Information-Seeking Patterns and COVID-19 in the United States

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In this paper, we describe how socio-economic background and political leaning are related to how U.S. residents look for information on COVID-19. Using representative survey data from 2,280 U.S. internet users, collected in fall 2020, we examine how factors, such as age, gender, race, income, education, political leaning, and internet skills are related to how many different types of sources and what types of sources respondents use to find information on COVID-19. Moreover, we describe how many checking actions individuals use to verify information, and how all of these factors are related to knowledge about COVID-19. Results show that men, those with higher education, higher incomes, and higher self-perceived internet ability, and those who are younger used more types of information sources. Similar patterns emerged for checking actions. When we examined different types of sources (mainstream media, conservative sources, medical sources, and TV sources), three patterns emerged: 1) respondents who have more resources used more types of sources; 2) demographic factors made less difference for conservative media consumers; and 3) conservative media were the only type of source used less by younger age groups than older age groups. Finally, availability of resources and types of information sources were related to differences in factual knowledge. Respondents who had fewer resources, those who used conservative news media, and those who engaged in more checking actions got fewer answers right. This difference could lead to information divides and associated knowledge gaps in the United States regarding the coronavirus pandemic.

Keywords: information-seeking, COVID-19, knowledge gaps

Introduction

With the onset of the coronavirus SARS-CoV-2 pandemic (COVID-19) in the United States in early 2020 came a vast amount of information about the virus. This included how it spreads, what could be done to prevent transmission, how to get tested, and what actions to take when someone is sick. Especially in the early days of the pandemic, when knowledge about the virus was limited, new information appeared at a rapid pace, as did misinformation and conspiracy theories (Enders et al., 2020; Mitchell et al., 2020; Nielsen, Fletcher, Newman, et al., 2020; Romer & Jamieson, 2020). The pandemic constituted—and still constitutes—a uniquely challenging context for individuals seeking information about COVID-19 and for public health communication campaigns. Although scientific understanding increased rapidly during the first months of the pandemic, major gaps in knowledge persisted among researchers and health experts. Consequently, the public needed to update information regularly to keep knowledge current.

These issues had to be navigated in the context of the final year of a controversial administration, a polarized political landscape, and a diverse, partisan, and very competitive media sector. The virus spread unevenly across the country, such that locales needed to develop responses at different points in time and contexts. Combined with the political context and the incompleteness of knowledge, the dynamic nature of the pandemic complicated individuals' ability to develop a reliable understanding of the crisis. Under these conditions, it is possible that multiple mental models (i.e., simplified, cognitive frameworks to explain and interpret the world) may emerge among individuals and sub-groups of the population. Mental models can be correct (i.e., be compatible with established facts) or they may be erroneous (Denzau & North, 1994). If incompatible mental models coexist, a common public health response is greatly complicated. Indeed, studies in the United States and in other countries document how individuals obtained information during the first wave of the pandemic, how they translated this knowledge into different behavioral responses, and how these information-seeking practices were associated with different

beliefs and levels of knowledge about the pandemic (e.g., Jamieson & Albarracin, 2020; Nielsen, Fletcher, Newman, et al., 2020).

Our study examines these issues nine months into the pandemic, when the United States was on the upswing of the third, biggest wave of the pandemic. This timing puts our effort in a different context compared to earlier studies, most of which covered the experience during the first and second waves. Data were collected during a time of increasing evidence that earlier assertions were untenable and erroneous, e.g., that the pandemic would fade away quickly and life could return to normal during the summer. Understanding how people under these conditions obtained and updated information about the virus and how information sources and updating practices are associated with mental models of the unfolding pandemic and willingness to take appropriate responses is of critical importance for the design of successful health campaigns and interventions.

Our work builds on prior research on information seeking in dynamic environments and its implications for the accuracy of the mental models that inform individual behavior. The unique pandemic conditions may create information and knowledge divides that separate the population into groups with potentially incompatible COVID-19 mental models of varying accuracy. The larger research project, upon which the results presented in this paper draw, explores the conditions under which divergent mental models might develop and what might be done to overcome the resulting predicaments.

Using representative survey data of internet users in the United States collected in late October and early November 2020, this paper describes the numbers and types of sources that Americans use to find information about COVID-19. In addition, we examine what kinds of checking actions individuals engage in to find or verify information on COVID-19. Finally, we assess different individuals' knowledge about COVID-19. Our study highlights patterns of information-seeking and checking behaviors across societal groups, as well as differences in knowledge. Before presenting our findings, we provide a

short overview of prior research in this area and the methods used in this paper. Finally, we discuss implications of our results in the context of the continuing pandemic.

Prior Research

The magnitude and impacts of the pandemic stimulated numerous social scientific studies, many of which are ongoing. Most of the studies that were published by the end of 2020 reflect developments during the first wave of infections (and also during the beginning of the second wave in the United States). This brief review focuses on studies that are directly or indirectly relevant for information seeking. Studies have approached the pandemic from several theoretical perspectives, including media effects and media psychology (e.g., Jamieson & Albarracín, 2020), digital inequality (e.g., Nguyen et al., 2020), health information seeking (e.g., Allington et al., 2020), and applying the Risk Information Seeking and Processing Model (RISP) (e.g., Kim et al., 2020). Researchers employed a range of empirical approaches, including surveys (e.g., Jamieson & Albarracín, 2020; Nielsen, Fletcher, Newman, et al., 2020; Romer & Jamieson, 2020), computational methods (e.g., Bento et al., 2020), and experimental methods (e.g., Vlasceanu & Coman, 2020).

Although findings vary somewhat, depending on timing and empirical method, these studies suggest that with the increase in available information came an increase in news consumption, including use of social media, search engines, and other digital media (Bento et al., 2020; Fletcher et al., 2020; Mitchell et al., 2020). News and information from public sources, such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO), increased sharply. But information from questionable sources, along with calculated misinformation campaigns, such as the "Plandemic" conspiracy video, also increased rapidly, raising major concerns among health professionals (Damian & Gallo, 2020; Kearney et al., 2020; Mitchell et al., 2020).

Misinformation campaigns that are focused on U.S. politicians, public health leaders, and governmental agencies have been common throughout the pandemic. In May 2020, the "Plandemic" conspiracy documentary was posted on YouTube and other social media platforms (Kearney et al., 2020). The video was viewed more than eight million times (Newton, 2020) and shared more than three million times on social media (Knuutila et al., 2020) before being removed by YouTube for spreading potentially harmful misinformation (Kearney et al., 2020). Other pieces of misinformation that served as barriers to the success of U.S. public health campaigns included the conspiracy theory that 5G cellphone towers spread COVID-19 and that drinking bleach could cure the virus (Brunson & Schoch-Spana, 2020).

In this context, in response to a need for information and as a public service, several news publishers, such as the *New York Times*, began to offer otherwise pay-walled content for free to the public (Jerde, 2020). State governments began airing televised press conferences to provide updates. Observations in the United States suggest a stronger reliance on local and national television news during this time (Jamieson & Albarracín, 2020; TVB Local Marketing Media Solutions, 2020). The increase in information seeking leveled off slightly during summer 2020 (Nielsen, Kalogeropoulos, et al., 2020), and a slow but steady decline in COVID-19-related information seeking occurred in the United States after a surge early in the pandemic. At the same time, differences increased in how political leaning affected which information sources Americans found trustworthy (Mitchell et al., 2020). This concurs with earlier research that found that past consumption of politically aligned media predicts similar engagement in the future, alongside a reduced likelihood of engaging with alternative, political viewpoints (Romer & Jamieson, 2020). These differences informed what Americans believed to be true or false about the pandemic and how the government was handling it (Jurkowitz & Mitchell, 2020; Mitchell et al., 2020).

Moreover, studies in the United States and in several other countries revealed inequalities in information seeking by age, gender, education, and income, as well as a negative association between social media use and health-protective behaviors (e.g.,

Allington et al., 2020; Fletcher et al., 2020; Nielsen, Kalogeropoulos, et al., 2020). This research suggests that some individuals were better positioned or able find reliable information and update their knowledge about the pandemic, whereas other groups or individuals were less likely to seek information, use reliable sources, or update their knowledge (Dhanani & Franz, 2020; Fletcher et al., 2020).

Current Study

In this study, we explore in greater detail the characteristics of the information space associated with the pandemic. The pandemic uniquely combines high levels of uncertainty and incomplete information with risks that are not fully understood. New information about COVID-19 and risks unfold dynamically and are not distributed evenly among population groups. The resulting information environment is ambiguous, and multiple interpretations of risk are possible, especially if it is time-consuming to gather and process information. Under such conditions, many individuals and groups will develop simplified, cognitive representations ("mental models") of the complex phenomenon (e.g., Denzau & North, 1994; Groesser & Schaffernicht, 2012). These mental models are "conceptual frameworks that individuals form, based on experience and formal knowledge acquisition, which allow them not only to predict the results of explicit behaviors but also to interpret and understand their environment" (Jacob & Shaw, 1998, cited in Westbrook, 2006, p. 565). Given the heterogeneity of information sources and messages, it is possible that multiple, and even incompatible mental models emerge and coexist at the individual and population levels (e.g., Alesina et al., 2020). It is likely that some of these mental models are closer to and some further away from the facts known about the pandemic (Abir et al., 2020).

These processes can be viewed through the lens of the knowledge gap hypothesis in mass communication research and the related concept of the "Matthew Effect." The knowledge gap hypothesis (Kümpel, 2020; Tichenor, Donohue, & Olien, 1970) refers to the fact that information is unevenly distributed in society. For instance, as the amount of

information available in a system increases, groups with higher socioeconomic status typically acquire and process it at a faster rate than groups with lower socioeconomic status, so that the gap in knowledge between these groups increases. The "Matthew Effect," alludes to the dynamics of this process. In its original formulation by Robert Merton (1968), it refers to the cumulative (and relative) advantages that privileged individuals and groups enjoy (Rigney, 2010). In a highly dynamic information environment with incomplete knowledge, the availability of more information does not necessarily translate into better factual knowledge. We therefore disentangle these dimensions empirically. Consequently, we examine whether the number of sources consulted is associated with factual knowledge and whether differences in socioeconomic status are related to how closely mental models correspond to established facts (see also Yu, 2006).

In the case of seeking and evaluating COVID-19 information, we would expect people with existing social and personal resources, such as higher income or higher educational qualifications, to be able to find and use accurate information more easily than those without that foundation, thus leading to different outcomes (e.g., Fletcher et al., 2020; Jamieson & Albarracín, 2020). Lack of digital access or insufficient, general, online skills (Eynon & Geniets, 2016; Kobayashi & Ishizaki, 2019), lower income, and lower education levels (Cain & Oakhill, 2011) are potential barriers to accessing and processing reliable, coronavirus information. Moreover, information overload and a proliferation of misinformation may cause individuals to feel overwhelmed and less able to parse through information (Islam et al., 2020).

However, less-privileged individuals and groups will not necessarily have *less* information. Although less information is one possible outcome, another potential outcome is that these individuals and groups accumulate much information. However, this information may be less reliable and become woven into mental models that are poorly aligned with established facts. As a result of the complexity of the information environment and the differential conditions of accessing and making sense of it, individuals may fragment into four groups: (1) information-rich and knowledge-rich (e.g., lots of

information is translated into accurate knowledge); (2) information-rich and knowledge-poor (e.g., lots of contradictory information begets confused or incomplete knowledge); (3) information-poor and knowledge-rich (e.g., limited use of a highly accurate source, such as a medical website or a reliable TV source, is translated into accurate knowledge); and (4) information-poor and knowledge-poor (e.g., limited information use is associated with deficits in knowledge).

With this background in mind, we examine where people seek coronavirus information as well as where and how they seek to update their knowledge, with a particular focus on information inequalities. Fletcher et al. (2020, p. 15) characterize this as "an uneven distribution of COVID-19 news use across the population." We also examine mitigating factors, such as the number of news sources utilized and the diversity of checking actions, which may reduce the risk of forming erroneous mental models and attitudes.

Methodology

Data

We use representative survey data from a web-based, cross-sectional survey conducted in late October and early November 2020. Working with Qualtrics panels, we collected data from 2,280 adults residing in the United States.[1] The data were stratified by age, gender, race/ethnicity, and region. We created post-stratification weights based on the 2018 American Community Survey (ACS) data on age, gender, education, region, and race/ethnicity to ensure that our data matched U.S. population proportions. The survey asked respondents a series of questions about their information sources, their information-seeking behaviors, information-checking actions, socio-demographics, political leaning,

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[1] The study was reviewed and approved by the Institutional Review Board at Michigan State University under MSU Study ID: STUDY00004862 (finalized on September 1, 2020).

and their self-rated ability to use the internet. We also asked respondents to answer six factual, true/false questions about the virus to assess knowledge.

Measures

In our analyses, we examine how socio-demographic factors and self-rated internet skills relate to information-seeking and updating patterns.

Demographics, Internet Skills, and Political Leaning. Age was measured in five categories: 18–29 years, 30–39 years, 40–51 years, 52–64 years, and 65+ years. Given the limitations of the U.S. Census, which collects only binary information about gender, we measured gender as a categorical variable with two values - male and female. Race/ethnicity was measured in four categories: White, Black, Hispanic[2], and other. Education was measured in three categories: high school or less, some college, and bachelor's degree or higher. We measured income in three categories: low (<$30K/yr.), medium ($30K–60K/yr.), and high ($60K+/yr.) incomes. Respondents were asked whether children aged younger than 18 years lived in their home (yes/no), and whether their residence was in an urban or rural area. We included self-rated internet ability, which was measured in three categories: below average, average, and above average internet skills. Finally, we asked respondents to share whether they were politically left-, center-, or right-leaning.[3]

COVID-19 information seeking and updating. We use several measures of information seeking and information updating. We asked respondents about their use of news sources: "When looking for information about either political news, including issues or elected officials, or information about health or the coronavirus, have you used the

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[2] Race and ethnicity were asked as separate questions (see Table I, Appendix). Anyone who indicated "yes" in response to the question "Are you of Hispanic, Latino/a or Spanish origin?" was categorized as Hispanic regardless of their race.

[3] The exact question and response wording for all variables described in this section are displayed in the Appendix, Table I.

following sources in the past week?"4 Respondents were given the option to answer yes or no to nine different news sources, such as "CNN or MSNBC (on TV or website)" or "Fox News (on TV or website)." Here we adopted a media repertoires approach and asked respondents about their use of grouped media types. The benefit of this approach is that it allows for a degree of specificity when asking survey respondents about media use while not overwhelming them with a large number of response options. It is also theoretically and empirically driven, rooted in prior works that have identified sets of ideologically and interest-based news repertoires in the United States across media sources and platforms (Mourão et al., 2018; Robertson et al., 2020).

In addition to news sources, we asked respondents about where they obtain health information. We posed the following question with four potential sources - a health website, a doctor or healthcare professional, the CDC, and Donald Trump: "When looking for coronavirus news or issues, have you used the following sources in the past week?" (Yes/No). In our subsequent analyses, we used these two variables in two ways: First, we ran a principal component analysis (PCA) with varimax rotation and Kaiser normalization to determine whether our thirteen types of information sources formed meaningful patterns (repertoires) of use. PCA is a statistical technique used to measure how a large number of variables correlate to one another and find groups of variables (called principal components). The factor loadings depicted in Table 1 are the correlations between the original variables and the components. If a variable loads higher than .400 on a component, it can usually be assumed that the item is important for this component. The PCA yielded four components with eigenvalues greater than 1.0: mainstream media, such as center-left-leaning newspapers and magazines, center-right leaning newspapers and magazines, liberal websites, and NPR/PBS; TV sources, such as ABC, NBC, and CNN; medical information sources, such as WebMD, doctors, and the CDC website; and conservative news sources, such as Fox News and conservative talk radio. These repertoires of source use align with prior research in the United States (e.g., Mourão et al., 2018; Robertson et al., 2020).

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[4] Due to space limitations in the long survey, the questionnaire asked about political and COVID-19 information for potential news sources in one combined question.

Second, we summed the number of different types of information sources that respondents used in the past week to a single scale with a range from 0 to 13. These analyses and all others were done in Stata 16.1.

Table 1. Rotated Principal Components Matrix.

Variable	TV sources	Conservative sources	Mainstream media	Medical sources
CBS, ABC, or NBC or other TV news shows	0.752			
CNN or MSNBC (on TV or website)	0.493			
Fox News (on TV or website)		0.539		
Conservative talk radio (e.g., Rush Limbaugh) OR Conservative news websites (e.g., The Drudge Report or Breitbart)		0.539		
President Donald Trump		0.605		
NPR or PBS news			0.410	
New York Times, *Washington Post*, *USA Today* or other newspapers (print or online)			0.432	
Wall Street Journal (print or online)			0.441	
Liberal news websites (e.g., Huffington Post or Slate)			0.421	
News magazines (e.g., *Economist* or *Time*)			0.434	

Health website, such as WebMD or Mayo Clinic	0.509
A doctor or healthcare professional	0.603
CDC or other federal government website	0.595

Note. *N*=2,084; Source: Quello Information-seeking Project (2020); factor loadings less than 0.400 are omitted.

Beyond the above measures for seeking information, we also included in our analyses five measures for checking actions. Using a 5-point frequency scale ranging from "very often (4)" to "never (0)," we asked respondents: "Thinking about recent information about the coronavirus, how often have you..." 1) "Discovered something that changed your opinion on the coronavirus?"; 2) "Learned something new?"; 3) "Checked a news source that's different from what you normally read?"; 4) "Looked online for people whom you trust to see what they say?"; and 5) "Tried to confirm information you found by checking major news outlets, such as TV news, radio, or the press online or offline?" We used the combined mean response to these five items in the results section (see Figure 2).

We note that, although there is an increasing ability to employ passive, digital tracking to collect data about news and information-seeking behaviors of individuals, there are limitations to such an approach. These include the absence of data on the use of offline sources (such as television), difficulties in recruiting representative samples of individuals willing to have their behavior tracked and linked to individual-level demographic characteristics, and the absence of data on in-app behavior even when online (Barthel et al., 2020). We use a self-report survey approach to capture the breadth of individuals' information seeking, to achieve representative sampling, and leverage the benefits of linked, individual-level, demographic data. However, we acknowledge the inherent recall limitations of self-report data.

COVID-19 knowledge. Finally, we asked respondents to rate a set of six true/false questions about COVID-19: 1) "Spraying or introducing bleach or another disinfectant into your body will NOT protect you against Covid-19." (True); 2) "5G mobile networks spread the coronavirus." (False); 3) "Drinking alcohol does NOT protect you against the coronavirus." (True); 4) "Antibiotics are effective in treating the coronavirus." (False); 5) "The coronavirus was created in a laboratory in China." (False); and 6) "The coronavirus was created deliberately by governments as a form of population control." (False). Items 1-4 were drawn from the World Health Organization's (WHO) 'Mythbusters' webpage, which provides information that debunks common COVID-19 misperceptions.[5] Items 5 and 6 were based on common misperceptions spreading online at the time of the survey. By counting the number of correct answers, we developed a scale ranging from 0 to 6, which measures the accuracy of knowledge about COVID-19, with a value of 6 signifying complete accuracy.

We note that the wording for items 1 and 3 includes the word 'NOT.' This is to avoid making 'False' the correct answer to all six items, and because this was the wording used by WHO. This use avoided having respondents receive perfect scores for simply ticking 'False' to all items (or the inverse, for ticking 'True' to all). We further note that the use of 'NOT' is intended to aid in understanding the question rather than to prime a response. We do not believe the nature of this wording makes the items more cognitively taxing to answer. Rather, respondents are aided in understanding the question when 'NOT' is used.

Analyses

In addition to frequencies and cross-tabulations, we also conducted ordinal logistic regression analysis. Our dependent variable has five ordinal categories, and this technique predicts into which category each respondent falls.

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[5] World Health Organization. (2020). Coronavirus disease (COVID-19) advice for the public: Mythbusters. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters

Results

We first describe the sample and how socio-demographic factors are related to the number of sources and checking actions used. We then describe their relationship to the specific types of media sources used. Finally, we examine how the numbers and types of information sources and checking actions used relate to how much Americans know about COVID-19.

Table 2 below shows the descriptive characteristics of our sample. Because the data were stratified by age, gender, and race, these factors closely reflect the characteristics of the U.S. population. The majority of our sample had at least some college experience (60.5%) and had a household income of more than $30,000 per year (70.5%). Almost three-quarters of our sample (71.6%) had no children living in the home, and the vast majority lived in urban areas (91.2%). A little more than half of the respondents rated their internet skills as above average (51.5%), 41.5% rated themselves as average, and a minority (7.0%) rated themselves below average. The political leaning of the respondents was evenly distributed, with about one-third each identifying as right, center, and left.

Table *2*. Demographics (after weighting).

	N	Valid %
Age		
18-29	448	19.7
30-39	410	18.0
40-51	468	20.5
52-64	502	22.0
65+	452	19.7
Gender		
Male	1,110	48.7
Female	1,170	51.3
Race		
White	1,393	61.1
Black	280	12.3
Hispanic	404	17.7
Other/mixed	203	8.9

Education		
High school or less	900	39.5
Some college/no degree	661	29.0
BA/other college degree	719	31.5
Income		
<$30K/yr.	661	29.5
30-60k/yr.	841	37.6
$60k+/yr.	737	32.9
Children in Home		
Yes	647	28.4
No	1,632	71.6
Place of Residence		
Rural	198	8.8
Urban	2,065	91.2
Internet Skills		
Below Average	159	7.0
Average	943	41.5
Above Average	1,167	51.5
Political Leaning		
Right	699	31.2
Center	770	34.3
Left	775	34.5

Note. Source: Quello Information-seeking Project (2020); Ns do not all add up to 2,280 due to missing values.

Number of Types of Information Sources

Several socio-demographic factors were connected to the mean number of types of information sources our respondents used to inform themselves about COVID-19, rated on a scale from 0 to 13 (see Figure 1). We see clear and statistically significant patterns by gender, education, income, online ability, children in the home, and area of residence.
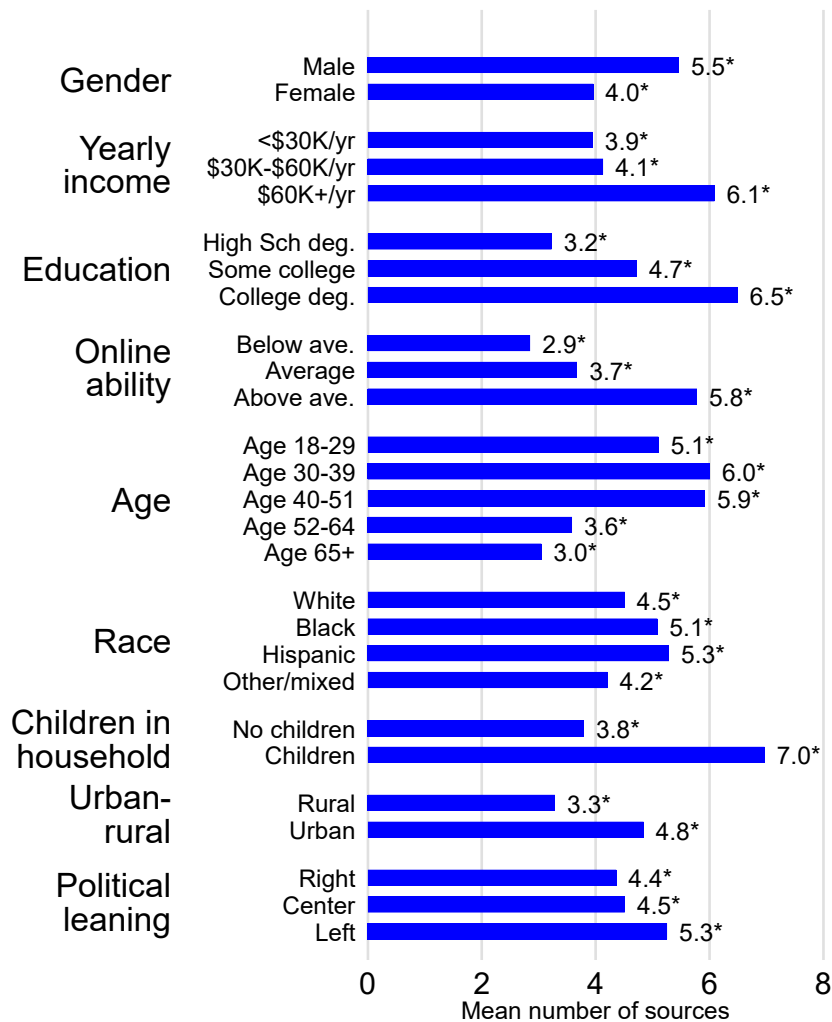
Figure 1. Number of types of information sources used.

Note. N=2,280; Source: Quello Information-seeking Project (2020); asterisks indicate statistically significant differences among the categories at p≤0.05.

Women used fewer types of information sources than men. There was also a pronounced difference in information sources used by individuals with higher income, education, and self-rated, online ability. Those earning more than US$60,000 per year used, on average, two more types of information sources than those earning less than US$30,000 per year, and respondents with a college degree used twice as many types of information

sources as those who had a high school degree. Further, those who rated their online ability as above average used more types of sources than those who rated their online ability as average or below average. We also found that younger respondents tended to report using a larger number of sources than older respondents. This difference became especially pronounced between the youngest three groups aged 18–29, 30–39, and 40–51, and the oldest two groups aged 52–64, and 65+, who used about half the number of information sources compared to their younger counterparts. In addition, Black and Hispanic respondents used more information sources, on average, than those who identified as white or other/mixed. We observed a clear difference between respondents with and without children in the household: those with children used twice the number of sources as those without children. Urban residents also used more sources than rural residents. Finally, we observed that people who lean left politically used more sources than those who lean center or right. However, this result may be due partially to the number of mainstream information sources (N=5) vs. conservative information sources (N=3) in the questionnaire.

Number of Checking Actions

A very similar statistically significant pattern emerged when respondents sought to learn something new or otherwise check or verify information (see Figure 2). Men checked information more often than women; respondents with higher incomes checked more than those with lower incomes; those with some college experience did more checking, and so did those with above average, self-rated, online skills. Younger age groups also engaged in more checking activities, as did Black and Hispanic respondents, those with children in the home, respondents living in urban areas, and those who were more politically left leaning.
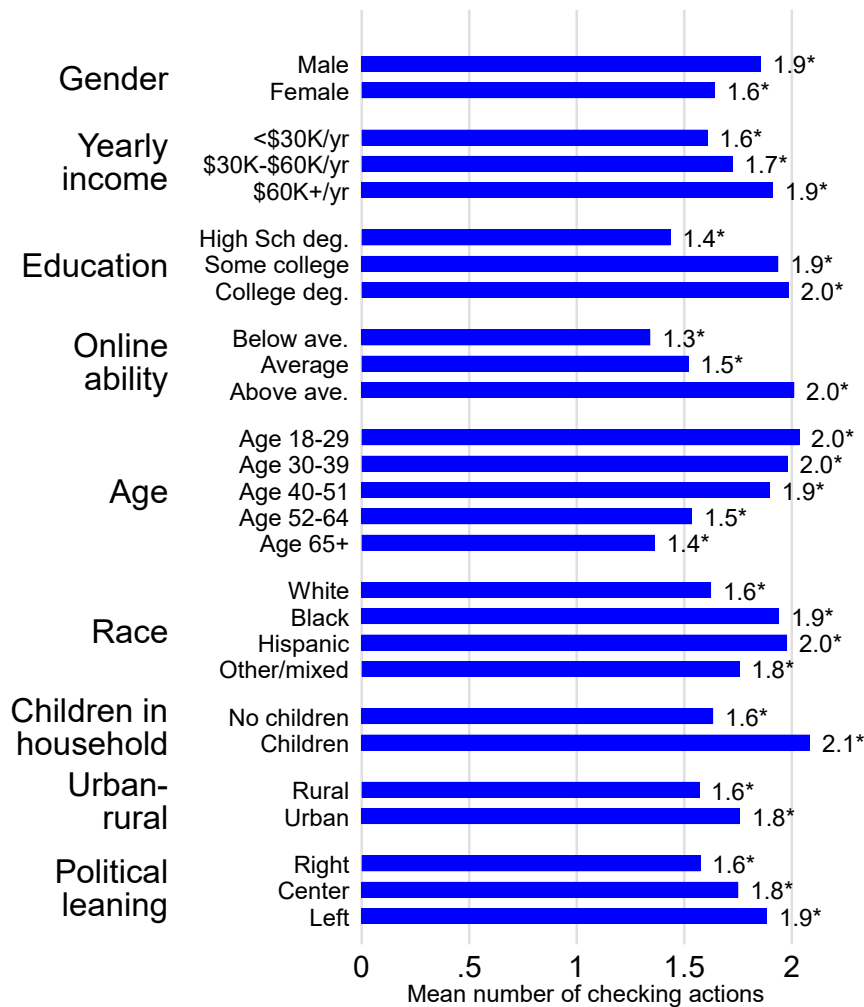
Figure 2. Number of checking actions.

Note. *N*=2,280; Source: Quello Information-seeking Project (2020); asterisks indicate statistically significant differences among the categories at p≤0.05.

Types of Information Sources

When we examined who is using different types of sources (TV sources, conservative sources, mainstream media, and medical sources), we found three patterns (see Table 3). First, there was a similar, statistically significant pattern as in Figures 1 and

2: respondents who have more resources used more types of sources. This applies to respondents who were more educated and had higher incomes. Furthermore, younger respondents, men, Black, and Hispanic respondents, and those who lean politically left also used more sources. In addition, those with children in the home, respondents living in urban areas, and those with higher, self-rated, internet abilities used more sources on average. The only exception is conservative media, which were used less by younger respondents and Black and Hispanic respondents, but more than any other type of source by those who were leaning right politically. It is also notable that Black and Hispanic respondents used all media sources, aside from conservative news sources, at a higher rate than white respondents.

Table 3. Percentage of respondents who used these types of sources in the past week.

	TV sources	Conservative sources	Mainstream media	Medical sources
Age				
18-29	42.9*	24.1*	47.5*	52.1*
30-39	49.7*	31.4*	57.5*	55.4*
40-51	54.9*	38.1*	47.3*	58.1*
52-64	31.0*	22.9*	17.9*	33.2*
65+	24.9*	25.6*	7.8*	28.0*
N	*2,280*	*2,274*	*2,273*	*2,274*
Gender				
Male	47.1*	35.7*	44.0*	51.0*
Female	34.0*	21.3*	26.2*	39.3*
N	*2,280*	*2,274*	*2,273*	*2,274*
Race/Ethnicity				
White	36.5*	33.9*	29.9*	41.6*
Black	52.4*	21.6*	38.8*	51.2*
Hispanic	45.9*	22.8*	47.6*	54.2*
Other	40.0*	10.5*	38.5*	41.3*
N	*2,280*	*2,271*	*2,273*	*2,274*
Education				
High school or less	27.3*	26.6*	9.2*	31.3*
Some college/no degree	41.0*	22.2*	41.2*	46.5*
BA/other college degree	56.4*	36.1*	61.1*	61.0*
N	*2,280*	*2,274*	*2,273*	*2,274*

Income				
<$30K/yr.	36.5*	23.1*	23.4*	39.2*
30-60k/yr.	34.8*	21.7*	30.6*	39.5*
$60k+ yr.	50.9*	41.5*	50.6*	56.9*
N	*2,246*	*2,240*	*2,239*	*2,241*
Children in household				
None	33.6*	21.0*	25.2*	36.1*
Children	57.6*	47.1*	59.4*	67.4*
N	*2,280*	*2,271*	*2,273*	*2,274*
Urban-rural				
Rural	18.8*	26.9	18.0*	29.4*
Urban	42.7*	28.6	36.6*	46.6*
N	*2,263*	*2,254*	*2,256*	*2,257*
Internet Skills				
Below Average	18.9*	26.3*	6.7*	25.0*
Average	33.1*	24.0*	18.4*	35.6*
Above Average	49.0*	32.4*	52.3*	55.6*
N	*2,270*	*2,264*	*2,263*	*2,264*
Political Leaning				
Right	25.8*	50.2*	22.7*	38.0*
Center	44.5*	20.5*	31.8*	44.1*
Left	50.0*	17.0*	49.6*	53.0*
N	*2,243*	*2,237*	*2,236*	*2,237*

Note. Source: Quello Information-seeking Project (2020); *Ns* vary due to missing cases; rows/columns do not add to 100% because respondents were able to select all that apply; asterisks indicate statistically significant differences among the categories at p≤0.05.

Second, users of conservative media contrasted with others. Generally, demographic factors made much less difference for conservative media consumers than for others. For example, the difference between most and least educated was 9.5 points for respondents who used conservative sources, compared to 51.9 points for those who used mainstream sources. Similar large percentage point differences in use of mainstream sources exist for age groups and self-rated, online skills but are absent for conservative media. Differences in rates of use persist for income and gender. Except for conservative

media, there is a similar pattern for political leaning: more left-leaning respondents reported using more types of sources.

Third, use of conservative media is also different in that the difference in use between young and old was small. All other media sources were much more likely to be used more by the young. For example, the youngest age group was about 40 percentage points more likely to use mainstream media than the 65+ age group. This reverses for conservative media: the oldest age group was 1.5 percentage points more likely to use conservative media than the youngest age group.

What America Knows about COVID-19

In our final step, we examined how the use of different types of information sources was related to what our respondents knew about the coronavirus. As mentioned in the methodology section, we asked respondents to rate as true or false six statements related to the virus. Table 4 below shows the results of an ordinal logistic regression with knowledge as the dependent variable. The results show that Black respondents, those with children in the home, and respondents living in urban areas (vs. rural) knew less about COVID-19. In contrast, those with a college degree, a household income of more than US$30,000 per year, and those who identified politically as left-leaning answered more answers correctly when asked about their factual knowledge about COVID-19. In addition, respondents who used more mainstream media sources and TV sources knew significantly more about the virus, whereas respondents who used more conservative sources knew significantly less about COVID-19, as did those who engaged in more checking actions.

Table 4. Knowledge about COVID-19.

	%	%StdX	p-value
Age (18-29)			
30-39 years	18.9	6.9	0.316
40-51 years	-1.5	-0.6	0.934
62-64 years	33.0	12.6	0.170

	%	%StdX	p
65+ years	10.3	4.0	0.673
Female	-5.8	-2.0	0.576
Race/Ethnicity (White)			
Black	-47.8	-18.4	0.000
Hispanic	-20.1	-8.5	0.151
Other	7.9	2.2	0.680
Education (High School or less)			
Some college	40.2	16.4	0.072
BA or higher	68.2	27.8	0.009
Annual household income (Less than US$30,000/yr.)			
US$30,000-60,000/yr.	63.5	26.9	0.000
More than US$60,000/yr.	67.2	27.6	0.000
Children under 18 in household	-41.5	-21.6	0.000
Urban residence	-31.6	-10.0	0.015
Political position (Right)			
Center	-2.9	-1.4	0.806
Left	45.1	19.5	0.007
Self-rated Internet ability (Below average)			
Average	-0.8	-0.4	0.967
Above average	25.6	12.0	0.293
Number of conservative media sources	-44.8	-45.9	0.000
Number of mainstream media sources	8.6	14.7	0.045
Number of medical media sources	6.5	7.6	0.200
Number of TV sources	24.0	18.6	0.003
Number of checking actions	-22.5	-20.5	0.000
Number of cases			2,029
McKelvey & Zavoina R^2			0.191

Note. Source: Quello Information-seeking Project (2020). Reference categories in parentheses. The column labeled "%" is the percent change in the dependent variable for a one-unit change in the independent variable. The column labeled "%StdX" is the percent change in the dependent variable for a one-standard-deviation change in the independent

variable. p-values indicate the level of statistical significance. p≤0.05 indicates a significant result.

Discussion

We examined information divides with respect to the COVID-19 pandemic. We explored how demographic and other factors relate to the number of types of information sources, the number of checking actions, and the types of information sources used by individuals in the United States. In addition, we examined how information access and other factors related to knowledge about the pandemic. Considering extant research on social inequalities and related literature on reinforcing effects, we expected those in more privileged positions in society to use more information sources and more checking actions to stay up to date on the pandemic.

Our data show that that is the case on average: those with higher education, income, and self-rated ability to use the internet make use of more information sources and more checking actions overall. We found this to be true regardless of the type of information sources that our respondents used; this means that those who were better off used all types of information sources more, including conservative news sources. Those with a higher education and income also had more knowledge about COVID-19. We also found that Black and Hispanic respondents, those who had children at home, and those who lived in urban areas used more information sources and checking actions.

However, here we find hints in our data that the association between the number and quality of information sources used, the updating practices employed, and the resultant mental models are multifaceted and complex, as shown by our ordinal logistic regression results. These results suggest that, despite using more sources, Black respondents, those with children at home, and those living in urban areas had significantly less factual knowledge about COVID-19. Such results provide an example of potentially information-

rich but knowledge-poor subgroups. Exploration of these patterns will require additional analyses.

In general, our findings point to some inequalities in information seeking along socioeconomic lines and by self-rated, online ability. These findings are in line with other coronavirus studies (Chen et al., 2020; Fletcher et al., 2020; Nielsen, Fletcher, Kalogeropoulos, et al., 2020) and with extant research, which points to differences in information seeking that arise from socioeconomic disadvantages (Słomczyński & Janicka, 2008) as well as from differences in digital access and skills (Eynon & Geniets, 2016; Kobayashi & Ishizaki, 2019). This is an important finding because, although information seeking at the start of the pandemic increased (it soon leveled off; Bento et al., 2020; Fletcher et al., 2020; Mitchell et al., 2020), it is apparent that the discrepancies between the information and knowledge 'haves' and 'have-nots' remained large and complicated in late October and early November 2020.

On average, more education or higher income is related to having more accurate information about COVID-19. The former group represents an information- and knowledge-rich sub-group, whereas the latter represents a potentially information- and knowledge-poor sub-group. We note here that although inequalities or differences in information seeking may exist for several concurrent reasons, they mean that socioeconomic and other disadvantages translate into information and knowledge gaps about the virus and create vulnerable individuals and groups.

We also found that those who were younger used more information sources, which contrasts with findings from Fletcher and colleagues (2020) in the United Kingdom, who found that older respondents used more information sources than younger respondents (though this finding aligns with findings from China; Chen et al., 2020). This finding is of particular note, because individuals in older demographic groups are more vulnerable. One might expect that older individuals would be more motivated to seek reliable information because of this vulnerability, but this is not what we found. A potential reason for this

finding may be lower digital skills among older individuals (e.g., Hargittai, 2002), possibly compounded by other factors. However, this did not seem to be negatively related to older individuals' knowledge about COVID-19 (see Table 4), which points to a potentially 'information-poor' yet adequately informed sub-group. Our future analyses will seek to further unpack these observations.

In addition, men, Black, and Hispanic respondents, those with children in the home, respondents living in urban areas, and those who identified as politically left leaning used more types of information sources. These patterns repeated for checking actions and along different repertoires of information sources. The differences we found between men and women align with research on differences in news interest and use (Hamilton, 2004), which may arise because of avoidance of negative news among women (Grabe & Kamhawi, 2006) or because of gendered socialization and "political, social, economic, and educational disparities woven into American society" (Poindexter et al., 2008, p. 7). Prior research has shown that Black adults are more likely than other demographic groups to rely heavily on local news sources (Miller et al., 2012), and they use more news media overall (Mastro & Stamos, 2018).

We found no prior evidence for differences in information seeking between those with and those without children in the home, but a handful of studies looked at differences between rural and urban populations and their news consumption. Wells and colleagues (2021) found that urban residents in Wisconsin consumed more "high quality" news than rural residents, but Liu (2020) found no differences in news consumption regarding COVID-19. We theorize that when it comes to Black and Hispanic respondents as well as individuals in urban areas and those with children at home, higher rates of COVID-19 information seeking and updating may be the product of higher salience and a need to stay informed. Individuals from minority backgrounds in the United States are at higher risk from coronavirus due to disparities in employment, income, and healthcare (Rollston & Galea, 2020), as well as the concentration of populations in urban areas. This latter factor may also account for higher levels of information seeking and updating among urban

respondents, because urban centers with higher population concentrations present a greater risk of virus transmission. For respondents with children, the same salience factors may apply, given the disruptions that the pandemic has had on schooling. Finally, differences by political ideology may result from a higher concern about COVID-19 among individuals on the left and a lower trust in news media on the right (Mitchell et al., 2020).

We also found that using more types of information sources or engaging in more checking actions are not necessarily associated with more accurate knowledge about the pandemic. Although Black respondents, those with children in their home, and those living in urban areas used more types of information sources and engaged in more checking actions, they had significantly less accurate knowledge about COVID-19. Our findings support the notion of information-rich but knowledge-poor groups, referred to by Nielsen, Fletcher, Kalogeropoulos, et al. (2020) as "infodemically vulnerable." Our data provide evidence that, although individuals may seek out more information from various sources, this may lead to more confusion and misinformation rather than accurate knowledge. This is clearly not always the case, e.g., those with higher incomes and higher educational qualifications use more information sources and have more factual knowledge about COVID-19. Nevertheless, it is important to highlight that more information does not automatically equal better knowledge, and that knowledge differences may reflect disparities in the resources needed to translate information access into accurate knowledge. We also note that engaging in more checking actions (learning new information, checking a news source outside the norm, trying to confirm existing information, etc.) was also associated with lower COVID-19 knowledge. This points to a potential risk of seeking to update one's knowledge in an information environment that is characterized by uncertainty and contradictory information: what is found may cause more confusion than might be the case if one relied only on a set of reliable, mainstream, news sources.

Finally, we found that individuals inclined to use conservative media sources have less accurate knowledge about COVID-19. This holds true and is relatively independent of socioeconomic factors. It points to the divergent mental models about the virus that may

be shaped by accessing information of different valences. Conservative media have been more likely to push narratives about the coronavirus that downplay its severity and promote misperceptions (Calvillo et al., 2020; Motta et al., 2020). As a result of different narratives, analyses have shown how individuals who relied on President Trump and his taskforce for information (alongside Fox News and conservative talk radio) are more likely to say the United States has dealt well with the pandemic and that the pandemic has been exaggerated and less likely to say the CDC had their facts straight (Jurkowitz & Mitchell, 2020; Mitchell et al., 2020). Moreover, surveys have noted that individuals who rely on conservative information sources are more likely to believe conspiracy theories and other misinformation (Jurkowitz & Mitchell, 2020; Mitchell et al., 2020; Dhanani & Franz, 2020; Romer & Jamieson, 2020). In addition, we find that these individuals (who tend to be politically right leaning) are also less knowledgeable about the virus (see Table 4).

Limitations

This study has several limitations. First, as mentioned in the methodology, a discrepancy may exist between what people say they do versus what they actually do. Our data relied on self-reported, information-seeking behaviors, which might be divergent from actual behaviors. Future studies should aim to combine self-reported, survey measures with actual, behavioral measurements, such as television watching, while also maintaining representativeness.

Second, because of the cross-sectional nature of our survey, the data can give us only a snapshot of reported behaviors and knowledge at one certain point in time. Prior work has shown that information seeking related to COVID-19 increased sharply in the beginning of the pandemic but decreased over time (Nielsen, Kalogeropoulos, et al., 2020). Our data were collected at the onset of the third and worst wave of the pandemic in the United States. This could have led to another subsequent increase or change in information seeking, especially because the first COVID-19 vaccines were set to be approved in late November and early December. A panel design, although costly, would allow researchers

to gauge whether information seeking changes on an individual level when new pandemic-related events occur.

Finally, due to time and space limitations, our survey did not differentiate between general information seeking and information seeking specifically related to the COVID-19 pandemic. Therefore, we cannot gauge whether the patterns observed in our data are unique to information seeking about the pandemic or whether these patterns would be similar for other areas. Future surveys should aim to differentiate different areas of information seeking to evaluate potential differences related to specific topics.

Conclusion

Several high-level conclusions for health policy emerge from this research. From a public health perspective, it is important for people to keep abreast of reliable information regarding the latest health advice, scientific findings, local or nationwide lockdown orders, vaccine distribution and safety, and other ongoing developments related to the pandemic. For individuals to seek out and consume reliable information is important for an informed public and for maintaining public health (Damian & Gallo, 2020). Given the magnitude of the challenges, the identified multifaceted information inequalities and knowledge gaps pose serious problems for individuals and society. Indeed, variations in levels of knowledge about the pandemic pose a risk in terms of lower overall compliance with public health guidelines and higher vulnerability to mis/disinformation about the virus (Enders et al., 2020; Fletcher et al., 2020; Nielsen, Fletcher, Kalogeropoulos, et al., 2020).

We found that individuals of lower income, education, and self-rated, online ability are less likely to seek out and update their knowledge about the pandemic. We found also that individuals with lower income and education have less accurate knowledge, which indicates some evidence for information-poor and knowledge-poor groups. However, we also found that Black respondents, those with children in the home, and those living in urban areas seek out and update their information more, but have less accurate knowledge

about the pandemic. This indicates a subgroup that is information-rich but knowledge-poor. These differences have public health implications. Considering that those who are socioeconomically worse off are more likely to contract the virus (Rollston & Galea, 2020), it would be especially important to obtain information not necessarily from more sources, but from selected, highly authoritative, and trusted sources.

In addition, the politicization of the pandemic leads to certain groups of the population not only having less information, but also believing wrong information about the virus, which can have dire public health consequences. Inaccurate knowledge about COVID-19 can have serious consequences for public health, if those who believe the virus may not be real or can be treated with antibiotics engage in unsafe behaviors, such as not socially distancing or not wearing face masks in public (Romer & Jamieson, 2020).

It is important that our work shows that having more information is not necessarily better than having less information. What is important is whether the mental models based on this information are aligned with what is known about the pandemic. It is about having the correct information. If additional sources of information are not factual and valid, more sources and/or quantities of information may not be better than fewer types and sources of more accurate information. Additional research is needed to further disentangle the quantity and quality aspects of information, the intertwining of information seeking and knowledge formation, and how these relate to preventive health behaviors related to COVID-19. Our findings clearly show the potential benefits of strategies to decrease inequalities in information access and processing, to increase the capacity for knowledge formation, and to reduce the politicization of the pandemic in the United States.

Funding

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Appendix

Table I. Question wording and response categories.

Variable	Question	Response categories
Age	In what year were you born?	
Gender	Which of the following best describes how you think of yourself?	Male Female
Race	To which of the following racial groups do you consider you belong?	White Black or African American American Indian or Alaska Native

		Asian Native Hawaiian or Pacific Islander Mixed race or other Prefer not to say
Ethnicity	Are you of Hispanic, Latino/a or Spanish origin?	No Yes Prefer not to say
Education	What is the highest level of education that you have completed or will complete at the end of this year?	Bachelor's degree or graduate school (e.g., BA, BS, MBA, MS, Ph.D., MD) Some college or Associate's Degree High School degree or GED 7th-11th grade 6th grade or less
Income	Household incomes differ a lot in the United States today. The table below shows the range of incomes that people have. Which of these categories best represents the total income of your household from all sources before taxes?	Up to $10,000 per year $10,000 up to $20,000 per year $20,000 up to $30,000 per year $30,000 up to $40,000 per year $40,000 up to $50,000 per year $50,000 up to $60,000 per year $60,000 up to $70,000 per year $70,000 up to $100,000 per year Over $100,000 per year Don't know
Children in Home	Do any CHILDREN (people under 18) live in your household?	No Yes Don't know
Marital Status	Are you...?	Single Married Living together with a partner Divorced or separated Widowed Prefer not to answer
Place of Residence	How would you describe the place where you live?	A big city The suburbs or outskirts of a big city A small city or town A country village A farm or home in the country Other Don't know

Internet Skills	Generally speaking, how would you rate your ABILITY to do things online?	Expert Advanced Average Below average Beginner Don't know
Political Leaning	Some people talk about 'left', 'right' and 'center' to describe parties and politicians. (Generally, liberal parties would be considered 'left wing' whereas conservative parties would be considered 'right wing'). With this in mind, where would you place yourself on the following scale?	Very left-wing Fairly left-wing Slightly left-of-center Center Slightly right-of-center Slightly right-wing Very right-wing Don't know

Note. Source: Quello Information-seeking Project (2020).