GenPopWeb2: Strategies to improve response rates in probability-based online surveys: A Systematic literature review

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1. Introduction

During the past decades, web has become the most common mode of data collection in surveys (Macer and Wilson, 2014). Although most of this increase can be attributed to nonprobability surveys (Callegaro et al., 2014), there has also been an increasing interest on probability-based online surveys for the general population (e.g. Blom et al., 2016; Bosnjak et al., 2018; De Vos, 2010; Revilla, Cornilleau, Cousteaux, Legleye, and de Pedraza, 2016). Probability-based online surveys can be defined as surveys which use a web mode to administer the questionnaire to sampled participants selected using a probability-based sampling approach.

Although probability-based online surveys allow conducting interviews cost-effectively, (Greenlaw and Brown-Welty, 2009; Hardigan, Succar, and Fleisher, 2012) and can help increase the measurement quality of the data collected (Kreuter, Presser, and Tourangeau, 2008), response rates to probability-based online surveys have been found to be lower than for other modes (11 percentage points lower: Manfreda, Bosnjak, Berzelak, Haas, and Vehovar, 2008; 12 percentage points lower: Daikeler, Bošnjak, and Lozar Manfreda, 2020). Different factors can explain why response rates are lower for probability-based online surveys than for their offline counterparts. For instance, the presence of an interviewer which makes the first contact with sample members may stimulate survey participation, while – if the survey invitation link is included in a paper based mailed communication – the additional burden on respondents to go online and accessing the questionnaire might discourage participation.

Nonresponse in probability based online surveys can pose threat to data quality: first, the reduction in sample size associated with non-response reduces the precision of survey estimates, second, if respondents and non-respondents are different on the concept of interest, estimates will be biased (Groves, Dillman, Eltinge, and Little, 2001). Although high nonresponse rates are not necessarily associated with selection bias (Groves and Peytcheva, 2008; Lugtig, Struminskaya, Dickson, van Kessel, van Henneveldt, Timmers, Groves, and Peytcheva, 2023), recent research (Felderer, Kirchner, and Kreuter, 2019) found nonresponse bias to be higher for a probability-based online survey than for a telephone survey.

As a matter of fact, researchers have been studying different strategies to increase response rates and minimise response bias. For instance, experimentation has been conducted on the provision of monetary incentives (e.g. Peycheva et al. 2023), on the timing and frequency of reminders (e.g. Lynn, Bianchi, and Gaia, 2023) and on the format of invitation letters (e.g. Kaplowitz, Lupi, Couper, and Thorp, 2012) to improve response rates and

representativeness in web surveys. In this context, it is key to improve our understanding of which strategies reduce nonresponse and nonresponse bias, and the best approaches to implement them.

Hence, in this working paper we conduct a systematic literature review in order to: 1) classify the different strategies available to maximise response rate and minimise bias and describe the characteristics of each strategy; and 2) assess existing evidence regarding the impact of each strategy on nonresponse and selection bias. Consequently, we aim at providing guidance to better understand available strategies and their effect on response rates and selection bias.

The remainder of this report is organized in the following way: first, we present the methodology used. Second, we discuss the results of the literature review, comparing the results found for the different strategies. Finally, we discuss the practical implications of this review, and recommend ways in which researchers can use the evidence emerged by this review to improve response rates when conducting research with probability-based online surveys.

2. Methodological procedure

To conduct this systematic literature review we explored existing evidence on approaches to maximize participation in probability-based online surveys. As a starting point, we defined our inclusion strategies with reference to: 1) probability-based online surveys, 2) participation rates and 3) strategies to increase participation rates.

First, although the focus of this report is on general population surveys, considering the little evidence available to date, we expanded our remit to include also evidence from other populations (i.e. students, members of professional groups, etc.)[1] and from mixed-mode[2] surveys. Hence, we searched evidence related to push-to-web surveys, list-based online surveys, probability-based online panels and mixed-mode surveys with an Internet component.

[1] For instance, we included studies focusing on specific populations when an exhaustive list of all units was available (e.g.like students, consumers or members of professional groups), as long as probability-based methods were used to sample them or the whole list was invited to participate in the survey (see Online Appendix A for a report of this).

[2] We considered results from mixed-modes surveys with an online component when the possibility to participate offline was provided: 1) to offliners (e.g. American Trends Panel), 2) to offliners and as an option for nonrespondents in mainly online panels (e.g. NatCen panel) or 3) for offline longitudinal studies transitioning part of their panel members to web interviewing (e.g. Understanding Society).

Second, in terms of participation rates, we considered studies testing how to increase definitions 1 and 2 of response rates presented in the 2016 AAPOR's standard definitions (Smith et al., 2016). Following these definitions, respondents are considered as either those who completed, or partially completed, the survey. However, specifically for probability-based panels, sampled units might also count as nonrespondents if they either: 1) are not recruited to the panel, 2) do not complete the initial profiling/welcome survey, 3) do not participate in a given survey wave or 4) abandon the panel at some point. Hence, we also considered studies focusing on how to increase recruitment rates, participation rates to profiling/welcome surveys, and response rates in specific survey waves, as well as approaches to reduce attrition.

Finally, regarding the explored strategies to increase response rates, we made the following considerations; first, online survey nonresponse can be generally conceptualized as the product of four different components: a) *sampled units are not contacted* (e.g. they do not receive the invitation or do not read it), b) *they refuse to cooperate* (see Keusch, 2015 for an overview of the different theories behind survey refusal), c) *they do not take action to participate* (e.g. find a device connected to the Internet, log into the survey URL, type in the credentials if necessary, and, finally, participate) and d) *they are unable to participate* (e.g. language barriers, disabilities or health conditions might impede participation even from sample members who are contacted and willing to participate). Hence, we explored strategies to: improve the likelihood of individuals to be contacted, reduce the tendency to refuse to participate, increase the willingness to take action, and/or improve surveys accessibility to different population subgroups.

Second, we only considered those strategies which could be implemented without changing the intrinsic nature of the survey. Hence, we excluded strategies which would require changing survey topic, data collection mode, questionnaire length or question wording. Consequently, following previous research (e.g. Keusch, 2015), we divided the strategies in three broad categories: 1) contacting sample members, 2) offering incentives and 3) delivering the survey. Nonetheless, each broad category is composed by different types of strategies (e.g. different types of contacts or incentives), which at the same time can vary in their characteristics (e.g. content of the contacts or size of incentives). Hence, we also looked for evidence on how, within each category, results vary across strategy types and their characteristics. Figure 1 visually summarizes the different categories and types of strategies explored, as well as their characteristics.

Following these specifications, we searched for evidence in four major electronic reference databases: Scholar, WebSM, JSTOR and Web of Science. Appendix A reports the

specific search terms used, drawing from a recent literature review by Daikeler et al. (2020). In addition, we adopted a snowballing technique staring from the reference lists of selected publications – i.e. two influential literature reviews: Fan and Yan (2010) and Keusch (2015). To avoid incurring in "publication bias" we extended our search to unpublished and non-peer-reviewed research (e.g. reports, presentations) obtained through contacts of the GenPopWeb2 network[3].

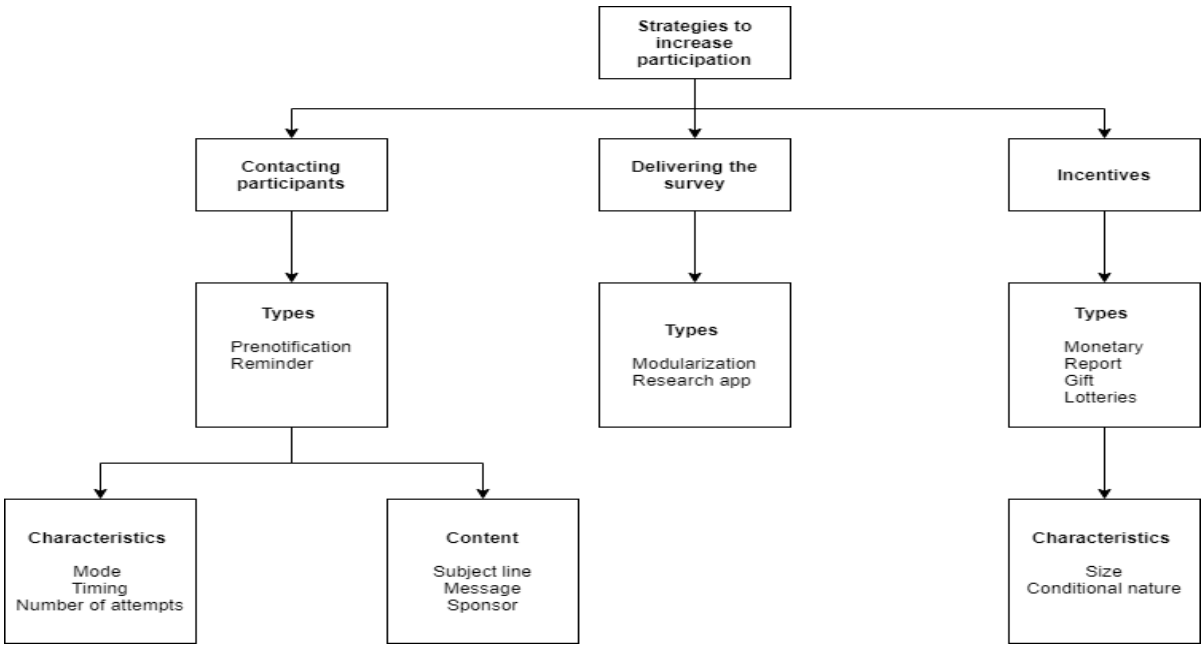

Figure 1. Strategies to increase survey participation explored.

3. The findings from the literature review

Based on an exhaustive search of published as well as unpublished research. 354 publications were identified and reviewed for inclusion (275 from database searching, 79 from other sources). Among those, 103 have been used. The online Appendix A provides a list of search terms adopted to identify the literature. with descriptive statistics on the literature included in this systematic review. Appendix B provides descriptive statistics on the literature included in this systematic review.

[3] https://www.ncrm.ac.uk/research/genpopweb2/

3.1. Contacting sampled units

Contacting sampled units to participate into the survey (or join the panel) is a crucial part of the survey process, regardless of the survey mode of data collection. For online surveys, contacting individuals serves at least three purposes: 1) letting them know that they have been selected to participate in a survey, 2) giving information about the survey, and 3) providing access to the URL or App in which the questionnaire is stored or hosted and information on how to access it. Contact strategies, nonetheless, can vary in three main dimensions. First, they may vary in the type of contacts. Apart from the necessary invitation to participate, researchers can also include extra contact attempts, either before (pre-notifications) or after (reminders) the survey invitation. Second, the contacts can present different characteristics. For instance, contacts can vary in number, mode used to send them, and even in the points in time and frequencies with which they are sent. Finally, the content of the contacts can vary highly too. For example, different subject lines, messages (communication style, topics covered, or length) or language used in the communication can be used to communicate with participants.

These different decisions on how to contact individuals can impact response rates. Better understanding of which decisions improve these rates – and which ones do not – would allow researchers design better contact strategies.

3.1.1. Types of contacts

Prenotification/advance letters. Before contacting sample members to ask them to answer a questionnaire online or to join an internet panel, advanced letters can be used to let sampled members know that they will be invited to answer a survey, and in some cases to introduce the study. Regardless of the characteristic and content of the prenotification, these has been found to increase response rates — both in the general population: Bandilla, Couper, and Kaczmirek, 2012; Rao, Kaminska, and McCutcheon, 2010; as well as in other subgroups: Dykema, Stevenson, Klein, Kim, and Day, 2012; Kaplowitz, Lupi, Couper, and Thorp, 2012; Keusch, 2012; Trouteaud, 2004; Wiley, Han, Albaum, and Thirkell, 2009. Nonetheless, these results are not universal, with a recent study (on the general population) finding no significant impact on response rates of sending a pre-notification (Ipsos MORI, 2018).

Reminders. Sampled units might not be able or willing to participate immediately when they receive the first invitation asking them to participate in the survey, or they might never even open and/or read the invitation. After that, sampled units might forget or actively avoid complying with the survey request. Reminders, as their name suggest, serve to remind and

persuade sampled units to answer the survey after the first invitations has already been sent. As for pre-notifications, regardless of the characteristics and content of the reminders, there is evidence of their effectiveness in increasing response rates — both in the general population (Carpenter and Burton, 2018; Jessop, Wood, and Marshall, 2016; Martinsson and Riedel, 2015; Rao et al., 2010) as well as in specific subgroups (Keusch, 2012; Sauermann and Roach, 2013; Wiley et al., 2009), although this is not a general finding (for example, this evidence was not confirmed in a study of nurse practitioners, i.e. Hart, Brennan, Sym, and Larson, 2008). In addition, some evidence, with respect to the general population, points out that reminders increase sample representativeness, even after several survey waves (Martinsson and Riedel, 2015).

3.1.2. Characteristics of the contacts

Mode of contact. Although online surveys are answered online, sampled units can be contacted through different modes. Sometimes the available contacting modes are limited by the sampling frame used, but in other cases researchers have some degree of agency when deciding through which modes to contact individuals. Each mode presents its own benefits and drawbacks. For instance, mail contacts can be overlooked and not even opened, telephone ones can be missed depending on the time of day or the characteristics of the participant (or may be re-directed if sample members set up filters to avoid phone calls from unknown numbers),and e-mail contacts, because of their volume and of spam filters, are more likely to be unintentionally overlooked or missed (Petrovčič, Petrič, and Lozar Manfreda, 2016).

In terms of prenotifications, some studies of specific population subgroups have found a positive effect of e-mail prenotification on participation rates (Keusch, 2012; Trouteaud, 2004; Wiley et al., 2009), while others have found no effect (e.g. a study on nurse practitioners, by Hart, Brennan, Sym, and Larson, 2009). Mail prenotifications, on the other hand, have consistently shown to increase response rates – both in the general population (Bandilla et al., 2012) as well as in specific population subgroups (Dykema, Stevenson, Klein, Kim, and Day, 2013; Kaplowitz, Hadlock, and Levine, 2004). Comparing modes, Porter and Whitcomb (2007), in a study on prospective students and graduates, found no difference on response rates between postal and e-mail prenotifications.

With respect to invitations, previous research has compared the effect of different modes on response rates. First, some scholars have compared postal invitations and e-mail invitations, finding mixed results. Specifically, some authors – i.e. Dykema et al. (2013) in a study of faculty members and Sakshaug, Vicari, and Couper (2019) in a study of establishments, found

the former to yield to higher response rates, while others – i.e. Hardigan, Popovici, and Carvajal (2016) in a study of practicing pharmacists, Kaplowitz et al. (2004) in a study of students, and Tai et al., 2018 in a study on healthcare workers – have found the latter to significantly increasing response rates, while, others found no difference (Millar and Dillman, 2011, in a study on students).

Second, comparing e-mail and SMS invitations, De Bruijne and Wijnant (CentERpanel: 2014) found that response rates were not significantly different between participants invited through text messages (SMS) and e-mail, while Toepoel and Lugtig (2018) found that inviting participants though SMS, apart from the usual e-mail invitation, did not affect response rates.

Third, Rao and colleagues (2010) compared sending invitations through mail *versus* using telephone calls, finding that the mail-out approach achieved a significantly higher recruitment rate. Finally, Scherpenzeel and Toepoel (2012), found no significant difference in recruitment rates between those contacted by telephone and those contacted by face-to-face.

In terms of reminders, some research has also compared the effect on response rates of different modes by which reminders are sent. Comparing postal and e-mail reminders, the available research has identified no difference between modes – in studies of students (Porter and Whitcomb,2007) and of physicians (Cook et al., 2016). In addition, Neal, Neal, and Piteo (2020), in a study on principals, found that, compared to only sending an e-mail reminder, a telephone follow-up reminding sampled units to participate increased their likelihood to take part in the study by more than three times. Without comparing with other modes, Cernat and Lynn (2018) found no significant effect of adding an e-mail reminder. Nonetheless, Sakshaug et al. (2019) noted that reminders can have different impacts depending on the initial mode used for the invitation. Authors discovered that using a paper mode for the invitation and a paper mode for the reminder achieved the highest response rates (20.34%), followed for an e-mail invitation and a paper reminder (18.20%). On the other hand, a paper invitation followed by an e-mail reminder (12.76%) and, specially, an e-mail invitation followed by an e-mail (6.43%) reminder yielded lower response rates. Authors also found that the increased response rates were also associated with lower nonresponse bias.

Timing. Contacts can be made at different days within the week and hours within the day (e.g. Monday morning, Wednesday afternoon), as well as at different frequencies (e.g. every day, every week). Previous research has investigated how the point in time and the frequency of the contact attempts affects response rates.

In terms of invitations, there is no consensus on the best timing to contact sample members (for a recent discussion see Lynn, Bianchi, Gaia, 2023). Specifically, in a study on researchers, Sauermann and Roach (2013) found that units are less likely to respond the same day if invitations are sent during weekends, but overall response rates do not vary across days; similarly Culinane and Nicolaas (2013) found no effect on response rates of varying the day of invitation (Monday *versus* Friday). Other research, nonetheless, has shown that Wednesday (mornings) (Faught, Written, and Green, 2004; Ipsos MORI, 2018; Lindgren et al., 2020) or Tuesday mornings (Lewis and Hess, 2017) yield the highest response rates. However, one study finds that while higher response rates at the end of fieldwork were obtained with an invitation sent on a Friday (*vs.* Monday or Wednesday), a higher number of reminder were needed to achieve the final level of cooperation (Bennett-Harper et al. 2007); also, one study found that the differences in prompt participation (i.e. participation within 24 hours from invitation) are eroded as fieldwork proceeds (Lindgren et al. 2020).

Given that the day of mailing may influence also the day in which reminders are sent, researchers have recently analysed the timing of the two (invitation and reminders) combined; indeed, Lynn, Bianchi and Gaia (2023) found that sample members who are contacted by email, in addition to postal letter, are more likely to participate if invited on Monday (with email reminders on Wednesday and Friday) than on a Friday (with email reminders on Sunday and Tuesday) as differences in participation is observed only after reminders were sent, the authors argue that the higher participation might be driven by the timing of reminders (towards the end of the week) rather than by the timing of the initial invitation; however, this analysis is limited to a particular subsample, composed of the 1/3 of sample members who provided an email address among their contact details (and, thus, might be either more familiar with Information Communication Technologies than the average respondent or more committed to the study to provide additional contact details).

Considering the hour of the day, Sauermann and Roach (2013) and Maineri and Van Mol (2021) found no difference on response rates depending on the hour of the day in which invitations where sent.

Lindgren et al. (2020) find that higher participation is observed if respondents are invited in their preferred day of participation, while Bianchi, Lynn and Gaia (2023) did not find a significant effect of matching the day of invitation to the date when panel members usually participate in the survey.

For reminders, Herzing, Vandenplas, and Axenfeld (2019), using information from 21 waves of the German Internet Panel (GIP), shown that reminders are more effective if sent on

Monday, while Lewis and Hass (2017) found that Tuesday mornings yield the highest response rates.

Apart from the day and hour, the time interval between contacts might also have an impact on response rates. Evidence is, however, mixed. Some researchers (analysing specific population subgroups) have found that the interval and frequency between reminders does not have a significant impact on response rates (Sauermann and Roach, 2013; Maineri and Van Mol, 2021). Conversely, Blumenberg and collegaues,(2019), on the 22 year follow up of the Pelotas Birth Cohort, 1993,indicated that a delay of 15 days versus a delay of 30 days yielded higher response rates, while evidence from the Gender and Generation Programme (Emery et al., 2020) found that sending two reminders in a one-week interval produced a significantly higher increase of response rates and a lower selection bias than sending reminders in a two-week time interval.

Number of attempts. Specifically for reminders, another aspect to take into consideration is the number of reminders to be sent. Most evidence (both from the general population as well as for specific subsamples) seems to point out that, while more reminders increase response rates, their impact is marginally lower at each subsequent attempt (Herzing et al., 2019; Aerny-Perreten, Domínguez-Berjón, Esteban-Vasallo, and García-Riolobos, 2015; Funkhouser et al., 2017; Van Mol, 2017). Conversely, other evidence (from the general population) suggests that no significant effects should be expected after the first reminder (Ipsos MORI, 2018a; Kantar Public, 2018). Regarding the impact of extra reminders on non-response bias, Van Mol (2017), in a study on students, found that extra reminders had no effect on sample composition, while Aerny-Perreten et al. (2015), in a research on doctors, found that reminders contributed to diversify the sample composition.

3.1.3. Content of the contacts

Subject line / envelop design. The subject line of email seems to have little impact on response rates. While Porter and Whitcomb, 2005 found that referencing the survey in the subject email has no effect, others found that it reduced response rates (Edwards et al., 2009) and others that it increases response rates (Zhang, Lonn, and Teasley, 2017). Similarly, some studies found that appealing for help do not increase response rates (Mavletova, Deviatko, and Maloshonok, 2014; Porter and Whitcomb, 2005) while Trouteaud (2004) found the opposite. Finally, mentioning an authority figure to request to participate (Kaplowitz et al., 2012) significantly increase response rates, while mentioning the sponsor (Maineri and Van Mol, 2021; Porter and

Whitcomb, 2005), the incentive (Linegang and Moroney, 2012), or leaving the subject line blank (Sappleton and Lourenço, 2016) has no significant effect on response rates. For mail invitations, Messer and Dillman (2011), in a survey of the population of Washington, found no effect of using priority mail. Similarly, Yan, Kalla, and Broockman (2018), using 12 different surveys (city, state and nationwide), shown no significant effect of applying a stamp outside the envelop instead of a postage meter printout. Furthermore, Ipsos MORI (2018), for the general population in the UK, explored the effect of the colour of the envelope containing the invitation, pre-notification and reminder letters, in an attempt to increase online responses. Although brown envelops shown higher response rates, differences were not statistically significant. Authors also explored personalizing the design of the envelops for Wales and Scotland, adding specific slogans in the envelop but no significant impact was found.

Message. The information comprised in the advanced letters, invitations, and reminders, as well as the way in which the information is presented, can affect the willingness of individuals to participate and complete the survey. Indeed, writing invitation letters imply taking various decisions which influence sample member's response propensities.

First, messages can be personalised, for instance, addressing units by their name. While several studies found that personalization increase response rates (Heerwegh, 2005; Heerwegh and Loosveldt, 2007; Joinson, Woodley, and Reips, 2007; Sauermann and Roach, 2013) others have found no effect (Joinson et al., 2007; Porter and Whitcomb, 2003; Trespalacios and Perkins, 2016; Wiley et al., 2009).

Second, the content of the message can be written in different ways, which could incite units to participate. Researchers found that response rates are significantly higher if the topic of the survey is described in the invitation letter in ways that could be perceived as highly salient to potential participants, instead of in a more general way (Marcus, Bosnjak, Lindner, Pilischenko, and Schütz, 2007), as well as if the survey includes pleading for help (Petrovčič et al., 2016), or if the invitation e-mails are signed mails showing the authority of the sender (Joinson and Reips, 2007; Joinson et al., 2007; Sutherland, Amar, and Laughon, 2013) and sample members are reminded that they will be contacted several times if they do not answer (Klofstad, Boulianne, and Basson, 2007). Conversely, remarking the authority of the sender or a sense of community did not increase response rates, as well as using persuasive concepts have been found to have no significant effect (Petrovčič et al., 2016; Scherpenzeel and Toepoel, 2012). Moreover, Yan, Kalla and Broockman (2018), using 12 different surveys (city, state and nationwide), found that framing surveys in a local manner by changing the survey name

emphasizing the respondent's city instead of the region, as well as changing the URL to show the city's name instead of the state's name, yields small but significantly positive effects on survey response. Similarly, Huskinson, Pantelidou, and Pickering (2019), found that adding in the invitation a leaflet describing various policies for families and children that had been influenced by the survey had no significant impact.

Third, researchers have also tried to manipulate the logistical and practical information included in the message. Nonetheless, presenting the deadline for participation (Edwards et al. 2009; Porter and Whitcomb, 2003; Maineri and Van Mol, 2021), varying the length of the message (Kaplowitz et al. 2012; Klofstad et al. 2008; Mavletova et al. 2014) or telling participants in the reminders about 1) the average time taken by participants that had already responded, 2) the number of respondents that had already responded and 3) a combination of both information (Van Mol, 2017), show rather inconclusive results.

Finally, the information provided on how to access/log in to the survey can be presented in different ways. Kaplowitz et al. (2012) found that showing the URL at the bottom of the e-mail instead than on the top increases response rates. Lugtig, Toepoel, Haan, Zandvliet, and Kranenburg (2019) found that replacing the icon of the PC shown next to the URL included in the invitation letter with a mobile phone, as well as to include an additional sentence below the URL that stated that the survey was easy to complete on PCs, tablets, or mobile phones, had no significant effect on response rates. In addition, Lugtig and Luiten (2021) found that including a QR code in the invitation did not significantly increase response rates, while Asensio, Roberts, and Herzing (2021) found a reduction of response rates but a slight improvement of the representativeness of the sample. Specifically for mail contacts, Messer and Dillman (2011), in a survey of the population of Washington, found that including a web card to the invitation mail explaining how to access the web questionnaire did not increase response rates.

Language. The language in which participants are addressed both in the envelop/subject line and in the invitation message, might affect the probability to open the mail/e-mail and participate both of those for whom the language of the survey is not mother tongue as well as of native speakers. Wells et al. (2019), using an experiment embedded within the pilot for the California Health Interview Survey (CHIS), explored the effect on response rates of contacting high-density Latino communities with a bilingual Spanish/English population with an envelope and an invitation letter in both languages. They found that those mailed in Spanish presented a 5.2% percentage points higher response rate than those mailed in English. However, this difference was not statistically significant, most likely due to the small sample size.

Conversely, Maineri and Van Mol (2021) found that presenting the subject line in both Dutch and English to a sample of students yielded significantly lower response rates than only presenting the subject line in Dutch.

Sender/sponsor. Although the project's sponsor cannot be modified in order to improve response rates, the decision on whether to highlight the sponsor in the invitation or message, or from which address to send the invitations is, to some extent, under the researcher's control. The sender or the sponsor can have an impact on the trust and proximity that sampled units feel when deciding whether to accept being contacted and when they decide whether to cooperate or not. Therefore, it important to understand the impact on response rates depending on the type of sponsor.

Previous research, conducted on samples of students, has found that, for e-mail invitations, the relationship with the sender (Porter and Whitcomb, 2007), the trust in the sponsor (Fang, Shao, and Lan, 2009) and the reputation of the sponsor (Fang, Wen, and Pavur, 2012) can increase response rates. For academic surveys, Wiley et al. (2009) found no influence of the sponsor or sender's affiliation with a university on response rates. Edwards, Dillman, and Smyth (2014), using two surveys of the general population of Washington and Nebraska, found that when the survey was sponsored by an in-state university compared to an out-state university, response rates were significantly higher. Nevertheless, no clear impact on nonresponse bias was found. On the other hand, Boulianne, Klofstad, and Basson (2011) found that when it was clearly stated that the survey was sponsored by the Transportation Department instead of the research centre, response rates significantly increased.

In addition, the characteristics of the sender beyond their affiliation can also influence response rates. A study on IT managers found that male respondents have a higher probability to participate if the sender is a female (Keusch, 2012).

3.2. Incentives

Incentives can be considered as a benefit given to an individual in order to nudge him or her towards a desired behaviour: in this case, participating in the survey (Krieger, 2018). Within the survey research literature, incentives normally refer to both material and non-material rewards, which range from money to gifts, access to lottery draws, feedback relevant to the respondent (e.g. health information) or reports on the study's results. Incentives have the potential of increasing the perceived benefit of participating in the survey, and to activate the norm of reciprocity: sampled units can perceive an increase benefit in participating, as well as

feel inclined to reciprocate the gesture by participating (Laguilles, Williams, and Saunders, 2011). Although much research has been conducted about the effectiveness of incentives on offline contexts (see Singer and Ye, 2013 for an extensive review), some questions remained unanswered in the context of web surveys. First, considering that incentives can be presented in the form of gifts, reports, money or even participation to lotteries, is there a variation in the effectiveness of incentives depending on their type? And if yes, which incentive type works best?

Second, as incentives can vary widely in size (e.g. amount of monetary incentive given), timing (i.e. when they are offered/announced) and on their conditional/unconditional nature (i.e. whether their offers is/is not conditional on survey participation), what characteristics should incentives have? The decision making process about these characteristics imply an assessment of the expected reduction of nonresponse rates and bias and consideration of different trade-off (e.g. to what extent increases in incentive size are worth given the expected increase in response rates/reduction in response bias).

3.2.1. Types of incentives

Monetary. We conceptualize monetary incentives as both cash and gift cards (e.g. Amazon gift cards), which allow individuals' to decide how to spend the provided incentive. For probability-based online surveys, there is the consensus that monetary incentives are an effective strategy to increase response rates. Regardless of the size of the incentive or whether it is conditional or unconditional, research has found a positive impact on response rates on offering monetary incentives, both in the general population (Emery et al., 2020; Huskinson et al., 2019; Jessop et al., 2016; Kantar Public, 2018; Krieger, 2018; Lipps and Pekari, 2016; Messer and Dillman, 2011; Rao et al., 2010) as well as in specific population subgroups/cohorts (Brown et al., 2016; Dykema et al., 2013; Guo, Kopec, Cibere, Li, and Goldsmith, 2016; Millar and Dillman, 2011b; Parsons and Manierre, 2014), with, to the best of our knowledge, only one exception (Wilson et al., 2010).

In terms of representativeness, there is no consensus in whether monetary incentives reduce nonresponse bias. Some have found no reduction on nonresponse bias (Emery et al., 2020) or effect on sample composition (Krieger, 2018). Others have shown, nonetheless, that the inclusion of monetary incentives brought the sample sociodemographic characteristics closer in line with the results of an equivalent face-to-face survey (Huskinson et al., 2019; Jessop et al., 2016) or administrative/census data (Lipps and Pekari, 2016); however, in a study on

students, Parsons and Manierre (2014), have found incentives exacerbating the overrepresentation of some subpopulations, like women.

Report of study. Sampled units can also be incentivized to participate by being offered to receive a report of the results and outcomes of the study. Nonetheless, for populations with exhaustive lists of all units, it has been found that, in general, offering a summary report of the results has no effect on both response rates and bias (Marcus et al., 2007; Sax, Gilmartin, and Bryant, 2003). Nevertheless, in a meta-analysis on medical online survey that offered their survey results, Edwards et al. (2009) found an increase in the probability of participating.

Gifts. We consider as gifts any material object or voucher that would allow respondents to obtain an object they might desire, and which can incentivise sampled units to participate. For instance, gifts could include pencils or tote bags, but also vouchers to buy goods. Different gifts have been used as incentives to increase response rates. For populations where an exhaustive lists of all units is available, there is ample evidence that gifts increase response rates (Cobanoglu and Cobanoglu, 2003; Laguilles et al., 2011;Mccree-Hale, De, Cruz, Ann, and Montgomery, 2010; Cook et al., 2016; Young et al., 2015; Huskinson et al., 2019; Magro, Prybutok, and Ryan, 2015).

Examples of gifts have span from: luggage tag, key chain, mini calculators (Cobanoglu and Cobanoglu, 2003; Laguilles et al., 2011), iTunes songs (Mccree-Hale, De, Cruz, Ann, and Montgomery, 2010), books (Cook et al., 2016; Young et al., 2015), tote bag (Huskinson et al., 2019; Ipsos MORI, 2018b), chocolate bar vouchers (Virtanen and Saari, 2019) and extra student credits (Magro, Prybutok, and Ryan, 2015).

Lotteries. Surveys have also explored the possibility of giving respondents lottery tickets as incentives. In this case, the incentive is offering respondents the possibility to participate in a lottery (i.e. a chance to win), rather than the actual monetary or nonmonetary (lottery of products) incentive, which is uncertain. For populations for which an exhaustive lists of all units is available, in most cases, lotteries have been found to increase response rates, regardless of whether money or products are being offered as lottery prizes (Bosnjak and Tuten, 2003; Doerfling, Kopec, Liang, and Esdaile, 2010; Dykema, Stevenson, Day, Sellers, and Bonham, 2011; Heerwegh, 2006; Laguilles et al., 2011; Wiley et al., 2009). Similarly, two studies of the general population in Scandinavian countries (Sweden and Norway) showed that the offer of participating to a lottery at the recruitment stage increase recruitment rates (Martinsson and Riedel, 2015; Hogestol and Skjervheim, 2013). Nonetheless, some authors have found little or

no significant impact of lottery prizes on response rates (Marcus et al., 2007; Porter and Whitcomb, 2003) and lower response rates than monetary incentives (Gajic, Cameron, and Hurley, 2011; Larose and Tsai, 2014). Furthermore, there is evidence that the effect of lotteries depends on the size of the prize and the chances of winning (Sauermann and Roach, 2013). In addition, Guo, Kopec, Cibere, Li, and Goldsmith (general: 2016) found that an instant lottery i.e. a lottery in which participants are informed of the outcome upon survey completion, also significantly increased response rates. In terms of nonresponse bias, Martinsson and Riedel (2015) found that lotteries improve the representativeness of the sample, although this effect faded after the first wave since hard to recruit panellists still presented a higher likelihood of attrition, while Laguilles et al. (2011) found that, for some of the prizes offered, biases were exacerbated (e.g. the offer of dining gift cards exacerbated overrepresentation of females).

3.2.2. Characteristics of the incentives

Incentive size. Incentives' sizes can vary substantially, going from small quantities (e.g. 1£) to very high ones (e.g. 50£ or more). It is important for researchers to understand if larger incentives will produce higher response rates (and lower selection bias) at a constant rate, or if marginal effects decrease substantially after a certain point. Although some researchers have found similar effects across incentive sizes (Scherpenzeel and Toepoel2012; Boulianne, 2013; Kypri and Gallagher, 2003) most research has found that higher incentives yield higher response rates (Emery et al., 2020; Hamlyn, Fitzpatrick, and Williams, 2015; Jäckle, Lynn, and Burton, 2015; Mcgonagle and Freedman, 2017; Schaurer, 2017; Stanley, Roycroft, Amaya, Dever, and Srivastav, 2020; Yan et al., 2018; DeCamp and Manierre, 2016; Dykema et al., 2011; Meuleman, Langer, and Blom, 2018). For longitudinal surveys, incentives given to encourage recruitment have been seen to also increase participation rates in subsequent waves (Schaurer, 2017). However, it is not clear whether there a linear relationship between incentives and response rates. Although some evidence suggests diminishing marginal returns to increasing incentive values (Meuleman et al., 2018), specially beyond 5 or 10€ incentives (e.g. Schaurer, 2017, Scherpenzeel and Toepoel, 2012; Neal et al., 2020), other authors have found higher incentives showing significantly higher response rates (Emery et al., 2020). Indeed, Yan, Kalla and Broockman (2018) found an increase of 0.2 percentage points on response rates for each dollar offered as incentive, with no decreasing marginal increase (in a study with a maximum incentive of $20).

In terms of nonresponse bias, most research has found that higher incentives, although increasing response rates, do not reduce nonresponse bias to a higher extent than lower incentives (Yan et al., 2018; Stanley et al., 2020; Schaurer, 2017) in some cases even showing a higher bias (Lugtig et al., undated). In that direction, Boulianne (2012) found that higher incentives decreased the likelihood of participating for women, while it increased the likelihood of participating for men. Nonetheless some actually find that higher incentives (2 vs 5$) improve the representativeness of the sample (DeCamp and Manierre, 2016).

Conditional or unconditional. Incentives can also be unconditional on survey participation (or pre-paid) – i.e. paid when the sample member is invited to the study, regardless of their participation – or conditional on survey participation (or post-paid) i.e. paid only to sample members who participate in the study. Unconditional incentives emphasize the role of the incentive as an appreciation for their effort, evoking the reciprocity norm in the respondent. Conversely, with conditional incentive the respondent is receiving a good in exchange for a service.

Some research has found that unconditional incentives yield higher response rates (Young et al. 2015; Scherpenzeel and Toepoel, 2012), even when unconditional incentives are lower than the conditional ones (Blom, Gathmann, and Krieger, 2015; Hamlyn et al., 2015). Indeed, Schaurer and Bosnjak, (2016) found that switching from an unconditional incentive scheme to a conditional incentive scheme between the first and second wave of a survey decreased the response rate substantively. These results have also been replicated in non-western contexts (Meuleman et al., 2018), with the difference that higher conditional incentives yielded higher response rates. However, these results are not universal, since some research has found no difference between conditional and unconditional incentives (Bosnjak and Tuten, 2003; Burton, 2015).

Others have explored with the combination of conditional and conditional incentives together. However, results are still inconclusive Some have found that offering an unconditional incentive with a conditional incentive upon completion increased response rates (Emery et al., 2020; Ipsos MORI, 2018b; Mcgonagle and Freedman, 2017; Patrick, Singer, Boyd, Cranford, and McCabe, 2013), even improving the sample representativeness compared to only using unconditional incentives of similar size (students: Patrick et al., 2013; Mcgonagle and Freedman, 2017). However, others have found no significant differences between unconditional incentives and unconditional plus conditional incentives of the same amount (Schaurer, 2017; non-general: Kipry and Gallagher, 2003) nor between conditional and

unconditional plus conditional incentives (Coopersmith, Vogel, Bruursema, and Feeney, 2014).

3.3. Questionnaire delivery

Finally, although not much research has been produced to date, some innovation has been proposed and tested during recent years on how surveys are delivered and made available to participants. As said in section 2, we do not explore ways in which to alter the design of the survey (e.g. mobile first designs), but on how to deliver it to sampled units. Specifically, we briefly discuss two ways in which online surveys can be delivered differently in order to improve response rates and reduce selection bias: modularization and research Apps.

3.3.1. Modularization

Modularization refers to partitioning an existing survey into smaller modules, which sample members are invited to complete separately (rather than as one single task). Hence, sampled units are invited to participate in the different survey modules as separate surveys, either at different points in time or one after the other.

Indeed, survey researchers can lead respondents to complete the survey at different points in time, for example, by sending out invitations for every module on 3 subsequent days, closing the fieldwork for the first module at the second day, and the second module at the third day. Alternatively, survey researchers can allow respondents to save up the modules and complete them all at the same time. The rationale behind modularisation is to help spreading out the burden of the response task over different point in time, or at least make participants perceive each module separately as less burdensome than the complete survey.

The empirical evidence on the effect of modularisation on response rates and response bias is, however, quite discouraging. In a survey of students, Peytchev, Peytcheva, Conzelmann, Wilson, and Wine (2020) explored the effect of partitioning a 30-minutes survey into two 15-minutes modules. After the first module, participants were offered the possibility to participate in the second 15-minutes module. Authors found that, contrary to their expectations, the modular survey yielded to lower response rates, mostly driven by a significantly lower proportion of participants participating in the second half of the survey, for those who were offered the two modules separately. Furthermore, authors also found some evidence that modularizing the survey increased non response bias, to some extent. Similarly, Toepoel and Lugtig (2018) did not find benefits of modularisation: the authors explored

whether partitioning a long survey into 3 or 10 different modules – to which participants were invited to participate separately, but in order – finding no significant impact of modularisation on nonresponse rates.

3.3.2. Research Apps

More and more participants complete online surveys using mobile devices (e.g. Bosch, Revilla, and Paura, 2019; Revilla, Toninelli, Ochoa, and Loewe, 2016; Gummer, Höhne, Rettig, Robmann, Kummerow, 2023). In light of this evidence, some researchers have considered to deliver online surveys though developing and/or adopting research Apps i.e. software that sample members can download into their mobile devices. Using research Apps to deliver surveys allows to contact individuals using their device's notifications ("push notifications") instead of by e-mail or SMS, as well as to complete the survey from the very same App without having to click into a link and go to the browser, and sometimes not even having to rely on having an Internet connection (Revilla, Paura, and Ochoa, 2021). Besides these many advantages, using research Apps for administering surveys has also disadvantages, including coverage issues (as not all sample members have mobile devices compatible with the study Apps) or sample members' reluctance to download/use data collection Apps (Jäckle, Wenz, Burton and Couper, 2023); as a matter of fact, in general population studies, participation in App-based data collection is still limited, as signalled by the low participation rates (Jäckle, Wenz, Burton and Couper, 2023; Jäckle, Burton, Couper and Lessof, 2019; Kreuter, Haas, Keush, Bähr and Trappman, 2020). In some cases, sample members have been offered the possibility to complete surveys on an App in addition to the "traditional" web data collection; for example, in a study on the general population in Switzerland, Asensio et al. 2021 found that offering sampled units to participate through an App Survey – i.e. download an App and answer through there instead as though the web browser – reduced response rates compared to not offering this option. Nonetheless, it had no substantial impact on selection bias.

4. Discussion

The aims of this report were to provide an up-to-date and comprehensive compilation of the research exploring the strategies to maximize participation rates in probability-based online surveys, as well as to compare which response maximisation strategies and survey characteristics work best. Overall, the evidence suggests that, for some strategies, significant

improvements in terms of participation rates should be expected. More specifically, it seems evident that the use of prenotifications, reminders and incentives have an overall positive impact on participation rates. Besides, it also appears clear that higher incentives and unconditional incentives can improve the effect of these. Nonetheless, the evidence available also suggests that, even if there seems to be a clear impact on participation rates, the impact on bias of these strategies is still unclear.

4.1. Main limits

There are several limitations of this report that should be kept in mind. First, no quantitative approach was used for summarising the results (e.g. meta-analysis) because of the high number of different indicators explored across and within sources of errors. Second, although we have used several databases and web search engine indexing scholarly literature (i.e. Google Scholar, WebSM, JSTOR, Web of Science), and have tried to capture as many unpublished reports as possible, some published or unpublished results might have not been captured by our review. Third, we did not analysed mixed-method surveys, apart from the mentioned exceptions. Fourth, the three broad categories which were used to differentiate between strategies might not be the only ones available. Nevertheless, since no consensus exist, we considered them as the most relevant for this review. Fifth, it could be argued that for some of the strategies or characteristics analysed there was no need to exclude non-probability surveys (e.g. content of the message). However, we wanted to avoid any potential confounding effect on the reported results due to the response behaviours of professional panellists (which could differ from the behaviour of other sample members). Sixth, we acknowledge that the different strategies and characteristics might interact with each other. For the sake of simplicity, we have not considered how different strategies and characteristics might interact. Nevertheless, we recognise that researchers should account for these interactions when designing and implementing strategies to increase response rates for probability-based online surveys. Finally, future research is needed on the impact of response maximisation strategies on nonresponse bias and sample representativeness (and on the correlation between survey characteristics and nonresponse bias/survey characteristics). It is mostly unclear to which extent different strategies can improve representativeness, beyond increasing sample size. In addition, for some strategies and characteristics, most of the results derive from subsamples of the population (e.g. samples of students); hence, caution should be used when trying to generalise results to the general population.

4.2. Main results

Based on our literature review, we can provide a summary of the results. Table 1 presents a summary of these findings, while in the following subsections we discuss them in more detail.

Table 1. Summary of results

Category	Strategy/Characteristic	Impact	
		Response rate	**Bias**
Contact	*Type*		
	Prenotification	Increase	Not conclusive
	Reminder	Increase	Reduce
	Characteristic		
	Mode	Not conclusive	Not conclusive
	Timing	Increase	Not conclusive
	Number of attempts	Increase	Not conclusive
	Content		
	Subject line	No effect	No effect
	Message	Not conclusive	Not conclusive
	Sender/sponsor	Increase	Not conclusive
Incentive	*Type*		
	Monetary	Increase	Reduce
	Report	Not conclusive	Not conclusive
	Gifts	Increase	Not conclusive
	Lotteries	Increase	Not conclusive
	Characteristic		
	Size	Increase	Not conclusive
	Unconditional	Increase	Not conclusive
Delivery	*Type*		
	Modularization	Not conclusive	Not conclusive
	App	Not conclusive	Not conclusive

4.2.1. Contacting sampled units

This review shows that there is a consensus about the significant increase of response rates produced by prenotifications and reminders. Specifically for reminders, some research has found that those can improve the representativeness of the sample, even after several waves. Regarding the characteristics of these contacts, the review shows inconclusive results about which mode works best. Although it appears that for reminders mail and e-mail modes work similarly, for invitations and reminders the evidence is inconclusive. Also, in terms of when to send invitations and reminders, there is no consensus; nonetheless, it appears that Monday,

Tuesday and Wednesday are the days that work best to send them. Similarly for the number of reminders to send, there is mixed evidence. Extra reminders seem to produce either no significant increase after the first one, or an increase which is marginally lower with every attempt. However, it is not clear whether extra reminders affect nonresponse bias.

Moving to the content of the contacts, the review shows that neither changing the subject line nor the type of envelop/mail seems to have a substantial impact on nonresponse. Similarly, although abundant research has explored better ways to write and present the messages sent on the invitation(s), and the information to add, their effects on response rates are rather null or inconclusive. Similar findings apply to other languages apart from the respondents' mother tongue to address sampled units, although little research has been conducted so far on the topic. Conversely, remarking the sender or sponsor when this has a high proximity, perceived trust or reputation has been mostly shown to increase response rates to some extent. However, no reduction of bias should be expected.

4.2.2. Incentives

The use of monetary incentives, gifts, and lotteries seem to significantly increase response rates, while it is unclear whether reporting the results of the study has the potential to increase response rates or not. Nonetheless, there is only a slight consensus that monetary incentives could reduce nonresponse bias. Furthermore, our review also suggests that higher incentives should produce significantly higher response rates, but with the possibility that the marginal returns will diminish after values of around 5 to 10€. Nonetheless, although response rates might increase, no clear difference on nonresponse bias has been found depending on incentive sizes. It also seems clear that unconditional incentives produce higher response rates than conditional ones, even when these are larger.

4.2.3. Questionnaire delivery

Not much research has explored ways to increase participation by modifying how the questionnaire is delivered. Nonetheless, for the two main approaches testes – modularization and research Apps – the evidence mostly points out to no significant effects or even a reduction of response rates. However, the evidence to date is very limited to conclude that these approaches should be avoided; conversely, with respect to research App, it might be the case that researchers have not yet identified an optimal design to overcome barriers to participation (Jäckle, Wenz, Burton and Couper, 2023).

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Appendix

Appendix A: Search terms

Search terms	Supplemented by
Web survey, Internet survey, online survey, web-based survey, Internet-based survey, electronic survey.	response rate, return rate, participation rate, nonresponse rate, incentive, incentives, lottery, reminder, notification, invitation, prenotification, advanced letter, attempts, subject line, envelop, message, language, contact mode, gifts, timing, increase response rates, sponsor, sender, mode, app, modularization

Appendix B: Descriptive information of the literature included in systematic review

Categories	Type of literature	Percentage of papers
Revision process	Peer-reviewed	83.50
	Not peer-reviewed	16.50
	Not applicable or unknown	0.97
Output	Journal	81.55
	Working paper	2.91
	Report	9.71
	Conference	3.88
	Dissertation	1.94
Country	UK	12.62
	USA	44.66
	Netherlands	5.82
	Germany	7.77
	Slovenia	0.97
	Ghana	0.97
	Norway	0.97
	New Zealand	1.94
	Belgium	5.83
	Spain	0.97
	Europe (General)	2.20
	Australia	0.97
	Canada	4.85
	China	1.94
	Brazil	0.97
	Others	7.52
Population	General	29.12
	Students	34.95
	Other	35.93