381-395.
- Brick J. M., Lohr S., Edwards W. S., Giambo P., Broene P., Williams D., Dipko S. (2013), "National Survey of Crime Victimization Companion Study - Pilot," Washington, DC: Bureau of Justice Statistics, retrieved from https://www.bjs.gov/content/pub/pdf/ncvs-cs_prr.pdf
- Brick J. M., Williams D., Montaquila J. M. (2011), "Address-Based Sampling for Subpopulation Surveys," *Public Opinion Quarterly*, 75(3), 409-428.
- Brown E. M., Olson L. T., Farrelly M. C., Nonnemaker J. M., Battles H., Hampton J. (2018), "Comparing Response Rates, Costs, and Tobacco-Related Outcomes Across Phone, Mail, and Online Surveys," *Survey Practice*, 11(2), 1-14.
- Cantor D., Coa K., Crystal-Mansour S., Davis T., Dipko S., Sigman R. (2009), *Health Information National Trends Survey (HINTS) 2007: Final Report*, Bethesda, MD: National Cancer Institute.
- Cantor D., Covell J., Davis T., Park I., Rizzo L. (2005), *Health Information National Trends Survey 2005 (HINTS 2005): Final Report*, Bethesda, MD: National Cancer Institute.
- Cernat A., Couper M. P., Ofstedal M. B. (2016), "Estimation of Mode Effects in the Health and Retirement Study Using Measurement Models," *Journal of Survey Statistics and Methodology*, 4(4), 501-524.
- Chang L., Krosnick J. A. (2009), "National Surveys via RDD Telephone Interviewing Versus the Internet Comparing Sample Representativeness and Response Quality," *Public Opinion Quarterly*, 73(4), 641-678.

- Chapman C., Hagedorn M. (2009), "Searching for Alternatives to a Random Digit Dial Telephone Interview — Redesigning the National Household Education Surveys," Paper presented at the Federal Committee on Statistical Methodology Conference, Washington, DC.
- Cheung G., Maher P. (2015), "Lessons Learned on Preparing and Managing Mixed-mode surveys," Paper presented at the 16th International Blaise Users Conference, Beijing, China.
- Christian L. M., Dillman D. A., Smyth J. D. (2008), "The Effects of Mode and Format on Answers to Scalar Questions in Telephone and Web Surveys," in *Advances in Telephone Survey Methodology*, pp. 250-275. eds. Lepkowski J., Tucker C., Brick M., DeLeeuw E., Japac L., Lavrakas P., Link M., Sangster R., Hoboken, NJ: Wiley.
- Clifford S., Jerit J. (2016), "Cheating on Political Knowledge Questions in Online Surveys: An Assessment of the Problem and Solutions," *Public Opinion Quarterly*, 80(4), 858-887.
- DeBell M., Jackman S., Maisel N., Amsbary M., Meldener V., Brick J. M., Krupenkin M., Peterson E. (2017), "Methodology and Findings of the ANES 2016 Recruitment Pretest Study," ANES Technical Report No. nes006978, American National Election Studies.
- Dillman D. A., Phelps G., Tortora R., Swift K., Kohrell J., Berck J., Messer B. J. (2009), "Response Rate and Measurement Differences in Mixed-mode surveys Using Mail, Telephone, Interactive Voice Response, and the Internet," *Social Science Research*, 38(1), 1-18.
- Dillman D. A., Tarnai J. (1991), "Mode effects of Cognitively-Designed Recall Questions: A Comparison of Answers to Telephone and Mail Surveys," in *Measurement Errors in*

- Surveys*, eds. Biemer P. P., Groves R. M., Lyberg L. E., Mathiowetz N. A., Sudman S., 73-93, New York, NY: John Wiley & Sons.
- DiSogra C., Dennis J. M. Fahimi M. (2010), “On the Quality of Ancillary Data Available for Address-Based Sampling,” Proceedings of the Survey Research Methods Section, American Statistical Association, Vancouver, British Columbia.
- Domnich A., Panatto D., Signori A., Bragazzi N. L., Cristina M. L., Amicizia D., Gasparini R. (2015), “Uncontrolled Web-Based Administration of Surveys on Factual Health-Related Knowledge: A Randomized Study of Untimed Versus Timed Quizzing,” *Journal of Medical Internet Research*, 17(4), e94.
- Edwards B., Maitland A., Connor S. (2017), “Measurement Error in Survey Operations Management: Detection, Quantification, Visualization, and Reduction,” in *Total Survey Error in Practice*, eds. P. Biemer, E. deLeeuw, S. Eckman, B. Edwards, F. Kreuter, L. E. Lyberg, N. C. Tucker, B. West, pp. 255-278, Hoboken, NJ: John Wiley & Sons.
- Elkasabi M., Suzer-Gurtekin Z. T., Lepkowski J. M., Kim U., Curtin R., McBee R. (2014), “A Comparison of ABS Mail and RDD Surveys for Measuring Consumer Attitudes,” *International Journal of Market Research*, 56(6), 737-756.
- Federal Communications Commission (Updated May 18, 2016), “Wireless Local Number Portability (WLNP),” Retrieved from <https://www.fcc.gov/general/wireless-local-number-portability-wlnp>
- Federal Highway Administration and Westat (2018), *2017 NHTS Data User Guide*, Federal Highway Administration, Office of Policy Information, Washington, DC. Retrieved from https://nhts.ornl.gov/assets/NHTS2017_UsersGuide_04232019_1.pdf

- Fricker R. D., Schonlau M. (2002), "Advantages and Disadvantages of Internet Research Surveys: Evidence from the Literature," *Field Methods*, 14(4), 346-367.
- Fricker S., Galesic M., Tourangeau R., Yan T. (2005), "An Experimental Comparison of Web and Telephone Surveys," *Public Opinion Quarterly*, 69(3), 370-392.
- Fulton J. A. (2012), "Respondent Consent to Use Administrative Data," unpublished dissertation, University of Maryland, College Park.
- Ghandour R. M., Jones J. R., Lebrun-Harris L. A., Minnaert J., Blumberg S. J., Fields J., Bethell C., Kogan M. D. (2018), "The Design and Implementation of the 2016 National Survey of Children's Health," *Maternal and Child Health Journal*, 22(8), 1093-1102.
- Gooch A., Vavreck L. (2019), "How Face-to-Face Interviews and Cognitive Skill Affect Item Non-Response: A Randomized Experiment Assigning Mode of Interview," *Political Science Research and Methods*, 7(1), 143-162.
- Greene J., Speizer H., Wiitala W. (2008), "Telephone and Web: Mixed-Mode Challenge," *Health Services Research*, 43(1), 230-248.
- Griffis S. E., Goldsby T. J., Cooper M. (2003), "Web-Based and Mail Surveys: A Comparison of Response, Data, and Cost," *Journal of Business Logistics*, 24(2), 237-258.
- Han D., Cantor D., Brick P. D., Sigman R., Aponte M. (2010), "Findings from a Two-Phase Mail Survey for a Study of Veterans," Proceedings of the Survey Research Methods Section, American Statistical Association, Vancouver, British Columbia, pp. 2776-2782.
- Harris K. (2018), "Overview of Add Health for New Data Users," Paper presented at the 2018 Add Health Users Conference, Bethesda, MD.
- Harter R., Battaglia M. P., Buskirk T. D., Dillman D. A., English N., Fahimi M., Frankel M. R., Kennel T., McMichael J. P., McPhee C. B., Montaquila J., Yancey T., Zukerberg A. L.

- (2016), "AAPOR Report: Address-Based Sampling," retrieved 5/16/2018 from <https://www.aapor.org/Education-Resources/Reports/Address-based-Sampling.aspx#SECTION%203>
- Heerwegh D. (2009), "Mode Differences Between Face-to-Face and Web Surveys: An Experimental Investigation of Data Quality and Social Desirability Effects," *International Journal of Public Opinion Research*, 21, 111-121.
- Heerwegh D., Loosveldt G. (2008), "Face-to-Face versus Web Surveying in a High-Internet-Coverage Population," *Public Opinion Quarterly*, 72(5), 836-846.
- Hicks W., Cantor D. (2012), "Evaluating Methods to Select a Respondent for a General Population Mail Survey," Paper presented at the 67th Annual Conference of the American Association for Public Opinion Research, Orlando, FL.
- Hox J. J., de Leeuw E. D., Klausch T. (2017), "Mixed-Mode Research: Issues in Design and Analysis," in *Total Survey Error in Practice*, eds. Biemer P. P., de Leeuw E. D., Eckman S., pp. 511-531, Hoboken, NJ: John Wiley & Sons.
- Iannacchione V. G. (2011), "The Changing Role of Address-Based Sampling in Survey Research," *Public Opinion Quarterly*, 75(3), 556-575.
- Jackson M. T., McPhee C. B., Lavrakas P. J. (2019), "Using Response Propensity Modeling to Allocate Noncontingent Incentives to an Address-Based Sample: Evidence from a National Experiment," *Journal of Survey Statistics and Methodology*, smz007.
- Jans M., Grant D., Lee A., Park R., Edwards S., Rauch J., Flores-Cervantes I. (2013), "Address-Based Sampling (ABS) as an "Alternative" to RDD: A Test in California," Paper presented at the 68th Annual Conference of the American Association for Public Opinion Research, Boston, MA.

- Kali J., Flores Cervantes I. (2016), "Conducting a Telephone Survey Using an ABS Sample: A Case Study of the California Health Interview Survey," Paper presented at the 71st Annual Conference for the American Association for Public Opinion Research, Austin, TX.
- Kaminska O., Lynn, P. (2017). "The Implications of Alternative Allocation Criteria in Adaptive Design for Panel Surveys." *Journal of Official Statistics* 33(3): 781-799.
- Keeter S., McGeeney, K., Igielnik, R., Mercer, A., Mathiowetz, N. A. (2015), *From Telephone to the Web: The Challenge of Mode of Interview Effects in Public Opinion Polls*. Pew Research Center: Washington, DC. Retrieved from <https://www.pewresearch.org/methods/2015/05/13/from-telephone-to-the-web-the-challenge-of-mode-of-interview-effects-in-public-opinion-polls/>
- Klausch T., Hox J. J., Schouten B. (2013), "Measurement Effects of Survey Mode on Equivalence of Attitudinal Rating Scale Questions," *Sociological Methods & Research*, 52(3), 227-263.
- Klausch T., Hox J. J., Schouten B. (2015), "Selection Error in Single- and Mixed-mode surveys of the Dutch General Population," *Journal of the Royal Statistical Society*, 178(4), 945-961.
- Klausch T., Schouten B., Buelens B., van den Brakel J. (2017), "Adjusting Measurement Bias in Sequential Mixed-Mode Surveys Using Re-Interview Data," *Journal of Survey Statistics and Methodology*, 5(4), 409-432.
- Klausch T., Schouten B., Hox J. J. (2017), "Evaluating Bias of Sequential Mixed-Mode Designs Against Benchmark Surveys," *Sociological Methods & Research*, 46(3), 456-489.

- Kolenikov S., Kennedy C. (2014), "Evaluating Three Approaches to Statistically Adjust for Mode Effects," *Journal of Survey Statistics and Methodology*, 2(2), 126-158.
- Kreuter F., Presser S., Tourangeau R. (2008), "Social Desirability Bias in CATI, IVR, and Web Surveys: The Effects of Mode and Question Sensitivity," *Public Opinion Quarterly*, 72(5), 847-865.
- Krysan M., Schuman H., Scott L. J., Beatty P. (1994), "Response Rates and Response Content in Mail versus Face-to-Face Surveys," *Public Opinion Quarterly*, 58, 381-399.
- Lavrakas P. J., Benson G., Blumberg S., Buskirk T., Cervantes I. F., Christian L., Dutwin D., Fahimi M., Fienberg H., Guterbock T., Keeter S., Kelly J., Kennedy C., Peytchev A., Piekarski L., Shuttles C. (2017), "Report From the AAPOR Task Force on: The Future of U.S. General Population Telephone Survey Research," retrieved 5/16/2019 from <https://www.aapor.org/Education-Resources/Reports/The-Future-Of-U-S-General-Population-Telephone-Sur.aspx>.
- LeClere F. B., Vanicek J. S., Xia K., Amaya A. E., Murphy W. E., Fiorio L., Carris K. L. (2012), "Changing Survey Modes: Does it Matter How You Get There," Proceedings of the Survey Research Methods Section, American Statistical Association, pp. 5344-5354.
- Lesser V. M., Newton L. D., Yang D. K., Sifneos J. C. (2016), "Mixed-Mode Surveys Compared with Single Mode Surveys: Trends in Responses and Methods to Improve Completion," *Journal of Rural Social Sciences*, 31(3), 7-34.
- Lesser V., Nawrocki K., Newton L. (2017), "Improving Response in Multimode and Single Mode Probability Based Surveys Compared to a Non-Probability Survey," Paper presented at the 2017 conference of the European Survey Research Association, Lisbon, Portugal.

- Liao D., Biemer P. P., Mullan Harris K., Burke B. J., Halpern C. T. (2019), "Transitioning from In-Person Mode to Web-Mail Mixed Mode in a Panel Survey," Paper presented at the 74th Annual Conference of the American Association for Public Opinion Research, Toronto, Ontario, Canada.
- Lien R. (2015), "Adding a Web Mode to Phone Surveys: Effectiveness Cost Implications," Paper presented at the 70th Annual Conference of the American Association for Public Opinion Research, Hollywood, FL.
- Link M. W., Battaglia M. P., Frankel M. R., Osborn L., Mokdad A. H. (2008), "A Comparison of Address-Based Sampling (ABS) Versus Random-Digit Dialing (RDD) for General Population Surveys," *Public Opinion Quarterly*, 72(1), 6-27.
- Liu M. (2018). "Data Collection Mode Effect on Abortion Questions: A Comparison of Face-To-Face and Web Surveys." *Gender and Women's Studies*. 1(1):2.
- Liu M., Wang Y. (2014), "Data Collection Mode Effects on Political Knowledge," *Survey Methods: Insights from the Field*. Retrieved from <http://surveyinsights.org/?p=5317>
- Liu M., Wang Y. (2015), "Data Collection Mode Effect on Feeling Thermometer Questions: A Comparison of Face-to-Face and Web Surveys," *Computers in Human Behavior*, 48, 212-218.
- Marine Recreational Information Program (2015), *Transition Plan for the Fishing Effort Survey*, Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration.
- Marken S. (2018), "Still Listening: The State of Telephone Surveys," Gallup Methodology Blog. Retrieved from <https://news.gallup.com/opinion/methodology/225143/listening-state-telephone-surveys.aspx>.

Marken S., Auter Z., Marlar J. (2018), "Mail or web first that is our question: A comparison of multi- and sequential mode offerings." Paper presented at the Annual meeting of the American Association for Public Opinion Research, Denver, CO.

Marlar J., Chattopadhyay M., Ander S., Kanitkar K., Andrews R., Foster J., Kitts-Jensen R. (2017), "Leveraging ABS to Conduct a Mixed-Mode, Multiphase Survey," Paper presented at the 72nd Annual Conference of the American Association for Public Opinion Research, New Orleans, LA.

Mathews M., Parast L., Tolpadi A., Elliott M., Flow-Delwiche E., Becker K. (2017), "Emergency Department Patient Experience of Care Survey in the Discharged to Community Setting - A Randomized Feasibility Study," Paper presented at the 72nd Annual Conference of the American Association for Public Opinion Research, New Orleans, LA.

Mayfield A., Frasier A., Vanicek J., Li Y., English N., Greene J., Leidy M. (2015), "Knowing When to Stop: Evaluating First 5 LA Family Survey Data Based on Data Collection Mode and Difficulty to Complete an Interview," Paper presented at the 70th Annual Conference of the American Association for Public Opinion Research, Hollywood, FL.

McGonagle K. A., Freedman V., Griffin J., Dascola M. (2017), "Web Development in the PSID: Transition and Testing of a Web Version of the 2015 PSID Telephone Instrument," Technical Series Paper #17-02, Institute for Social Research, University of Michigan.

McPhee C., Jackson M., Bielick S., Masterson M., Battle D., McQuiggan M., Payri M., Cox C., Medway R. (2018), *National Household Education Surveys Program of 2016: Data File User's Manual* (NCES 2018-100), National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, DC.

- McQuiggan M., Medway R., Zhang M., Megra M. (2015), "Prepaid Incentives in ABS Surveys: Effect on Nonresponse and Measurement Errors," Paper presented at the 2015 International Total Survey Error Conference, Baltimore, MD.
- Montaquila J. M., Brick J. M., Williams D., Kim K., Han D. (2013), "A Study of Two-Phase Mail Survey Data Collection Methods," *Journal of Survey Statistics and Methodology*, 2013(1), 66-87.
- Murphy J., Biemer P., Berry C. (2018), "Transitioning a Survey to Self-Administration using Adaptive, Responsive, and Tailored (ART) Design Principles and Data Visualization," *Journal of Official Statistics*, 34(3), 625-648.
- Murphy J., Mayclin D., Richards A., Roe D. (2015), "A Multi-Method Approach to Survey Pretesting," Paper presented at the Federal Committee on Statistical Methodology, retrieved from https://nces.ed.gov/fcsm/pdf/D3_Murphy_2015FCSM.pdf.
- Murphy W., Harter R., Xia K. (2010), "Design and Operational Changes for the REACH U.S. Risk Factor Survey," Proceedings of the American Statistical Association, Survey Research Methods Section, Vancouver, British Columbia.
- National Academies of Sciences, Engineering, and Medicine (2018), *Measuring the 21st Century Science and Engineering Workforce Population: Evolving Needs*, Washington, DC: The National Academies Press.
- Nicolaas G., Tipping S. (2006), "Mode Effects in Social Capital Surveys," *National Statistics Survey Methodology Bulletin*, 58, 59-74.
- Olson K., Smyth J. D. (2017), "Within-Household Selection in Mail Surveys: Explicit Questions are Better than Cover Letter Instruction," *Public Opinion Quarterly*, 81(3), 688-713.

- Penn State Harrisburg Center for Survey Research (2019a), *Benefits of the Lion Poll Methodology*, Penn State Harrisburg Center for Survey Research, Harrisburg, PA, retrieved from <https://csr.hbg.psu.edu/Lion-Poll/Benefits-of-the-Lion-Poll-Methodology>.
- Peytchev A., Peytcheva E., Conzelmann J. G., Wilson A., Wine J. (2019). “Modular Survey Design: Experimental Manipulation of Survey Length and Monetary Incentive Structure.” *Journal of Survey Statistics and Methodology*. doi:10.1093/jssam/smz006
- Pew Research Center (2015), “Advances in Telephone Survey Sampling: Balancing Efficiency and Coverage Using Several New Approaches,” Pew Research Center, Washington, DC, retrieved from <https://www.pewresearch.org/methods/2015/11/18/advances-in-telephone-survey-sampling/>.
- Peytchev A., Ridenhour J., Krotki K. (2010), “Differences Between RDD Telephone and ABS Mail Survey Design: Coverage, Unit Nonresponse, and Measurement Error,” *Journal of Health Communication: International Perspectives*, 15, 117-134.
- Preisendorfer P., Wolter F. (2014), “Who is Telling the Truth? A Validation Study on Determinants of Response Behavior in Surveys,” *Public Opinion Quarterly*, 78(1), 126-146.
- Sakshaug J. W., Cernat A., Raghunathan T. E. (2019), “Do Sequential Mixed-Mode Surveys Decrease Nonresponse Bias, Measurement Error Bias, and Total Bias? An Experimental Study,” *Journal of Survey Statistics and Methodology*, published advanced access online. <https://doi.org/10.1093/jssam/smy024>
- Sakshaug J. W., Hulle S., Schmucker A., Leibig S. (2017), “Exploring the Effects of Interviewer- and Self-Administered Survey Modes on Record Linkage Consent Rates and Bias,” *Survey Research Methods*, 11(2), 171-188.

- Sakshaug J. W., Ofstedal M. B., Guyer H., Beebe T. J. (2015), "The Collection of Biospecimens in Health Surveys," in *Handbook of Health Survey Methods*, 1st ed., eds. Johnson T. P., pp. 383-419, Hoboken, NJ: John Wiley & Sons, Inc.
- Seeskin Z. H. (2016), *Evaluating the Use of Commercial Data to Improve Survey Estimates of Property Taxes*. US Census Bureau: Washington, DC. Retrieved from <https://www.census.gov/content/dam/Census/library/working-papers/2016/adrm/carra-wp-2016-06.pdf>
- Sinozich S., Langer G., Filer C., De Jong A. (2019), "New and Improved? Investigating Mode Effects in Two RDD-Online Transitions," Paper presented at the 74th Annual Conference of the American Association for Public Opinion Research, Toronto, Ontario, Canada.
- Skalland B., George J., Welch V., Hill H A., Elam-Evans L. D., Knighton C., Smith C. (2017), "Testing the Impact of Mail Materials on Web Participation in the National Immunization Survey," *Proceedings of the Survey Research Methods Section, American Statistical Association*. Alexandria, VA: American Statistical Association. Pp. 3708-3732.
- Skalland B., Khare, M. (2013), "Geographic Inaccuracy of Cell Phone Samples and the Effect on Telephone Survey Bias, Variance, and Cost," *Journal of Survey Statistics and Methodology*, 1(1), 45-65.
- Smyth J. D., Olson K. M., Stange M. (Forthcoming), "Within-Household Selection Methods: A Critical Review and Experimental Examination," in *Experimental Methods in Survey Research: Techniques that Combine Random Sampling with Random Assignment*, eds. Lavrakas P., de Leeuw E., Traugott M., Kennedy C., Holbrook A., West B., Hoboken, NJ: John Wiley & Sons, Inc.

- Sterrett D., Malato D., Stern M. J., Tompson T., Benz J., Reimer B. (2015), "Benefits and Challenges of Web Surveys in Mix-Mode Designs: Demographic and Data Quality Differences Across Modes in Survey of Households Recovering from Superstorm Sandy," Paper presented at the 70th Annual Conference of the American Association for Public Opinion Research, Hollywood, FL.
- Suzer-Gurtekin Z. T., Valliant R., Heeringa S. G., de Leeuw E. D. (2018), "Mixed-Mode Surveys: Design, Estimation and Adjustment Methods," in *Advances in Comparative Survey Methodology*, eds. Johnson T. P., Pennell B. E., Stoop I., Dorer B., pp. 409-430, Hoboken, NJ: John Wiley & Sons.
- Tourangeau R., Yan T. (2007), "Sensitive Questions in Surveys," *Psychological Bulletin*, 133(5), 859-883.
- U.S. Census Bureau (2018a), *2017 National Survey of Children's Health Methodology Report*, Washington, DC: U.S. Bureau of the Census, retrieved from <https://www.census.gov/content/dam/Census/programs-surveys/nsch/tech-documentation/methodology/2017-NSCH-Methodology-Report.pdf>.
- U.S. Census Bureau (2018b), *2016 National Survey of Children's Health Methodology Report*, Washington, DC: U.S. Bureau of the Census, retrieved from <https://www.census.gov/content/dam/Census/programs-surveys/nsch/tech-documentation/methodology/2016-NSCH-Methodology-Report.pdf>
- Wells B. M., Hughes T., Park R., CHIS Redesign Working Group, Rogers T. B., Ponce N. (2018), *Evaluating the California Health Interview Survey of the Future: Results from a Methodological Experiment to Test an Address-Based Sampling Mail Push-to-Web Data Collection*, Los Angeles, CA: UCLA Center for Health Policy Research, retrieved from

<http://healthpolicy.ucla.edu/chis/design/Documents/CHIS%20Spring%202018%20ABS%20Web%20Field%20Experiment%20Report.pdf>.

- Wells, B.M., Hughes, T., Park, R., CHIS Redesign Working Group, Ponce, N. (2019), *Evaluating the California Health Interview Survey of the Future: Results from a Statewide Pilot of an Address-Based Sampling Mail Push-to-Web Data Collection*. Los Angeles, UCLA Center for Health Policy Research. Retrieved from [http://healthpolicy.ucla.edu/chis/design/Documents/CHIS%20Fall%202018%20ABS%20Web%20Pilot%20Report%20for%20DHCS%20\(July%202019\).pdf](http://healthpolicy.ucla.edu/chis/design/Documents/CHIS%20Fall%202018%20ABS%20Web%20Pilot%20Report%20for%20DHCS%20(July%202019).pdf)
- Wernimont J., Snowden R. (2015), “Integrated Management of Survey Modes,” Paper presented at the 2015 research conference of the Federal Committee on Statistical Methodology, Washington, DC.
- Westat. (2013), *Health Information National Trends Survey 4 (HINTS 4): Cycle 2 Methodology Report*. Rockville, MD: Westat.
- Williams D., Edwards S., Giambo P., Kena G. (2018), “Cost Effective Mail Survey Design,” Paper presented at the Federal Committee on Statistical Methodology Research and Policy Conference, Washington, DC.
- Ye C., Fulton J., Tourangeau R. (2011), “More Positive or More Extreme? A Meta-Analysis of Mode Differences in Response Choice,” *Public Opinion Quarterly*, 75(2), 349-365.
- Zuckerberg A., Mamedova S. (2012), “Speaking the Same Language: Effective Techniques for Reaching Spanish Speaking Households in a Mail Survey,” Paper presented at the 67th Annual Conference of the American Association for Public Opinion Research, Orlando, FL.

