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Mixed-Mode and Mixed-Device Surveys

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Introduction

Mixed-mode surveys are not new and can be traced back to the early 1960s. In a mixed-mode design, researchers combine multiple data collection methods to meet the challenges of single mode surveys and improve coverage of the intended population, to increase response rates, and to reduce survey costs. Examples of these early applications of mixed-mode designs include mail surveys with a telephone follow-up to increase (single mode) mail survey response at affordable costs and face-to-face and telephone mixes to compensate for undercoverage of telephone owners in single mode telephone interviews. Mixed-mode designs really increased in popularity with the advent of online survey data collection. Web surveys have now become one of the most prominent survey data collection methods in Europe and the USA. Web surveys and especially online panels are very cost effective, have a short turnover time, and combine the advantages of self-administration with computer technology. As a result data quality in well-designed online surveys is high, especially when sensitive questions are asked. However, some major disadvantages of single mode online research are undercoverage, as not everyone has Internet access, and high rates of nonresponse. To overcome these problems, and still enjoy the advantages of web surveys, a mixed-mode

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D.L. Vannette, J.A. Krosnick (eds.), *The Palgrave Handbook of Survey Research*, https://doi.org/10.1007/978-3-319-54395-6_8

approach with web surveys as one of the data collection methods in the mix is an attractive option (De Leeuw and Berzelak 2016; Tourangeau 2017).

While a mixed-mode approach may solve major coverage and nonresponse problems of online surveys, a new technological challenge is facing survey designers as mobile devices, such as, smartphones and tablets, are increasingly being used to access the Internet. Web surveys are now morphing from a computer-oriented (i.e., desktop or laptop PC) into a multi-device (i.e., PC, smartphone, and tablet)-oriented concept (Buskirk 2015; Couper et al. 2017). Many researchers doing web surveys do not necessarily think of themselves as doing mixed-device surveys and rarely account for the different types of devices that respondents are using when assessing survey errors. A mixed-device survey is not a mixed-mode survey in the traditional sense of the word. In a mixed-mode approach two disparate data collection methods (e.g., a self-administered online survey and an interviewer administered telephone survey) are combined. In a mixed-device survey, we have one overall data collection principle: a self-administered, computer-assisted (online) survey. However, respondents may choose to respond through a variety of devices. These devices not only widely vary in screen sizes, but also in data entry interface (e.g., keyboard and mouse, touchscreen, on screen keyboard), and the question arises whether or not answers obtained via smartphone and tablet are comparable to answers obtained from pc or laptop. Excluding mobile respondents may lead to serious coverage errors (see Peterson et al., 2017) and researchers should design optimal surveys to accommodate for different devices (e.g., Buskirk, 2015)

In the next sections, we first discuss the most common mixed-mode approaches and summarize the empirical findings on reducing coverage, nonresponse, and measurement error and the implications for design and analysis. We will then review the main issues in mixed-device surveys, again focusing on empirical knowledge and optimal design. We will end with recommendations and a research agenda for the future.

Mixed-Mode Surveys: Design and Implications

There are many forms of mixed-mode designs; researchers may mix contact strategies (e.g., a postal mail prenotification letter, potentially including an incentive for a web survey), or they may mix the actual data collection procedures (e.g., a web and a paper mail survey); for a detailed overview

see De Leeuw (2005). Here we will discuss mixed-mode design in its strictest sense: the use of multiple methods of data collection within a survey. Two main implementation strategies can be applied: concurrent and sequential mixed-mode surveys. In a concurrent mixed-mode design, two or more data collection methods are offered at the same time; for instance a web survey offered together with a paper mail survey or a telephone interview. The main reason for a concurrent mixed-mode approach is to overcome coverage problems and include those not on the Internet (e.g., elderly, lower educated). A special form of concurrent mixed-mode is encountered in international studies, as different countries have different survey traditions and a mixed-mode design across countries is the only practical solution. In many cases, standardization and restriction to a single mode of data collection may result in a sub-optimal design (e.g., poor sampling method) for some countries, which may even threaten comparability. A good example of the need for a mixed-mode approach across countries is the International Social Survey Program that started out as a single mode self-administered paper questionnaire, but when more countries joined in a mixed-mode design was implemented allowing face-to-face interviews for low literacy countries.

In a sequential mixed-mode survey, one data collection method is offered after another, in order to improve coverage and response. The most common sequential mixed-mode design starts with the least expensive mode (e.g., mail or web) and follows up with more expensive modes (telephone and/or face-to-face). A well-known example is the American Community Survey. In panel research, a different sequential approach is often used; there the most expensive interview mode is used first for the recruitment interviews or first panel wave to guarantee a high response for the baseline survey. Data for subsequent waves are then collected with a less expensive mode. This design has proved to be successful for the establishment of probability-based online panels. Since there are currently no sampling frames for the population of Internet users, a probability sample is drawn using a well-established sampling frame (e.g., of street addresses or postal delivery points) and an interview survey is used for recruitment to the online panel. A prime example is the pioneering work of the Dutch online Longitudinal Internet Studies for the Social Sciences (LISS) panel, where a probability sample of Dutch households was recruited using the face-to-face mode. To reduce coverage error, the LISS-panel offered a free Internet connection and a simple PC to those who had none.

A slightly different approach was used by the GESIS-Leibnitz Institute for the establishment of the German GESIS panel. Similar to the LISS-approach, a probability-based sample was recruited using face-to-face interviews; however, those without Internet were not offered an Internet connection, but in the next waves were surveyed using postal mail surveys, while those with Internet were surveyed online. In other words, after recruitment, the GESIS panel uses a concurrent online-paper-mail approach.

Whether or not mixing modes improves response rates depends on the type of design used. Sequential mixed-mode designs do work and switching to a second, or even third mode in a sequential mixed design has proven to increase response rates in studies of the general population as well as for special populations (De Leeuw and Berzelak 2016). However, a consecutive approach does not clearly increase response rates. While offering two modes and giving the respondents a choice has an intuitive appeal – it appears respondent friendly since respondents themselves can decide what is most suitable to them – it also increases the respondent burden. When presented with a mode choice, respondents have to make two decisions instead of one: not only whether or not to respond, but also through which mode if they do decide to participate. Furthermore, the choice dilemma may distract from the researchers' carefully formulated arguments on the importance and saliency of the survey (De Leeuw and Berzelak 2016). As a result, Tourangeau (2017) advises researchers not to offer respondents a choice and to prevent them from procrastinating with carefully scheduled multiple contacts, such as reminders or a sequential mixed-mode approach. From a cost perspective it pays to start with the most cost effective method and reserve more expensive modes for the follow-up. Regarding the improvement of coverage, empirical studies are scarce. In their review, De Leeuw and Berzelak (2016) conclude that different modes do bring in different types of respondents and do improve representativity.

Mixed-mode surveys may reduce coverage and nonresponse error, but what about measurement error? There has been a long tradition of empirical mode comparisons and they all point to small but systematic differences between interviewer-administered and self-administered surveys. These differences may influence the overall measurement error in a mixed-mode design. From a Total Survey Error perspective, researchers wish to reduce all survey errors, including measurement error. There are two general approaches to designing questionnaires for mixed-mode and mixed-device surveys. The first approach is the unified or unimode design, where the goal is to produce equivalent questionnaires in each mode. An example is using a series of yes/no questions in both online and telephone interviews, instead of

a yes/no format in telephone and a check-all-that-apply format online. The second approach is to try to optimize each mode independently in order to minimize overall measurement error; this approach could result in different question formats and implementation procedures for each mode. The latter approach is only desirable when one overall population estimate is needed and for factual questions only since attitudinal questions are more susceptible to question format effects (Tourangeau 2017). When the goal of the survey is the comparison of groups, researchers should try to minimize mode measurement effects by design and use equivalent questionnaires. This is extremely important in cross-national studies, where different modes are used in different countries, mixed-mode longitudinal studies, and multi-site studies (e.g., schools, hospitals). But also in cross-sectional studies subgroups are often compared and if certain subgroups are overrepresented in a certain mode or device use (e.g., younger more online and/or younger more mobile phones), nonequivalent questionnaires over mode or over device may threaten the validity of the comparisons.

Designing equivalent questionnaires does *not* mean regression to the lowest common denominator. De Leeuw and Berzelak (2016) summarize the design principles of Dillman and illustrate these with two examples. When self-administered and interview surveys are mixed, there are two mode-inherent differences: (1) availability of interviewer help and probes or not, and (2) the sequential offering of questions in an interview versus grouped questions (e.g., in a grid) in a self-administered form. De Leeuw et al. (2016) showed that it is possible to successfully emulate interviewer probes in an online survey and by doing this implement an interviewer procedure in an online self-administered questionnaire. The second example (sequential offering versus grid questions) is of importance for both mixed-mode and mixed-device studies. In online questionnaires, a set of similar questions or statements are often presented together in a matrix (grid) format. The advantages of grid questions are that the response format saves space, the questionnaire appears to be shorter, and respondent burden is relatively low because respondents do not generally have to click the next button as often. A main disadvantage is that respondents often do not pay as much attention to each question separately as they do when questions are offered sequentially and are more prone to satisficing behavior (e.g., straightlining). A new online question format, the so-called auto-advance or carrousel question, does present questions one-by-one as in an interview, but because of the auto-advance function there is no extra respondent burden. After the respondent has given an answer, the next question automatically appears on the screen, mimicking an interviewer-administered survey. Auto-advance questions have

proved themselves in online and online-interview mixes. This format may also be promising for mixed-device surveys as grid questions are burdensome on mobile phones. For a detailed description and examples, see De Leeuw and Berzelak (2016).

Careful expert design of multiple mode surveys improves quality and helps prevent unwanted mode-measurement effects (e.g., more do-not-know answers or missing data and less differentiation in online surveys). Still, the data may contain mode inherent measurement effects. Consequently, researchers should always try to estimate mode differences and, if these occur, adjust for mode measurement effects in the data. Several statistical methods for estimation and adjustment have been proposed and are still under development. For an introduction and overview, see Hox et al. (2017).

Mixed-Device Surveys

Mixed-device surveys are a unique sort of concurrent mixed-mode surveys since online surveys are being completed on a range of different devices that respondents can choose at their own convenience. It is important to distinguish between mobile phone, tablet, laptop, and desktop PC devices since they differ in several dimensions such as the size of the screen, technology features (e.g., processing power, connectivity, method of navigation), user characteristics, and context of use (Couper et al. 2017). Mobile penetration rates differ greatly per country. But simply possessing a mobile device does not necessarily mean that people use their mobile device for survey completion. For example, in 2013 in the Netherlands, the majority, about three out of four people, owned a mobile phone with Internet access. Only about 11 percent used their mobile device for survey completion in the Dutch LISS Panel (2 percent mobile phone and 9 percent tablet); similar rates are found for the GESIS-panel in Germany. However, with a clear invitation for mobile phone use and a mobile-friendly (optimized) design the percentage of mobile phone completion can increase to 57 percent (Toepoel and Lugtig 2014).

Survey software is increasingly adapting to the demands presented by mobile survey responding via implementations of responsive survey designs. The software detects the device being used to access the survey and optimizes the format accordingly. Browser-oriented online surveys can either use responsive design and be optimized for mobile devices or involve no optimization and be designed for completion on computers (with only the possibility of being completed on mobile devices without

optimization). Optimization for mobile devices can involve shorter question text, other types of response options (sliders, tiles), and formats (no grids). Most market research organizations have changed their format into a responsive (optimized) design. Other online surveys use apps. They need more action from the respondents since they have to be installed on the respondent's own device. The main advantage of mobile apps is that they give researchers more control over the design of the online surveys. However, separate versions of these apps must be designed for different platforms such as Android or iOS, and the respondents must be willing to download these apps.

Lynn and Kaminska (2013) propose a theoretical framework of ways in which mobile surveys may differ from computer-assisted web surveys, including issues such as multi-tasking, distraction, the presence of others, and differences inherent in the technology such as input mode (e.g., clicking on a PC versus touching on a mobile device). Empirical research on mixed-device surveys either uses a natural setting in which respondents can choose their own device for completing a survey spontaneously, or an experimental design in which respondents are assigned to use a particular device. Some find differences between mobile phone, tablet, and regular desktop PC respondents including longer survey completion times, lower unit and higher partial and item nonresponse rates, shorter open responses and different personal characteristics for mobile responses compared to the other devices, while others find no differences between devices. In general, response rates for mobile online surveys are lower than for PC and there is evidence for a higher mobile break-off rate. Furthermore, surveys take longer to complete on mobile devices both for optimized and nonoptimized mobile surveys. Positive is that there is little evidence for lower data quality in mobile surveys. For a detailed summative review of research on mixed devices, see Couper et al. (2017). Also the cognitive processing between PC-administered web surveys and mobile web surveys appears to be similar. Lugtig and Toepoel (2015) demonstrate by using consecutive waves of a panel that measurement errors do not change with a switch in device within respondents.

The main differences between mobile and PC surveys lie in the way the survey invitation can be send (text versus e-mail), survey length, question format, and the possibility of measuring without asking questions. Text is faster for mobile and designed survey length is ideally shorter for mobile phone completion. Grids or matrix questions should be eliminated since they are too difficult to render in an equivalent manner on small screens and larger screens. Tiles, in which entire areas of question text are clickable are preferable for mobile phones since they give more area to tap in comparison with

traditional (online survey) radio buttons. In addition, passive data collection offers new opportunities for mobile devices.

Mobile data can be collected from respondents while they are on the go as well as passively collected data. Examples of passively collected data include user agent strings, biomarkers, and GPS coordinates. While passive data collection still requires initial permission from the respondents, they are generally collected without the respondent having to provide direct answers to survey questions (Buskirk 2015). This passive data collection not only reduces respondent burden, but can also reduce measurement error since they are collected on the spot and are less susceptible to recall and estimation bias.

Future Research

Society and technology are continuously changing and our data collection methods are changing accordingly. Online surveys were pioneered at the beginning of the twenty-first century; probability-based online panels started in 2007 and are now established in both Europe and the USA. Mixed-mode surveys and mixed-device surveys show promise to answer the challenges of single mode surveys and improve response and data quality at affordable cost. However, combining several modes or devices in one survey also has implications for questionnaire design and analysis and we have summarized the challenges and best practices previously from a Total Survey Error perspective. It is evident that more research is still necessary. As suggested by Buskirk (2015), to further understand survey errors in both mixed-mode and mixed-device surveys, we need experiments that compare question formats both within and across modes and devices to understand mode effects. Researchers should focus on disentangling effects that are associated with self-selection, question design, and mode/device inherent factors. Future research should emphasize the minimization of measurement error across modes and devices. Research on adjustment for measurement error is still under development and at present need detailed auxiliary data and complex statistics. Further research in this field is of great importance (see also, Tourangeau 2017; Hox et al. 2017).

The mobile society also has consequences for attention span, multitasking, and changing societal patterns. Respondents do not want to spend a lot of their precious free time on surveys; furthermore mobile devices are typically used for short messaging. As a consequence, the optimal survey duration might be shorter for mobile surveys. Short surveys, or if this is

not possible, multiple measures using data chunking, in which a questionnaire is divided and administered in several smaller parts, may help to increase response rates for online, mixed, and mobile surveys. How this affects data quality is a matter of further investigation.

Finally, we have entered the world of big data and passive measurement (see Callegaro and Yang and Lessof and Sturgis, this volume). Sometimes respondents are aware of this, as they are requested to download specific apps. Many respondents still refuse to take part in these measurements and are, for instance, concerned about privacy issues; how to overcome their reluctance is of great importance. Often big data are harvested without the active awareness of respondents. Both forms involve privacy concerns that should be addressed. Finally, harvested big data are usually not collected with a primary research question in mind. How to address the validity of big data studies, what are the lacks in the obtained information, and how to decide and design for additional surveys are high on the research agenda.

Areas for future research:

- Experiments into optimizing question formats and reduce measurement error across modes and devices
- Disentangling (self) selection and measurement effects in mixed-mode and mixed-device studies
- Further development of adjustment method in general
- Development of adjustment methods that are applicable in daily survey practice
- Applicability and consequences of implementing short surveys, segmented surveys, and data chunking
- Investigating the use of apps and sensors (GPS, health) to reduce the number of questions being asked in a survey

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