

Effectiveness of Using Quick Response (QR) Codes in Survey Invitation Letters: Experiment Conducted in Generations and Gender Survey in the UK

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In the first wave of the UK's Generations and Gender Survey, conducted as an online-only, probability-based survey, an experiment was carried out to examine the impact of providing Quick Response (QR) codes with URLs versus just URL links in the invitation and reminder letters. The aim of the experiment was to investigate differences in participants' likelihood of engaging with the survey, as well as in the quality of the data collected, between the two experimental conditions. The results suggest that respondents who received letters with a QR code were more likely to participate and to use smartphones, rather than PCs/desktops, to complete the survey compared to those who received letters with only URL links. The finding is important because QR codes could be leveraged to encourage respondents to use smartphones for surveys that require additional tasks to be completed via mobile devices. No significant differences in data quality were observed between the two conditions, indicating that QR codes show promise for future survey data collection. However, the experiment did not determine whether the observed effects were specifically associated with participants using the QR code to access the questionnaire. Future studies offering QR codes for online survey access should ensure that the data on how respondents access the survey (via QR code or URL) is collected. This will allow for a more in-depth analysis of the factors associated with the different methods of survey access.

Keywords: experiment; online survey; response rate; QR code; smartphone

1 Introduction

Quick Response (QR) codes are two-dimensional barcodes that can be scanned using smartphones or tablets, directing users to a specific website or survey questionnaire. Although QR codes are not a new technology, their use has gained popularity, particularly since the COVID-19 pandemic, as a contactless method for transactions (Davies et al., 2023; Gostin, 2021). For survey methodologists, QR

codes can be useful in contexts where initial contact with potential survey participants is established through physical invitation letters.

However, a key limitation of QR codes is that they require respondents to have a smartphone or tablet, which may not be accessible to everyone. Additionally, prior to 2017, most smartphones did not have built-in functionality to scan QR codes (Marlar & Schreiner, 2024). Since then, this feature has become standard on most smartphones, making QR codes more accessible for smartphone users.

The COVID-19 pandemic accelerated the adoption and use of QR codes, leading to a growing, though still limited, body of research testing their effectiveness in survey invitations. These studies reveal distinct differences in earlier and more recent findings. Earlier studies reported mixed

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findings: some found that including QR codes on survey invitations had no impact on participation (Lugtig & Luiten, 2021; Marlar, 2018), while others observed only a modest increase in response rates (Harrison et al., 2019; Patrick et al., 2022). In contrast, more recent studies have demonstrated that QR codes significantly improved participation rates and increased access to surveys via smartphones or tablets (Endres et al., 2023; Hupp et al., 2023; Olson & Ganshert, 2024).

While some studies found that QR codes enhanced participation among younger age groups, individuals from ethnic minority backgrounds, and those with lower educational attainment (Hupp et al., 2023; Leary et al., 2023; Lee et al., 2023; McDaniel et al., 2023), others did not find such effects (Olson & Ganshert, 2024). Marlar & Schreiner (2024) conducted two experiments from 2015 and 2022 and found that, in 2022, the inclusion of QR codes had a small but significant positive effect on response rates, particularly among Hispanic respondents—a result not observed in 2015.

There may also be data quality concerns since QR codes are typically accessed via smartphones. Some studies have reported that completing surveys on smartphones can take longer (Struminskaya et al., 2015; Maslovskaya et al., 2024), increase the likelihood of break-offs—especially when the questionnaires are not optimised for mobile completion (Mavletova & Couper, 2016), lead to higher item non-response (Mavletova & Couper, 2015; Struminskaya et al., 2015), and result in a greater tendency for respondents to engage in response style behaviours, such as primacy effects (Stapleton, 2013) and straightlining (Guidry, 2012; Maslovskaya et al., 2024). However, other research suggests that there are little to no differences in data quality between smartphone and PC/desktop users, including in response behaviours and measurement error (Keusch & Yan, 2017; Lugtig & Toepoel, 2015; Sommer et al., 2016; Stapleton, 2013).

QR codes are appealing for survey research because they can potentially reduce respondent burden by providing direct access to the questionnaire, eliminating the need to manually enter a URL from the invitation letter. This ease of access can potentially increase participation. QR codes can also eliminate the risk of errors in the URL when project acronyms are unfamiliar. Furthermore, they can boost participation from smartphone users, which is particularly valuable for surveys that require additional tasks, such as using apps. Additionally, because smartphone users tend to have specific characteristics, QR codes could potentially help attract higher proportions of younger individuals, ethnic minorities, and those with lower educational attainment.

Additional evidence is needed to obtain more conclusive results about the effectiveness of including QR codes in invitation and reminder letters for online survey access, particularly for long and complex self-administered

surveys, as many high-quality surveys have already transitioned or are in the process of transitioning to self-administered modes of data collection. The UK GGS QR code experiment provides a unique opportunity to assess this, as it employed a long, complex questionnaire. Additionally, the GGS provided an opportunity to examine, within a probability-based sample, whether response rates can be increased without compromising data quality and whether using QR codes can help reach specific population subgroups.

This study formulated four hypotheses. First, response rates by letter condition are investigated, followed by an analysis of response rates by device type to assess the first two hypotheses: whether response rates are higher in the QR-with-URL letter condition (H_1), and whether the proportion of smartphone users is higher in the QR-with-URL letter condition (H_2). This is followed by bivariate analyses exploring the relationship between the experimental conditions and respondents' demographic and socio-economic characteristics, addressing H_3 (whether the QR-with-URL letter condition attracts a higher proportion of young people, ethnic minorities, and individuals with lower education levels). Finally, H_4 is tested by comparing data quality indicators between the two conditions to determine if data quality is lower in the QR-with-URL letter condition.

Most previous studies have been conducted in the US, making it essential to report on experiments conducted in other countries. Perceptions of QR codes, along with familiarity and adoption rates, may vary across cultural contexts, highlighting the need for broader international research. In this study, the inclusion of a QR code alongside a URL in invitation letters for the experimental group allowed for an investigation of response rates, smartphone participation, demographic composition, and data quality in a probability-based online survey. However, similarly to some other studies (Asensio, 2024; Harrison et al., 2019; Lugtig & Luiten, 2021), a failure of this experiment was that it did not capture whether respondents accessed the survey via the QR code or the URL link. The QR code lacked two specific query parameters—the survey URL and a unique access code per respondent—which would have enabled survey practitioners to track QR code usage through an entry log. As a result, these findings only reflect the effects of including a QR code alongside a URL in invitation letters and follow-up reminders, compared with including a URL alone, rather than the effects of respondents actually *using* the QR code to access the survey.

This study contributes to the literature on the use of QR codes in survey invitation letters and highlights an important lesson: future studies should include mechanisms to distinguish how respondents access the survey (via QR code or URL) to allow for a more detailed assessment of the impact of QR code usage.

2 Data

The QR code experiment was one of two independent experiments embedded in the UK Wave 1 Generations and Gender Survey (GGS), a probability-based online-only survey targeting UK residents aged 18–59 (Howe et al., 2024; Perelli-Harris et al., 2024). A stratified random probability-based sample of addresses was drawn from the Postcode Address File, and selected households were sent an invitation letter followed by two reminder letters. One respondent per household was invited to participate, with the respondent selected using the most recent birthday method.

The survey was conducted between September 2022 and February 2023 in two stages, with approximately half of the sample issued in each stage. During the first stage, an incentive experiment was carried out to assess the effectiveness of different incentive values on response rates and sample composition. The findings from this stage informed the targeted incentive approach implemented in the second stage, during which the QR code experiment was implemented to test differences in response rates and data quality by different survey access modes. These experiments are independent from each other and were carried out in different stages of data collection.

For the QR code experiment, 41,450 invitation letters were sent. Half of these letters contained only a URL to the survey, while the other half featured both a QR code and a URL (QR-with-URL letter condition). Each household was informed that the survey would take approximately 50 min to complete and that a voucher (£15 or £20) would be issued upon survey completion. An example of the invitation letter with a QR code can be found in Fig. 1. In addition, two reminder letters were sent to each sampled household, which differed in the same way as the initial invitation letter (with/without the QR code on the right side—see Howe et al. (2024) for all communication materials). This strategy resulted in a final productive sample of 3740 respondents.

3 Methods

To test H_1 (differences in response rates and break-off rates), we calculated the AAPOR response rate 3 (RR3), and break-off rates by experimental conditions (AAPOR, 2023). To test H_2 (differences in device used), H_3 (differences in demographic composition), and parts of H_4 (differences in data quality), chi-square tests are used, which are reported in Table 1. To investigate the association between experimental conditions and survey length, Mood's median test (Mood, 1954) is employed, as survey length is a continuous measure. This nonparametric test

allows for the comparison of medians without making assumptions about the underlying distributions.

The following data quality indicators are analysed to address H_4 : survey length (actual time spent on survey), time of response, consent for future survey waves, item non-response (measured as the number of “don't know” answers and refusals divided by the total number of questions answered), break-off rates, and response style behaviours such as straightlining and extreme responses in two batteries of attitudinal questions concerning intimate partnerships and parenthood, and inter-generational values.

4 Results

4.1 H1: Response Rate and Break-Off Rates

The GGS yielded AAPOR RR3 of 14% (AAPOR, 2023). The response rate was significantly higher for the QR-with-URL letter condition (14%) compared to the URL-only letter condition (13%). Break-off rates did not significantly differ between the conditions: 9% for the URL condition and 9% for the QR-with-URL letter condition. These findings support H_1 , indicating a higher response rate in the QR-with-URL letter condition.

We examined the cumulative responses over time to assess whether the higher response rate in the QR-with-URL letter condition was maintained across multiple contact attempts. Fig. 2 demonstrates that the overall pattern of responses is similar across the two conditions but a relatively higher number of responses were accumulated in the QR-with-URL letter condition after the first reminder letter.

4.2 H2: Device Type Use

Table 1 suggests that there is a significant association between the experimental conditions and device type. Respondents in the QR-with-URL letter condition were significantly more likely to use smartphones (59%) compared to those in the URL-only letter condition (46%). This finding supports H_2 , indicating a higher proportion of smartphone users in the QR-with-URL letter condition.

4.3 H3: Demographic Composition

In Table 1, chi-square tests demonstrated that the QR-with-URL letter condition resulted in significantly more completed questionnaires from respondents with children, but no other statistically significant associations with demographic characteristics were identified. These results do not



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 THE RESIDENT
 1 THE STREET
 EXAMPLE
 AB12 0CD

Your reference: P17181 2222222222/R

Dear Resident,

Your household has been chosen to take part in an online survey about families, individuals, and work – we hope we can count on your help with this.

This Survey is administered by the National Centre for Social Research (NatCen) on behalf of the University of Southampton. The study is aimed at women and men aged 18 to 59 and concerns all situations: in a couple or single, with or without children.

Taking part is voluntary, and you will be asked a range of questions about yourself and, if applicable, your partners and children, including a small number of sensitive questions, which you may choose not to answer if you wish.

How to take part

- 1 Go to the survey on your mobile or computer: **mysurvey.natcen.ac.uk/GGS**
- 2 Enter your unique access code: **12A-3B4-56C**
- 3 Complete the survey and receive a **£20** voucher as a thank you

Or scan
code below:



How long will it take?

The survey will take about 50 minutes of your time. You will then receive a **£20 voucher**.

Who should take part?

We would like one adult aged between 18 and 59 in your household to take part. If there is more than one adult, then the person who most recently had a birthday should take part.

When should I complete it by?

You have until **Sunday 19th February** to take part online. By taking part you can make sure that policymakers better understand changes in society and consider the opinions and experiences of people like you.

Thank you for your support,



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Fig. 1*Invitation letter with a QR code***Table 1***Distribution of respondent characteristics between treatment vs. control group along with indications of statistically significant differences using chi-square tests*

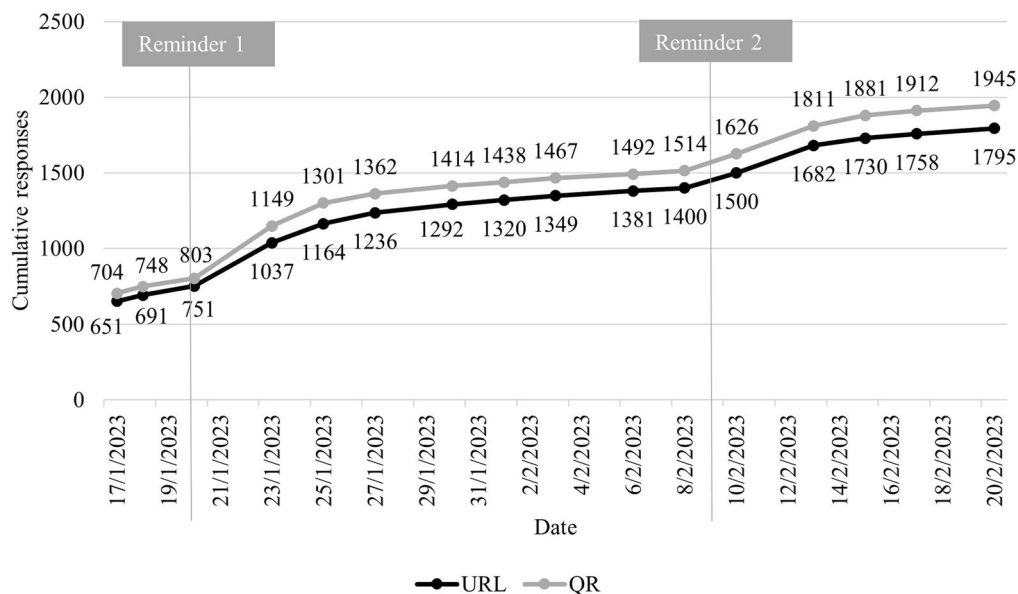
	URL-only		QR-with-URL	
	<i>n</i>	%	<i>n</i>	%
Device used***				
Desktop	813	52	658	39
Smartphone	699	45	984	58
Tablet	56	4	48	3
Demographic characteristics				
<i>Sex</i>				
Male	595	38	627	37
Female	973	62	1063	63
<i>Age</i>				
18–29	335	21	346	21
30–39	434	28	447	26
40–49	360	23	406	24
50–59	439	28	491	29
<i>Education</i>				
Below degree	744	48	833	49
Bachelor's or higher	824	53	857	51
<i>Ethnicity</i>				
Non-White	192	12	220	13
White	1376	88	1470	87
<i>Country of birth</i>				
Born outside of the UK	227	14	274	16
Born in the UK	1341	86	1416	84
<i>Has a partner</i>				
No	484	31	519	31
Yes	1084	69	1171	69
<i>Has children*</i>				
No	663	42	652	39
Yes	905	58	1038	61
Data quality indicators				
<i>Median time spent (min)</i>				
Desktop	42	N/A	44	N/A
Smartphone	38		39	
Tablet	45		46	
<i>Extreme responses (all "strongly agree")^l</i>				
Attitudinal Block 1	1	0	9	1
Attitudinal Block 2	15	1	24	1

Table 1*(Continued)*

	URL-only		QR-with-URL	
	<i>n</i>	%	<i>n</i>	%
<i>Straightlining¹</i>				
Attitudinal Block 1 (9 items)	9	1	19	1
Attitudinal Block 2 (4 items)	391	25	399	24
<i>Average item non-response</i>				
Don't know	N/A	3	N/A	3
Refused to answer	N/A	1	N/A	1
<i>Consent to future waves*</i>				
Yes	1329	85	1381	82
No	239	15	309	18
<i>Time of response</i>				
After invitation letter	674	43	701	41
After first reminder	570	36	624	37
After second reminder	324	21	365	22
<i>Incentive</i>				
£15 voucher	1425	91	1543	91
£20 voucher	143	9	147	9
<i>Total</i>	1568		1690	

The analytical sample used in the analysis comprises 3258 respondents, excluding respondents with missing values on the variables of interest. Unweighted analysis. Fully productive responses only. Time spent on survey obtained from the survey's paradata. The p-values associated with the adjusted chi-square tests are indicated by *** $p < 0.001$, ** $p < 0.01$ and * $p < 0.05$.

¹For extreme responses and straightlining, the table only reports the frequency of all those who responded with extreme values or straightlined across two attitudinal blocks, and the percentage is out of the total sample.

**Fig. 2**

Response patterns across the two experimental conditions during the fieldwork period

support H_3 , which expected that the QR code would improve sample composition by attracting traditionally harder-to-survey respondents, such as younger individuals, those with lower education levels, and ethnic minorities.

4.4 H4: Data Quality

The median completion time was 39 min. Smartphone respondents spent less time on the survey than those using other devices, but Mood's median test (Mood, 1954) demonstrated no significant difference in median survey completion time by condition. Additionally, no differences were found between the two conditions for time of response, item non-response, incentive levels, or response style behaviours. The overall incidence of extreme responses was very low (<2%), and there was no significant difference in straightlining between experimental groups. These findings contradict H_4 , suggesting that there are no differences in data quality between QR-with-URL and URL-only letter conditions, and that the use of QR codes on invitation letters is not associated with poorer data quality.

A surprising significant finding emerged regarding respondents' willingness to participate in future waves by letter condition. Participants in the URL letter group were significantly more willing to take part in future waves than those who received a letter containing both a QR code and a URL. It is possible that differences in digital literacy, privacy perceptions, or device usage patterns across the two groups underlie this finding, which warrants further investigation.

5 Discussion

The results suggest that the QR-with-URL letter condition is associated with a higher response rate compared to the URL-only letter condition and a higher likelihood of respondents using smartphones over desktops/PCs, which aligns with previous literature on QR codes (Endres et al., 2023; Harrison et al., 2019; Hupp et al., 2023; Olson & Ganshert, 2024; Patrick et al., 2022). Given that many social surveys now incorporate smartphones for additional tasks, such as geo-tracking, biometrics, time diaries, digital trace data collection, and other tasks—these results are reassuring. They suggest that QR codes included in the letters could be an effective strategy for encouraging respondents to use smartphones for survey completion.

The results also suggest no significant demographic differences between the experimental groups, which is consistent with some earlier studies (Olson & Ganshert, 2024). These results imply that QR codes included in the invitation and reminder letters may not be an effective strategy

for increasing participation from harder-to-reach respondents, such as younger people, those with lower education levels, and respondents from ethnic minority groups, who are more likely to use smartphones for survey completion (Hupp et al., 2023; Leary et al., 2023; Lee et al., 2023; Mcdaniel et al., 2023). It was reassuring, however, that no differences in data quality were found between the experimental conditions, suggesting that inclusion of QR codes in the letters is a viable option to increase participation and responses via smartphones without compromising data quality. These findings are consistent with Hupp et al. (2025). However, it is important to note that GGS respondents are below 60 and this age range might influence the results. This hypothesis should be tested in the context of a general population survey. Additionally, it is important to further investigate the finding regarding respondents' willingness to participate in future waves, as those in the QR-with-URL letter group appeared to be less willing to do so.

6 Experiment Failure and Recommendations

The main limitation of this study is its inability to differentiate between respondents who used QR codes and those who used URLs to access the survey within the QR-with-URL letter condition. Consequently, most of the analyses conducted are limited to assessing whether respondents received an invitation letter that included a QR code, rather than capturing their actual behaviour in using it. However, despite this limitation, the results of the analysis still allow for important general insights and conclusions.

Identifying respondents who accessed the survey via QR codes would enable more detailed analyses and a better understanding of QR code usage. Future survey practitioners should consider assigning unique access codes to each respondent to track how they accessed the survey or creating separate landing pages for those entering via URL and QR codes. Additional tracking enhancements could include indicators identifying whether the respondent accessed the survey through the initial invitation letter or a reminder letter.

It is strongly recommended that survey agencies ensure that variables identifying the methods of questionnaire access are available for researchers. Future studies should also clearly specify whether reported QR code effects are based on distinct access methods or merely the presence of QR codes in invitation materials, as was the case in this experiment, when more detailed access data were unavailable.

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Data availability These data are deposited at Generations and Gender Project (GGP) Colectica repository (<https://ggp.colectica.org/>), and the UK Data Archive, where registered users can access the data (Perelli-Harris et al., 2024).

Ethical standards We obtained ethics approval for the study from the University of Southampton Ethics Committee, registered on the Ethics and Research Governance Online.

Conflict of interest The authors have no conflicts of interest to declare.

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