Beliefs in Conspiracy Theories and Online News Consumption during the onset of the COVID-19 pandemic

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Using an original survey covering 17 countries, this paper documents the prevalence of beliefs in conspiracy theories related to the COVID-19 pandemic and characterizes the informational, demographic, and trust profiles of individuals who believe them. There is considerable variation across countries in the level of conspiracy beliefs, with people in a set of countries like Romania, Poland, Greece, and Hungary being relatively more susceptible than respondents in Northern Europe. We find several factors are correlated with conspiracy beliefs across countries. Relative to respondents who do not read news on social media, social media users tend to endorse more conspiracies, and this is the case for Facebook, Instagram, and YouTube users in particular. We also observe a link between distrust in medical experts or government and endorsement of conspiracy theories in most countries. In a subset of countries, we also find that individuals with medium level of education and those who are younger believe in a higher number of conspiracy theories.

Keywords: conspiracy theories, COVID-19, misinformation, social media, digital platforms, online news, trust

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After the outbreak of COVID-19, governments, health officials, and experts stressed the importance of taking preventative measures such as social distancing, mask-wearing and, eventually, vaccination. But these guidelines were often undermined by conspiracy theories (CTs), circulating widely on social media, casting doubt on the seriousness of the illness and on expert advice, hindering people's willingness to adopt such measures (Bierwiaczonek et al. 2022). Against this background, susceptibility to endorsement of CTs thus became an object of scholarly interest. Past work has identified various limitations in the study of conspiracy theories, such as its overwhelming focus on the so-called Western, educated, industrialized, rich, and democratic (WEIRD) countries, and inconsistent results partly due to varying definitions of what constitutes a conspiracy theory (Douglas and Sutton 2022). Against this backdrop, we explore the correlates of COVID-19-related conspiracy theories by answering two questions using a large-scale cross-country study. First, how widespread were beliefs in such theories across the European continent at the onset of the pandemic? Also, as exposure to social media in general, and video-sharing platforms in particular, is suspected of facilitating the spread of conspiracy theories (Tufekci 2018; Wang et al. 2019; Bruns et al. 2020), we also focus explicitly on people's information consumption profiles. Thus, our second question is: what is the informational and demographic profile of those who endorse COVID-19-related conspiracy theories and how are these beliefs related to individuals' levels of trust in institutions?

We use individual-level data from 16 European countries (Austria, Belgium, Denmark, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Romania, Spain, Sweden, Switzerland, and the UK) and Israel. This dataset provides a rare opportunity to study general correlates of conspiracy beliefs by considering commonalities and differences across countries. One notable advantage of this dataset is that it enables us to analyze individuals' news consumption patterns across specific social media platforms, such as Facebook, Twitter, YouTube, Instagram, and WhatsApp, rather than bundling them all under "social media" category. This granularity allows for a more nuanced approach to understanding the distinctive roles that different platforms may play in shaping the spread of (mis)information.

At the country level, the data suggest that cultural context and historical legacies play a role; we observe greater propensity to believe CT in new (post-communist) democracies (Romania, Poland, Hungary) as well as in Greece. By contrast, respondents in Northern European countries (Sweden, Denmark, Norway) and Austria on average believe fewer conspiracy theories about COVID-19.

With regards to exposure to news via social media in general, we find a general pattern of higher prevalence of beliefs in CTs among people who use social media frequently for news consumption, though we fail to observe this association in a minority of countries such as Greece, Romania, and Sweden. When it comes to associations between beliefs in CTs and specific platform use, YouTube has a particularly strong association with CT beliefs in many countries and we observe the opposite when it comes to news consumption via Twitter. In countries such as Poland, France and Denmark respondents who receive news via WhatsApp endorse more CTs relative to their counterparts who don't use WhatsApp (but, as we show later, news consumption via this platform was relatively rare in most countries in 2020).

We also document to what extent COVID-19-related CT beliefs vary by levels of trust in medical experts and the government – both aspects that are related to the country's cultural context – as well as by sociodemographic factors. In line with the previous studies, there is a strong association between distrusting medical experts and the government and CT beliefs - though exceptions do exist (Romania, Hungary). In most countries, contrary to what one might expect, people with medium level of education (higher secondary and short tertiary level of education) tend to believe in CTs more than people with low education (less than lower secondary level). We also find that CT beliefs are more prevalent among younger age groups (less than 30 years old) than among older age groups (60 years or older). In a subset of the investigated countries (7 out of 17), CT beliefs of women are more pronounced than those of men (especially in the U.K, and in Poland) but in the rest of countries, these differences are very small.

While our study does not have any causal component, our results speak to contemporary discussions about the characteristics and behaviors that increase susceptibility to CT beliefs. We are able to highlight the general correlates of CT beliefs across countries while pointing out specific country differences. We expect subsequent work can further probe and attempt to explain determinants of CT beliefs.

Literature

Social media

Since the beginning of the COVID-19 pandemic, concerns have been voiced by journalists (e.g., BBC Monitoring and UGC Newsgathering 2020; McDonald-Gibson 2020), scientists (e.g., Brennen et al. 2020) and the World Health Organization (WHO, 2020) that segments of the population may be inclined to embrace unfounded rumors and conspiracy theories (CTs), which could dissuade them from adhering to preventive measures aimed at curbing the spread of COVID-19. Given the ease of spread of misinformation on social media during past epidemics (such as the Zika virus, where misinformation on Facebook may have exceeded accurate information (Sharma et al., 2017)), the role of social media in perpetuating CT has once again come to the fore during the COVID-19 pandemic. Studies have demonstrated that individuals who prefer social media as a source of information or who are exposed to COVID-19 information on social media are more susceptible to COVID-19-related misinformation (Bridgman et al. 2020; De Coninck et al. 2021; Freeman et al. 2022; Jamieson and Albarracin 2020; Roozenbeek et al. 2020). On the other hand, Altay et al. (2023)'s study suggests that social media use help raise awareness of the existence of misinformation. This, however, might also depend on the affordances of social media which vary from service to service, possibly affecting each platform's users' exposure to CTs and to viewing them as potentially true.

First, platforms' content moderation strategies against misinformation and CT vary greatly from service to service. While we cannot extensively review past work here, some prior work indicates that Facebook moderated such content less

than Twitter (Papakyriakopoulos et al., 2020). Moreover, by the time YouTube reported to be cracking down on pandemic-related misinformation (Duffy, 2021), many still criticized the slow pace with which Facebook was responding to the flood of misinformation during the pandemic (Jackson et al., 2021; O'Sullivan et al., 2021). Misinformation is also prevalent on private messaging apps where content moderation by the platform is not possible, and corrections are made by the individual participants in a conversation (Rossini et al., 2021). Taking into account the lax content moderation practices of some platforms and what we know about the prevalence of CTs from previous studies (e.g., Sharma et al. 2017), we could expect more exposure to, and beliefs in CTs by users on Facebook and WhatsApp than on other platforms.

Second, structural characteristics of platforms (e.g., followers and following on Twitter, friends on Facebook), may affect users' experiences with, or attitudes towards, corrections or exposure to counter-attitudinal information. Social networks on Facebook and instant messaging apps such as WhatsApp are made up mostly of strong ties as users connect on those platforms primarily through mutual agreement. Strongly connected and politically homogeneous networks could make people more tolerant to fake news (Gill and Rojas 2020); in Brazil, for example, 25 % of survey respondents answered that they have shared misinformation on Facebook and WhatsApp (Rossini et al., 2021). At the same time, people might feel more comfortable about correcting misinformation in more private environments (such as messaging apps) than on Facebook (Rossini et al. 2021), yet such differences between Facebook and private messenger apps like WhatsApp are not entirely clear. On the other hand, Twitter and YouTube networks comprise of relatively weak ties because following other accounts without permission from an account owner is generally possible. Networks without mutual agreement allow users to expand their social networks beyond their acquaintances in real life, which could lead to exposure to political information that is not congruent with their views (Vraga and Bode 2018). In addition to these affordances, YouTube has other particular characteristics, such as that the user experience is anonymized and de-individualized (Halpern and Gibbs, 2013). Users depend largely on an algorithmic recommendation system when they explore the platform.

While recommendation systems open the possibility of being exposed to diverse topics, there has been a lot of concern that YouTube's recommendation system leads people down a rabbit hole of extremity (e.g., Tufekci 2018; Newton 2019). Yet empirical evidence whether YouTube's recommendation system results in something along the lines of a filter bubble remains contested (Ibrahim et al., 2023; Yesilada and Lewandowsky, 2022).

We stress here that different architectural features of social media platforms have different consequences for the correction of misinformation. A study by Vraga and Bode (2018) found that correction of misperception works better on Twitter than on Facebook. They speculated that this could be attributed to the fact that the main purpose of using Facebook for people is social activity (Vraga et al. 2015; Ellison et al. 2007) when Twitter might be regarded as a place where people chiefly turn for news as it helps them increase their understanding of current affairs (Mitchell et al., 2021; Odabaş, 2022).

While affordances seem to play a role, past work also provides grounds to expect that the context matters too. For instance, Altay et al. (2023)'s study which included the UK, India, and Brazil, observed that platform effects vary by country. While they generally found null effects of social media on beliefs, they also showed that in the UK, Twitter and Facebook use reduces false beliefs while Facebook Messenger increases false beliefs. Moreover, in Brazil, Facebook Messenger and Pinterest use increases false beliefs, while in India, Facebook use increases false beliefs and YouTube appears to increase beliefs in true information. Those contradictory results (Facebook helping reduce false beliefs in the UK but doing the opposite in India) underline the importance of taking country differences into consideration. At the same time, consistently adverse effects by platforms such as Facebook Messenger may signal that some platform effects might be generalizable across countries.

Considering all the above, we expect that Facebook and instant messaging app users who use these platforms for news will be more susceptible to misinformation than

users of other platforms — particularly, Twitter — as the chances of being exposed to CTs without experiencing corrections are high. We also expect that news consumption on YouTube will be strongly associated with CT beliefs due to its anonymized, de-individualized nature and algorithmic recommendation system.

Trust in institutions and leaders

Considerable works in the social sciences show that a lack of trust in institutions contributes to beliefs in CTs (Miller et al., 2016; Galasso et al., 2020; Walter and Drochon, 2020; Merkley and Loewen, 2021). Moreover, low trust in official figures, which can be a root for denialism (Uscinski et al. 2020) or anti-intellectualism (Merkley and Loewen 2021), makes corrections difficult as people could simply deny the corrections from experts (Uscinski et al. 2020) as well as be less open to COVID-19-related news and expert-featured news than other news (Merkley and Loewen 2021). Evidence from the US, UK, Canada, Australia, and New Zealand, suggests that people with low trust in health officials are more likely to amplify misinformation (Pickup et al. 2022).

However, in a crisis like COVID-19, the relationship between trust in institutions and CT beliefs becomes more nuanced as the reactions to COVID-19 of political figures and experts, their attitudes towards misinformation, and their competence in handling the pandemic vary greatly by country. For instance, a recent study conducted in six countries (the UK, Ireland, the US, Spain, and Mexico) found that US citizens with higher trust in government are more prone to believing misinformation and that in the US, Spain and Mexico, trust in politicians' COVID-19 approach to the pandemic may inhibit their ability to discern misinformation (Roozenbeek et al., 2020). Of course, elites in many countries have at times sent mixed signals (e.g. Donald Trump was a proponent of masking but a critic of masking and lockdowns). Again, country differences seem to be a potential source of variation with regard to relationships that have been documented in prior studies.

Sociodemographic characteristics

Sociodemographic factors have long been considered important in the study of conspiracy thinking (Min, 2021; Douglas et al., 2016). Among them, the following are often considered important: education, age, and gender. Previous literature has shown that people with low education are more likely to believe CTs than people with higher levels of education (Van Mulukom et al., 2022). Some work suggests that this is because education improves people's reasoning (Douglas et al. 2016), rational thinking (Mancosu et al. 2017), or exposure to information (Van Mulukom et al. 2022). On the other hand, other research argues that high levels of education represent other factors, such as socialization (Uscinski and Parent 2014).

Age is also one of the factors which is closely related to beliefs in CTs. Although it has often been observed that younger people are more susceptible to endorsing CTs (Galliford and Furnham 2017; Goertzel 1994; Stempel et al. 2007; Roozenbeek et al. 2020), it would be premature to generalize this to all societies, especially when the sharing behavior and experience with corrections amongst older people is considered. Existing research shows that people over 65 tend to share misinformation seven times more than younger respondents (Guess et al. 2019), are more likely to be exposed to fake news on social media (Grinberg et al. 2019), and less likely to experience corrections of COVID-19-related misinformation on social media. At the same time, younger people are more likely to witness corrections of misinformation, correct others, or be corrected themselves (Bode and Vraga 2021). Especially when it comes to COVID-19-related CTs, age effects seem to differ by country (Van Mulukom et al. 2022), calling for more cross-national research before firmer generalizations are made.

Finally, gender is another characteristic of citizens which might shape how they experience the pandemic and respond to it (Galasso et al. 2020; Haischer et al. 2020; Wenham et al. 2020), but research that puts emphasis on its role for CT beliefs remains limited (Cassese et al. 2020). In addition, existing findings are mixed; some studies have found no gender differences in COVID-19-related CT beliefs (Freeman

et al. 2022; Tonković et al. 2021), while others have showed that men are less likely to engage with COVID-19 conspiratorial thinking and conspiracy beliefs (Erceg et al. 2020). Or, others have found that women are more resistant to them (Cassese et al. 2020) and were less exposed to foreign influence campaigns on Twitter than men in 2016 (Eady et al., 2023).

In all, previous scholarship has shed light on how different media habits, trust and socioeconomic dimensions might be associated with and help to explain beliefs in CTs. We build upon these key findings to further explore the role of these factors in COVID-19 CT beliefs using a dataset which comprises of a relatively large set of countries.

Data

We used data from an online survey designed by the Network of European Political Communication Scholars (NEPOCS). Respondents were surveyed in 17 countries: Austria, Belgium, Denmark, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Romania, Spain, Sweden, Switzerland, and the UK. The first wave of the survey was fielded in December 2019 and included 28,317 participants who were recruited by Dynata, a public opinion and market research company. Shortly after the COVID-19 outbreak (May and June 2020), we fielded a second wave with the same participants; 14,218 participants remained in the survey (attrition rates varied by country from 39.9% to 60.6%). We have data about the respondents' COVID-related CT beliefs only in the second wave of our survey as the first wave was conducted before the pandemic.

Dynata recruited respondents from their participant pool and invited them to the online survey after confirming their identities. Age, gender, and metropolitan region were used for quotas. The number of respondents varied by country from 641 to 1,002. We constructed weights with demographic information (education, age, gender) from census data. For 16 European countries, we gathered the census data from the statistical office of the European Union, Eurostat (Eurostat, 2021) and for

Israel, we acquired the census data from the Central Bureau of Statistics (CBS). Weights were applied in all analyses that follow.[1]

Before explaining our measurement, we elaborate on our definition of conspiracy theory and conspiracy beliefs. As conspiracy theories are studied in many disciplines, definitions vary depending on the field and purpose of the study. Yet one of most commonly referred characteristics is a claim positing that powerful individuals or groups with sinister intentions orchestrate significant social events while keeping their involvement hidden from public view (Sunstein and Vermeule, 2008; Uscinski and Parent, 2014). We restrict our consideration of conspiracy theories to assertions which are potentially harmful and false (based on the best available evidence) for a pragmatic reason in line with Sunstein and Vermeule (2008).

Accordingly, three conspiracy narratives, which have been widely circulated on social media and amplified by political figures (Kertscher 2020; Knight 2021), are employed to measure beliefs in CTs. These are: (1) coronavirus is a bioweapon developed by China, (2) pharmaceutical companies have already developed but are hiding a vaccine from the public, (3) the coronavirus is the result of a US military experiment (for exact question wordings, see Supplementary Information Table S2). Respondents were asked to what extent they agreed with the aforementioned three statements on a five-point scale (0 = Very certain it's false, 1 = Somewhat certain it's false, 2 = Uncertain whether it's true or false, 3 = Somewhat certain it's true, 4

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[1]To assess representativeness of our data, we compared our data with population data, by comparing the gender distribution, the median age, and percentages of high educational attainment between 25-64 years old (more than bachelor's degree). This information can be found in Supplementary Information Table S1.

= Very certain it's true).[2]

As one of the main correlates, social media consumption and its relationship with CT beliefs was examined. The frequency of following news via social media was measured with a 7-point Likert scale. Respondents who answered either 'several times a day' or 'daily' to that question were collapsed into a 'daily news consumption via social media' category. Those who answered '5-6 days, 3-4 days, 1-2 days a week' or 'rarely' were put in a 'infrequent usage' group. Those who answered 'never' were categorized as 'not reading news via social media'. The use of social media for news consumption was also measured for each social media platform: respondents were asked which social media provides political news to them. Social media included in the list were Instagram, Facebook, Twitter, YouTube, and WhatsApp (selected = 1, not selected = 0).

Trust in institutions was gauged by respondents' trust in medical experts and the national government, both of whom have played a major role in the management of the pandemic (we didn't aggregate two variables into one variable because beliefs in medical experts may tap into beliefs in science while trust in national government could be more closely related to political attitudes). Respondents' answers ranged from 'Trust completely' to 'No trust at all' in seven levels. They were divided into three groups to make visual comparisons clearer; (1) No trust at all, (2) Medium

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[2]To check the reliability and validity of our measures of CT beliefs, we performed a correlation test and factor analysis with 6 items about the coronavirus to see whether our CTs load together into one factor. Three of the six items asked respondents about their beliefs in CTs. One question was a false claim which does not involve a conspiracy ("Vitamin C can protect against the coronavirus"), and two items probed respondents' beliefs in true information about COVID-19. The correlation test showed that the three CTs are substantially correlated. Particularly, the correlation between the US military lab leak theory and the China bioweapon theory is at a substantial 0.54. When the Exploratory Factor Analysis (EFA) with additional false and true items was performed (eigenvalue > 1), three CTs and false information loaded into one factor (RMSEA = 0.05, TLI = 0.96, RMSR = 0.02) indicating one dimension despite the fact that the US and China CTs effectively contradict one another by placing the origin of the virus in two different countries at the same time.

(people who are in the middle of 'complete distrust' and 'complete trust') and (3) Trust completely.

Lastly, the level of education was measured by asking respondents what was the highest level of education completed. Creating comparable levels of education in cross-national studies is a challenge. In this case, to facilitate cross-national comparisons, education level was divided into three levels: high, medium, and low—based on the standards set by International Standard Classification of Education (ISCED11).[3] When a person's highest education level was at, or above, tertiary, a person was categorized as having a high education. When it was between higher secondary and short tertiary, one was categorized as having a medium level of education, and when it was no education or primary or lower secondary level, the person was categorized as having a low education. The share of low educated people in our sample ranges from 0.7% (Germany) to 24.1% (UK).

For the purpose of observing generational differences, people were divided into three groups. People younger than 30 were categorized into a younger age group, those aged between 30 and 59 were put into a middle age group, and those over 60 years old were categorized as the older age group. Around half of the respondents were female (52%).

Results

Figure 1 lists the three COVID-19-related CTs included in the survey and summarizes their prevalence across countries. In the pooled sample of all 17 countries, the average citizen believe 0.37 of the three conspiracy narratives. The top-left panel also shows how many of the CTs (out of three in total) are believed on average in each country. We can see that beliefs in CTs are by far the most widespread in younger European democracies. Romania shows the highest beliefs in CTs, followed

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[3]The International Standard Classification of Education (ISCED) was developed by the United Nations International Family of Economic and Social Classifications, in order to assemble, compile and analyse cross-national data.

by Poland, Greece, and Hungary. This is in contrast with countries such as Denmark, Sweden, Austria, Norway, and Switzerland (less than 0.25 theories believed out of 3). Other countries like Germany, the United Kingdom, Belgium, the Netherlands, Italy, Israel, Spain, and France (in ascending order) have comparatively modest average CT beliefs (between 0.25 and 0.4).
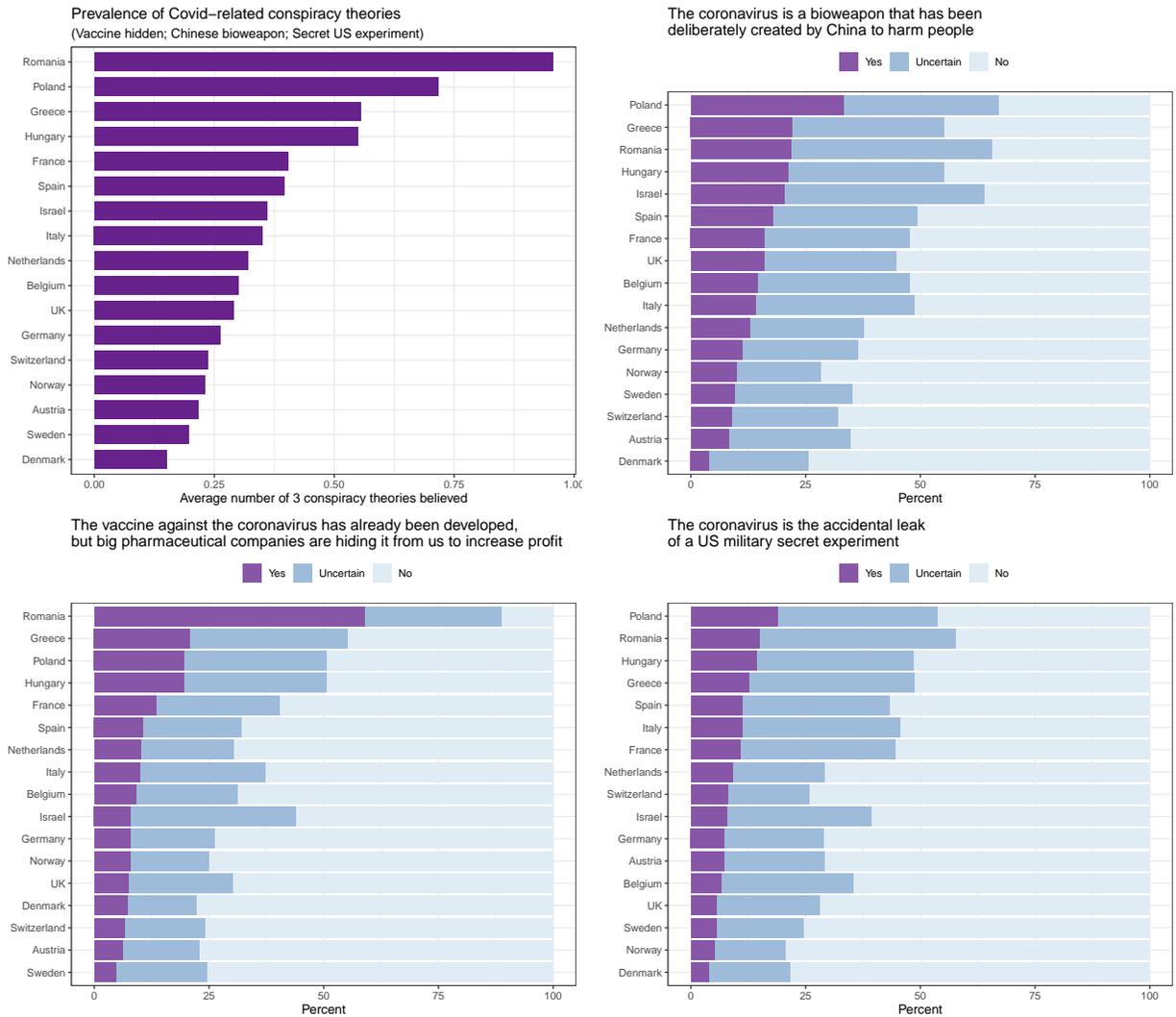

Figure 1. Beliefs in COVID-19 conspiracy theories in 17 countries.

As shown in the figure, there are no considerable variations in beliefs when

we look into support separately per each CT. We note that, in the Spring of 2020, more than half of the survey participants from Romania believed that pharmaceutical companies withheld a vaccine to make a profit (and the majority of the remaining participants said they were uncertain). In general, the share of uncertain participants across countries is relatively high. It appears that many people were uncertain whether to believe COVID-19-related CTs.

Social Media

Figure 2 provides information about the specific percentages of respondents who use social media for news consumption in each country. There is considerable variation across countries; while we can see the high level of news consumption via social media in Romania, followed by Poland, Greece, Hungary, and Israel – Germany, the UK, France, Denmark, and the Netherlands exhibit lower levels. Percentages of daily or infrequent users of social media for news vary widely by country between about 90 percent and about 60 percent.
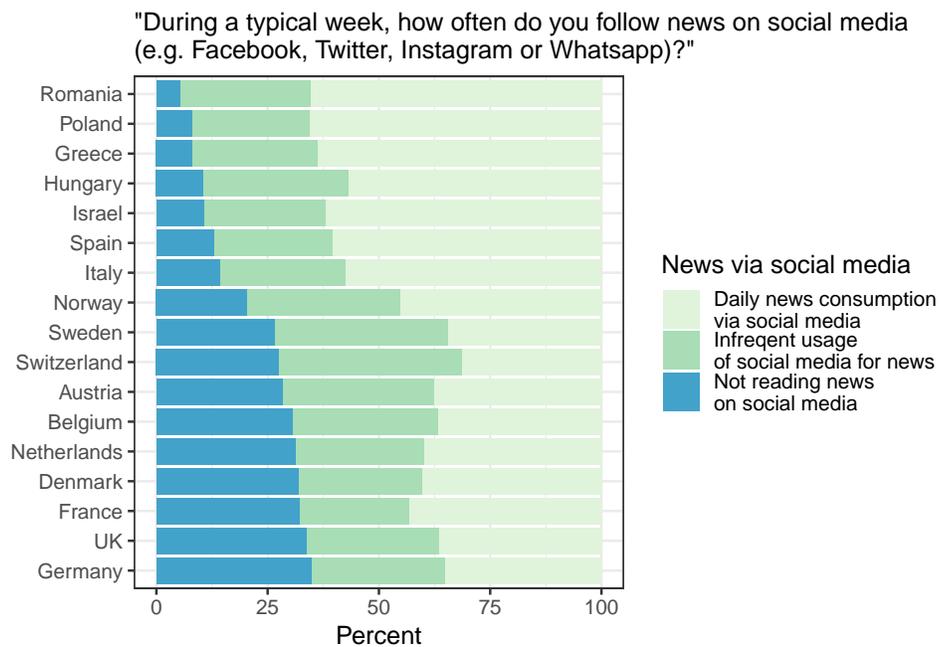

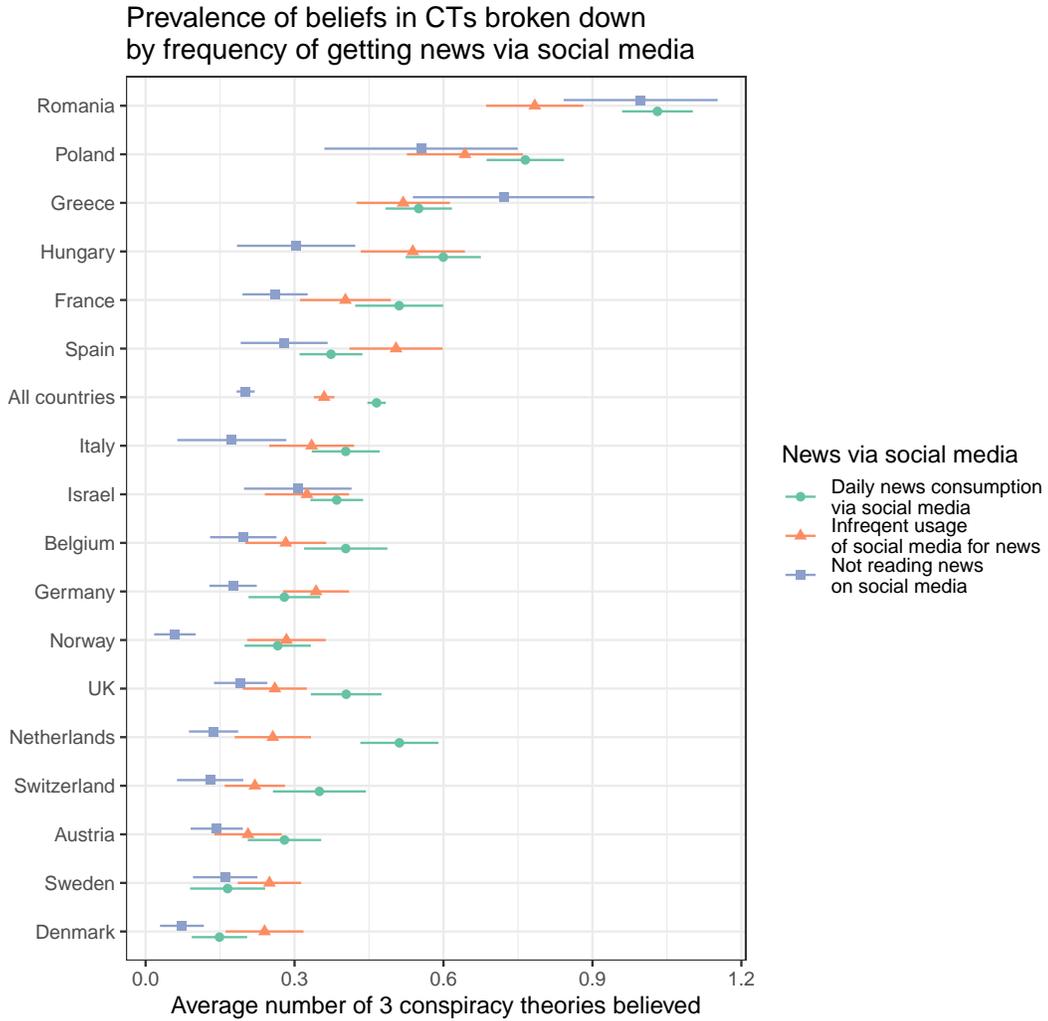**Figure 2. News consumption on social media by country**

Figure 3 shows the average number of endorsed CTs in each country, broken down by news consumption habits. It shows that in most countries, the number of CT believed is lower among those respondents who do not receive any of their news via social media. On average, they believe 0.26 CTs less than frequent users.[4] In Denmark, Germany, Norway, and Spain, infrequent news consumption via social media is associated with a higher number of CT beliefs than daily consumption of news via social media but the difference between infrequent and daily consumption is minor. The chart also indicates a distinct pattern for Greece, with individuals who do not consume social media news having higher CT belief levels. It is also noteworthy that while daily usage is associated with a higher number of CT beliefs in Romania, this is closely followed by non-consumption of news on social media, perhaps indicating that social media is better consumed in moderation.

Given the earlier discussion of platform affordances, we break down social media use and CT beliefs by platform. First, we document the frequency of using each platform for political news. Facebook is by far the most popular online platform in every country with 56 percent of European citizens getting political news from that platform (Figure 4). YouTube is the second most common social media platform for political news in 6 out of 17 countries (Hungary, Romania, Poland, Greece, France, and Switzerland). Popularity of YouTube stands out in Poland with 47% of participants saying they use YouTube for news consumption. In Israel, Italy, Austria, Germany, and the Netherlands, WhatsApp is the second most popular platform. Also, Twitter is the second most popular platform in Belgium, Spain, and the UK. Instagram is the second most common platform for political news in Sweden and Denmark.

Moving on to COVID-19 CT beliefs by platform (Figure 5), we see in the analysis with the pooled sample that non-consumers of news via social media have a
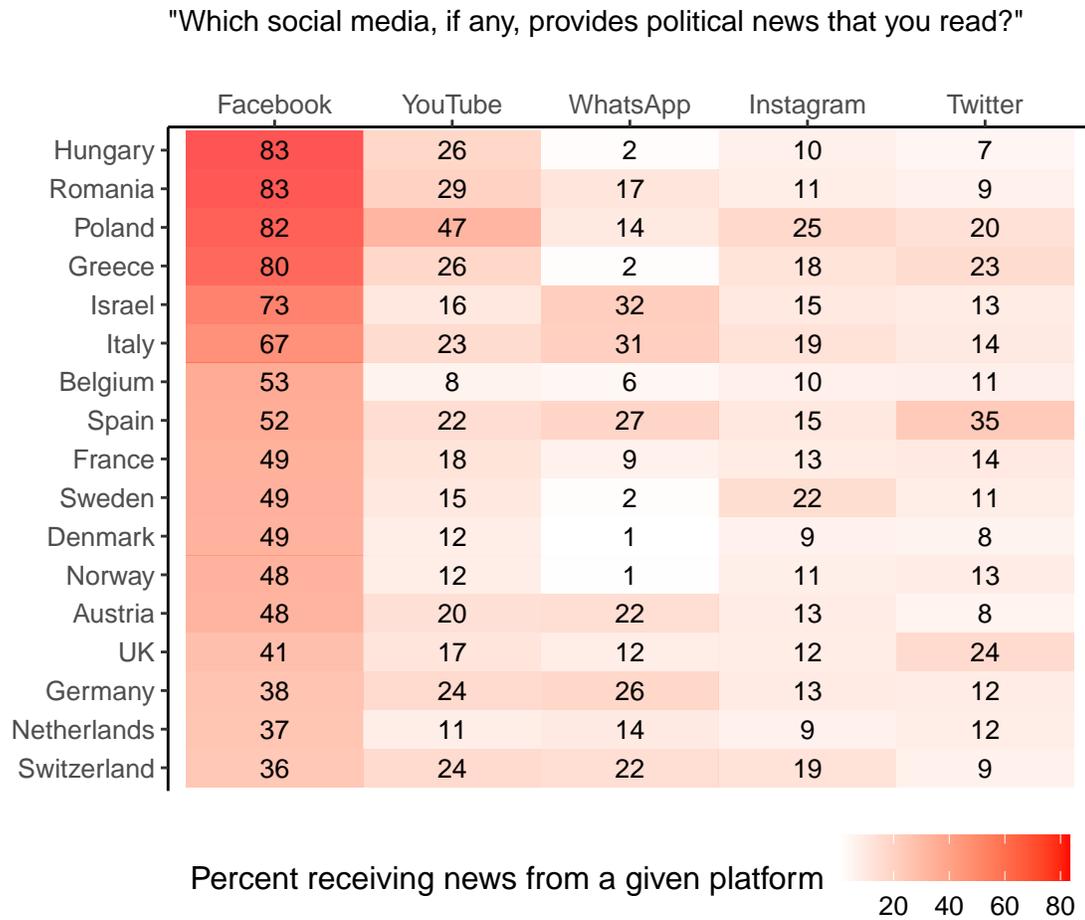
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[4]Or, in standardized terms, respondents who use social media daily to consume news have a +0.34 SD higher level of conspiracy beliefs relative to their counterparts who do not rely on social media for news consumption.

Figure 3. Prevalence of beliefs in conspiracy theories by frequency of news consumption via social media use

lower level of CT beliefs than average (except in the case of Twitter). In the pooled sample, people who consume news via YouTube believe CTs the most, believing 0.54 CTs out of three CTs. Considering that YouTube is the second most popular platform for news consumption in several countries, this finding is noteworthy. Following that, WhatsApp news consumers believe 0.50 CTs and Instagram users believe 0.46 CTs on average. Interestingly, Twitter users have lower levels of CT beliefs than social

"Which social media, if any, provides political news that you read?"

	Facebook	YouTube	WhatsApp	Instagram	Twitter
Hungary	83	26	2	10	7
Romania	83	29	17	11	9
Poland	82	47	14	25	20
Greece	80	26	2	18	23
Israel	73	16	32	15	13
Italy	67	23	31	19	14
Belgium	53	8	6	10	11
Spain	52	22	27	15	35
France	49	18	9	13	14
Sweden	49	15	2	22	11
Denmark	49	12	1	9	8
Norway	48	12	1	11	13
Austria	48	20	22	13	8
UK	41	17	12	12	24
Germany	38	24	26	13	12
Netherlands	37	11	14	9	12
Switzerland	36	24	22	19	9

Percent receiving news from a given platform

20   40   60   80

**Figure 4. Digital sources of political news by country**

media non-consumers, adding support to the work of Altay et al. (2023) that some social media could be more effective in preventing beliefs in CTs than others (either because of their affordances or because of the type of users inhabiting the platform - which of the two is the case, is of course unclear).

The bottom panel of Figure 5 provides more insights into country specifics. Generally, Twitter has a weak association with levels of CT beliefs in most countries except Romania. Furthermore, CT beliefs tend to be higher among YouTube and Facebook users. The relationships between YouTube and CT beliefs stands out

in some countries (e.g., France, and Netherlands). The level of CT beliefs among YouTube news consumers is especially prominent in Sweden and Denmark.

Trust in institutions

Consistent with previous research, we find that having no trust at all in medical experts has a distinctly strong association with CT beliefs (Figure 6). Romania and Hungary are exceptions. There, all three levels of distrust in medical experts are associated with similar levels of CT beliefs. With regards to trust in the national government, we observe again a general pattern where distrust is associated with believing in a higher number of CTs, though exceptions exist here too. For instance, in Denmark, the UK, Israel, Poland, and Romania, those who trust the government completely on average do not believe fewer CTs than their counterparts with little or on trust in government. The gap in CT beliefs between those who fully trust and those who don't trust the national government at all is largest in Greece, Norway, Belgium, the Netherlands, and Italy.
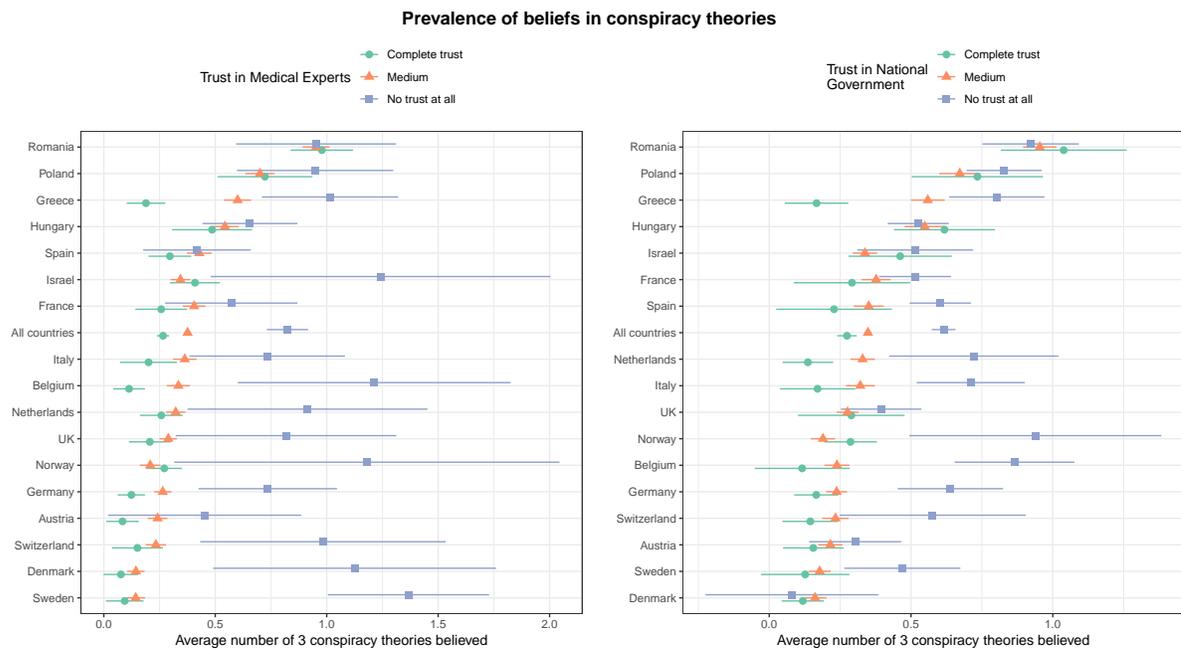
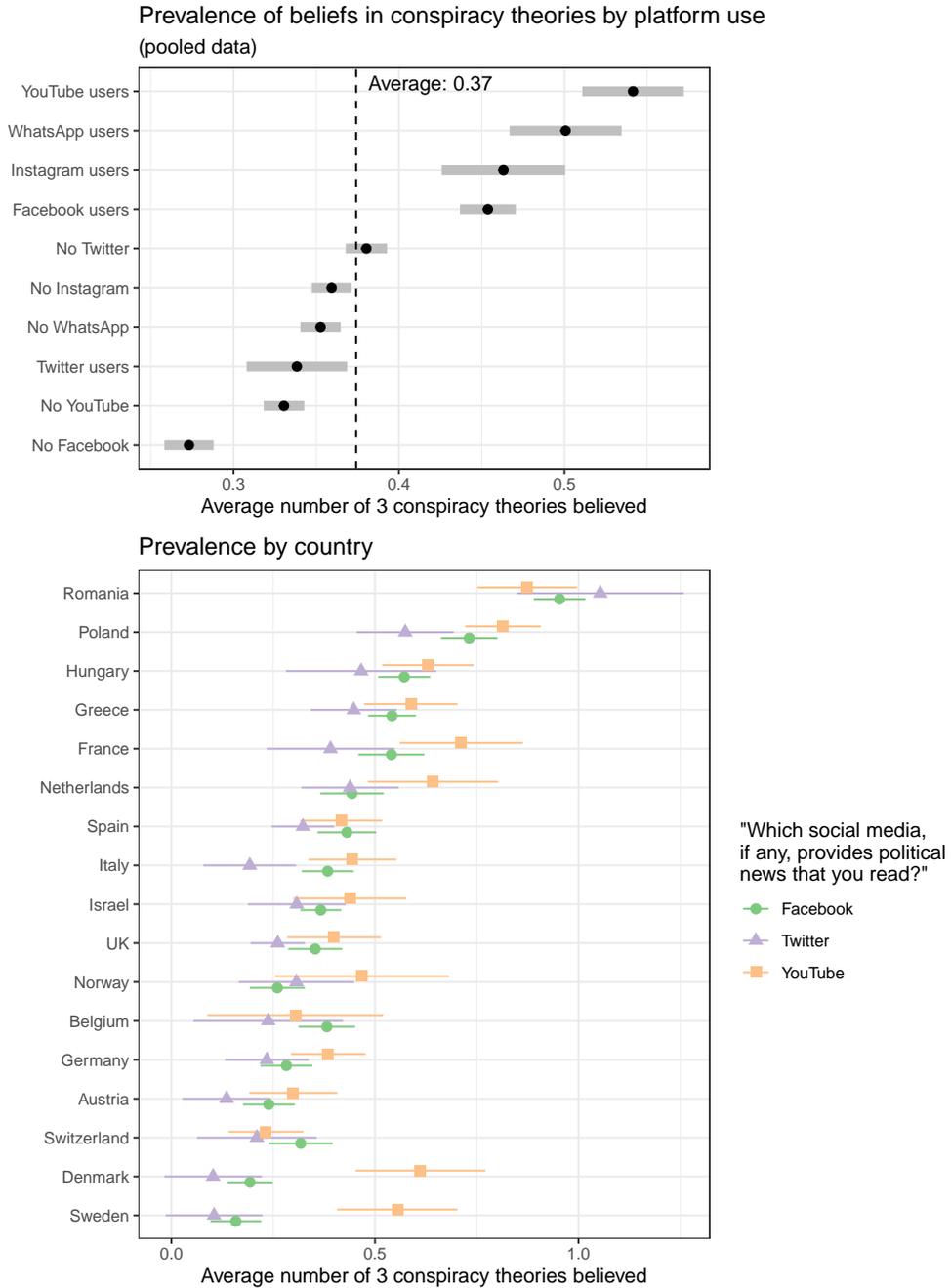**Figure 6. Beliefs in COVID-19 conspiracy theories by trust in institutions**

Figure 5. Prevalence of beliefs in conspiracy theories among social media users and non-users, by platform.

Sociodemographic characteristics

To what extent do beliefs in COVID-19 CTs vary by people's sociodemographic profiles? As can be seen in Figure 7, contrary to the expectation that people with low education would believe in CTs the most, it is those with medium education levels who tend to believe more CTs compared to those of both low and high educational level. In more than half of the studied countries, people with higher education levels indicated, on average, a lower number of believed CTs. People with low education believed a particularly high number of CTs in Germany and Greece (but these averages are imprecisely estimated).

Another pattern could be seen in Figure 7, which displays differences in CT beliefs by age groups. In most countries, the younger age group (aged 30 or less) shows higher levels of CT beliefs. This is notable given that past work on misinformation - though predominantly in the US - has shown that it is mainly older people who both share and consume this type of content.

Finally, when it comes to gender, the overall findings are mixed (Figure 7). While in Romania, Poland, Greece, Hungary, UK, Germany, and Sweden, we observe that women believe, on average, in a higher number of CTs than men, in some countries, like Italy, Netherlands, Switzerland, and Norway, no gender gaps are observed or are small. Distinctly, in Denmark, women believe on average fewer CTs than men.

Conclusion

The COVID-19 pandemic, like other significant events, has been accompanied by its share of conspiratorial narratives. Building on past research exploring the correlates of beliefs in specific conspiracy narratives, we document how media consumption habits, political attitudes and demographic attributes are associated with the propensity to endorse CTs about COVID-19.

We found sizeable country variation in beliefs in COVID-19-related CTs, with
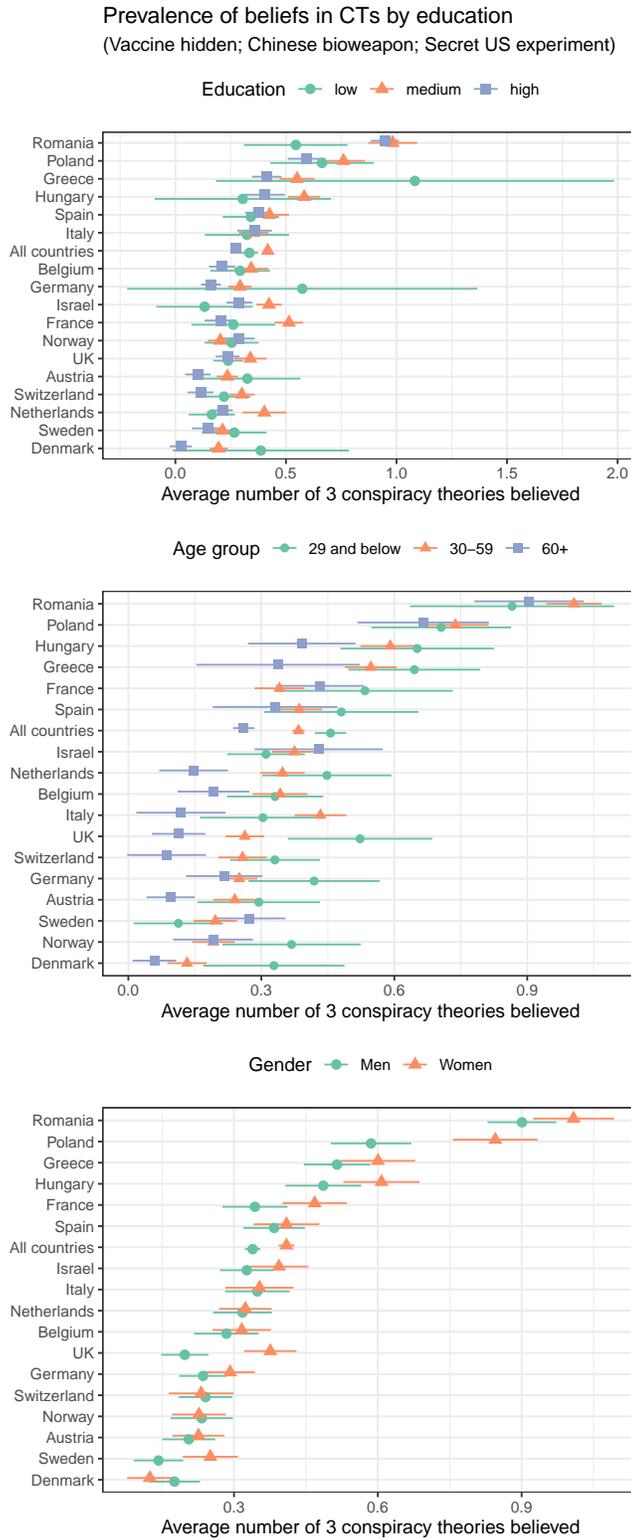
Figure 7. Beliefs in conspiracy theories by sociodemographic
characteristics

respondents in Romania, Poland, Greece, and Hungary believing in a larger number of CTs on average. On the other hand, Northern European countries (Norway, Denmark, Sweden) and Austria have very low levels of CT beliefs. Frequent news consumption via social media was found to be correlated with CT beliefs in most countries. People who consume news via social media every day hold a larger average number of CT beliefs than individuals who infrequently or never consume news via social media. When comparing users of different platforms, we found that YouTube users endorsed more conspiracy theories and Twitter news consumers perform better than other social media news consumers in a majority of countries.

Moreover, respondents who trust health experts and national government tend to believe fewer CTs (but Romania, Poland, and Hungary are some notable exceptions).

Sociodemographics are prognostic of conspiratorial beliefs but the results are not always consistent across countries. Respondents with a medium level of education typically held a higher number of CT beliefs compared to respondents with low or high education. Older respondents tend to believe fewer COVID-19-related CTs than their younger counterparts. In a subset of countries — the UK, Sweden, France, and Poland — women believe more CTs than men, but gender differences are minimal in other countries.

Romania and Hungary stand out in some respects, e.g. there is no difference in CT beliefs between social media news consumers and non-consumers. Romania also stands out in the prevalence of the view that pharmaceutical companies withheld a vaccine to make a profit. Romanians' particular beliefs in the "big pharma" CT and the absence of a relationship between distrust in medical experts and high CT beliefs make this country an interesting case study for future research.[5]

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[5]Among the reasons for Romania's exceptional patterns could be the frequent refusal of vaccination in Romania even among experts (Manolescu et al. 2021) and a general perception that the Romanian government failed in containing COVID-19 (Dascalu et al. 2021).

The results have several implications for the future study of conspiracy theories, particularly regarding policies around content moderation. YouTube and other social media platforms remain closely intertwined due to the easy cross-platform sharing of content. Past work has shown that the majority of alt-right groups' shared URLs on Twitter are from YouTube (Berger, 2018) and when YouTube introduced stricter measures for content moderation, YouTube URLs shared on Twitter and Facebook containing misinformation decreased (Alba, 2021). Given that we find a strong association between consuming news on YouTube and CT beliefs, YouTube may be an important vector for monitoring and moderating content related to CTs in the future.

Our study also highlights the important role of local culture and technological habits, which might make some platforms more prominent in some countries than others. In Spain and Italy, for example, the number of people consuming news from WhatsApp is considerable and those people seem to have a higher tendency to believe in CTs. Given the complete lack of content moderation in messenger platforms, addressing a proliferation of CTs in countries where citizens rely on such platforms may be particularly challenging. The context matters when it comes to trust in institutions too. The example of Hungary, where higher trust in institutions is not linked to lower CT beliefs points towards the need for more research on how political elites' signals and behaviors may be affecting the endorsement of unsupported beliefs and narratives among the public.

The fact that we did not find a general pattern with regard to some factors suggests that previous studies' lack of consistent findings could be attributed to issues related to scope and geographic coverage. Context remains important even when it comes to frictionless communication technologies that in certain sense (but sometimes misleadingly) are viewed as "having no borders".

Finally, contrary to the popular belief that people with more education are more resistant to CT beliefs, we caution that the relationship between education

and CT beliefs is unlikely to be monotonic or linear. This finding raises questions about the "education solutionism" that permeates many of the debates on combating misinformation. It can further potentially point to difficult questions about which educational interventions can foster skepticism without veering off to excessive questioning of all official narratives.

Although the cross-sectional survey design does not permit us to make causal claims about the underlying processes resulting in CT beliefs, our research points to fruitful directions for further investigating to what extent social media platforms — fertile spaces for invention and circulation of misinformation and conspiracy theories — actually contribute to opinion and behavior change among the exposed citizens.

Acknowledgments

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Supporting Information

Table S1: Comparison between population and survey data

	Population			Survey			
country	Female (%)	Age (median)	High Education (%)	Female (%)	Age (median)	High Education (%)	N
Austria	51	42.6	20	52.23	48.0	25.00	852
Belgium	51	48.0	44	57.46	49.0	46.73	764
Denmark	50	41.2	37	54.73	51.0	14.51	751
France	52	41.4	27	54.67	48.0	33.41	889
Germany	51	45.0	31	50.52	48.0	43.49	968
Greece	51	44.4	34	50.84	42.0	52.74	895
Hungary	52	42.5	29	53.88	44.0	36.50	811
Israel	50	29.0	38	52.76	38.0	37.79	995
Italy	51	46.4	20	50.82	45.0	39.58	854
Netherlands	50	41.7	41	52.66	50.0	58.91	864
Norway	50	39.0	35	54.91	46.0	40.09	641
Poland	52	45.0	34	54.91	43.0	50.12	856
Romania	52	41.6	20	46.46	46.0	68.17	663
Spain	51	43.5	28	49.94	45.0	55.80	905
Sweden	50	39.5	37	55.76	48.5	30.00	660
Switzerland	50	41.7	45	47.52	43.0	20.05	848
United Kingdom	51	39.5	41	51.90	50.0	46.41	1002

Note 1: Population's sex rate and age source is based on United Nation's 2022 report.

Note 2: Population's high education rate is based on OECD reports (2021).

Note 3: High education indicates having more than bachelor's degree (between 25-64 years old).

Note 4: Romania's high education data is from Eurostat (between 25-54 years old).

Note 5: In Eurostat, the UK's low educated population data is not provided.

Note 6: Switzerland census data in Eurostat include only the ones with permanent residence permits.
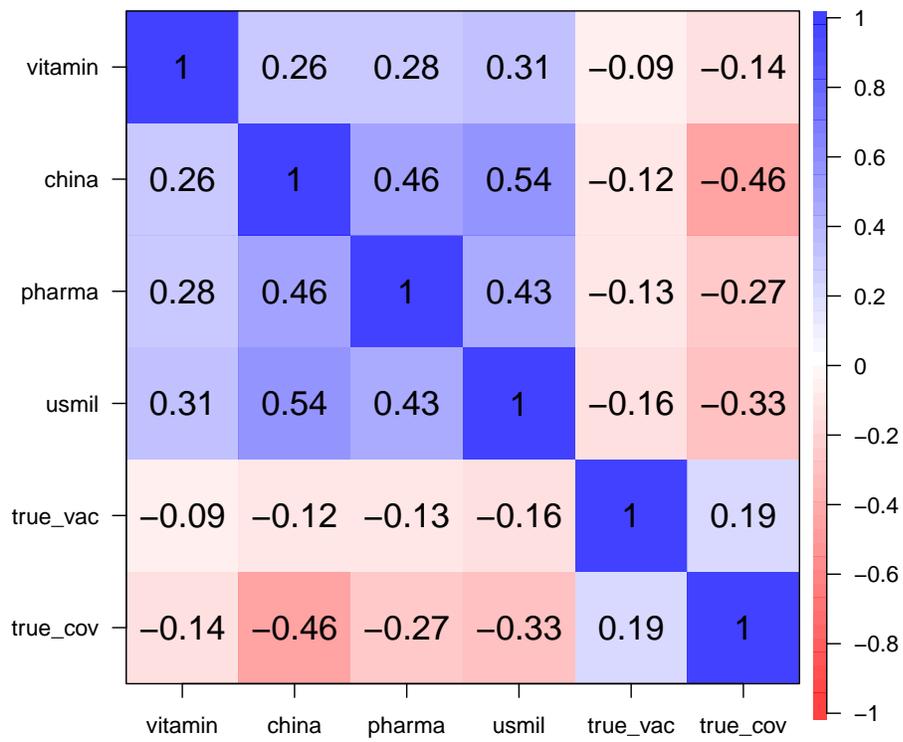
Figure S1. Correlation test between CT/false and true statements

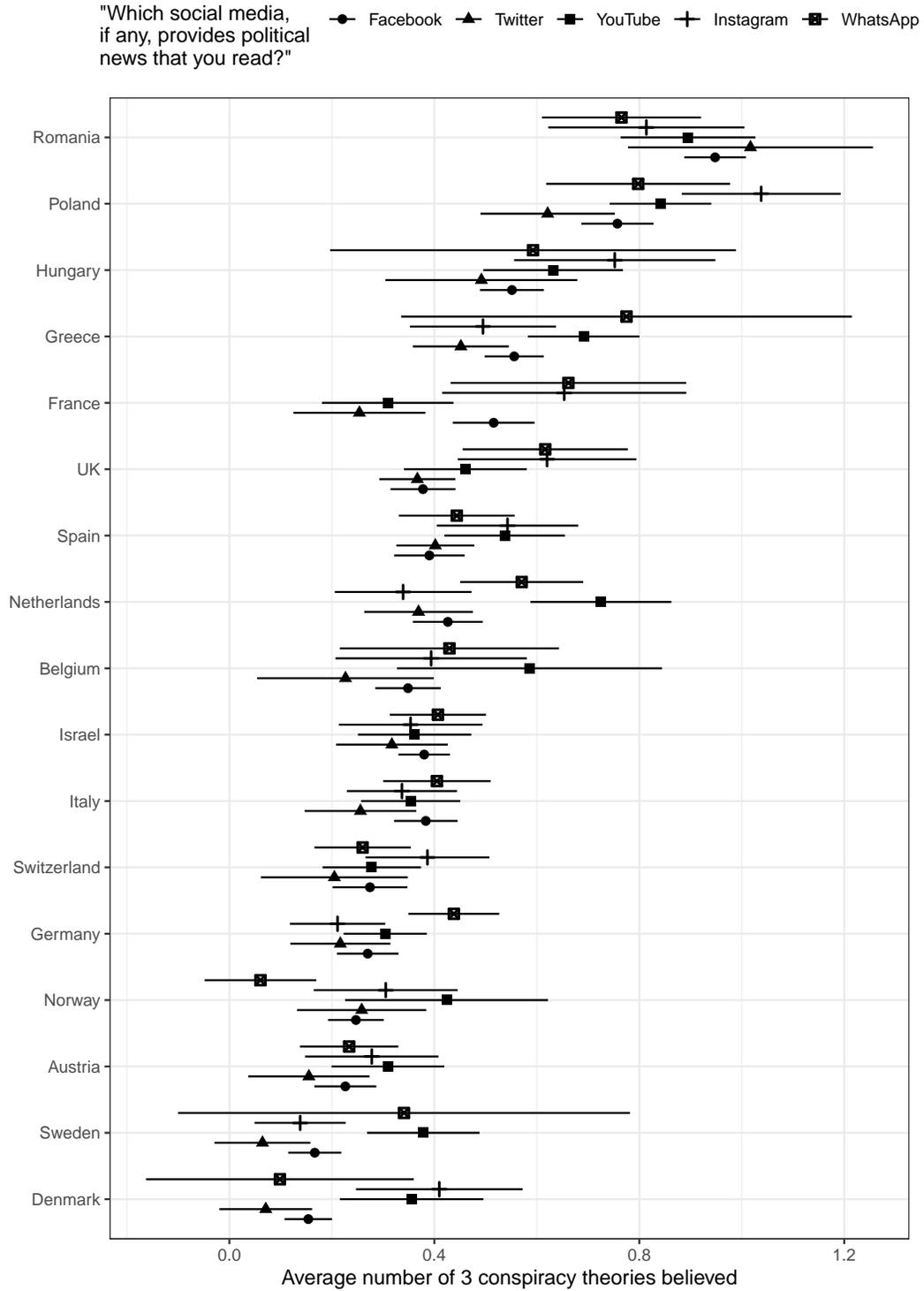Prevalence of beliefs in CTs broken down by platform

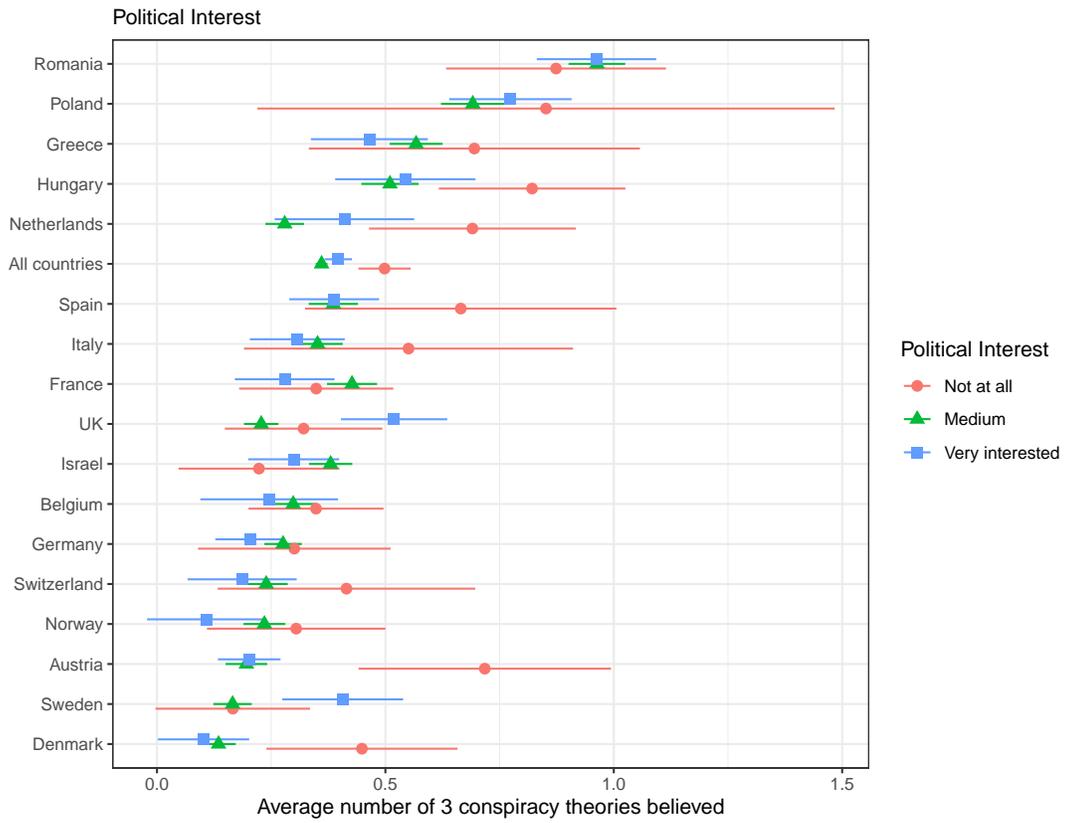Figure S2. Beliefs in COVID-19 conspiracy theories by social media platform usage.

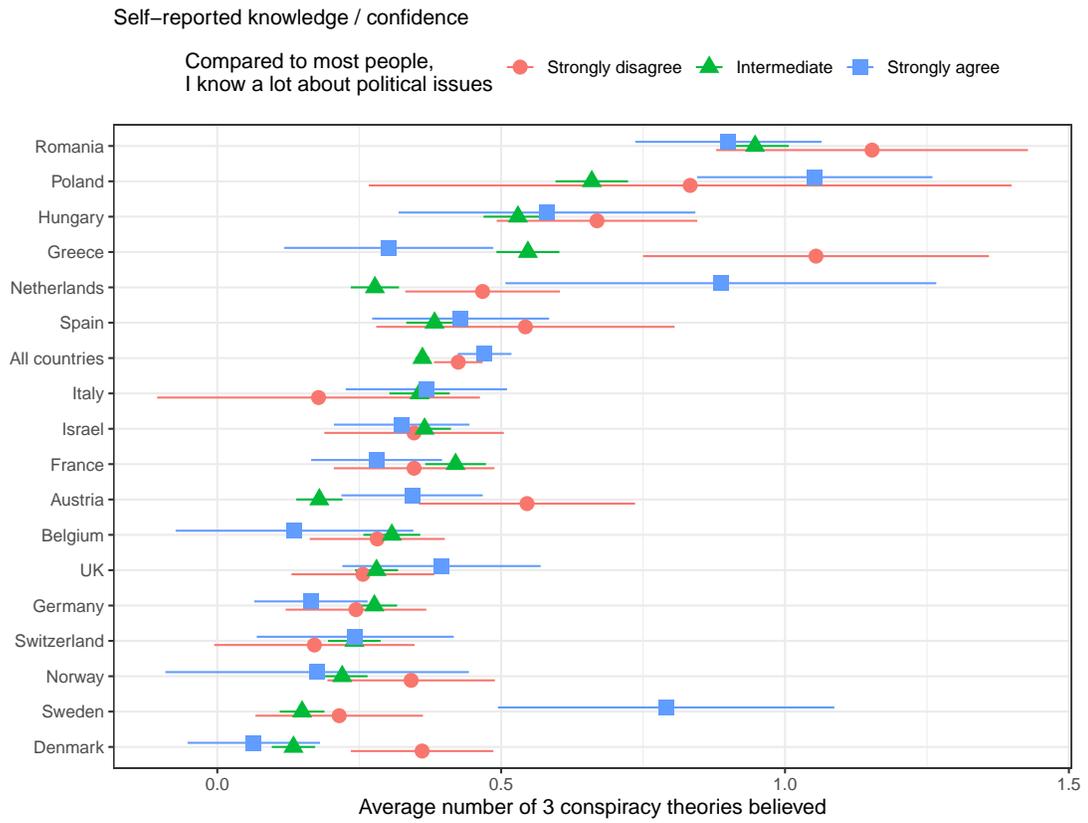**Figure S3. Interest in politics and average number of CTs believed.**

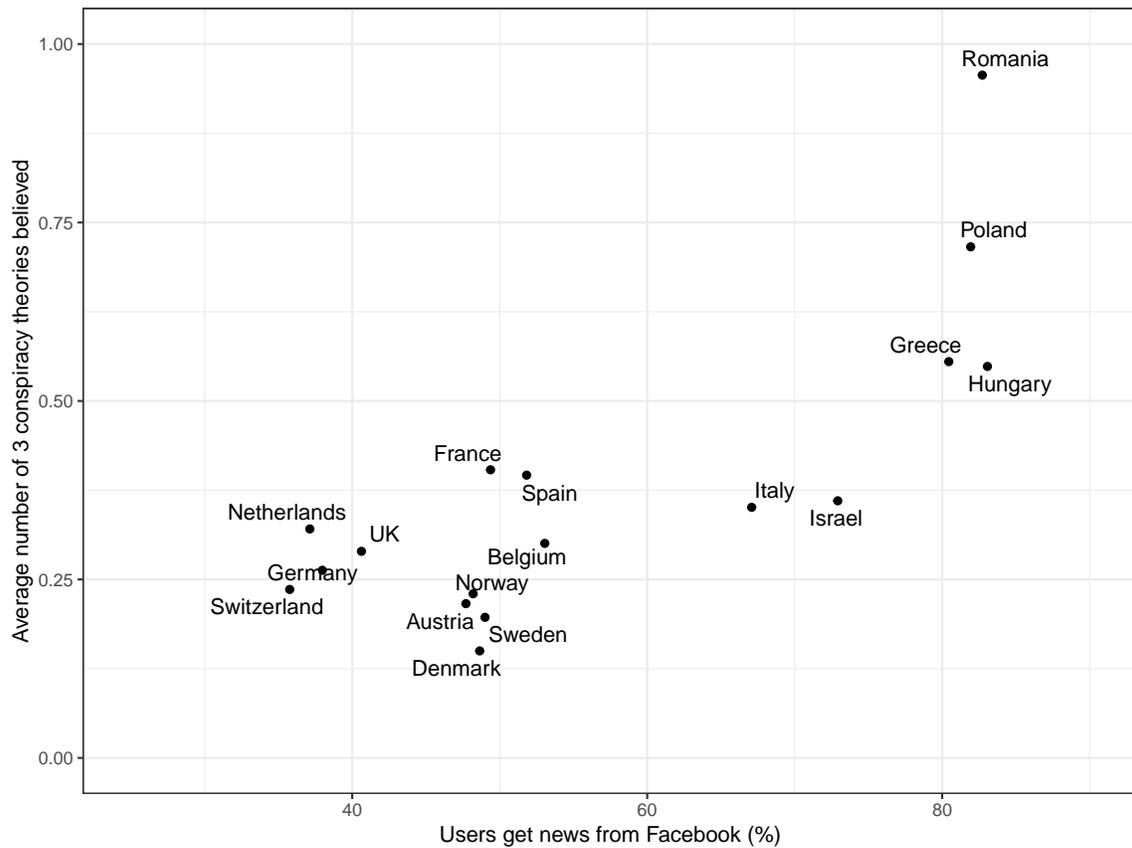**Figure S4. Self-reported political knowledge and average number of CTs believed.**

Figure S5. Country-level average Facebook usage among respondents and prevalence of CT beliefs.

Table S2: Description of variables

	Full question
	Thinking about the coronavirus, to what extent do you believe the following statements are true or false?
vitamin	Vitamin C can protect against the coronavirus (knowledge question 1)
china	The coronavirus is a bioweapon that has been deliberately created by China to harm people (Conspiracy theory 1)
pharma	The vaccine against the coronavirus has already been developed, but big pharmaceutical companies are hiding it from us to increase profit (Conspiracy theory 2)
usmil	The coronavirus is the accidental leak of a US military secret experiment (Conspiracy theory 3)
true_vac	The vaccine against it is currently being developed, and there are trial vaccines that cannot be used before they have been extensively tested (knowledge question 2)
true_cov	The coronavirus is a natural infectious disease that has spread globally creating a pandemic (knowledge question 3)

Table S3: Associations between social media use and beliefs in COVID-related conspiracy theories (estimates from OLS models)

	Dependent variable:			
	Number of endorsed conspiracy theories (0-3)			
	(1)	(2)	(3)	(4)
Daily news consumption via social media	0.091***	0.090***	0.047***	
	(0.014)	(0.014)	(0.013)	
Not reading news on social media	−0.146***	−0.133***	−0.084***	
	(0.016)	(0.016)	(0.016)	
Lagged daily news consumption via social media				0.038**
(measured in 2019)				(0.013)
Lagged non-reading of news on social media				−0.081***
(measured in 2019)				(0.016)
Women		0.036**	0.047***	0.050***
		(0.012)	(0.011)	(0.011)
Age: 29 and below		0.025	0.039*	0.038*
		(0.018)	(0.018)	(0.018)
Age: 60+		−0.080***	−0.072***	−0.071***
		(0.016)	(0.016)	(0.016)
Education: high		−0.053***	−0.112***	−0.112***
		(0.012)	(0.012)	(0.012)
Education: low		−0.020	−0.015	−0.014
		(0.023)	(0.023)	(0.023)
Education: medium	Ref. category	Ref. category	Ref. category	Ref. category
Education: missing		−0.023	0.036	0.034
		(0.085)	(0.082)	(0.082)
Constant	0.352***	0.363***	0.237***	0.239***
	(0.011)	(0.014)	(0.026)	(0.026)
Country FEs	NO	NO	YES	YES
Observations	14,218	14,194	14,194	14,194
R^2	0.018	0.022	0.086	0.085

Significance cut-off points: *p<0.05; **p<0.01; ***p<0.001

Table S4: Associations between social media use in general, and Facebook specifically, and beliefs in COVID-related conspiracy theories (estimates from OLS models)

	Dependent variable:		
	Number of endorsed conspiracy theories (0-3)		
	(1)	(2)	(3)
Daily news via (any) social media	0.067***	0.067***	0.039**
	(0.014)	(0.014)	(0.014)
Not reading news on social media	−0.083***	−0.073***	−0.064***
	(0.018)	(0.019)	(0.018)
Using Facebook for news	0.110***	0.104***	0.036*
	(0.015)	(0.015)	(0.015)
Women		0.034**	0.046***
		(0.012)	(0.011)
Age: 60+		−0.078***	−0.071***
		(0.016)	(0.016)
Age: 29 or less		0.025	0.038*
		(0.018)	(0.018)
Education: high		−0.049***	−0.111***
		(0.012)	(0.012)
Education: low		−0.019	−0.016
		(0.023)	(0.023)
Education: missing		−0.019	0.036
		(0.084)	(0.082)
Education: medium	Ref. category	Ref. category	Ref. category
Constant	0.288***	0.302***	0.217***
	(0.014)	(0.017)	(0.027)
Country FEs	NO	NO	YES
Observations	14,218	14,194	14,194
R^2	0.021	0.025	0.086

Significance cut-off points: *p<0.05; **p<0.01; ***p<0.001