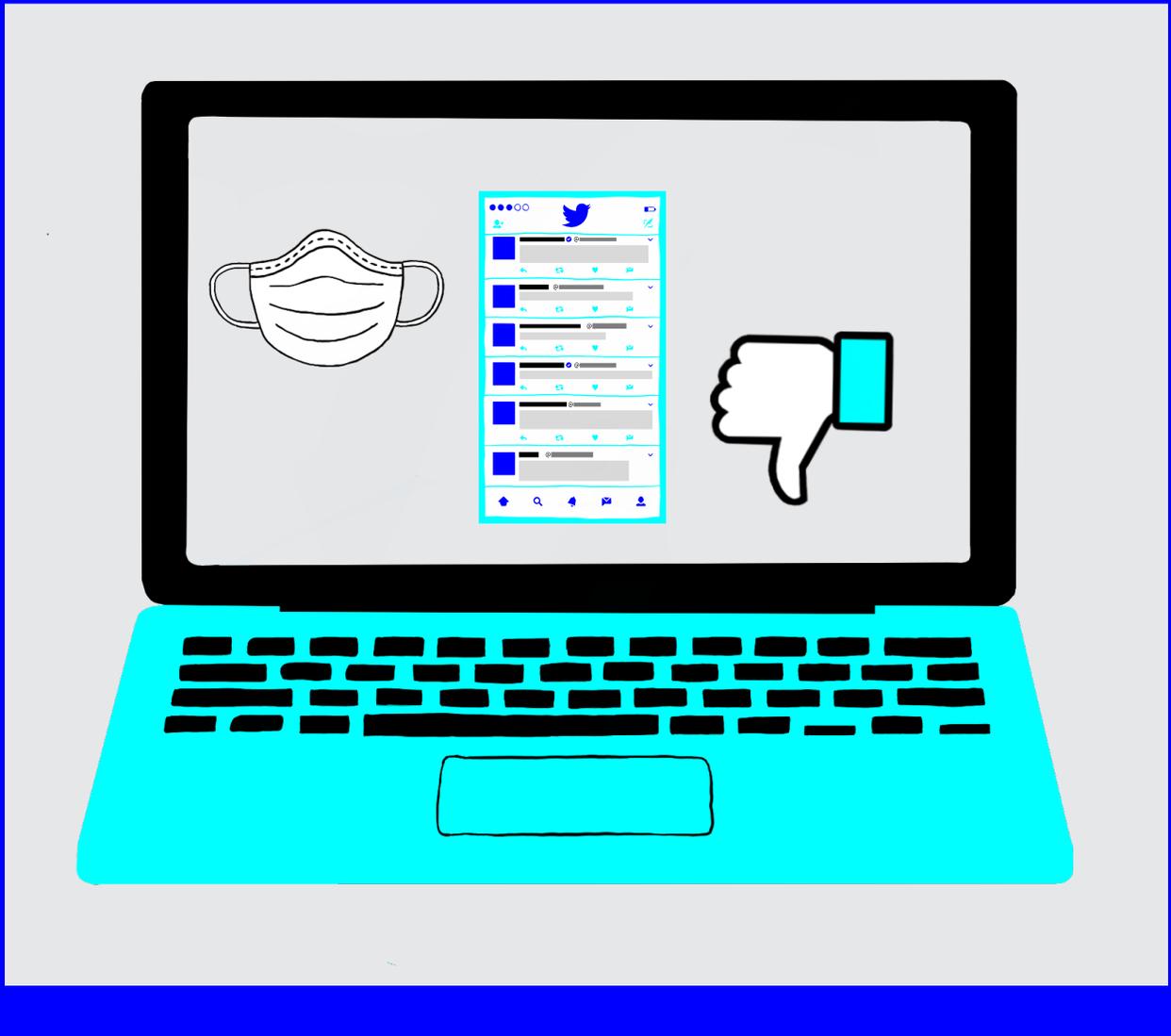


Understanding vaccine hesitancy in Canada: attitudes, beliefs, and the information ecosystem

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Description & Acknowledgements



The Media Ecosystem Observatory (MEO) is a joint effort of labs at McGill University and the University of Toronto. Together, the Centre for Media, Technology, and Democracy (McGill), the Network Dynamics Lab (McGill), and PEARL (the Policy, Elections, and Representation Lab, Toronto) produce work examining the relationships between information and media ecosystems and citizen behavior. MEO's three principal investigators are Taylor Owen, Derek Ruths, and Peter Loewen.

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Executive Summary

SUMMARY OF FINDINGS

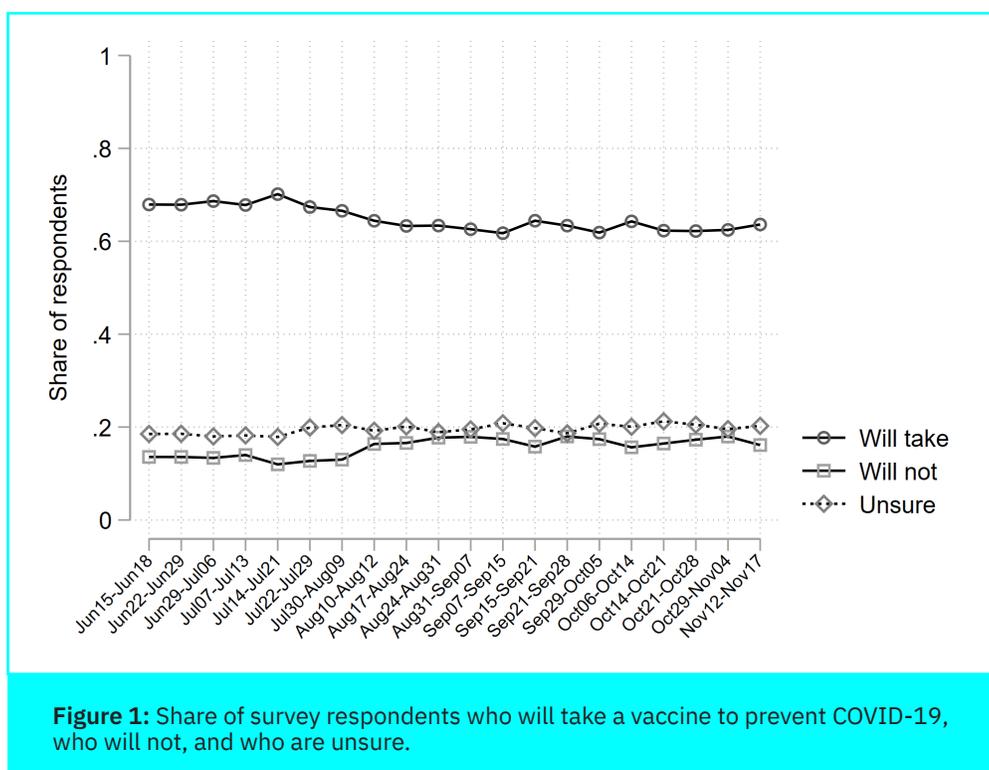
- 65% of Canadians intend to take a vaccine, with some slight erosion since a high in July. Approximately 15% of Canadians are unwilling and 20% are unsure.
- Our best opportunity to reach those who are unsure is to address important concerns around the safety and effectiveness of the vaccine.
- Among those who do not plan to take a vaccine, many also believe that COVID-19 is not a serious threat. It will be very difficult to convince these individuals to take a vaccine. The efficacy, safety, country-of-origin, type of vaccine, and other characteristics of a hypothetical vaccine simply do not matter to this population, whereas for other Canadians these characteristics are critical for their decision to vaccinate or not.
- Canadians are increasingly talking about vaccines on social media. The overall positive sentiment that health officials have promoted regarding vaccines hasn't taken hold in these conversations, however.
- There is minimal coverage of vaccine conspiracies in Canadian mainstream media. Instead mainstream media coverage has focused on stories about development, provision, and access, with wide scale vaccination highlighted as the solution to the pandemic.
- Despite this positive coverage, vaccine-related stories from independent outlets have appeared on social media that more heavily feature conspiratorial thinking and cynicism about vaccines. This type of content tends to elicit stronger and more emotional responses from Canadians, which may cause this content to spread more widely and rapidly on social media platforms.
- The vaccine conversation on social media largely originates from U.S.-based discussions. Canadians on social media are heavily influenced by U.S.-based information and are far more likely to propagate non-Canadian content. This flood of U.S.-based information represents a unique Canadian vulnerability, where Canadian elites, medical professionals, scientists, and journalists may be comparatively less able to reach and inform Canadians.

SUMMARY OF DATA

- Surveyed 39,297 Canadians from June to November on attitudes related to vaccines
- Analyzed 277 million posts from the most vocal Canadians on Twitter, 204 Reddit communities, 7,838 Canadian Facebook pages and groups, and 4,774 news articles shared on social media platforms to understand the vaccine conversation in Canada

Trends in Vaccine Hesitancy

Our project has been tracking the public’s willingness to take a SARS-CoV-2 vaccine since June. We ask respondents the following question: “Would you take a vaccine to prevent COVID-19 infection once it becomes available?” (Response categories: Yes, No, Unsure). Across all of our survey waves (N=39,297), 65% of Canadians are willing to take such a vaccine, with 15% unwilling and 19% that are unsure. We plot average responses on this question over the course of our fielding in Figure 1.



We have seen some slight erosion in the public’s willingness to take a SARS-CoV-2 vaccine, reaching a high watermark of 70% for the survey wave between July 14 and 21 and falling to a low of 62% in early September. The public’s willingness to take a vaccine has since stabilized. In Figure 2 below we plot the share of respondents who will take the vaccine by education (no bachelor’s degree vs. bachelor’s degree or higher), age (18 to 34 vs. 55 or older), gender, urban density, region, and importance of religion. There are baseline differences between these groups – which are discussed more below – but no notable differences in over time dynamics.

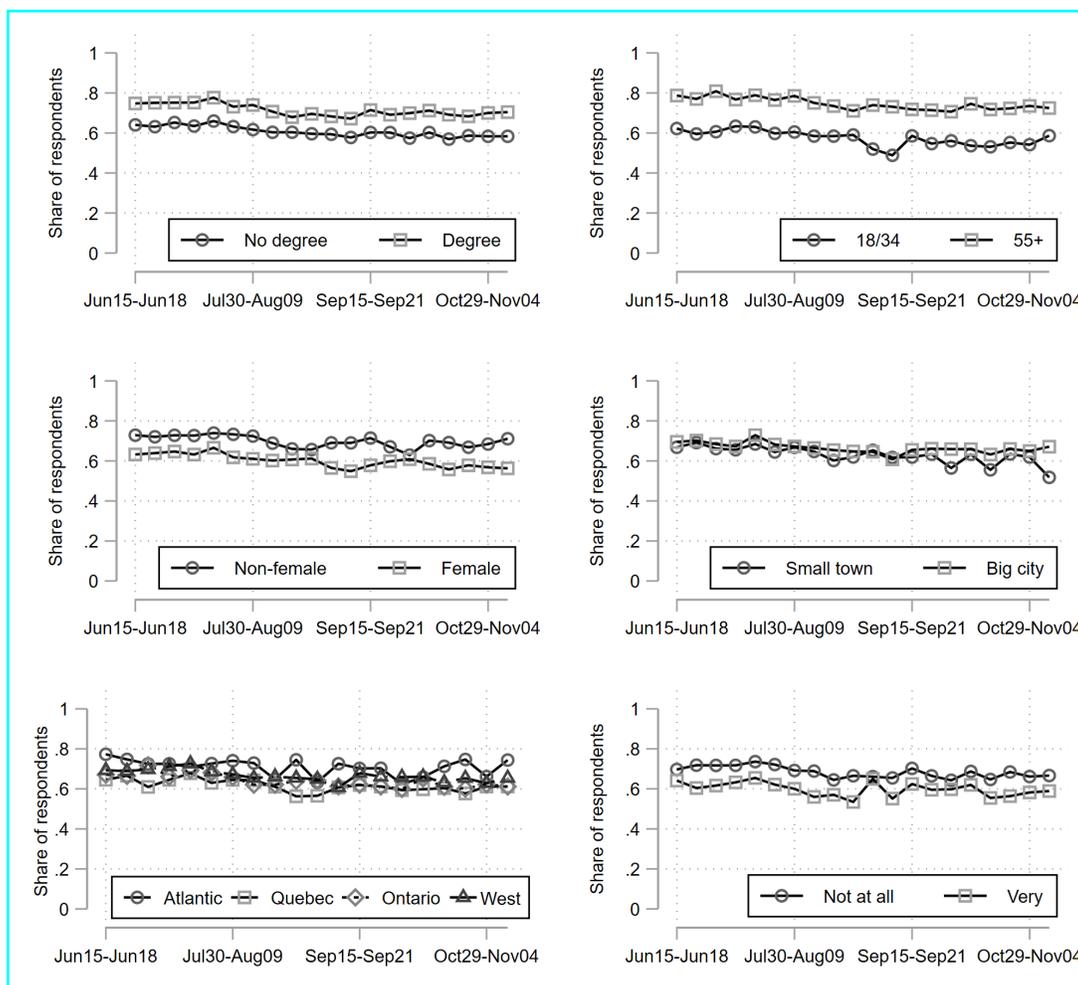


Figure 2: Share of respondents who will take a vaccine to prevent COVID-19 by demographic group: education (top-left), age (top-right), gender (centre-left), residence (centre-right), region (bottom-left), importance of religion (bottom-right).

Reasons for vaccine hesitancy

There appears to have been some softening of prospective vaccine uptake since the summer. In survey waves 22 through 28 (N=11,034) conducted between September 21 and November 17, we asked respondents who indicated either an unwillingness to vaccinate or uncertainty as to whether they would vaccinate the following question:

“You reported you [*do not intend on getting/are not sure as to whether you will get*] vaccinated against COVID-19 once it becomes available. Why is this the case? Please select all that apply” (Response categories: The vaccine won’t be safe; The vaccine won’t be effective at stopping the disease; I will not be able to access a COVID-19 vaccine; COVID-19 is not a serious enough health risk to warrant vaccination; I already had COVID-19 and recovered; Other; Unsure).

The responses are shown in Table 1 (N=4,052 who are vaccine hesitant). Important differences emerge between those who are set against taking a vaccine and those who are unsure. Among those who won’t vaccinate, nearly half (46.4%) identify safety as one reason. A third (32%) indicate a belief that the vaccine will be ineffective, and one-in-five indicate that COVID-19 is not a serious enough health risk. Importantly, only 8% of these respondents choose all three of these reasons.

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Table 1. Reasons for vaccine hesitancy

Reasons for vaccine hesitancy	% of respondents who...	
	will not take the vaccine	are unsure if they will take vaccine
Unsafe	46.4	35.4
Ineffective	32.2	22.9
No access	8.4	5.6
COVID-19 is not a serious enough health risk	22.8	5.7
Already had COVID-19	2.6	1.0
Other	14.3	18.2
Don’t know	13.3	34.9
N	1,860	2192

Correlates of vaccine hesitancy

Among those who are uncertain, 35% indicated a concern about safety and 22% expressed reservations about a vaccine's effectiveness. 35% reported uncertainty as to the reason for their hesitance. There is, in sum, a notable difference within those currently unwilling to take a vaccine. Those who are set against a vaccine have a larger set of reasons for their resistance, while those who are unsure appear more genuinely uncertain about the reasons for their opposition.

The reasons people provide for their unwillingness to take a SARS-CoV-2 vaccine are only somewhat informative. That people are concerned about the safety and efficacy of a vaccine does not help us explain how they arrived at those concerns to begin with. To understand what has generated these views, we focus on three sets of explanatory factors.

First, there may be important demographic differences. Individuals with higher levels of education are likely to be more trusting of science and aware of the benefits of vaccination. Previous research has found religiosity to be correlated with vaccine hesitancy (Reuben et al. 2020). We may also expect people most at risk of complications from infection or more exposed to infection to be more willing to take the vaccine and accept its risk, such as older citizens and those in denser urban areas. Individuals with children in their household may be more supportive of vaccination as a means of keeping schools open.

Second, we might anticipate information sources to have important influences on COVID-19 vaccine uptake. Our analysis suggests news media coverage of SARS-CoV-2 vaccines has been broadly positive. We thus might expect news consumption to be positively related to vaccine uptake. Previous work by our research team has shown COVID-19 misinformation to be prevalent in certain social media platforms (Bridgman et al. 2020), so we might expect the opposite for social media usage.

Lastly, we expect certain predispositions to strongly shape vaccine hesitancy. Our research has shown anti-intellectualism or a lack of trust in experts to be an important factor in COVID-19 risk perceptions and the public's willingness to adopt masks and to engage in social distancing (Merkley and Loewen 2020). COVID-19 conspiracy theories have spread throughout the pandemic (Uscinski et al. 2020), some of which involve vaccines (Miller 2020). One's propensity to engage in such thinking may increase hesitancy. Cognitive sophistication or science literacy are important factors in shaping COVID-19 risk perceptions (Pennycook et al. 2020). They might reduce vaccine hesitancy as well. Finally, there is the possibility that vaccine adoption has become polarized along partisan or ideological lines. Although political elites have been united in Canada on the science of COVID-19, we nonetheless see evidence of modest ideological polarization on a number of dimensions (Merkley et al. 2020; Pennycook et al. 2020).

We estimate three models pooling across our survey waves. The first model includes demographic characteristics alone. The second includes our attitudinal and information variables along with demographics. The third includes an index of vaccine hesitancy and COVID-19 risk perceptions since we expect our predispositions to influence vaccine uptake through overall vaccine hesitancy and perceptions that COVID-19 is a threat. In other words, anti-intellectuals, conservatives, and those with less understanding of science are both more likely to be skeptical of COVID-19's threat and more likely to endorse skepticism towards vaccination as a health intervention, which in turn influence their decision to take or refuse the COVID-19 vaccine. We control for region and gender in all models, and control for political discussion and generalized trust in models 2 and 3. Descriptions of all variables can be found in Table A1 in the Appendix. Our vaccine hesitancy scale is only included in the last three waves, so model 3 only utilizes these data.

Figure 3 provides a plot of the estimated coefficients of our models. The left panel provides the coefficient estimates for the demographics-only model, while the right panel contains the estimates for models 2 and 3. They can be interpreted as the effect of going from the minimum to the maximum on each explanatory variable on the share of people willing to take a SARS-CoV-2 vaccine. We describe our results for demographics first (left panel), followed by our other variables (right panel).

As expected, those with a bachelor's degree or higher are 17 points more likely to take the SARS-CoV-2 vaccine ($p < 0.001$). Individuals who view religion as very important in their lives are 9 points less likely to take the vaccine than those for whom religion is not important at all ($p < 0.001$). Age is associated with vaccine uptake ($p < 0.001$). Every twenty year increase in age is associated with an 8 point increase in willingness to take the vaccine ($p < 0.001$). Individuals living in big cities are 6 points more likely to take the vaccine than those in rural areas ($p < 0.001$). Interestingly, women are 6 points less likely to take the vaccine ($p < 0.001$) and surprisingly individuals with kids under the age of 15 are 1.5 points less likely to take the vaccine, though this effect is substantively very small ($p < 0.05$). Atlantic Canada also leads in willingness to vaccinate.

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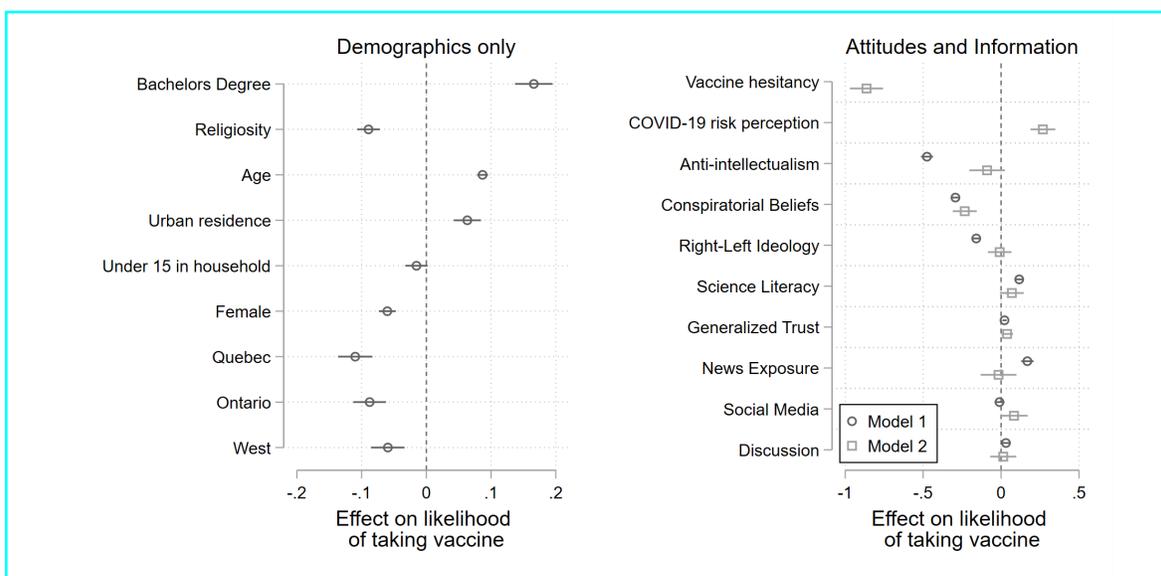


Figure 3: Correlates of willingness to take SARS-CoV-2 vaccine. Note: 99% confidence intervals. Baseline for region is Atlantic Canada. Models in right panel are also controlling for demographics. Model 3 only contains waves 26-28.

Model 2 shows us that the strongest determinant of vaccination hesitancy is anti-intellectualism. Moving the range of the anti-intellectualism scale is associated with a 47 point drop in willingness to vaccinate ($p < 0.001$). Conspiratorial thinking is also associated with hesitancy. Moving the range of this index is associated with a 29 point drop in willingness to vaccinate ($p < 0.001$). Science literacy and conservative ideology each have smaller effects in the expected direction, associated with a 12 point increase and 16 point decrease in willingness to vaccinate, respectively ($p < 0.001$ each).

News exposure is associated with vaccination willingness as expected. Moving the range of the news exposure index is associated with a 17 point increase in willingness to vaccinate ($p < 0.001$). Contrary to expectations, social media exposure is not associated with vaccination willingness. Political discussion is associated with a small, 3 point increase in willingness to vaccinate ($p = 0.010$).

Model 3 includes indices of vaccine hesitancy and COVID-19 risk perceptions. There is a powerful relationship between overall levels of vaccine hesitancy and willingness to take the COVID-19 vaccine. Moving from the minimum to the maximum on the scale is associated with a 86 point drop in likelihood of taking the vaccine ($p < 0.001$). Moving from the maximum to the minimum in COVID-19 threat perceptions is also associated with a 27 point increase in likelihood of vaccinating. Anti-intellectualism, news exposure, and ideology drop in importance with these items in the model, suggesting they influence vaccination uptake through their influence on overall vaccine hesitancy and COVID-19 risk perceptions.

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In addition to this pooled model, we have also estimated these models in each of our 20 waves of survey data. We find these results do not meaningfully change over the course of the pandemic, suggesting a stable opinion structure, despite the changing nature of the COVID-19 vaccines and their news coverage. These graphs can be found in Figures A1 and A2 in the Appendix.

Correlates of vaccine hesitancy

The most common justifications for vaccine hesitancy are concerns about the safety of the vaccine and its effectiveness at stopping the COVID-19 disease. It is worth evaluating whether people change their evaluation of different vaccine candidates based on these characteristics and others. Do vaccines with fewer side effects and higher levels of effectiveness actually generate more prospective uptake than those that are riskier and less effective? Do high performing vaccines have the potential to reduce current levels of vaccine hesitancy?

We conducted a conjoint experiment in wave 26 of our survey conducted between October 21 and October 28 (N=1,495). Following a similar experiment conducted by Motta (2020) in the United States, we expose our respondents to three pairs of potential vaccine candidates with their characteristics displayed in table form. We randomize the following for each hypothetical vaccine:

- Country of origin: Canada, United States, Russia, China
- Effectiveness: 50%, 70%, 90%
- Side effects: 1 in 2, 1 in 10, 1 in 100
- Type: Weakened virus, mRNA
- Doses: 1, 2
- Months in development: 9, 12, 15

After each profile pair, we ask respondents how likely they would be to take the vaccine candidate (Response categories: very likely, somewhat likely, not very likely, not at all likely). We rescale this variable from 0-1 where 1 is for those who are very likely to take the vaccine candidate.

We estimate a model to recover the Average Marginal Component Effect of each attribute. This tells us the causal effect of each vaccine characteristic averaged across the distributions of all other randomized attributes. We cluster standard errors by respondent. From this analysis we can see which characteristics of the vaccine candidates matter the most for respondents. We present the estimates as marginal means for ease of interpretation in Figure 4 below.

The first thing to note is that there is a penalty for vaccine candidates produced outside of Canada. Respondents are much more willing to take a Canadian vaccine (0.60) than an American (0.52), Russian (0.42), or Chinese (0.43) equivalent. This is concerning since a Canadian-made vaccine is not likely to be a possibility in the near-term.³

3. <https://nationalpost.com/news/canada/trudeau-warns-covid-19-vaccine-will-come-later-to-canada-than-other-countries>

Effectiveness matters a great deal in shaping willingness to take a vaccine. Individuals were much more likely to take a vaccine that is 90% effective (0.57) compared to 70% (0.50) and 50% (0.41). Respondents are also responsive to vaccine side effects, with fewer people willing to take vaccine candidates with side effects in 50% of cases (0.45), compared to 10% (0.49) and 1% (0.54). This is good news since recent vaccine candidates have shown to have high levels of effectiveness.⁴ None of the other vaccine characteristics were found to be important.

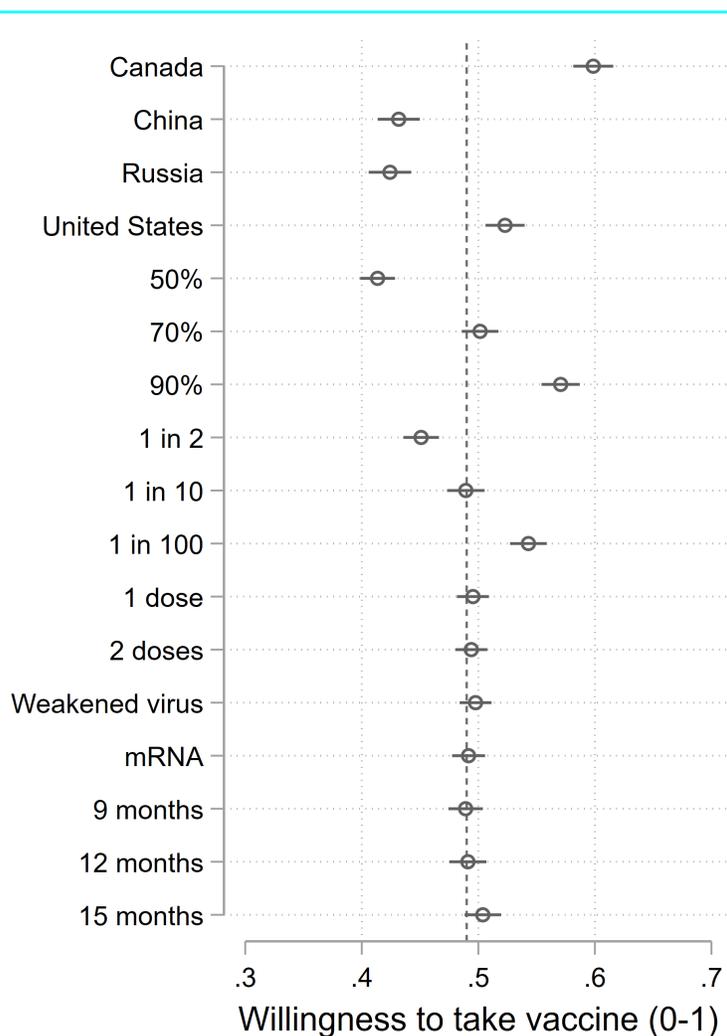


Figure 4: Marginal mean willingness to take a vaccine per profile characteristic. Note: 95% confidence interval. Dashed line indicates the grand mean.

4. <https://www.nytimes.com/2020/11/18/health/pfizer-covid-vaccine.html>

These overall findings mask an important heterogeneity among respondents. We ask: are all respondents equally responsive to the safety and efficacy of vaccine candidates? Or, is this information most effective among people who are resistant to vaccines because of safety or efficacy concerns? Are these individuals unmoved by this information? We estimate our experimental effects for people who say they will take a COVID-19 vaccine once it becomes available, those who say they will not, and those who are uncertain either way. These results are shown in Figure 5.

As is clear from the graph, the safety and efficacy candidate attributes do not matter at all for people who indicated they would not take a SARS-CoV-2 vaccine once it is available. These individuals are resistant to the information contained in the conjoint experiments, likely because they don't trust the information provided by pharmaceutical companies regarding their vaccine candidates. The reported efficacy and safety of vaccine candidates, however, matter for both people who indicated they will take the vaccine once it is available and those who are uncertain. So, we need to care about efficacy and safety to maintain support for a vaccine among those who report willingness to take it and to persuade those on the fence to do the same. But new arguments need to be found for those who are set against a vaccine. Merely sharing facts about the provenance, efficacy, and safety of a vaccine with do little to convince these individuals.

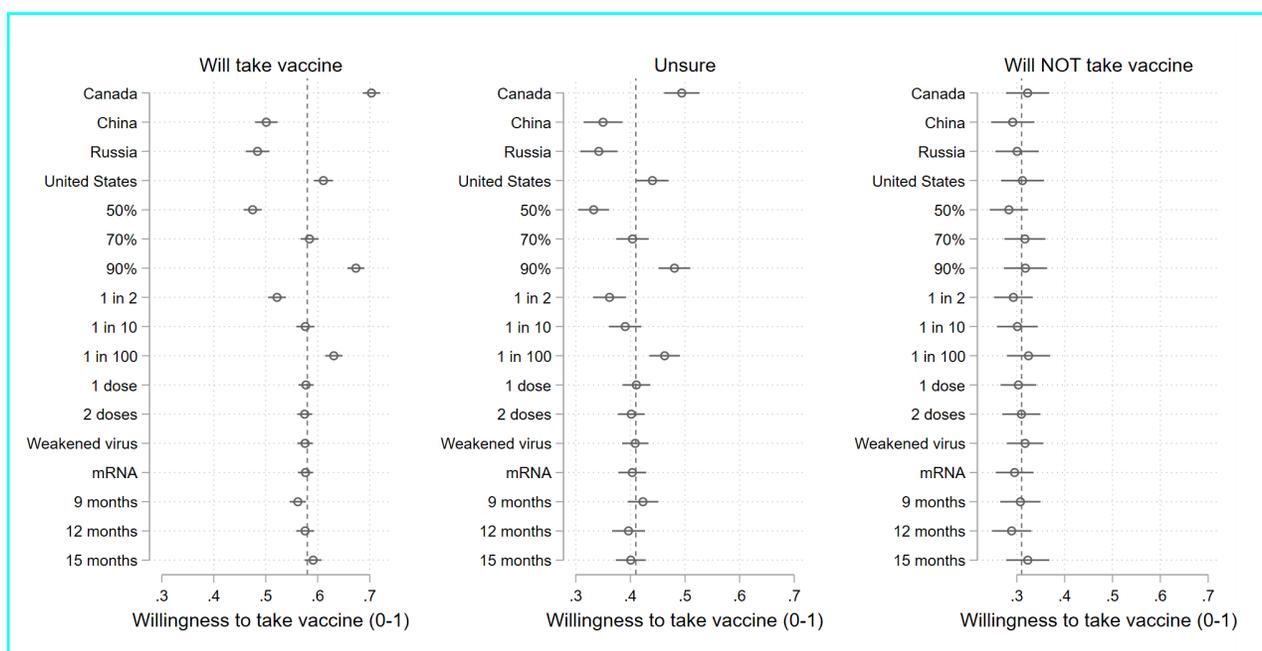


Figure 5: Marginal mean willingness to take a vaccine candidate per profile characteristic. Results for those who will take a vaccine once available (left), who are unsure (centre), and who will not take a vaccine once available (right). Note: 95% confidence intervals. Dashed line indicates the grand mean.

Vaccine Discourse

Health information seems to be uniquely vulnerable to broader trends in misinformation (Krishna and Thompson 2019), with many individuals seeking medical information online from non-official sources (Guess et al. 2020). Moreover, misleading medical information has been extensively documented on social media platforms, notably related to vaccines (Burki 2020; Radzikowski et al. 2016). To better understand the information circulating online among Canadians regarding a COVID vaccine, we examined the social media conversation on Facebook, Reddit, and Twitter - three popular social media platforms in Canada. On Facebook we looked at 5539 groups and 2299 pages, on Reddit we examined 204 Canadian communities or subreddits, and on Twitter we used the follows, tweets, and retweets of approximately 200,000 of the most active Canadian users.

Figure 6 shows the frequency of conversation about COVID-19 (top) and vaccines (bottom) since the beginning of the pandemic on Reddit, Facebook, and Twitter. Shown is the percentage of overall weekly volume of posts identified as about COVID-19 or a vaccine. The Canadian conversation about the COVID-19 pandemic was highest in March but has remained steady at approximately 10% of posts on Facebook and Reddit and 2.5% of overall tweet volume since then. Meanwhile, Canadian discussion of the vaccine hit an early high in May and has remained steady at approximately 0.5% on Facebook, and about 0.25% on Reddit and Twitter since then. In the last few weeks, however, with the results of clinical trials and vaccine approvals, many are now talking about vaccines online (data extends to November 31st and does not capture the December conversation).

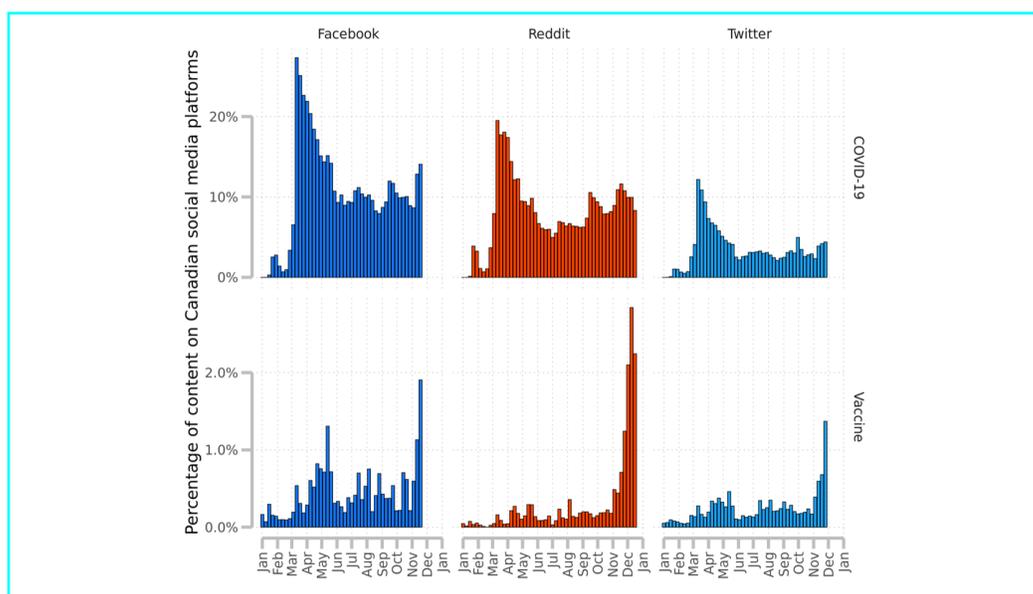


Figure 6: Weekly percentage of all Facebook, Reddit, and Twitter conversation focused on COVID-19 (top) and vaccines (bottom) since the beginning of the pandemic.

Vaccine stories in online news media

To understand this conversation, we focused on url links from three social media platforms to stories whose headline contained the word vaccine (or *vaccin* in French). From March to November 18, 2020, we identified 4,774 distinct French- and English-language media stories about the vaccines that were posted on social media platforms Reddit, Facebook, and Twitter by Canadians or on Canadian groups or communities. We anticipate with the recent clinical trial results and vaccine approval in Canada that the number of articles written and shared in December will be high. Overall, discussion of vaccines has been high since the beginning of the pandemic, with steady coverage. Canadian vaccine-related news has been prominent on all social media platforms examined.

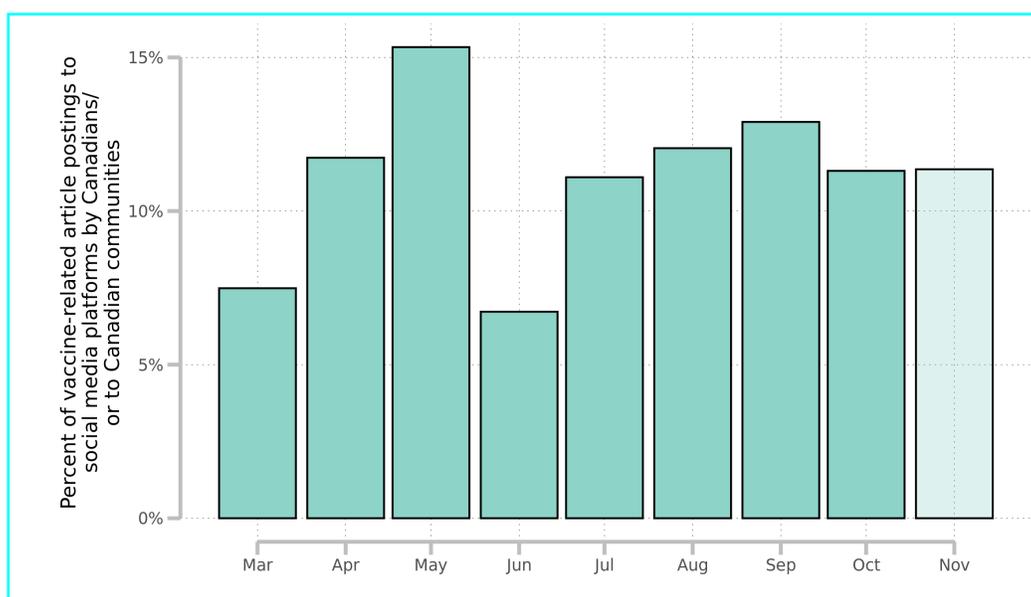


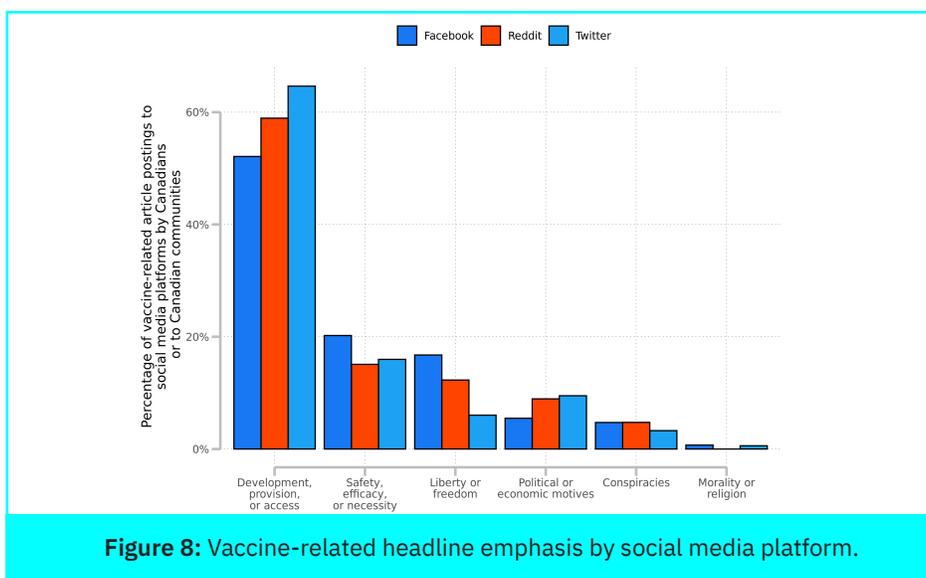
Figure 7: Percent of overall March-November postings on Reddit, Facebook, and Twitter (total of 7720 article postings on social media that contained vaccine/vaccin in the headline). November faded out as data was collected for only part of the month.

To understand what was being discussed in these articles, each headline was coded as one of the following six categories of discussion (taken from Smith, Cubbon, and Wardle 2020):

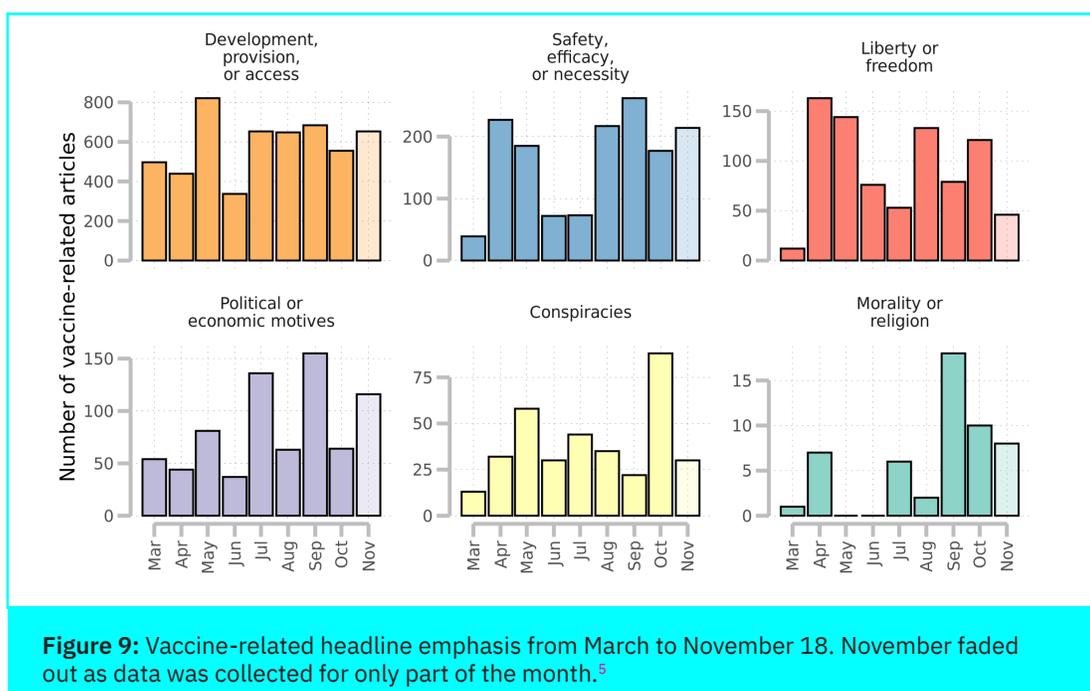
1. *Development, provision or access*: Posts related to the ongoing progress and challenges of vaccine development. This also includes posts concerned with the testing (clinical trials) and provision of vaccines as well as public access to them.
2. *Safety, efficacy or necessity*: Posts concerning the safety and efficacy of vaccines, including how they may not be safe or effective. Content related to the perceived necessity of vaccines also falls under this topic.
3. *Liberty or freedom*: Posts pertaining to concerns about how vaccines may affect civil liberties and personal freedom - as well as - vaccine acceptance.
4. *Political or economic motives*: Posts related to the political and economic motives of actors (key figures, governments, institutions, corporations, etc.) involved with vaccines and their development.
5. *Conspiracy theory*: Posts containing well-established or novel conspiracy theories involving vaccines - as well as - reporting on conspiracy theories.
6. *Morality or religion*: Posts containing moral and religious concerns around vaccines, such as their composition and the way they are tested.

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As Figure 8 below shows, development, provision, or access articles represent over 50% of the total across all three platforms, although they are somewhat less represented on Facebook. Next, articles on safety, efficacy, or necessity of the vaccine were prominent along with arguments about vaccines in relation to liberty or freedom. These articles were more common on Reddit and Facebook as compared to Twitter. There were few morality or religion-based arguments made in the Canadian context. Both political or economic motive articles and those that featured conspiracy theories were relatively infrequent, taking up between 5-10% of total articles on all three platforms.



We further examined whether certain types of articles were more or less likely to be published in a particular month. Figure 9 shows monthly counts across all three platforms for the six categories of article. Articles focused on the development, provision or access of the vaccine have been consistently published since March. The last several months have seen an increased focus on safety, efficacy, or necessity, with November marking the beginning of a large increase. Meanwhile, liberty or freedom arguments which we anticipated to be increasing since the beginning of the pandemic given similar arguments being made regarding masks, do not appear to be featured heavily across online media outlets. In the lead up to the U.S. election, there were numerous articles published and linked to that focused on conspiracy theories and political or economic motivations around vaccines, but the interest in that content has not been sustained strongly in November.



Overall, the information coming from online news has focused on factual information while avoiding propagating conspiracies. This information output appears to have been absorbed by a large majority of Canadians who, as reported in the survey data, are willing to take a vaccine. We disaggregated these links by mainstream online news sites and independent ones, as shown in Figure 10. Generally, mainstream outlets have focused much more on stories of the development, provision, and access of the vaccine, while independent outlets have published relatively more stories on liberty, freedom, political or economic incentives, and highlighting/promoting conspiracy theories. There are some notable differences across platforms, particularly on Facebook, with links to many independent media stories focused on political or economic motives behind vaccine development.

⁵ Mainstream outlet refers to any news media owned by a media organization with a historically large market share (e.g. CBC, Global, Sun Newspapers, The National Post), while independent refers to an emerging set of independent voices (e.g. Blacklocks, PressProgress, The Postmillennial, The Tye).

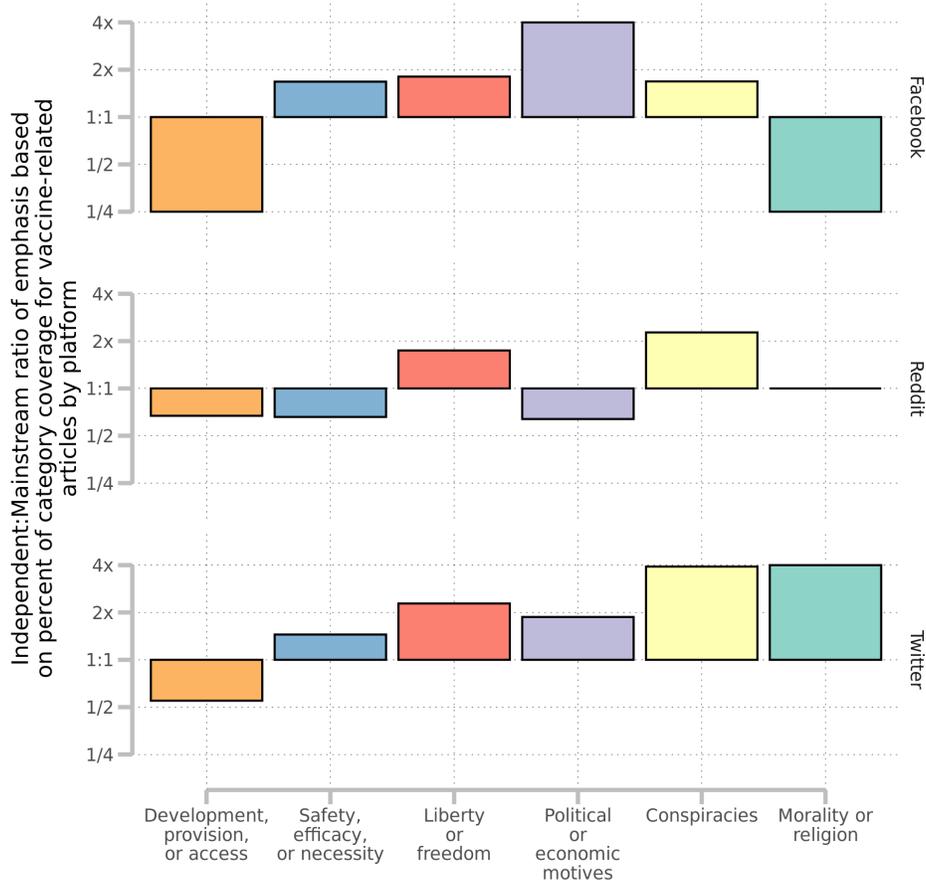


Figure 10: Online story source by category and platform as a percentage of all stories published by the source category on a given platform. Bars above the line indicate that independent media content was relatively more likely to have been shared to social media.

Across the platforms, different categories of story receive disproportionate attention. Figure 11 shows common reaction metrics across the three platforms. We show retweets and favourites for Twitter, number of comments and the internal score of a post for Reddit, and comments, likes, and emotional reactions (e.g. anger, sad, love) for Facebook. On Twitter, both liberty or freedom and conspiracy stories have attracted more attention relative to the other categories. On Reddit, stories about political or economic motives and conspiracy stories tend to attract many “upvotes” but fewer comments. Across all platforms, stories about development, provision, or access are simply less engaged with than the other categories. Both liberty or freedom and conspiracy stories attract a lot of response on Facebook but fewer likes than stories about development, provision, or access.

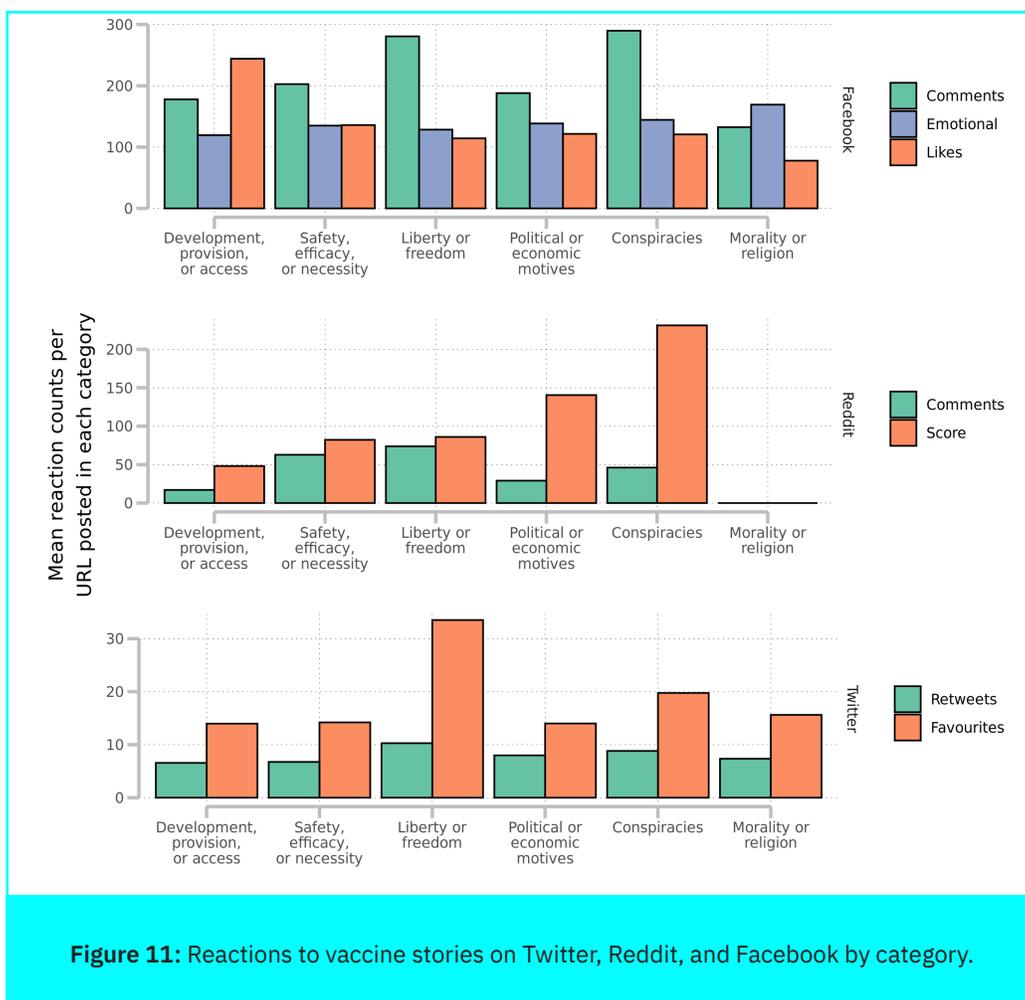


Figure 11: Reactions to vaccine stories on Twitter, Reddit, and Facebook by category.

While mainstream media coverage of vaccines has focused heavily on considerations of development, provision, and access, alternative outlets have highlighted political or economic motives around a COVID-19 vaccine, liberty or freedom arguments, and discussed conspiracy details in more detail. These articles tend to elicit stronger reactions from Canadians which will make them more likely to have wider reach on social media platforms. On Facebook groups and public pages, when these stories are posted, they tend to attract many more comments than likes (a phenomenon called “ratioing” which typically indicates a strongly negative reaction to a post).

To better understand how this information ecosystem is influencing how Canadians talk about vaccines, we did a deep dive into Twitter behaviour. We first used a sentiment dictionary to examine all 639,165 tweets identified as vaccine related from January 1st to December 1st. Sentiment around the vaccine over the period is shown in Figure 8 and gives a coarse view into how Canadians are talking about the vaccine. Since the beginning of the pandemic there has been a slow but steady rise in vaccine-related sentiment on Twitter, with much more positive sentiment in the last weeks of November. Overall, however, sentiment related to vaccines has been mixed positive and negative and not the overall positive that health officials might be hoping for.

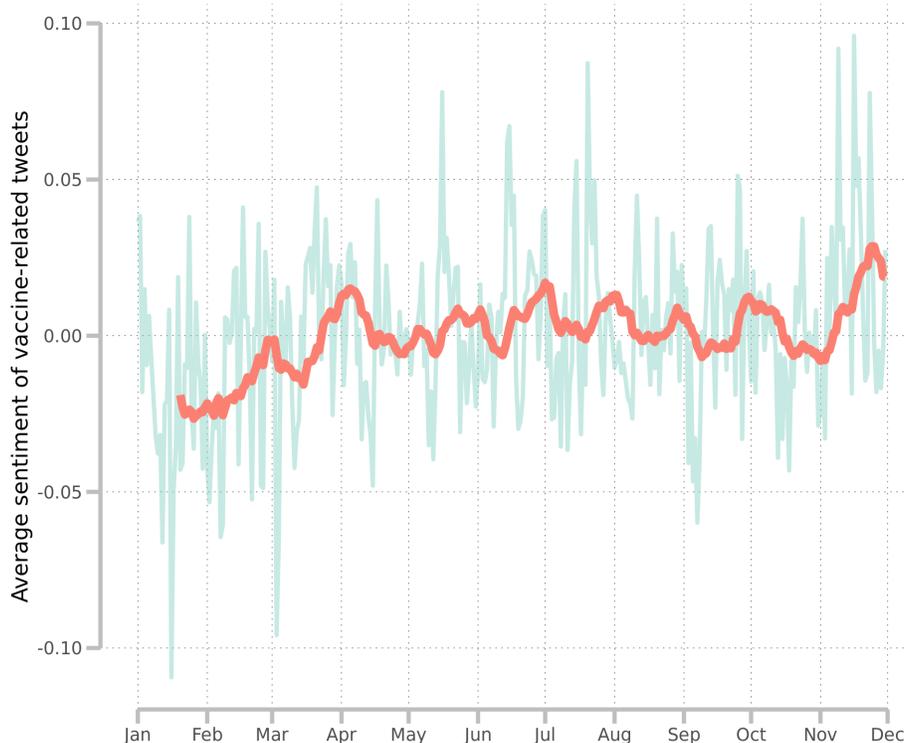
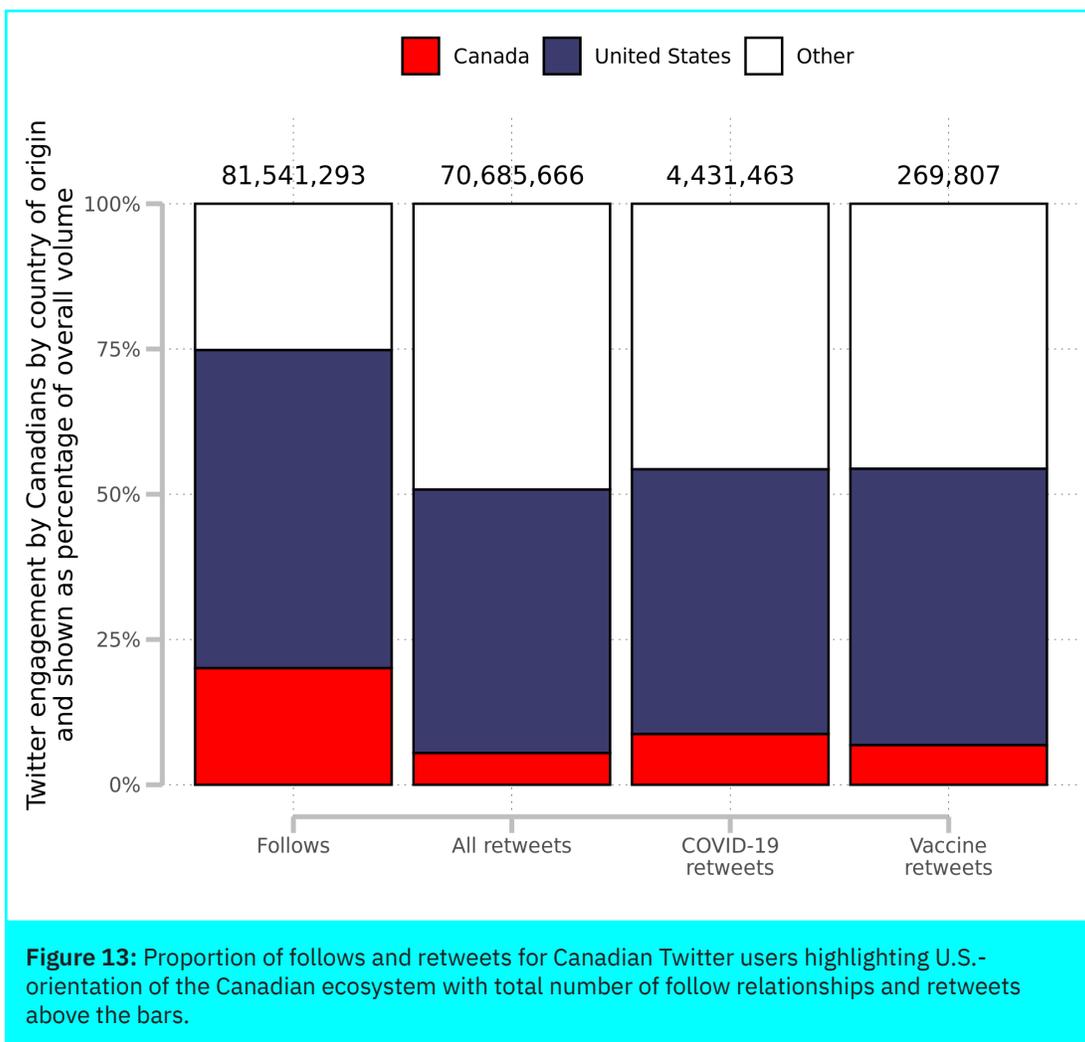


Figure 12: Sentiment in vaccine-related tweets from January to early December.

Canadian exposure to the U.S. information ecosystem

A concern many scholars have identified is wide-scale misinformation circulating in the American information ecosystem, driven in part by political elites and a highly partisan media ecosystem (e.g. Uscinski et al. 2020). This U.S.-based ecosystem extends outside national borders and we investigated whether this has an outsized influence on the Canadian information environment.

Across 194,359 Canadian high-volume accounts for whom we collected follow behaviour, we find that Canadians follow far more accounts based in the United States than in Canada. Among our sample, Canadians follow a median of 32 Canadian accounts, 87 accounts from the United States, and 25 accounts from other countries. While only approximately 18% of follows are Canadian, an astonishing 57% are based in the United States, with the rest of the world accounting for only a quarter of follows.



While Canadians follow far more non-Canadian accounts, they are even more likely to share (through retweeting) information coming from non-Canadian sources on Twitter. The ratio for U.S. to Canada follows only 3:1 but the retweeting rate is a massive 10:1 – for every tweet retweeted from a Canada-based user, 10 tweets are retweeted from U.S.-based users. There is some preference for local health information, with COVID-19 and vaccine retweets more likely than other topics (7:1 and 8:1 respectively) – a result largely driven by retweeting of political and health leadership across the country.

We find that Canadians are consuming and propagating enormous amounts of U.S.-based news and information. This flood of U.S.-based information, and potentially misinformation, represents a Canadian vulnerability, where Canadian elites, medical professionals, scientists, and journalists may be comparatively less able to reach and inform Canadians. Figure 14 shows the relative volume of U.S.-based versus Canada-based vaccine retweets.

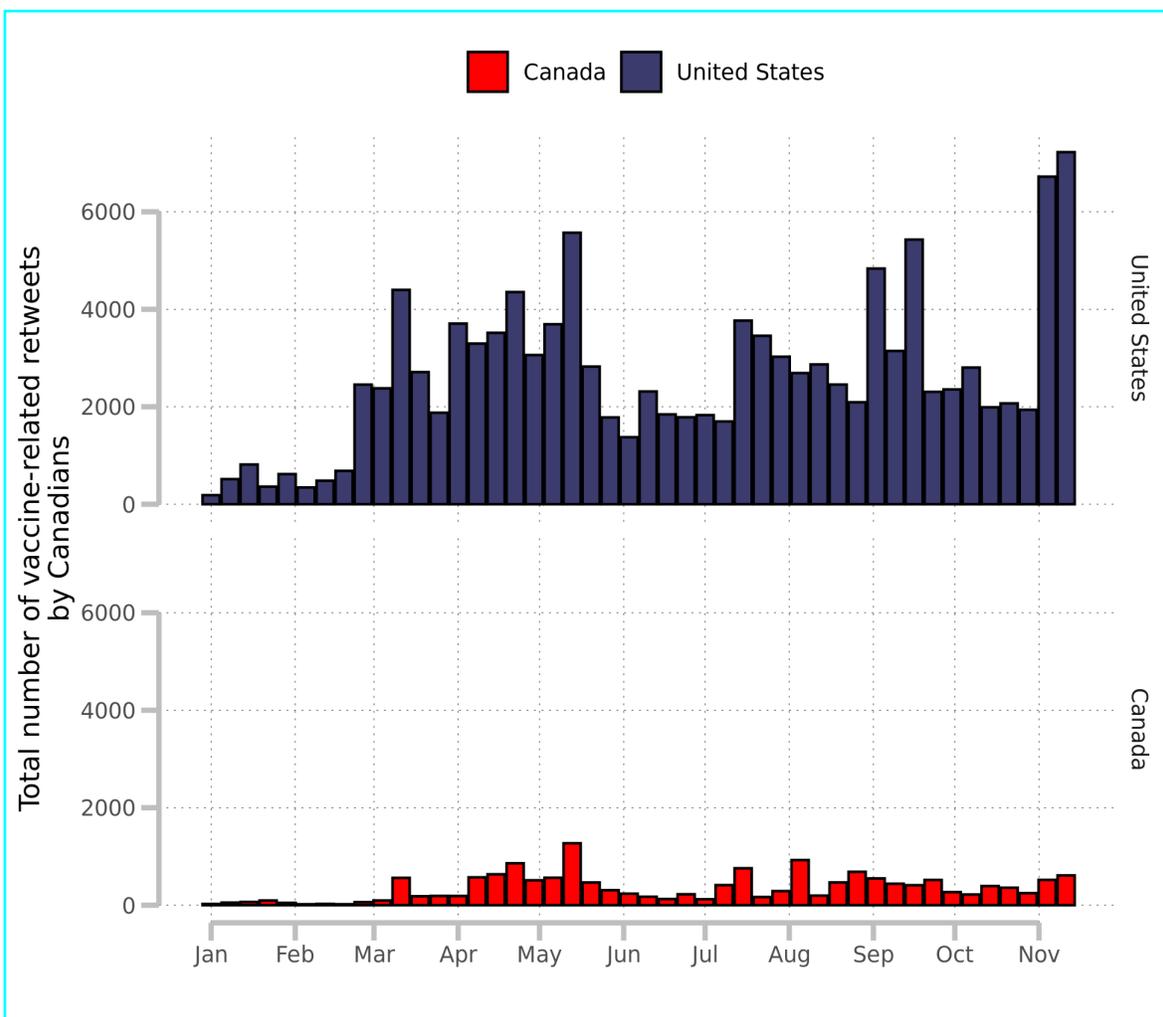


Figure 14: Total volume of vaccine-related tweets retweeted by 200,000 Canadian Twitter users from January to end of November from Canadian and U.S.-based accounts.

Methodology

SURVEY

The survey-based analyses in this memo come from waves 9 through 28 of the Media Ecosystem Observatory survey (N=39,297). The fielding dates are provided below:

- Wave 9: June 15-June 18, 2020 (N=2,552)
- Wave 10: June 22-June 29, 2020 (N=2,548)
- Wave 11: June 29-July 6, 2020 (N=2,495)
- Wave 12: July 7-July 13, 2020 (N=2,539)
- Wave 13: July 14-July 21, 2020 (N=2,526)
- Wave 14: July 22-July 29, 2020 (N=2,536)
- Wave 15: July 30-August 9, 2020 (N=2,535)
- Wave 16: August 10-August 12 (N=2,500)
- Wave 17: August 17-August 24, 2020 (N=1,513)
- Wave 18: August 24-August 31, 2020 (N=1,508)
- Wave 19: August 31-September 7, 2020 (N=1,502)
- Wave 20: September 7-September 15, 2020 (N=2,008)
- Wave 21: September 15-September 21, 2020 (N=1,481)
- Wave 22: September 21-September 28, 2020 (N=2,503)
- Wave 23: September 29-October 5, 2020 (N=1,510)
- Wave 24: October 6-October 14, 2020 (N=1,481)
- Wave 25: October 14-October 21, 2020 (N=1,523)
- Wave 26: October 21-October 28, 2020 (N=1,495)
- Wave 27: October 29-November 4, 2020 (N=1,512)
- Wave 28: November 12-November 17, 2020 (N=1,030)

For each survey wave we set quotas that match the 2016 Canadian Census on gender, age (18/34, 35/54, 55+), language (French, English), and region (Atlantic, Quebec, Ontario, West) to ensure the representativeness of our sample. We further implement a raked weighting procedure to ensure our data are representative within region by age and gender. The average weight is 1 with a minimum of 0.65 (N=111) and a maximum of 2.624 (N=28). Each survey consists of a number of questions asking respondents their basic demographic characteristics, political attitudes, and opinions and behaviours related to the COVID-19 pandemic. The median time to completion is 26 minutes.

SOCIAL MEDIA

For the analysis evaluating the extent to which Canadians who are active on social media are exposed to information from U.S.-based sources, we began with a labelled set of Canadian politician, journalists, and political influencers that included all members of the legislature in Canada, hundreds of journalists from across the media landscape in Canada, and a range of prominent political voices. We then collected their follower network of 6,569,634 users. We pulled the location and biography information for all these users. Every character sequence that appeared 10 or more times in these location fields was put through the GoogleMaps API with country data extracted to identify Canadian locations (e.g. The 6ix is placed in Toronto, Ontario). We then searched the biographies for major Canadian cities, provinces, and the text string *canad*. This 2-step process yielded 747,158 self-identified Canadian-based accounts. We began pulling the tweets from this population in January 2020 and took the most active 200,000 accounts measured by tweeting volume for the period from January 1 - July 31, 2020. We then collected every account that these Canadian users followed yielding 9,118,496 unique users. We then collected the location and biography of those users and ran the same location-identifying process described above. This allows us to precise the intra-country follow network, retweet behaviour, and content posted across a massive set of active self-identifying Canadian Twitter accounts. We used all tweets, retweets, and follows of this population for this analysis. In total, these users tweeted 146,843,277, retweeted 130,722,397 times, and had 81, 541,203 follower relationships where the country of the followed individual could be identified. To identify COVID-19, COVID-19 misinformation, and vaccination tweets/retweets we draw upon a dictionary developed by Evanega et al. (2020) or simply search for the character string *vaccin*.

Facebook analysis is based on all postings from 5539 Canadian Facebook groups and 2299 Canadian. These pages were collected based on keyword and manual searches by paid research assistants since late 2019. We scanned these at regular intervals to track the growth of posts and associated reactions. For Reddit, we accessed the PushShift API to search for all posts on Reddit from 204 Canadian-identified subreddits. Any relevant posts were then scraped using the Reddit API for updated comment and score counts. To identify vaccine-related stories we searched every link posted to any of these pages/communities or by any user tracked on Twitter and extracted the headline and text of any news story. Each headline was then reviewed by a researcher and classified into one of six categories.

Facebook data was sourced from CrowdTangle, a social media analytics tool owned by Facebook. CrowdTangle tracks public posts on Facebook, Instagram and Reddit, made by public accounts or groups. The tool does not track every public account and does not track private profiles or groups, so this data is not representative of performance across the entire platform. The numbers shown here reflect public interactions, but do not include reach or referral traffic. The data does not include paid ads unless those ads began as organic, non-paid posts that were subsequently “boosted” using Facebook’s advertising tools. CrowdTangle also does not track posts made visible only to specific groups of followers.

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Appendix

Table A1. Variable Descriptions

Measure	Description
Social Media Exposure	Logged, 0-1; Over the past week, which of the follow social media applications did you use to watch, read, or listen to news about politics? Please select all that apply. 1) Twitter 2) Facebook; 3) Instagram; 4) Youtube; 5) Reddit; 6) LinkedIn; 7) Tumblr; 8) WhatsApp; 9) Snapchat; 10) WeChat; 11) Another application
News Exposure	Logged, 0-1; Over the past week, which of the follow news media outlets did you watch, read, or listen to for news about politics? Please select all that apply. 1) CBC; 2) CTV; 3) Global; 4) CityNews; 5) Globe and Mail; 6) National Post; 7) Toronto Star; 8) Local newspaper; 9) TVA (QC only); 10) TV5 (QC only); 11) La Presse (QC only); 12) Journal de Montreal (QC only); 13) Journal de Quebec (QC only); 14) Le Devoir (QC only); 15) Radio-Canada (QC only); 16) Rebel Media; 17) National Observer; 18) Toronto Sun; 19) The Tyee; 20) Post Millennial; 21) APTN; 22) True North News; 23) Press Progress; 24) Huffington Post; 25) Another outlet
Political Discussion	0-1; How often in the past week did you talk about politics or public affairs with the following people? 1) Your family; 2) Your friends; 3) Your co-workers (never, once, a few times, almost every day, daily, don't know)
Conspiratorial Thinking	0-1; 1) Much of our lives are being controlled by plots hatched in secret places; 2) Even though we live in a democracy, a few people will always run things anyway; 3) The people who really 'run' the country are not known to the voter; 4) Big events like wars, recessions, and the outcomes of elections are controlled by small groups of people who are working in secret against the rest of us (strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree)
Anti-intellectualism	0-1; Below is a list of groups and institutions in society. Please tell us the degree to which you trust or distrust members of these groups or institutions: 1) Experts; 2) Economists; 3) Scientists; 4) Doctors and medical professionals; 5) University professors (distrust a lot, distrust somewhat, neither, trust somewhat, trust a lot, don't know)

Right-left Ideology	0-1; 1) The government should take measures to reduce differences in income levels; 2) Protecting the environment is more important than creating jobs; 3) Canada should increase the number of immigrants it admits each year; 4) People who don't get ahead should blame themselves, not the system; 5) The government should see to it that everyone has a decent standard of living (Strongly, somewhat, neither agree/disagree). Each item coded in left-wing (-1) and right-wing (1) direction. Don't knows and neither coded as neutral (0)
Vaccine hesitancy scale	0-1; Please indicate your level of agreement or disagreement with the following statements: 1) Childhood vaccines are important for the health of children; 2) Getting vaccines is a good way to protect children from disease; 3) Having children vaccinated is important for the health of others in my community; 4) All childhood vaccines offered by the government in my community are beneficial; 5) The information I receive about vaccines from the government is reliable and trustworthy; 6) Generally I do what my doctor or health care provider recommends about vaccines (Strongly, somewhat, neither agree nor disagree)
COVID-19 risk perceptions	0-1; How serious of a threat do you think the corona virus is to [yourself/Canadians]? Very serious (3); Somewhat serious (2); Not very serious (1); Not serious at all (0)
Religiosity	0-1; How important is religion in your life? Not at all important (0); Not very important (1); Somewhat important (2); Very important (3)
Urban/rural	0-1; Thinking about the place where you live, what word best describes it: A large city, a medium sized city, a large town, a small town, a rural place.
Generalized trust	0-1; Generally speaking, would you say that most people can be trusted or that you cannot be too careful in dealing with people?" (Most people can be trusted/cannot be too careful in dealing with people)
Under 15 in household	0-1; How many of your household members (excluding yourself) fall into the following age groups. These people should live at the same address and share a kitchen with you. (0-5 years old, 6-15 years old). Set 0 for those under the age of 20 who report household member 0-5 years old. Set 0 for those under the age of 25 who report household member 6-15 years old.

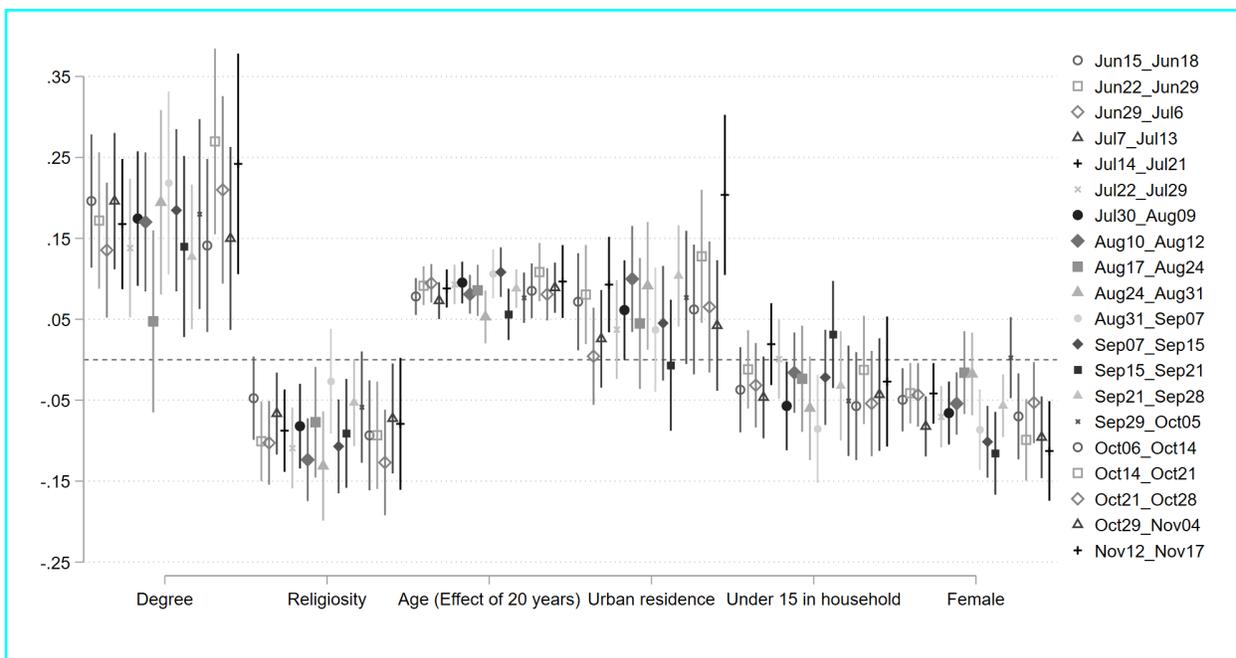


Figure A1. Demographic correlates of willingness to take SARS-CoV-2 vaccine. Note: 95% confidence intervals.

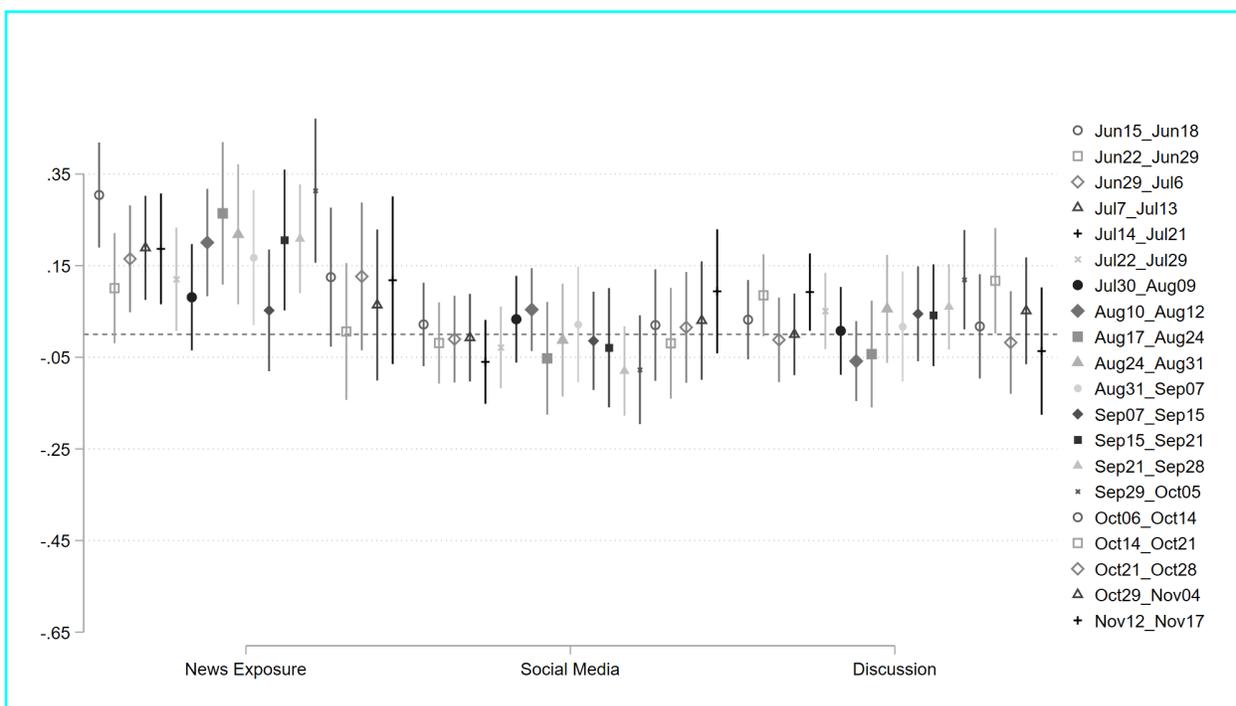


Figure A2. Information correlates of willingness to take SARS-CoV-2 vaccine. Note: 95% confidence intervals.

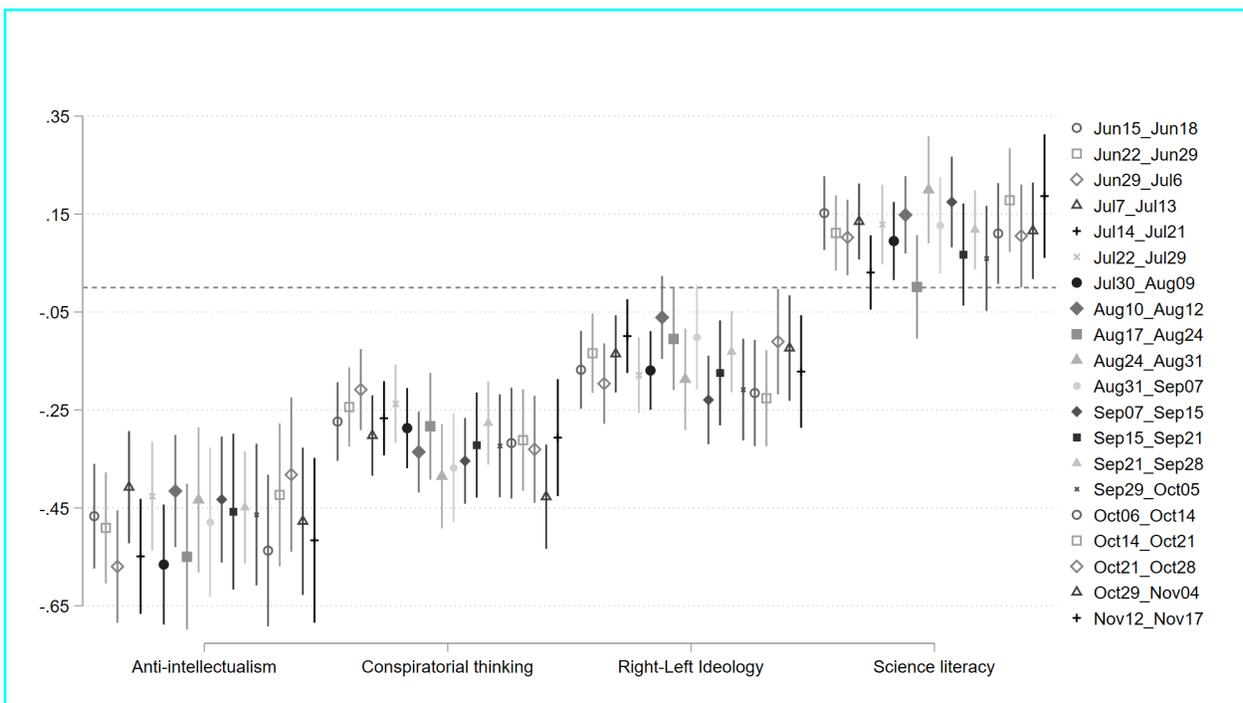


Figure A3. Attitudinal correlates of willingness to take SARS-CoV-2 vaccine. Note: 95% confidence intervals.

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