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Investigating the social, economic and political consequences of the COVID-19 pandemic: A rolling cross-section approach

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In this article, we present an application of the rolling cross-section (RCS) design to monitor changes in public opinion during the COVID-19 pandemic in Italy (ResPOnsE Covid-19 project, University of Milan Statale). The RCS is a dynamic survey tool used predominantly in the analyses of public opinion during electoral campaigns. Because of its dynamic nature, we argue that it is an ideal instrument to monitor public opinion during a pandemic. Specifically, we present an RCS online survey implemented in Italy from April to July 2020 and we present some illustrative analyses of changes in behaviors, attitudes, and opinions during the Covid-19 crisis to highlight the potential of the design. Ultimately, we assert that RCS surveys could be very powerful instruments to inform policy makers of the dynamics of public opinion during a crisis, especially when inserted within existent high-quality survey infrastructures.

Keywords: COVID-19, survey methods, dynamic analysis, rolling cross-section, policy-making

1 Introduction

The global COVID-19 pandemic is not only a health emergency. It encompasses all levels of societal life. The main challenge for social sciences in this time is to detect and understand social, economic and political consequences of this crisis and, in fact, we have witnessed a proliferation of both national and international social research projects aimed at analysing the effects of the pandemic from different perspectives[1]. In this framework, survey research plays an important role in monitoring public opinion, and many surveys were launched on social media platforms and carried out by academics or professional companies throughout the emergency period. Most of them have taken a cross-sectional approach, by producing snapshots of national and global public opinions[2].

Nonetheless, the spread of the novel Corona-virus SARS-CoV-2 is evolving rapidly as well as the measures taken to contain it. In the lapse of a couple of months—from the first half of March to the first half of May 2020—most countries in the world went from a normal situation to a total lockdown and then to a gradual lifting of restrictions. Since the pandemic is a dynamic phenomenon, the tool to study its effects should consider and account for its nature explicitly.

A powerful research tool that allows monitoring short-term dynamics in public opinion is the rolling cross-section (RCS) design, which was introduced to study electoral campaigns (Brady & Johnston, 2006; Johnston & Brady, 2002; Kenski, 2006). The design consists of collecting standardized interviews on independent daily samples during a certain time-span. Unlike other cross-sectional survey designs, RCS has the big advantage of capturing daily variations in public opinion. Despite this significant advantage, such a design remained neglected beyond electoral studies[3].

In this article, we propose the RCS as a design perfectly

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[1] https://wprn.org/worldwide

[2] https://wapor.org/resources/covid-19-public-opinion-research

[3] Among the rare exceptions, Donahue et al. (2014) and Volinsky, Kranzler, Gibson, and Hornik (2018) report the use of RCS survey data, respectively, to estimate the effectiveness of influenza vaccines and to monitor support towards a policy proposal of increasing the age requirement for tobacco purchase. Notwithstanding, in both cases the design of the surveys was not a typical RCS one, as data collection took place every week and every quarter, respectively.

suited to study the unfolding of public opinion during large-scale dynamic processes, such as pandemics. We then provide an application of this design to the study of the social, economic, and political consequences of the COVID-19 crisis. The research has been implemented in Italy, one of the countries most severely hit by the pandemic, in the period from April to July 2020 (ResPOnsE COVID-19 project, University of Milan). In addition, we suggest that by integrating a longitudinal dimension to the study (i.e. follow-up panel waves) this project can serve as the basis for the establishment of a research infrastructure meant to monitor public opinion in the medium-long term, with the aim of informing policy-makers.

2 The rolling cross-section design

A rolling cross-section survey is a survey carried out on a cross-sectional sample of respondents. The sample is then further divided into several independent sub-samples fielded in different consecutive days, typically during an electoral campaign. Thus, for each day of the campaign, a sub-sample of individuals coming from the overall sample receives an invitation to answer a survey (Brady & Johnston, 2006; Johnston & Brady, 2002; Kenski, 2006).

Originally, RCS electoral surveys were carried out through telephone interviews (CATI) but, in recent days, they are increasingly realized by means of online interviews (CAWI)[4]. The online mode does not only affect costs: it also allows a full-fledged implementation of the RCS design. In fact, the respondent is not bound to answer on the day of the invitation, but she could answer also on the following days. Unlike CATI, there are no managing costs in online surveys related to maintaining the daily samples open as long as necessary for the respondent to answer the questionnaire[5].

One could argue that different response styles, such as the speed of reaction to the invitation to participate in the survey, could lead to sample bias. However, after a take-off period of a few days, the composition of daily samples stabilizes, being each sub-sample approximately made up of comparable proportions of "fresh" and "old" invitees (Lutz et al., 2013, p. 17)[6]. In this way the sample is actually rolling, assuring the additional value of an RCS design: the time of the interview becomes a random variable.

Once the RCS design is applied properly, there is another important derived property, which is independence among all sub-samples. This guarantees the comparability of the daily samples over time and the possibility of aggregating daily samples in larger ones, maintaining the property of independence (e.g. in weekly samples).

Given that data collection usually takes place in a broad time span[7], the original sample should be sufficiently large to avoid the issue of the "small n" of daily samples and to obtain sufficient statistical leverage to dynamic analyses. However, this requirement is often conflicting with other constraints, such as the capacity of the institute in charge of the data collection and the research budget (Kenski, 2006).

3 The application of the RCS design to monitor the COVID-19 crisis

The characteristics of the RCS design make it completely adequate to monitor public opinion during the COVID-19 pandemic. The nature of the phenomenon is dynamic, as each element of the COVID-19 conundrum changes over time and is interrelated to the others. Indeed, the spread of the pandemic influences governments' and citizens' responses, that in turn affect the spreading of the virus, and governments themselves influence public opinion and the other way around. Moreover, the pace of change is very quick, with the number of contagions, hospitalizations and deaths, as well as governmental policies and public opinion response, progressing day by day. Thus, the study of a phenomenon with daily dynamics needs a tool able to detect daily changes.

We thus developed an RCS survey to monitor changes in public opinion in Italy, the first country where the virus spread beyond Asia and reached pandemic proportion (Remuzzi & Remuzzi, 2020).

Here the timing plays a relevant role, given the suddenness of the outbreak and the need to be timely with data collection. We started defining the design and the organization of the fieldwork on March 13th, 2020, and we were in the field on April 6th. The survey is planned to continue for 90 days (3 months) in order to monitor the descending curve of contagions until stabilization, being the peak predicted between the end of March and the beginning of April (Remuzzi & Remuzzi, 2020; Sebastiani, Massa, & Riboli, 2020).

We aimed at collecting interviews on daily sub-samples of approximatively 140 to 150 respondents, that is about 1000 interviews per week, when fully operational after the take-off phase. By estimating a response rate of roughly 35%, our initial sample counted 38.000 individuals, subsequently di-

[4]See RCS surveys carried out within the National Annenberg Election Survey 2008 (Johnston, 2008), the Italian National Election Study 2013 (Vezzoni, 2014), and the Election Study Baden-Wuerttemberg 2011 (Faas & Blumenberg, 2012).

[5]In contrast, CATI requires a very high number of calls to obtain an interview: for example, Lutz, De Rocchi, and Pekari (2013) show that over 50% of interviews in the Swiss RCS electoral survey 2011 required at least eight calls.

[6]To avoid biases, previous research suggests excluding from the analysis observations collected during the first days until the composition of the daily samples becomes balanced between "fresh" and "old" respondents (Hagen, Johnston, Jamieson, Dutwin, & Kenski, 2000).

[7]Typically, during the electoral campaigns ranging from one to three months (Brady & Johnston, 2006; Lutz et al., 2013; Schmitt-Beck, Faas, & Wolsing, 2010; Vezzoni, 2014).

vided in 90 sub-samples, each of them associated with a day of the fieldwork period. Each respondent is associated with an email address where she receives an invitation on the day associated with her sub-sample. The invitation remains valid until the end of the fieldwork, while on the second and fourth day after the first invitation the individual receives a reminder to answer, in case she has not done so yet. Excluding a take-off period of a week, our daily samples were composed by 69% of individuals answering the same day of the invitation, 9% the second day, 9% the third day and the remaining 12% later days. The response rate was 47% and between April 6th and May 10th we collected 5700 interviews.

The sample was drawn from the opt-in online community of a commercial research institute (SWG S.p.A), stratifying by macro-area of residence and, subsequently, quoting by gender and age class. As for any non-probabilistic sampling, representativeness is a major concern, together with the fact that online surveys systematically suffer from a coverage error as the target population is only made by individuals with internet access (Couper, 2000). Nonetheless, the increasing levels of internet penetration are gradually reducing the gap. Furthermore, recent research shows that high-quality opt-in online surveys provide estimations as accurate as the ones produced by telephone surveys using Random Digit Dialing sampling technique (Ansolabehere & Schaffner, 2014). As we needed to be very timely in the implementation of the survey, but we could not rest on an existent online survey infrastructure based on probabilistic selection, the sample is inevitably biased on certain individual characteristics, such as education and interest in politics. Therefore, point estimates of the data cannot be generalized to the Italian population. However, the main aim of our instrument is to monitor the dynamics of certain phenomena over time. Since daily samples are independent, and the time of the interview represents a random variable, the variation of a quantity over time is assumed to reflect a variation in public opinion.

A *post-hoc* analysis of the design shows how closely it fits all the requirements suggested by the World Health Organization to develop instruments to monitor the COVID-19 emergency at the societal level. In fact, the tool is evidence-based; can be rapidly and regularly applied; is simple and flexible to adjust to the changing situation; and is low cost and cost effective[8]. The match with the first two requirements is self-evident. As far as the third one, *ceteris paribus* CAWI is generally more convenient than other data collection modes. Simplicity and flexibility are illustrated below in the description of the questionnaire.

4 The questionnaire

The COVID-19 ResPOnsE questionnaire—which requires between 20 and 25 minutes for completion—consists of two sections: a core questionnaire, running through all the fieldwork, and a varying section, allowing for rotating modules fielded for shorter periods.

The core questionnaire includes several modules, which cover topics such as behaviour compliance (e.g. staying at home, social distancing, wearing masks); attitudes towards the economy and media use; evaluation of the government and trust in institutions; perception of the risks related to the COVID-19 crisis; personal well-being; opinions about science and political attitudes. The core questionnaire also includes a socio-demographic module including age, gender, position in the household, region of residence, employment status, level of education and feelings about household income.

The varying part, approximately 15% of the questionnaire, allow for the inclusion of rotating modules with a focus on specific topics (similar to the European Social Survey rotating modules) or the insertion of single questions on issues emerging in the public debate during the unfolding of the COVID-19 emergency. The first rotating module was fielded starting from the 17th of April 2020 and addressed issues related to religious attitudes, behaviour and beliefs before and after the onset of the COVID-19 health crisis. Additional models are planned for the remaining of the fieldwork and include: i) attitudes toward European solidarity; ii) the trade-offs between economy and health; iii) the socio-economic costs of the crisis with a focus on gender.

Overall, the questionnaire follows the suggestions of the World Health Organization in terms of both covered topics and flexibility of the instrument that can be forthwith adjusted to the changing situation (WHO, 2020).

5 Illustrative results

The RCS design assures a fine "granularity" of the sample that is spread all over the observation period. Thanks to this peculiarity, RCS data allows capturing the potential impact of selected events[9] by looking at the dynamics of certain phenomena over time at the aggregate-level. In this respect, there are two main kinds of analyses that an RCS approach permits. In its simplest formulation, RCS data allow analyzing the dynamics of the mean (or a proportion) of one or more variables by applying smoothing techniques (Krewel, Schmitt-Beck, & Wolsing, 2011; Ladini, 2020; Lanz & Sciarini, 2016), also distinguishing among certain individual characteristics (Johnston, Thorson, & Gooch, 2010; Vezzoni & Mancosu, 2016). The second set of analysis allows exploiting one of the main strength of RCS data, namely, the possibility of linking daily survey data with contextual data, such as daily media content (Johann, von Königslöw, Kritzinger, & Thomas, 2018; Tresch & Feddersen, 2019) and other contextual variables that can meaningfully vary during

[8] See WHO tool for behavioural insights on COVID-19 (WHO, 2020).

[9] For instance, tv debates in the study of electoral campaigns

the period of data collection. RCS data can be also aggregated to measure the public opinion climate and to represent an independent contextual variable (Vezzoni & Mancosu, 2016). In this respect, multilevel models can be employed to test whether contextual variations related to the unfolding of time affect individual attitudes and behaviours and their relation with other individual properties.

What follow are three examples of the potential of the RCS design to dynamically analyse individual behaviors, attitudes, and opinions during a central phase of the Italian COVID-19 crisis going from April 6th to May 10th. In each example we highlight three key moments that may have had a profound impact on respondents' behaviour and attitudes: i) Easter, celebrated on April 12th, holiday period; ii) A press conference that took place on April 26th when the Italian Prime Minister Giuseppe Conte announced that the total lockdown would end on May 4th and illustrated what measures would be in place to limit the spread of the virus thereafter (so called "phase 2"); iii) May 4th as the beginning of the second phase which involved the staggered re-opening of factories and allowed people to go visit relatives and go outside for physical exercise.

Figure 1 shows, separately for women and men, the changes over time of four of the main obligations that characterized the first phase and that have been relaxed starting from May 4th. Overall, women appear to comply to the rules more than men. Individual compliance regarding the avoidance of public places and the recommendations of washing hands frequently decreased monotonically over time, whereas social distancing remained rather stable among both women and men. In contrast, men and, to a greater extent, women became more likely to wear masks and gloves as the crisis unfolded and the use of such devices in public became compulsory in many regions.

Figure 2, instead, shows the change over time in opinions regarding what the government should do concerning the restrictions, plotted together with the percent of new COVID-19 cases recorded on the day. The graph clearly shows that, together with the amelioration of the emergency situation (measured by the declining percent of new cases), respondents have decidedly turned towards asking for less restrictions, with a notable anticipation effect with respect to the press conference of April 26th. Interestingly, opinions stabilize from April 26th onward, as the share of respondents asking for further reducing the restrictions remains constant after the press conference. However, in the last week of the survey fielded after the onset of phase 2 on the May 4th, we observe a decline in the percentage of subjects asking for a decrease in the restrictions and, conversely, a growth in the percentage of subjects who would like to see the restrictions increase. This could suggest that the measures put in place by the government to limit the spread of the virus in the second phase might not be considered fully adequate by the respondents.

Finally, Figure 3 reports the percentage of subjects—broken down by macro area of residence—who think that the risk of contagion in their macro-region is higher compared to the rest of the country. The distinction between areas is informative because the COVID-19 outbreak began in the North of the country, the area that is still most affected by the health crisis at the time of the writing. The different diffusion of the virus is represented on the graph by the number of new COVID-19 cases averaged in the respective area. As can be seen, the perception of the risk of contagion is coherent with the actual presence of people affected in the area. For the North, the perception of risk increased rapidly at the beginning of the observed period when COVID-19 cases grew very rapidly, and then failed to decline at a similar pace as the rate of contagion decreased, thus suggesting that the perception of risk is elastic to the worsening of the situation and inelastic to improvements to it. The perception of risk is instead much lower and more stable in the Center and South, which throughout the period registered considerably less cases of COVID-19.

Conclusions

If there is a lesson to be learned from the COVID-19 pandemic, it is that measures to contrast the spreading of the new, highly contagious disease by central and local governments are subject to great uncertainty, because little is known of the virus at the biological, epidemiological, as well as medical level, especially during the first few months of the contagion. In open societies, this condition exposes decision making to the influence of political debates, competition between governments and oppositions and to divergent evaluations within public opinion. As a result, the adopted measures are heterogeneous, sometimes even contradictory, and their timing changes not only according to the trend of the contagion in different areas or countries. Learning more about the virus and the related disease can obviously reduce uncertainty. However, this is only part of the equation bringing to the definition of effective measures. The reception of the public, its support and compliance with these measures, as well as its acceptance of the costs of the fight, have an important role in the success of authorities' strategies to contrast the wicked consequences of the virus at all levels, from public health to social cohesion and economic performance. Thus, having a reliable instrument to monitor the evolution of public opinion since the debut of the epidemic can help policy makers to understand the feasibility and effectiveness of different measures and to increase the chances of their success. In this article we showed that, given the dynamic nature of the COVID-19 pandemic, the rolling cross section (RCS) is an effective design to monitor public opinion in the short term of the unfolding of the crisis. In addition, RCS surveys fulfill the requirements stated by the WHO for social research

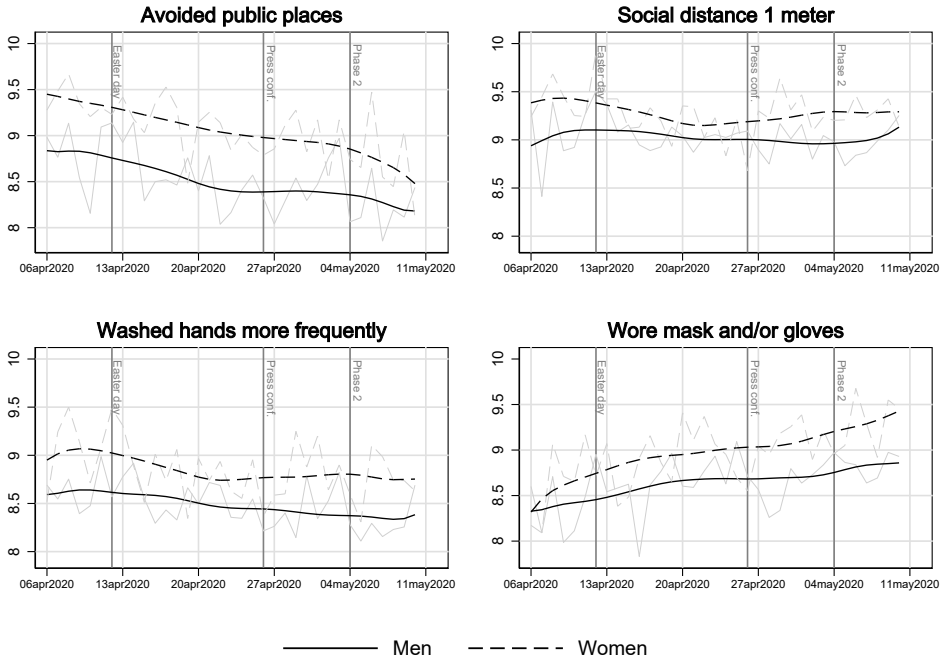

Figure 1. To what extent do the following activities correspond to your behaviours in the past seven days? Answers range from 0 "Does not correspond at all" to 10 "Corresponds completely". Daily mean in compliance and LOWESS smoothing (bandwidth=0.6) by gender.

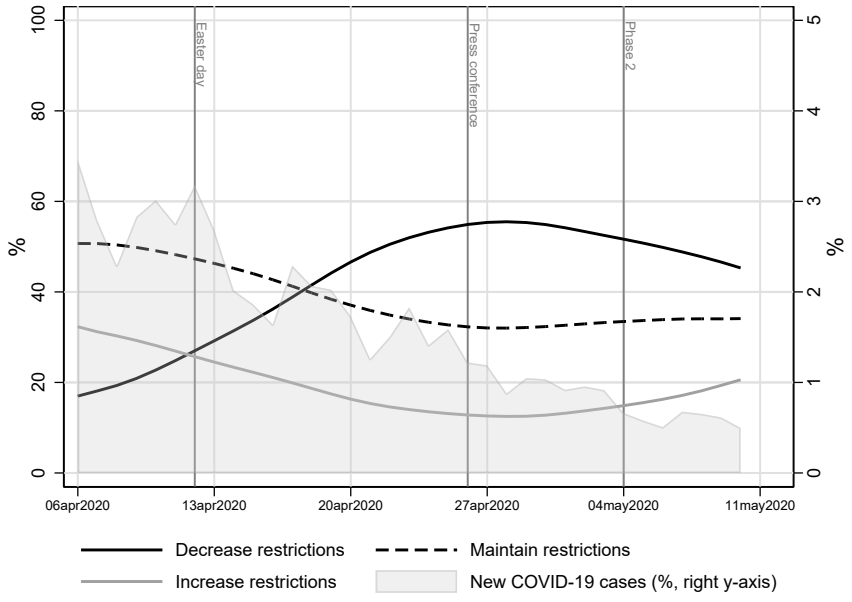

Figure 2. In your opinion, what should the government do now? Decrease, maintain or increase restrictions? Daily percentage of responses with LOWESS smoothing (bandwidth=0.6).

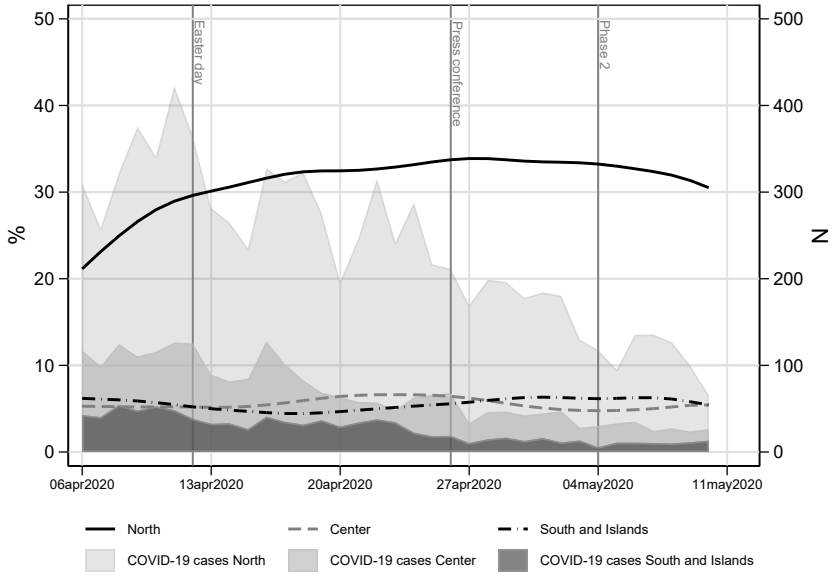

Figure 3. "Do you think that people living in your area are more or less exposed to contagion compared to the majority of the national population?" Lines indicate the percent of subjects feeling more or much more exposed by area with LOWESS smoothing (bandwidth=0.6). Shaded areas indicate the number of new COVID-19 cases occured on the day of the interview in each area (right y-axis).

on pandemics.

One could wonder whether a short-term panel design could represent an alternative to our proposal. Previous experiences show that an RCS overperforms a panel design in detecting the short-term variability of public opinion during a period characterized by several events, which can potentially lead to a rapid change in attitudes and behaviour. As Lutz et al. (2013, p. 4) point out, in panel surveys "the timing of the waves cannot be planned in a way that captures all the main campaign events, as it is not necessarily known in advance what the important campaign events will be". In the case of a pandemic, where the potential effects at the societal level could last even beyond the acute phase, the RCS design can be combined with follow-up panel waves re-interviewing the same respondents participating in the RCS. This allows the study of both individual- and aggregate-level variation over time in the mid- and long-term.

Finally, this article is also a plea to call for the development of social research infrastructures meant to monitor social change, constantly and frequently. Years before the COVID-19 crisis, Gates (2015, p. 1384) warned that "there are still big holes in the world's ability to respond to an epidemic". Unfortunately, this pandemic has shown that he was right. As social scientists we must realize that this warning does challenge our discipline and its responsibility to supply a timely understanding of societies in times of unexpected crisis.

In this article, we proposed a strategy to achieve this goal under emergency. Although we matched most of the requirements of the WHO for COVID-19 related behavioural research, we are aware that our solution was in many concerns sub-optimal. The existence of an established infrastructure would have assured faster implementation and higher quality selection of the respondents. An additional cross-national coordination would have enhanced comparability and cumulativity of the results. These are the main lessons from our experience in the broader context of social sciences and an indication for future commitments of our discipline.

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Commentary

I am sympathetic to the idea of a rolling design, which is probably not surprising since we are applying a rolling design ourselves (but in an existing probability-based panel, rather than in sequence of cross-sections). I also agree with the plea by the authors "... to call for the development of social research infrastructures meant to monitor social change, constantly and frequently."

There is great value in having an infrastructure in place that monitors developments continuously. One important aspect of this, is the availability of baseline information from before the emergence of an event. In this case, such baseline information is missing since the surveys started on April 6, well after the COVID-pandemic had hit hard. For monitoring the evolution of public opinion during the pandemic, this may be less of an issue, but a full-fledged social observatory should probably also cover many other aspects, such as effects on physical and mental health, financial and labor market consequences, etc. For all of that, measurement before the start of the pandemic would be invaluable.

Although the purpose of the paper is clearly more to illustrate the benefits of a rolling design than to explain in great detail the sampling, survey design and weighting, the use of an opt-in panel does raise questions about its representativeness of the population as a whole. The authors simply accept the sample for what it is, and do not claim representativeness, except for assuming that the dynamics observed within the sample may be representative of the dynamics in the population at large. That is however only an assumption that cannot be verified.

It is not clear on what basis the sample size was chosen. The paper mentions 140-150 respondents per day. It would be nice to see standard errors or confidence intervals (even if we ignore the fact that the observations are not from a random sample of the population). The top-panel of Figure 1 suggests substantial variation of responses day-to-day and the smoothed graphs have no confidence intervals, so it is hard to know if the trends in the figures are real or just reflect some random variation that gets smoothed out by the LOWESS procedure.

This may all be too much nitpicking of an interesting approach that has potential for considerable generalization. However, returning to the plea by the authors for the development of social research infrastructures to monitor social change, such an infrastructure has maximal benefits if data are freely available to the research community at large. This enhances opportunity for replication and taps into the research capacity of the wider community. This leads to my only major quibble with the authors. Why would the data only be available "after a limited embargo period"? Actually, why not make the data available before the end of the field period? Give everyone a chance to peer into the social laboratory.

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