DEMOGRAPHIC RESEARCH

Research Article

Traditional versus Facebook-based surveys: Evaluation of biases in self-reported demographic and psychometric information

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Contents

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Abstract

BACKGROUND

Social media in scientific research offers a unique digital observatory of human behaviours and hence great opportunities to conduct research at large scale, answering complex sociodemographic questions. We focus on the identification and assessment of biases in social-media-administered surveys.

OBJECTIVE

This study aims to shed light on population, self-selection, and behavioural biases, empirically comparing the consistency between self-reported information collected traditionally versus social-media-administered questionnaires, including demographic and psychometric attributes.

METHODS

We engaged a demographically representative cohort of young adults in Italy (approximately 4,000 participants) in taking a traditionally administered online survey and then, after one year, we invited them to use our ad hoc Facebook application (988 accepted) where they filled in part of the initial survey. We assess the statistically significant differences indicating population, self-selection, and behavioural biases due to the different context in which the questionnaire is administered.

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RESULTS
Our findings suggest that surveys administered on Facebook do not exhibit major biases with respect to traditionally administered surveys in terms of neither demographics nor personality traits. Loyalty, authority, and social binding values were higher in the Facebook platform, probably due to the platform's intrinsic social character.

CONCLUSION
We conclude that Facebook apps are valid research tools for administering demographic and psychometric surveys, provided that the entailed biases are taken into consideration.

CONTRIBUTION
We contribute to the characterisation of Facebook apps as a valid scientific tool to administer demographic and psychometric surveys, and to the assessment of population, self-selection, and behavioural biases in the collected data.

1. Introduction

Social sciences are going through a revolution, in light of the immense possibilities that arise from the ability to observe real-world human behaviours via digital data, timely, and at a grander scale. Digital data offer rich, fine-grained individual information at a population level depicting a complementary view of the society (Lazer et al. 2009; Kalimeri et al. 2019a), especially when official records are sparse or unavailable. A rapidly growing body of research now employs social media data as a proxy to address challenging demographic research questions of a wide range of social issues. Topics may range from understanding migrants' assimilation in society (Dubois et al. 2018) to tracking unemployment rates (Burke and Kraut 2013; Bonanomi et al. 2017; Llorente et al. 2015), or even to predicting the probability that a protest will turn violent (Mooijman et al. 2018).

In the demographic research field, many studies regularly rely on surveys to tackle the interplay between psychological well-being and societal issues (Parr 2010; Moor and Komter 2012; Bernardi and Klärner 2014; Ho 2015; Teerawichitchainan, Knodel, and Pothisiri 2015; Morrison and Clark 2016). These are often administered to a scientifically constructed sample of the population, however, high-quality survey data require a substantial investment of time, effort, and resources (Wilson, Gosling, and Graham 2012; Schober et al. 2016), especially in cases dealing with fast-evolving phenomena such as crisis response (Imran et al. 2015) and deployment of resources during health emergencies (Vespignani 2009). In addition to providing rich observational data, social media platforms can also act as surveying tools, adding to existing traditional practices (Snelson 2016). The vast potential of this approach was demonstrated when a Facebook-hosted

surveying application (FB-app hereafter) reached over four million users (Stillwell and Kosinski 2004). In line with this approach, Bonanomi et al. (2017), studied the phenomenon of youth unemployment – and in particular, the NEET (not in education, employment, or training) community – while Kalimeri et al. (2019b) analysed the attitudes, behaviours, and opinion formation towards vaccination. Both studies administered psychologically validated questionnaires via FB-apps.

There are indisputable benefits of such approaches, ranging from the possibility to rapidly reach out to populations previously unavailable (Pew Research Center 2018), complementing the traditional data sources in a cost-effective way (Murphy, Hill, and Dean 2014; Adler et al. 2019). However, and despite their enormous potential, social media data come with their own biases and limitations (Reips 2002; Pew Research Center 2018; Araújo et al. 2017). Olteanu et al. (2016) provided an in-depth survey on the methodological limitations and pitfalls in social media studies, that are often overlooked. Well-studied data quality issues common to all social media platforms include sparsity (Baeza-Yates 2013), representativity (Ruths and Pfeffer 2014), and noise (Salganik 2017), but also include biases regarding data samples (Tufekci 2014; Metaxas, Mustafaraj, and Gayo-Avello 2011) and content (Wu et al. 2011; Baeza-Yates 2018). When social media platforms are employed as surveying tools, the entailed biases are even more challenging to define and quantify; for instance, the psychological predisposition towards a specific form of social media. The existing studies on biases focus mainly on representativity aspects compared to census data (Schober et al. 2016), or on the consistency of survey data obtained via crowdsourcing platforms (Law et al. 2017). Still, no studies are assessing the consistency of surveys administered in a traditional online mode versus social media platforms.

In line with the scheme proposed by the total error framework (Sen et al. 2019), we place the focal point on three types of biases – namely, population, self-selection, and behavioural – following a straightforward experimental scenario. Initially, a survey was administered in a traditional online manner. Subsequently, after approximately one year, the same cohort was invited to use an ad hoc FB-app. The core contribution of this study is a systematic assessment of biases that may be entailed in data obtained from social-media-administered surveys, and in particular on the Facebook platform. We focus not only on demographic differences that might be more expected but also on psychological biases due to the nature of the conveyed surveys. Here we operationalise the psychometric constructs in terms of personality traits and moral values. Our findings suggest that Facebook is indeed a valid research tool to administer social and psychometric research surveys; nonetheless, its not entirely neutral character should be taken into consideration.

2. Experimental design

Our experimental design consists of two phases. In the first phase, we engaged a probability-based and demographically representative cohort of the youth population in Italy. The cohort originated from a nationwide project launched in 2015 – the 'Rapporto Giovani' – which focuses on youth-related issues (age range 18 to 33 years, average 25.7 ± 4.7, N = 9.358) carried out by Istituto Giuseppe Toniolo di Studi Superiori (2017). We invited participants via email to fill in an initial survey, administered following a CAWI (computer-assisted web interviewing) methodology. This survey consisted of demographic questions and two validated psychometric questionnaires, namely, the five-factor inventory (Big5, hereafter) (Gosling, Rentfrow, and Swann 2003; Costa Jr and McCrae 1992) for personality and the moral foundations theory (MFT, hereafter) (Haidt and Joseph 2004) for morality assessment. In the second phase – approximately one year after the initial survey – the cohort received an email invitation to access our ad hoc FB-app, accessible at likeyouth.org, that among other functions, administered the same Big5 and MFT psychometric questionnaires (Bonanomi et al. 2018). A consent form was obtained in terms of a privacy agreement which the participants declared to accept upon registration. Our experimental design is postulated in three studies, where we assess the differences in:

- *Study 1: Population bias – platform*
  Demographics and psychometric attributes between the population of users who maintain a Facebook profile against those who do not.
- *Study 2: Self-selection bias – recruitment*
  Demographics and psychometric attributes between the population of users who accepted to participate in the FB-app and those who did not.
- *Study 3: Behavioural bias*
  User behaviour across platforms; here, the comparison is made on the psychometric self-assessments in the traditional survey versus those given through the Facebook-administered survey.

Since our data include both categorical and ordinal attributes, we employed the Mann-Whitney U nonparametric statistical test to compare the populations in question for Studies 1 and 2. The effect size is estimated as $d = \frac{2U}{mn} - 1$, where n and m represent the population sizes and U is the Mann-Whitney U statistic (Cliff 1993). We consider any effect size with magnitude d as 'negligible' if $|d| < 0.147$, 'small' if $|d| < 0.33$, 'medium' if $|d| < 0.474$ and 'large' otherwise, according to the interpretation intervals suggested by (Romano et al. 2006). The Wilcoxon signed-rank nonparametric test (Wilcoxon 1946) was used to test differences of paired data in Study 3. The choice of the test was based on the fact that the assumption of normal distribution of the differences, required for the

paired t-test, is not satisfied for all the psychometric attributes. The effect size here is estimated according to the simple difference formula proposed by Kerby (2014).

3. Results

The traditionally administered survey was filled in by 6,380 participants. To improve the data quality, we excluded from the study those participants who either (1) gave identical responses to both Big5 and MFT individual questionnaire items, or (2) gave mistaken responses in the two quality control questions. After this preprocessing step, we excluded approximately 34% of the participants. The remaining 4,239 individuals became our initial cohort (see Table 2). After our email invitation approximately one year after the initial survey, about 76% of the initial cohort (denoted as the traditional cohort hereafter) did not log into the FB-app. The remaining 23% of the initial cohort did log into the application and are denoted as the FB cohort hereafter.

Table 2 reports the statistics on the two populations along with their demographic characteristics. All analysis is performed in Python Rossum (1995). Data and source code are available online at `https://osf.io/gx7df/`. For each demographic attribute, we compared the traditional and FB cohorts against the initial cohort. No significant differences emerged for any of the attributes, providing evidence that both the traditional and the FB cohorts are demographically representative subsets of the initial cohort with respect to age, gender, employment, and educational level.

3.1 Study 1: Population bias – platform

We denote the participants who declare to maintain a Facebook profile as 'On-FB' and those who do not as 'Off-FB'. Table 1 reports the total number of participants in both populations as well as their demographic information. We compared the two populations, On-FB and Off-FB, according to the self-reported information they provided in the initial survey regarding their demographic and psychometric attributes. The outcome of the test showed a small difference in the age of the two cohorts, with the FB cohort representing a slightly younger population (p-value < 0.001 and $|d| < 0.17$), but no other difference in demographic attributes was pointed out (see Table 1). Regarding personality and moral traits, we observe that participants without a Facebook profile were less extroverted (p-value < 0.001, $|d| < 0.14$) with minor differences also present in other traits, as for example, their lower level of openness to new experiences (p-value < 0.001, $|d| < 0.1$). At the same time Off-FB participants appear to be more conscientious (p-value < 0.001, $|d| < 0.1$) and more neurotic (p-value < 0.01, $|d| < 0.1$) (see Table 3). Despite the limited size of the Off-FB sample – only 8.4% of the cohort claimed not to

have a Facebook profile – these differences are statistically significant and hence, should be considered. No significant differences were found for the moral domain attributes.

3.2 Study 2: Self-selection bias – recruitment

To assess the self-selection biases in the recruitment phase, we compared the demographic and psychometric attributes of the participants in the traditional cohort against those in the FB cohort. To avoid any confounding factors introduced by the platform, we compared the responses obtained from the initial survey for both groups. The Mann-Whitney U test did not show any significant differences, neither for the demographic attributes (see Table 1) nor for the Big5 personality traits (see Table 3). Instead, small differences in purity (p-value < 0.001, $|d| < 0.06$), loyalty (p-value < 0.01, $|d| < 0.09$) and binding (p-value < 0.001, $|d| < 0.06$) values emerged (see Table 3).

3.3 Study 3: Behavioural bias

Finally, we focused on behavioural biases due to self-reporting; to do so, we compared the participants' responses in the traditional survey against their responses on the Facebook administered survey. The Wilcoxon signed-ranks test showed that when responding in the FB-app, the median scores were statistically significantly higher than the median scores obtained in the traditional survey for the attributes of authority, loyalty, and social binding. Participants judged themselves as slightly more authoritarian (p-value < 0.001, $r = -0.32$) and loyal (p-value < 0.001, $r = -0.24$) (Table 3). They also claimed to value more social binding principles (p-value < 0.001, $r = -0.26$). These latter findings may be due to Facebook's intrinsic social character.

Moving from a population to the individual scale, we assessed the within-subject variability between the traditional and the FB-app survey. For each psychometric attribute, we estimated the Kendall's tau correlation values obtained from the individual responses in the traditional and the respective Facebook survey. Then, we randomly shuffled the answers of all participants in the traditional and FB cohorts 1,000 times and computed the Kendall's tau correlation value each time. The mean and standard deviation of the bootstrapped distributions are reported in Table 4 for the personality and morality attributes, respectively. The correlations between the two surveys lie at an intermediate range (from 0.3 to 0.55) but are significantly higher than for the null model (see Table 4). This supports the idea that there is good consistency in self-reporting.

Table 1: **Descriptive statistics of the population that declared to maintain a Facebook profile (On-FB) and the one that does not (Off-FB)**

	On-FB	Off-FB
# of Participants	3,882	357
Age (std)	26.9 (4.2)	28.1 (4.0)
Gender (Males)	65.8%	59.9%
Employed (Yes)	50.9%	49.0%
Education (High)	54.4%	51.8%

Note: We compare the following demographic information of the two cohorts: (1) population, (2) age, (3) gender distribution, (4) employment, and (5) educational level, reporting the percentage of participants who pursue or have a university degree. A Mann-Whitney U test on the two cohorts pointed out only the age difference as statistically significant with $p < 0.001$ and small effect size $|d| < 0.17$.

Table 2: **Population size for the initial cohort as well as its two subsets, participants who filled in the online survey but chose not to enter the FB-app (traditional), and those who filled in the online survey and then participated also in the Facebook-administered survey (FB)**

	Initial	Traditional	FB
Population	4,239	3,251	956
Age (std)	27.0 (4.2)	27.1 (4.3)	26.9 (4.2)
Gender (Males)	65.3%	64.3%	65.8%
Employed (Yes)	50.8%	50.4%	50.9%
Education (High)	54.1%	55.2%	54.4%

Note: For the three cohorts we present a comparison of the basic demographic information in terms of population, average and standard deviation of age, gender distribution of the population in terms of the percentage of male participants, the percentage of the population who are employed, and the level of education referring to the percentage of participants who have a university degree of any level or are enrolled in the university. Mann-Whitney U tests on all variables did not detect any statistically significant differences.

Table 3: **Effect sizes and statistical significance for the Big5 and MFT attributes**

	Population bias		**Self-selection**		**Behavioural**	
Extraversion	0.135	⋆⋆⋆	0.02	–	0.25	⋆⋆⋆
Agreeableness	−0.07	⋆	0.00	–	−0.08	–
Conscientiousness	−0.09	⋆⋆	0.03	–	0.00	–
Openness	0.09	⋆⋆	−0.01	–	0.09	–
Neuroticism	−0.07	⋆	0.05	⋆	0.104	–
Care	−0.02	–	0.00	–	−0.11	–
Fairness	−0.04	–	0.00	–	−0.11	–
Loyalty	0.05	–	0.05	⋆	−0.24	⋆⋆⋆
Authority	0.00	–	−0.14	⋆⋆⋆	−0.32	⋆⋆⋆
Purity	−0.02	–	0.06	⋆⋆	−0.05	–
Binder	0.01	–	0.06	⋆⋆	−0.26	⋆⋆⋆
Individualism	−0.03	–	0.00	–	−0.12	–

Note: Assessing: (1) population bias of the platform, comparing those who maintain a Facebook profile against those who did not (Mann-Whitney U), (2) self-selection bias due to recruitment, comparing those who participated in the survey but did not access the FB-app against those who accessed the application (Mann-Whitney U), (3) behavioural bias due to within-individual variability, the comparison is made between the responses to the traditional survey and those given to the Facebook-administered survey (Wilcoxon signed-ranks). The effect size is reported in terms of d-Cliff for the Mann-Whitney U test and with the simple difference formula for the Wilcoxon signed-ranks. The null hypothesis represents that both distributions are similar. A positive sign means that the median of the first population is higher than that of the second population. Note that '⋆ ⋆ ⋆' a p-value < 0.001, '⋆⋆' a p-value < 0.01, '⋆' a p-value < 0.05, and '–' indicates no statistical significance observed.

Table 4: **Individual self-consistency of personality traits (Big5) and moral dimensions (MFT) reporting evaluated by means of Kendall's tau correlation between an individual's responses on the traditional survey and on Facebook**

	Correlation	Bootstrapping Mean (STD)
Extraversion	0.53 ⋆⋆⋆	0.000 (0.03)
Agreeableness	0.42 ⋆⋆⋆	0.000 (0.03)
Conscientiousness	0.52 ⋆⋆⋆	0.000 (0.03)
Openness	0.50 ⋆⋆⋆	0.000 (0.03)
Neuroticism	0.52 ⋆⋆⋆	0.000 (0.03)
Care	0.43 ⋆⋆⋆	−0.001 (0.03)
Fairness	0.30 ⋆⋆⋆	−0.001 (0.03)
Loyalty	0.44 ⋆⋆⋆	0.000 (0.03)
Authority	0.41 ⋆⋆⋆	−0.001 (0.03)
Purity	0.40 ⋆⋆⋆	0.000 (0.03)
Binder	0.46 ⋆⋆⋆	0.000 (0.03)
Individualism	0.38 ⋆⋆⋆	0.000 (0.03)

Note: We report the median and interquartile range of the Kendall's tau correlation values obtained when we shuffle the responses in the traditional and FB cohorts for all the individuals 1,000 times. The difference between the actual correlation value and the randomised experiment sustains the claim for self-consistency between traditional and Facebook-administered surveys. Note that, '⋆⋆⋆' indicates p-value < 0.001.

4. Limitations

Understandably, this study entails a series of limitations; first and foremost, our sample is from a young population in Italy. Apart from the geographical and cultural effect, young people are more at ease with sharing their private information (Anderson and Rainie 2010; Burkell et al. 2014; Kezer et al. 2016). At the same time, since they have already participated in a traditional survey, they are accustomed to taking questionnaires regarding their personal and demographic attributes. Since our initial cohort is representative of the Italian youth and the recruited population on Facebook closely follows the same demographic characteristics, we claim that a participant that is recruited on Facebook follows the demographics of the population under investigation. We are able to make claims only about the people that are part of our cohort though, and we cannot draw conclusions on the average Facebook user, who does not fall under the scope of this study. Given the limited size of our cohort (approximately 4,000 participants), our findings are to be interpreted with caution. Moreover, we acknowledge that the initial survey might be subject to the same methodological biases of every survey (Groves and Lyberg 2010; Olteanu et al. 2016), which, are beyond our control; the same holds for the recruitment and the follow-up survey.

5. Conclusions and future directions

Since the 2000s, the massification of the internet has brought significant advantages to the collection of research data, in terms of enrichment and diversity of data, while at the same time reducing the research costs. Social sciences are shifting into employing social media as both behavioural proxies and surveying tools, complementing existing practices and providing new insights into complex societal questions. The core contribution of this study is the systematic assessment of biases entailed in data obtained from surveys administered on social media platforms and in particular Facebook. We focused on differences in demographic and psychometric attributes that might indicate (1) population, (2) self-selection in the recruitment phase; and (3) behavioural biases.

The major shortcoming of this study is the limited size of our cohort (4,000 people on the initial survey and 988 people on the FB survey), and the focus on a specific geographic location and age range. Given this limitation, our findings suggest that the population that chose not to proceed to the Facebook-administered survey does not exhibit major deviations with respect to the population of the traditionally managed survey in terms of neither demographics nor psychometric attributes. Consequently, we conclude that this evidence supports the claim that self-selection biases of the Facebook platform are negligible.

Conversely, when carrying out surveys on Facebook, population and behavioural biases are to be taken into account. In terms of population biases, when we analysed the personality traits (Big5) of the sample that declared not to maintain a Facebook profile, we found these participants to be more introverted, conscientious, and neurotic than those who do use Facebook. Regarding behavioural biases, some small, yet statistically significant, behavioural differences emerged between the responses in the traditional and the Facebook-administered surveys. When on Facebook, participants rated themselves as more loyal, authoritative, and more fond of social binding values, which may indicate that engaging in a social media platform like Facebook affects the individuals' behaviour reflected by their self-reporting.

This study contributes to the limited body of research on this arising issue, with an empirical assessment on population, self-selection, and behavioural biases present in surveys administered on social media. The results obtained from Facebook-administered surveys are similar to those of the traditional surveys in terms of basic demographic and psychometric attributes. Moreover, given the cost-effectiveness of the platform, such surveying approaches can supplement the traditional demographic and sociological practices in addressing research questions in a more timely manner and on a grander scale. Keeping in mind the limitations of our study and the observed biases, our findings suggest that the Facebook platform can be employed as a potent research tool to administer social and psychometric research surveys; because the character of the Facebook platform is not entirely neutral.

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