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COVID-19 MISINFORMATION: PREPARING FOR FUTURE CRISES

An overview of the early behavioural sciences literature

Joint Research Centre

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COVID-19 Misinformation: Preparing for future crises

An overview of the early behavioural sciences literature

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Abstract

The goal of this report is to take stock of the early behavioural sciences literature on COVID-19 misinformation. Specifically, this report addresses the following three main questions. (1) Who was most likely to believe or share COVID-19 misinformation? (2) What were the consequences of being exposed to or believing COVID-19 misinformation? (3) Which behavioural policy interventions were effective in countering COVID-19 misinformation? In addition to addressing these core questions, the report also provides a snapshot of the narratives of COVID-19 misinformation and the prevalence and spread of this misinformation. The report provides insights into policies that can help foster societal resilience against misinformation beyond the specific case of COVID-19, thereby contributing to policy preparation for future crises.

Acknowledgements

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Executive summary

Context and objective

The COVID-19 pandemic has seen a surge in misinformation. Taking root in the fertile ground of uncertainty and fear, these false narratives can have dire consequences for those who believe them.

Behavioural scientists have attempted to answer various questions regarding how people dealt with COVID-19 misinformation. For instance, what type of people are most likely to fall into its trap? How does it affect people's attitudes and behaviours, such as their willingness to get vaccinated? Which interventions could help people spot lies or misleading claims in COVID-19 misinformation?

The goal of this report is to take stock and make sense of this burgeoning literature from the behavioural sciences. Although the findings reported here are restricted to the context of COVID-19, policymakers have much to learn from this phenomenon. A better understanding of COVID-19 misinformation can help policymakers to better anticipate and address future waves of misinformation that are likely to emerge with future crises.

Findings

Characteristics of COVID-19 misinformation

Narratives

COVID-19 misinformation narratives do not focus only on health aspects. While topics concerning the severity of the virus, alleged cures and preventive measures have been important, prominent narratives have also revolved around political responses to the pandemic and the origins of the virus. Notably, some pieces of COVID-19 misinformation have built on conspiracy theories that existed pre-pandemic. Naturally, the types of narratives have changed over time, and varied by country.

Prevalence

People reported being exposed to COVID-19 misinformation quite regularly. When measured objectively, the actual amount of COVID-19 misinformation was lower than the amount of true information about COVID-19. Importantly, the prevalence of COVID-19 misinformation varied across online platforms, depending on their user base and their level of content moderation.

Belief

Belief in COVID-19 misinformation narratives was highly variable, as it depended on the topic, time and location. The most endorsed topics of misinformation seemed to relate to the non-natural origin of the pandemic.

Spread

COVID-19 misinformation often originated from small fringe groups. The starting point was often online platforms gathering users who tended to believe misinformation on other topics, and who were therefore especially receptive to COVID-19-related misinformation. Public figures and mainstream media sometimes popularised COVID-19 misinformation. Social media platforms and messaging services varied with respect to how likely they were to disseminate misinformation.

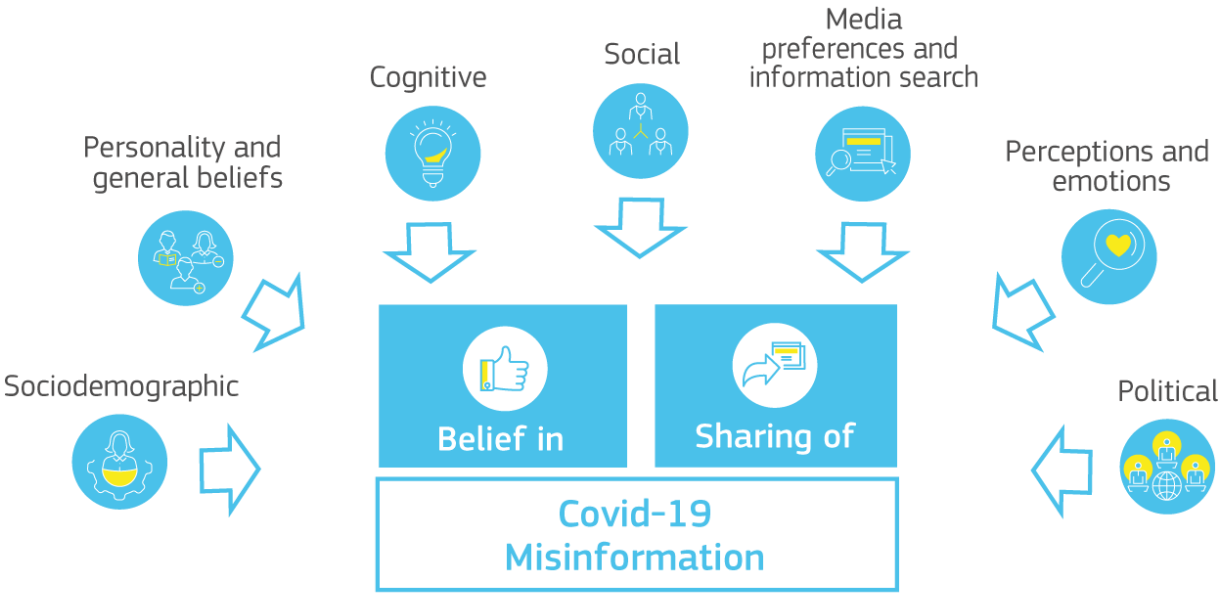
Antecedents to and consequences of COVID-19 misinformation

Antecedents

Sociodemographic variables were poor predictors of why some people believed or shared COVID-19 misinformation and others did not. Other, more psychological, antecedents were more consistently correlated with how people dealt with COVID-19 misinformation. We categorise these antecedents into sociodemographic antecedents, personality and general beliefs, cognitive antecedents, social antecedents, political antecedents, those related to media preferences and information search, and perceptions and emotions regarding the pandemic (see Figure 1).

Some antecedents most associated with believing or sharing COVID-19 misinformation were people's tendency to decide and think intuitively, political conservatism, people's sense of powerlessness and perceived lack of control, their distrust of science, and their trust in social media as an information source.

Figure 1. Mapping and classifying the antecedents of believing and sharing COVID-19 misinformation

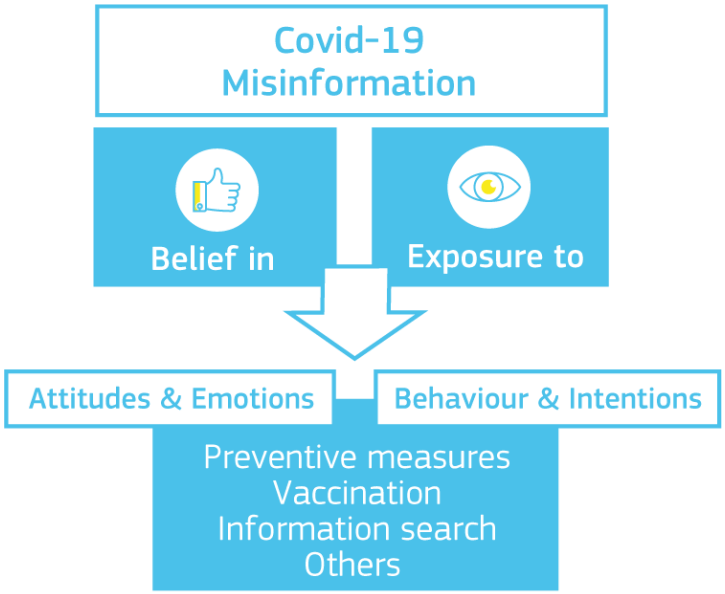


Source: Created by the authors.

Consequences

We differentiate between behavioural and attitudinal/emotional consequences of misinformation (Figure 2). Exposure to and belief in COVID-19 misinformation were associated with less social distancing, less compliance with official guidelines and less support for COVID-19 public policies. It is equally important to note that there was a consistent association between believing COVID-19 misinformation and having not intending to receive a COVID-19 vaccine. Those more exposed to COVID-19 misinformation were more likely to distrust public institutions, political leaders and governments. Finally, COVID-19 misinformation can affect how people seek and trust information.

Figure 2. Mapping and classifying consequences of COVID-19 misinformation



Source: Created by the authors.

Interventions to address COVID-19 misinformation

Before exposure: prebunks

Prebunking interventions consist of equipping people with the skills required to recognise misinformation and understand the techniques associated with it. Such pre-exposure interventions are closely connected to the broader concept of media literacy. There is ample evidence that such educational interventions are effective for topics other than COVID-19. The evidence regarding prebunking specifically in relation to COVID-19 is limited, but suggests that it may help combat COVID-19 misinformation. An example of an effective prebunking intervention is an online game in which people learn about the techniques associated with COVID-19 misinformation, such as the use of emotional language.

During exposure: nudges

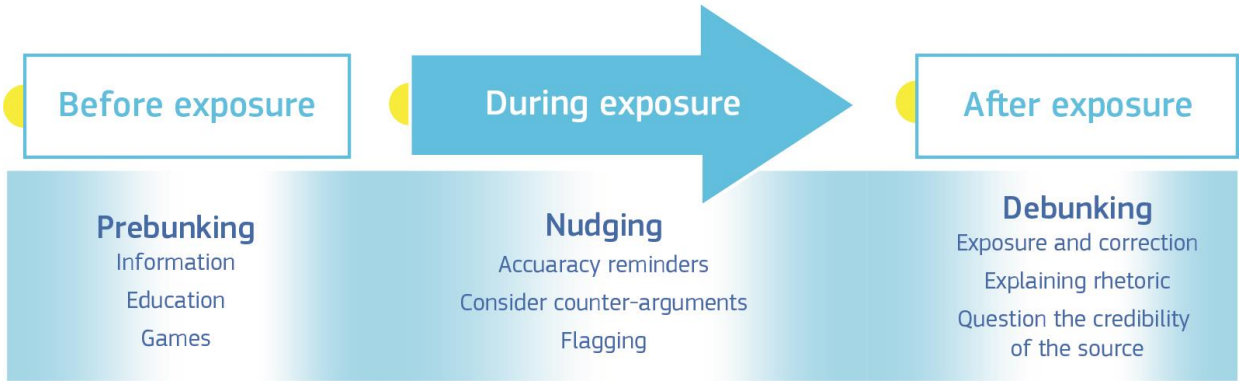
Nudges are interventions that affect people's behaviour without significantly changing their incentives or restricting their choices. They frequently do so by changing the context in which people's decisions are made. Nudges can be employed when people encounter misinformation, or shortly before. Several nudges proved effective in reducing people's belief in or sharing of COVID-19 misinformation. For instance, prompting people to evaluate the accuracy of a headline made them less likely to share COVID-19 misinformation. Another example of an effective nudge is flagging tweets as coming from bot accounts; this reduced the amount of misinformation people were willing to share.

After exposure: debunks

Debunking interventions correct beliefs in misinformation by establishing falsity. This is frequently accompanied by correcting the falsity and by explaining the misleading techniques associated with misinformation. Debunking happens after people have been exposed to misinformation. For instance, debunking might involve stating that hot baths cannot prevent COVID-19, explaining the rhetoric used in the false claim and showing why the source is not credible. Most of the evidence suggests that debunking COVID-19 misinformation is effective, although it is perhaps not as effective in the long run. Initial evidence on the format of debunks suggests that a textual format might be more effective than other formats, and that people who are interested in the topic of COVID-19 are more responsive to debunks.

Figure 3 positions these intervention types with respect to the stage of exposure. The figure also indicates that the differences between the intervention types are not always clear-cut.

Figure 3. Behavioural interventions to address misinformation by stage of exposure to misinformation



Source: Created by the authors.

Looking ahead: six policy messages

1. **Research on COVID-19 misinformation can inform responses to future crises.** While there are important differences between the COVID-19 pandemic and other crises, such as the climate change crisis and wars, there are also many similarities. The antecedents of belief in COVID-19 misinformation – for instance, distrust of science or lack of analytical thinking – are not specific to COVID-19, but rather constitute fertile ground for vulnerability to other topics of misinformation. Therefore, the researched COVID-19 interventions can be effective in preventing the spread of misinformation on other topics.
2. **All policymakers should worry about misinformation.** The topics and the consequences of COVID-19 misinformation did not only concern health. COVID-19 misinformation also affected social cohesion and the functioning of democratic systems and institutions.
3. **Misinformation and its antecedents should be monitored.** Early detection of misinformation is crucial, yet challenging. Datasets can be exploited to spot a sudden increase in the prevalence of certain misinformation topics on social media. Surveys can monitor the antecedents that make people vulnerable to misinformation, such as distrust of science. Combining these data can help policymakers act on time.
4. **The malleable antecedents of misinformation should be addressed.** Policy interventions ought to focus on the antecedents of belief in misinformation that can be altered. For instance, it is possible to address people's lack of attention by prompting them to evaluate the accuracy of information. Other antecedents, such as political ideology, cannot and/or should not be changed. However, they can still inform the design and administration of interventions.
5. **Interventions should be targeted and/or tailored.** Understanding who is most likely to believe or act based on misinformation allows for interventions to be targeted towards the most vulnerable groups, provided their viewpoints are neither too extreme nor too fixed. Testing policy interventions before rolling them out can also help identify those groups that are most responsive.
6. **Different types of interventions should be combined.** We identified three types of interventions that can be used to limit the spread of misinformation: prebunks, nudges and debunks. There are upsides and downsides to each of these interventions. An adequate combination of multiple interventions appears to be most promising in terms of increasing societal resilience against misinformation.

Conclusions

The COVID-19 pandemic has seen a rapid and unprecedented surge in misinformation. Understanding the dynamics of COVID-19 misinformation, its topics, its antecedents, its consequences and the mechanisms to fight its spread is necessary to prepare for future crises.

1. Introduction

In early 2020, the COVID-19 disease became a global pandemic. The world saw the spread not only of a deadly virus, but also of misinformation about the virus. According to one study, the number of articles disseminating, amplifying or reporting on COVID-19 misinformation grew from virtually none in January 2020 to more than 30 000 in a single day in April 2020 (Evanega et al., 2020). Although this remained a small number in relation to all COVID-19-related articles, the views and beliefs that misinformation articles contained gained footing.

Misinformation about COVID-19 covered various topics: its origin, its health consequences, its potential cures and vaccination. Some circulating misinformation narratives had devastating effects on public health, worsening the pandemic. A survey conducted in May 2021 indicated that misinformation could lead people to delay vaccination against COVID-19 or not to get vaccinated at all (European Commission, 2021). Almost two in three non-vaccinated respondents claimed that COVID-19 vaccines had not been sufficiently tested. Almost one in three stated that COVID-19 vaccines were ineffective. Both of these reasons correspond to widespread COVID-19 misinformation claims. COVID-19 misinformation could also hamper social cohesion by diminishing support for and trust in political decisions, health institutions and science (Pummerer et al., 2021). COVID-19 misinformation sometimes even led to aggressive actions. For instance, in the United Kingdom, claims that fifth-generation mobile technology (5G) broadband masts were transmitting the coronavirus were accompanied by vandalism of these installations (Bruns, Harrington, and Hurcombe, 2020).

Against this backdrop, governments had to manage two things at the same time: the circulation of COVID-19-related misinformation and the spread of the coronavirus itself. An obvious avenue to reduce misinformation is to avoid its creation in the first place. However, solely addressing the supply side of misinformation is not enough. Instead, policies must empower people to limit the spread of misinformation (European Commission, 2020). To do so, governments need to understand what makes people believe misinformation, why they share misinformation with others and which interventions have proven successful in mitigating the spread and negative consequences of COVID-19 misinformation. **Presenting the behavioural factors underlying COVID-19 misinformation and the evidence relating to these is the main goal of this report.** We believe that this will prepare policymakers for waves of misinformation that could accompany disasters in the future.

To help policymakers in this endeavour, this report presents a literature review with three main **objectives**.

- First, outline the narratives, prevalence and spread of COVID-19 misinformation.
- Second, present factors that explain why people believed or shared COVID-19 misinformation, and the consequences that belief in or exposure to COVID-19 misinformation had on people's behaviours and attitudes.
- Third, present interventions to curb the spread and impact of COVID-19 misinformation.

This report is part of a broader exploratory research project that explores the potential of targeted behavioural interventions to address misinformation. The review seeks to inform the future research conducted as part of that project. However, it does not offer an exhaustive, systematic overview of the literature. Instead, it provides a digested, **narrative account of the available evidence**. The report intends to present this literature in an accessible format. Policymakers are the main target audience of this report. Most of the reported empirical findings are from the early stages of the pandemic. COVID-19 misinformation is part of a dynamic situation, and the evidence must be interpreted in the light of that. By no means do we or can we provide an up-to-date account.

To achieve these objectives, we used the following **methodology**. We gathered evidence from the behavioural and communication sciences, focusing on empirical evidence from experiments and surveys, and evidence from meta-analyses. We searched Google Scholar, Web of Science and COVIDScholar at the beginning of 2021. An additional search was conducted around 1 year later to update references where relevant. During the update, we specifically focused on studies testing behavioural interventions against COVID-19 misinformation, as these usually take longer to be conducted than surveys, which are predominantly used to explore antecedents of misinformation. The search terms used are shown in Annex 1 (Table 14). We identified the final papers to be included by screening titles and abstracts and skimming the full texts. We focused on COVID-19 misinformation circulated online, as the internet is fertile ground for the spread of misinformation.

We adopted a broad definition of 'misinformation'. Unless otherwise stated, we refer to 'misinformation' as encompassing misinformation, disinformation, fake news and conspiracy theories. This is in line with recent research (Ecker et al., 2022). Box 1 elaborates on the various types of misinformation.

The report is structured as follows. First, we present the European Union policy context regarding misinformation. Second, we outline literature related to the following **seven questions on COVID-19 misinformation**.

1. **What is COVID-19 misinformation about?** We outline narratives of COVID-19 misinformation and provide insights to categorise them.
2. **How much COVID-19 misinformation was there?** We look at the amount and development of COVID-19 misinformation on different platforms.
3. **To what extent did people believe COVID-19 misinformation?** We investigate the extent to which people believed false and misleading narratives around COVID-19.
4. **How does COVID-19 misinformation spread?** We provide the evidence on the spread patterns of COVID-19 misinformation through networks.
5. **Who is more or less likely to believe COVID-19 misinformation?** We identify the main antecedents of believing or sharing COVID-19 misinformation.
6. **What are the consequences of COVID-19 misinformation?** We focus on the consequences in terms of adoption of preventive measures, vaccination and information search.
7. **Which behaviourally informed interventions effectively address COVID-19 misinformation?** These include both preventive and curative measures.

We conclude by providing specific policy messages, while acknowledging the limitations of this review.

Box 1. Definitions of misinformation, disinformation, fake news and conspiracy theories

Four different terms are often used to talk about misinformation: misinformation, disinformation, fake news and conspiracy theories. There does not seem to be consensus on the scope of each term (Martens et al., 2018).

The following list presents commonly accepted definitions of these terms.

— **Misinformation** is 'false or misleading content shared without harmful intent, though the effects can still be harmful, e.g. when people share false information with friends and family in good faith' (European Commission, 2020a, p. 18).

— **Disinformation** is 'false or misleading content that is spread with an intention to deceive or secure economic or political gain and which may cause public harm' (European Commission, 2020a, p. 18).

— **Fake news** is intentionally false or misleading information communicated through news media that seem legitimate and trustworthy, but that deceive consumers for economic profit (Allcott and Gentzkow, 2017).

— **Conspiracy theories** are often treated as a specific type of misinformation. Conspiracy theories are frequently defined along the lines of 'a proposed explanation of some historical event (or events) in terms of the significant causal agency of a relatively small group of persons – the conspirators – acting in secret' (Keeley, 1999 p. 116). Conspiracy theories do not, by definition, need to be false, although they often are (Uscinski, 2019).

2. Policy context in the European Union

The EU identified the spread of misinformation as a central threat early in the COVID-19 pandemic. The European Commission acknowledged the need for action while preserving freedom of expression (Box 2). In March 2020, the European Commission and the Member States declared their determination to 'counter disinformation with transparent, timely and fact-based communication' (European Council, 2020). Around the same time, the European Commission launched a webpage to provide accurate information around COVID-19 and to address COVID-19 misperceptions ([1]).

In June 2020, the European Commission published a joint communication dedicated specifically to tackling COVID-19-related disinformation (European Commission, 2020). The communication identified key challenges posed by the COVID-19 'infodemic' and proposed steps to address them. It acknowledged the need to calibrate responses to types of false or misleading content and to consider the intent, form and degree of harm caused by the content, the origin of the content and the actors involved in its dissemination. 'Well-targeted rebuttals and myth busting and media-literacy initiatives' (European Commission, 2020b, p. 4) were proposed as solutions. The communication also stressed the need to consider vulnerable citizens. For disinformation, the document proposed governmental actions in tandem with actions by social network platforms and other online platforms. The communication identified misinformation around a possible COVID-19 vaccine as a major future challenge, even though vaccines were still being developed.

Before the outbreak of the COVID-19 pandemic, the EU had identified misinformation in general as a major challenge. The European Commission's action plan on disinformation aimed to develop a coordinated response to the challenges posed by disinformation (European Commission, 2018). It focused on disinformation on climate change, migration, public security, health and finance. This action plan acknowledged the importance of preserving freedom of speech while combating misinformation (Box 2).

The communication on tackling online disinformation prompted the creation of the EU code of practice on disinformation (European Commission, 2018). This initiative gathers, on a voluntary basis, leading social networks, advertisers and the online advertising industry to address the spread of online disinformation and fake news. In May 2021, the European Commission published guidance to strengthen this code of practice (European Commission, 2021). Online platforms that signed the code of practice regularly publish reports for the European Commission; these reports detail their efforts to limit disinformation regarding COVID-19 and vaccination ([2]). Their actions include, for instance, third-party fact-checking (Meta, 2022) or the promotion of true information in search results, for instance regarding COVID-19 vaccines (Google, 2022).

The European democracy action plan was published in late 2020 (European Commission, 2020). It aims to strengthen the EU's efforts to counter misinformation. It acknowledges that digital media are a channel through which targeted misinformation can be disseminated and that protecting individuals against misinformation and empowering them to spot and counter misinformation are necessary for a resilient society.

Notably, this is not the first JRC publication that explores the implications of behavioural sciences literature for understanding misinformation and for policymaking. Reports from the enlightenment 2.0 research programme have argued that 'social media changes people's political behaviour', focusing on the role of misinformation and disinformation (Lewandowsky et al., 2020); explored how thinking skills are being challenged by today's information environment and the implications of this for vulnerability to disinformation (Mair et al., 2019); and elucidated the pivotal role of values and identities in believing and sharing misinformation (Scharfbillig et al., 2021).

([1]) https://ec.europa.eu/info/live-work-travel-eu/health/coronavirus-response/fighting-disinformation_en
([2]) https://digital-strategy.ec.europa.eu/en/library/fighting-covid-19-disinformation-reports-november-and-december-actions

Box 2. Tackling disinformation and preserving freedom of expression: a delicate balance

Article 11 of the EU Charter of Fundamental Rights and the constitutions of Member States guarantee the preservation of freedom of expression ([3]). Article 6(1) of the Treaty of the European Union confers binding force on the charter and states that it 'shall have the same legal value as the Treaties'. This freedom entails respect for free and pluralistic media. It also guarantees the right of EU citizens to have free thoughts and opinions and to interact with information 'without interference by public authorities and regardless of frontiers'. Consequently, it forbids state actors to interfere with this freedom and to censor in general, maintaining an inclusive and diverse public debate.

At the same time, the EU strives to counter misinformation and disinformation without limiting the rights to inadvertent errors, satire and parody, or partisan news and commentary identified as such (European Commission, 2018).

Reliable information is needed to make autonomous and good decisions. Both are indispensable for the functioning of a democratic system (European Commission, 2020). Policies to counter misinformation must respect the rights of citizens to free speech and freedom of expression. Optimal policies take into account the lived experiences of the people they affect (Lewandowsky et al., 2022). This sets important boundaries for governmental actions.

([3]) https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:12012P/TXT

3. What is COVID-19 misinformation about?

Takeaways

COVID-19 misinformation did not focus only on health aspects such as cures and preventive measures.

Prominent COVID-19 misinformation narratives revolved around political responses to the pandemic, the origins of the virus and its severity.

Some pieces of COVID-19 misinformation built on existing conspiracy theories.

The prevalence of the different topics of COVID-19 misinformation has changed over time.

The COVID-19 pandemic has had serious social and political consequences. Thus, it is not surprising that misinformation did not only concern health aspects. A content analysis focusing on COVID-19 misinformation from January to March 2020 found that the largest category of COVID-19 misinformation was **political** (39 % of misinformation according to this source). This category consisted of misleading or outright false claims about policy actions, including those of the World Health Organization (WHO) and the UN (Brennen et al., 2020). Other analyses found that most of the early COVID-19 misinformation concerned **societal** topics. According to Montesi (2020), these were concerned with well-known people and companies, and often had a racist or ironic undertone (43.1 % of misinformation). Societal topics were followed by political (24.4 % of misinformation) and **health** (23.6 % of misinformation) topics (Montesi, 2020). A more recent report, from March 2021, concluded that the major focus of misinformation in Europe was on the governmental and non-governmental **response** to the pandemic (Siwakoti et al., 2021). The same report also stressed the prevalence of other misinformation topics and narratives, such as the nature of the virus, false cures and anti-vaccination.

Many early COVID-19 misinformation narratives revolved around the **origin** of the coronavirus. This is not surprising, given people's need to find explanations for events. These explanations often mark an agent as responsible (Douglas, Sutton, and Cichocka, 2017). Indeed, one of the first rumours around COVID-19 claimed it was caused by the roll-out of 5G in Wuhan, China, and other parts of the world (BBC, 2020; Bruns, Harrington, and Hurcombe, 2020; Evanega et al., 2020). Incidentally, the 5G roll-out in some parts of the world coincided with the pandemic outbreak. Another claim was that the coronavirus was manufactured in a high-security laboratory in Wuhan – possibly as a bioweapon (Evanega et al., 2020; Imhoff and Lamberty, 2020; Paull, 2020). Scientists studying COVID-19 rejected these rumours, citing solid scientific evidence consistent with the virus originating from wildlife (Calisher et al., 2020) ([4]). Another prominent conspiracy theory saw Bill Gates as the orchestrator of the entire pandemic (Evanega et al., 2020). #billgates was one of the most circulated hashtags on Twitter in early 2020 (Sharma et al., 2020). Misinformation narratives referring to classic pre-COVID-19 conspiracy theories have also seen a surge during the pandemic, for example referring to the 'new world order' / 'deep state' or (in the US context) presenting the pandemic as orchestrated by the Democratic Party (Evanega et al., 2020).

A different set of misinformation narratives concerns potential **cures and preventive measures** (Posetti and Bontcheva, 2020). For example, false narratives promised ways to avoid contracting the virus or to cure people (Evanega et al., 2020). Some recommended actions appeared relatively benign (e.g. eating garlic, heat exposure). Others were clearly dangerous (e.g. drinking bleach) (WHO, 2022). Narratives on curing or preventing the disease appeared to constitute a large proportion of the misinformation. This could reflect people's attempts to protect themselves and to feel in control of the situation. One study found that misinformation about miracle cures made up roughly 25 % of an assessed misinformation sample. Other narratives ranged from 0.6 % to 4.4 % (Evanega et al., 2020).

([4]) Note that it cannot be scientifically ruled out that the virus was created in a laboratory (see Andersen et al., 2020).

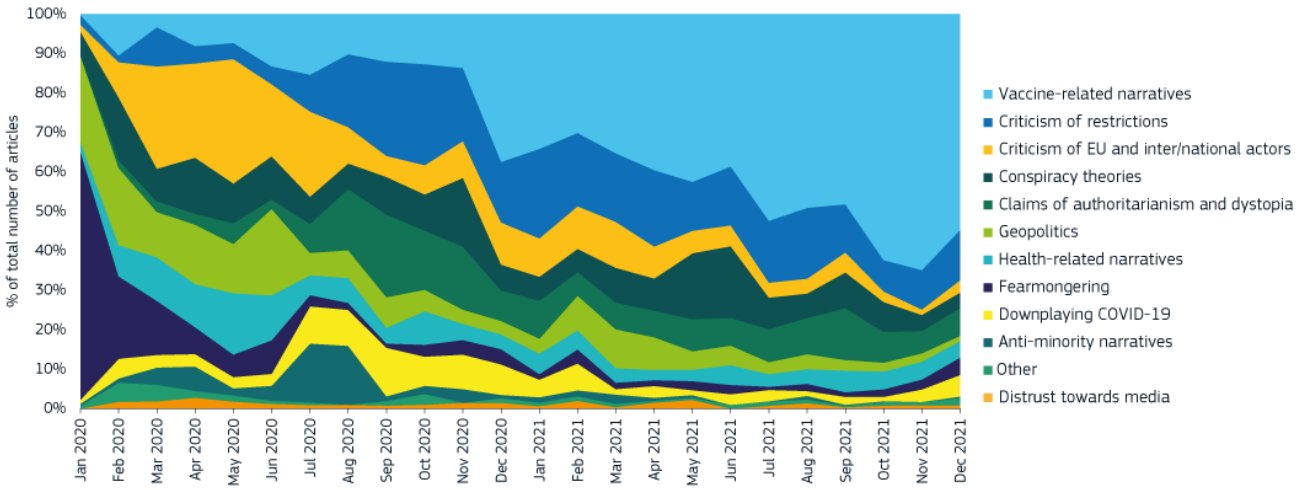
Likewise, the **spread** of the virus, the **incidence** of the disease and the related **health symptoms** were topics of identified misinformation (Posetti and Bontcheva, 2020). For instance, an early narrative was that the symptoms of COVID-19 were no worse than those of the flu (Singh et al., 2020). Thankfully, one study found that only a very small portion of the detected misinformation (only 17 out of 214 analysed news items) was classified as dangerous to people's health (Montesi, 2020).

Some narratives were completely new, for instance those regarding the cure for COVID-19. However, many other pieces of COVID-19 misinformation (for instance those related to the origin of the virus) were inspired by **existing conspiracy theories**, such as those revolving around vaccination, the 'new world order' or the role of the Bill and Melinda Gates Foundation.

Of course, narratives also **changed over time** and in line with pandemic developments. One study analysed more than 5 000 distinct COVID-19 misinformation stories (Siwakoti et al., 2021). It found that in Europe, from the beginning of the pandemic until December 2020, the number of stories on false cures and preventive measures increased substantially. Other narratives decreased in prominence over time, such as those about non-governmental responses to COVID-19 (i.e. individual, non-profit organisation, social and business responses) or those about the COVID-19 status of individuals. Other narratives (e.g. on the origin of the virus) remained largely constant.

A quantitative text-and-trend analysis of COVID-19 misinformation narratives using the Europe Media Monitor software identified some of the main narratives of COVID-19 misinformation. It analysed these with respect to how they spread over time and across countries (Kotseva et al., 2022). Figure 4, based on the analysis of 42 410 COVID-19-related articles from unverified sources, shows trends in the different narratives over time. It shows peaks that correspond to real events.

Figure 4. Stacked time area chart showing the changing spread of the 12 supernarratives between 1 January 2020 and 31 December 2021



Source: Kotseva et al. (2022).

4. How much COVID-19 misinformation is there?

Takeaways

People reported often being exposed to COVID-19 misinformation.

The actual prevalence of COVID-19 misinformation on the internet was relatively low.

The user base and moderation activities of online platforms affected the prevalence of COVID-19 misinformation on these platforms.

Reliably quantifying the prevalence of misinformation is difficult.

The prevalence of COVID-19 misinformation determines the extent to which policymakers need to worry about this problem. Some COVID-19 narratives may be very widespread on the internet, while others may be more restricted to specific groups. The prevalence of misinformation narratives can change rapidly over time. It can change differently according to the country or the website/platform. Furthermore, quantifying misinformation raises several methodological issues (Box 3).

There are two main ways to measure the prevalence of misinformation:

- asking people how much misinformation they (think they) have encountered (**perceived prevalence**);
- measuring the absolute or relative amount of misinformation in the media (**actual prevalence**).

As will be shown in the following section, the share of people reporting that they encountered COVID-19 misinformation is sometimes quite high. However, this may erroneously suggest very high prevalence of COVID-19 misinformation, which is not confirmed if one looks at the ratio of online COVID-19 misinformation to the total amount of COVID-19 information. This discrepancy suggests that, although there is relatively little COVID-19 misinformation, this misinformation attracts attention. In fact, it is frequently designed to attract viewers' attention (Ecker et al., 2022).

However, it is important to note that people can have problems in discerning truth from falsehoods, for various reasons (Pennycook and Rand, 2021). First, asking people about whether they encountered misinformation relies on their judgement of what constitutes misinformation. Second, it relies on their skills in detecting it in the first place. Notably, their perceptions can be biased. For example, a lack of careful reasoning can lead to misperceptions. Similarly, decision heuristics, such as evaluating information based on how familiar it appears, can lead to wrong conclusions. In turn, a high perceived prevalence relies on people thinking they encounter a lot of misinformation, but there is not necessarily a lot of misinformation.

4.1. Perceived prevalence

According to a survey conducted in late March and early April 2020 in Argentina, Germany, South Korea, Spain, the United Kingdom and the United States, one third of respondents reported coming across 'a lot' or 'a great deal' of false or misleading information around COVID-19 both on social media and in messaging applications (Nielsen et al., 2020). Another study, conducted in March 2020, reported that participants from Germany, the Netherlands, the United Kingdom and the United States encountered misinformation or disinformation to a large extent (respondents rated their belief in being surrounded by misinformation and disinformation on average as 4.88 on a scale of 1–7, where 7 means they believed they were surrounded by misinformation and 1 means they believed they were not) (Hameleers, van der Meer, and Brosius, 2020). Notably, levels of perceived misinformation prevalence in this study differed across countries. Perceived prevalence in the Netherlands was lower than in the United Kingdom and the United States. A survey conducted in April 2021 showed that 30 % of Spaniards and 27 % of Germans said they had seen 'a lot' or 'a great deal' of false or misleading COVID-19 information on social media in the previous week. The respective values for messaging apps were 29 % and 21 % (Nielsen, Schulz, and Fletcher, 2021).

There are many possible reasons for differences in the perceived prevalence of COVID-19 misinformation between and within countries. One explanation might be that the actual prevalence is different. Another might be that people have different skills in detecting misinformation. In a Flash Eurobarometer survey conducted in 2018 in the EU-28, an average of 37 % of respondents (with countries ranging from 18 % to 55 %) reported that they came across what they believed was misinformation every day or almost every day. This is complemented by, on average, 71 % of respondents (countries ranging from 55 % to 87 %) saying they were at least somewhat confident in being able to detect misinformation, should they encounter it (European Commission, 2018). Thus, EU citizens appear to be quite confident in their ability to spot misinformation. Of course, the extent to which (1) this perception corresponds to objective capability and (2) the apparent misinformation fulfils the criteria of actual misinformation is not always clear. Evidence that online users frequently spread misinformation because they are inattentive suggests that subjective perception of skill might be an unreliable indicator for actual skill (Pennycook et al., 2021).

Box 3. Methodological challenges in measuring the prevalence of COVID-19 misinformation

At least five reasons make it difficult to measure the prevalence of misinformation.

First, it is not always easy to agree on what qualifies as misinformation (Baines and Elliott, 2020; Vraga and Bode, 2020). Especially in the domain of politics and policies, different people may find different solutions to the same problem as acceptable or effective. This might lead to different assessments of what is true or false, and hence misinformation.

Second, it is practically unfeasible to verify every circulating piece of information, and even less so over a long period of time. Consequently, any account on misinformation prevalence can only be a temporary and partial reflection of the actual situation.

Third, referring to or sharing misinformation online does not imply endorsement on behalf of the sharer. For example, many tweets quoting misinformation are for the purpose of debunking or ridiculing it. For instance, a study of articles about COVID-19 in the media found that around one in six articles referring to COVID-19 misinformation actually fact-checked it (Evanega et al., 2020). This is primarily a problem for the automated analysis of large datasets. While this type of analysis is often used to quantify misinformation, it does not commonly consider contextual information that signals endorsement or disagreement. Distinguishing between share-to-endorse and share-to-criticise is important to identify the consequences of misinformation. It also highlights the importance of measuring individuals' belief in misinformation separately (see next subsection).

Fourth, the amounts of circulating or shared misinformation are often presented without reference to the amount of overall or correct information being circulated or shared. This can produce biased and decontextualised perceptions of how much misinformation there is.

A final challenge, regarding the extent to which people believe misinformation, is the way of asking participants. Some results are interesting in this regard. In one study, 10 % of UK respondents strongly endorsed conspiracy theories around COVID-19 (Freeman et al., 2020). This was presented in some media headlines as indicating that COVID-19 conspiracy beliefs had become mainstream, at least in the United Kingdom. However, later scrutiny of Freeman et al.'s methodology revealed that this conclusion was exaggerated and probably resulted from a biased framing of the response options available to participants (McManus, D'Ardenne, and Wessely, 2020; Sutton and Douglas, 2020).

4.2. Actual prevalence

We understand actual prevalence to mean an objective measurement of the prevalence of COVID-19 misinformation. Actual prevalence can be measured both in absolute terms and relative to the total amount of information. One report provides an example for the absolute prevalence (Avaaz, 2020). It estimated that a small set of fake claims about COVID-19 was shared 1.7 million times and viewed 117 million times on Facebook until mid April 2020. Beyond these absolute figures, it is worth comparing the amount of misinformation with that of total information. The latter covers both misinformation and correct information. Both are frequently verified as such by researchers or external fact-checkers and journalists. In relative terms, evidence presented below suggests that the prevalence of COVID-19 misinformation is rather low, although this can depend considerably on the platforms on which it circulates.

Evanega et al. (2020) focused on the prevalence of COVID-19 misinformation in English-language traditional and online media: online news, blogs, podcasts, television and radio. They analysed a sample of almost 39 million articles that mentioned the COVID-19 pandemic between January and May 2020. They found that

2.9 % of these articles (i.e. over 1.1 million articles) mentioned COVID-19 misinformation. Crucially, less than half (46.6 %) of the articles that mentioned COVID-19 misinformation appeared to endorse them. Relevant narratives comprised stories regarding miracle cures, the 'new world order' / 'deep state', Bill Gates, etc. Thus, the actual prevalence in the media of COVID-19 misinformation articles that endorse the misinformation was about 1.4 % (i.e. 46.6 % of 2.9 %) ([5]).

Slightly higher figures are revealed in another study (Sharma et al., 2020). Between March and June 2020, Sharma et al. (2020) looked at unreliable information, conspiracy theories, clickbait and political and biased information relating to COVID-19 on Twitter ([6]). Of the identified 54.32 million English-language tweets on COVID-19, 4.58 million contained links to websites. Of the tweets that contained links, the authors classified 150 800 (3.29 %) as misinformation ([7]). The absolute volume of tweets that linked to misinformation increased over time. This did not necessarily reflect an increase in the relative prevalence of misinformation. Instead, it could be attributed to the general increase of COVID-19 content. In a set of 2.7 million tweets in many languages related to COVID-19 posted between mid January and mid March 2020, the prevalence of misinformation appeared lower. Less than 0.6 % (around 16 000 of the tweets) mentioned at least one myth (e.g. that COVID-19 is like the flu) (Singh et al., 2020).

One study estimated the prevalence of misinformation on a different platform, Gab, as much higher. This higher estimate is likely to be attributable to the moderation conventions and users of this platform. Gab is a crowdfunded, Twitter-inspired platform that attracts users aligned with far-right politics. It exerts little control over published content compared with, for example, Facebook or Twitter. It is often labelled a fringe platform due to its appeal to non-mainstream user groups. The study found that, between January and mid February 2020, posts on Gab from questionable sources amounted to 70 % of all its posts (Cinelli et al., 2020).

A systematic review of studies dealing with COVID-19 misinformation on social media covering six studies, confirmed that the prevalence of COVID-19 misinformation varied a lot. Prevalence appeared to depend on the platform (e.g. Twitter, Facebook, Weibo), the methodology used to investigate the misinformation and the definition of misinformation used. The analysis found that the proportion of posts containing COVID-19 misinformation on social media ranged between 0.2 % and 28.8 % depending on the platform and the methodology used (Gabarron, Oyeyemi, and Wynn, 2021).

Two studies provide a different view of the relative prevalence of COVID-19 misinformation. The first study compared nearly 2.5 million tweets and 9 000 professional news media articles from Canada (Bridgman et al., 2020). The tweets and articles included those from Canadian news sites that reported on COVID-19 between late March and early April 2020. They found that misinformation was more prevalent on Twitter than in traditional media. Nevertheless, debunking COVID-19 misinformation played a bigger role in traditional media. The second study compared the relative actual prevalence of health misinformation on Twitter and Facebook during the beginning of the COVID-19 pandemic (8 March to 1 May 2020) with that during the same period in 2019 (Broniatowski et al., 2022). Compared with 2019, the URLs in 2020 were **more** likely to link to credible sources and **less** likely to link to 'less' credible or 'not' credible sources. Figure 5 shows the percentages of each credibility category in a sample of 3 000 posts. Sources were considered 'more credible' if they belonged to government or academic outlets, or, in the case of traditional media sources, had a high rating on NewsGuard ([8]) or on the Media Bias / Fact Check factual reporting scale ([9]). Sources were considered 'less credible' or 'not credible' when they were given a medium or low credibility rating. The more credible sources were, as expected, much less likely to contain misinformation than less and not credible sources. More specifically, in their sample of 3 000 posts that were manually assessed for the presence of false claims, misinformation constituted almost 25 % of the content of posts from non-credible sources, while this was 8.5 % for less credible sources and 5.33 % for more credible sources.

Box 4 provides a more detailed account of how the prevalence of a specific COVID-19 misinformation narrative – the roll-out of 5G as the purported cause of COVID-19 – developed over time.

([5]) The authors also categorise conversations into those that mention Donald Trump (almost 50 %). Some articles reference more than one topic.

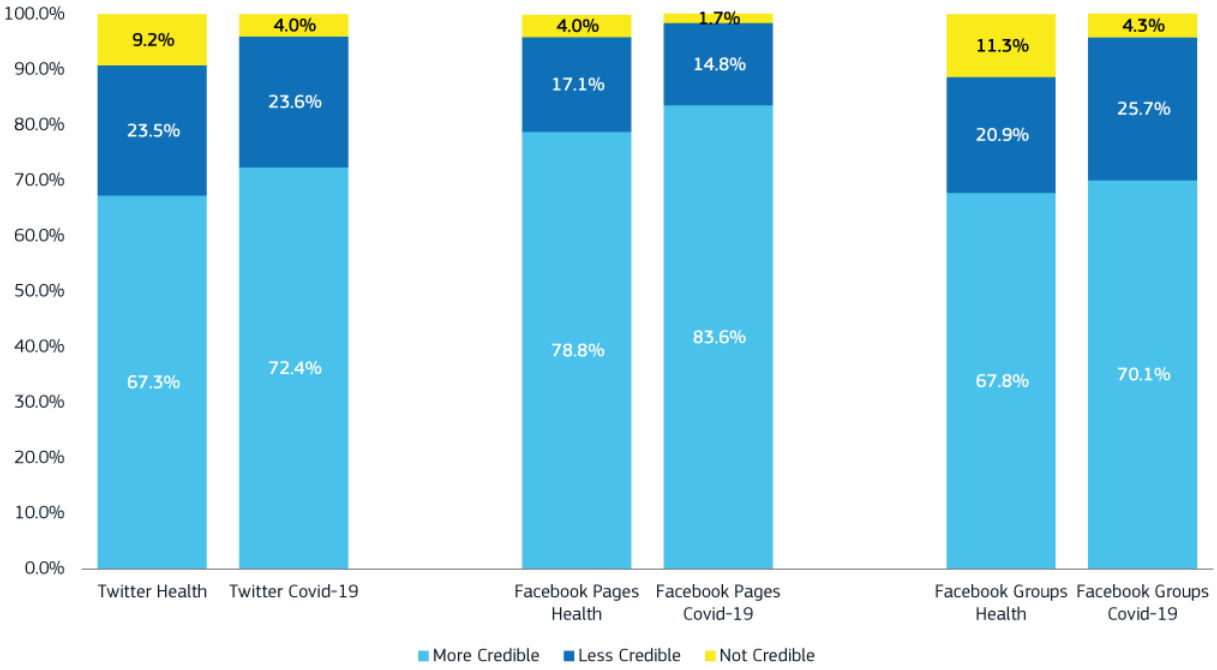
([6]) The dashboard showing (parts of) the analyses can be found at University of Southern California Melady Lab, 'Coronavirus on social media: misinformation analysis' (https://usc-melady.github.io/COVID-19-Tweet-Analysis/misinfo.html).

([7]) In this specific study, a tweet was labelled as misinformation if it linked to a source that was labelled by fact-checking sources as misinformation. Notably, these linked sources included clickbait and political and biased news. The latter is not considered misinformation by the European Commission (2018a) or by others conducting research in this field.

([8]) NewsGuard (https://www.newsguardtech.com).

([9]) Media Bias / Fact Check (https://mediabiasfactcheck.com).

Figure 5. Proportions of health URLs (2019) and COVID-19 URLs (2020) posted on Twitter, Facebook pages and Facebook groups, for each source credibility category



Source: Broniatowski et al. (2022).

Box 4. Increasing prevalence of misinformation on 5G as the purported cause of COVID-19

A prominent COVID-19 conspiracy theory asserts that the roll-out of 5G caused the coronavirus (Bruns, Harrington, and Hurcombe, 2020). This conspiracy theory is interesting since its real-world effects led to the vandalism of (supposed) 5G masts and threats directed at technicians (BBC, 2020; Kelion, 2020).

Bruns, Harrington, and Hurcombe (2020) identified four phases of the online spread of this conspiracy theory on public Facebook pages, groups and profiles in many languages, based on 89 664 posts containing topic-related terms (Figure 6).

Phase 1 (1–26 January 2020) was characterised by posts repeating pre-existing conspiracy theories (e.g. claiming that 5G is part of a secret plan to exterminate parts of the world's population). Emerging COVID-19 events were incorporated into pre-existing conspiracy narratives. The volume of related posts during this phase of emergence was small.

During Phase 2 (27 January to 24 February 2020), the Wuhan–5G narrative (see Section 3) spread globally, with over 220 daily posts. Articles on this topic were shared in different communities, reaching larger audiences. They existed in multiple languages and contained many variants of the theory.

Phase 3 (25 February to 11 March 2020) was associated with the localisation and embellishment of the conspiracy theory. Around 500–1 000 daily posts in a substantially increased number of languages were widely circulated, thus gaining local traction. The uptake of the narrative at different points in time in various locations can be linked to the gradual imposition of quarantine and lockdown measures in these places.

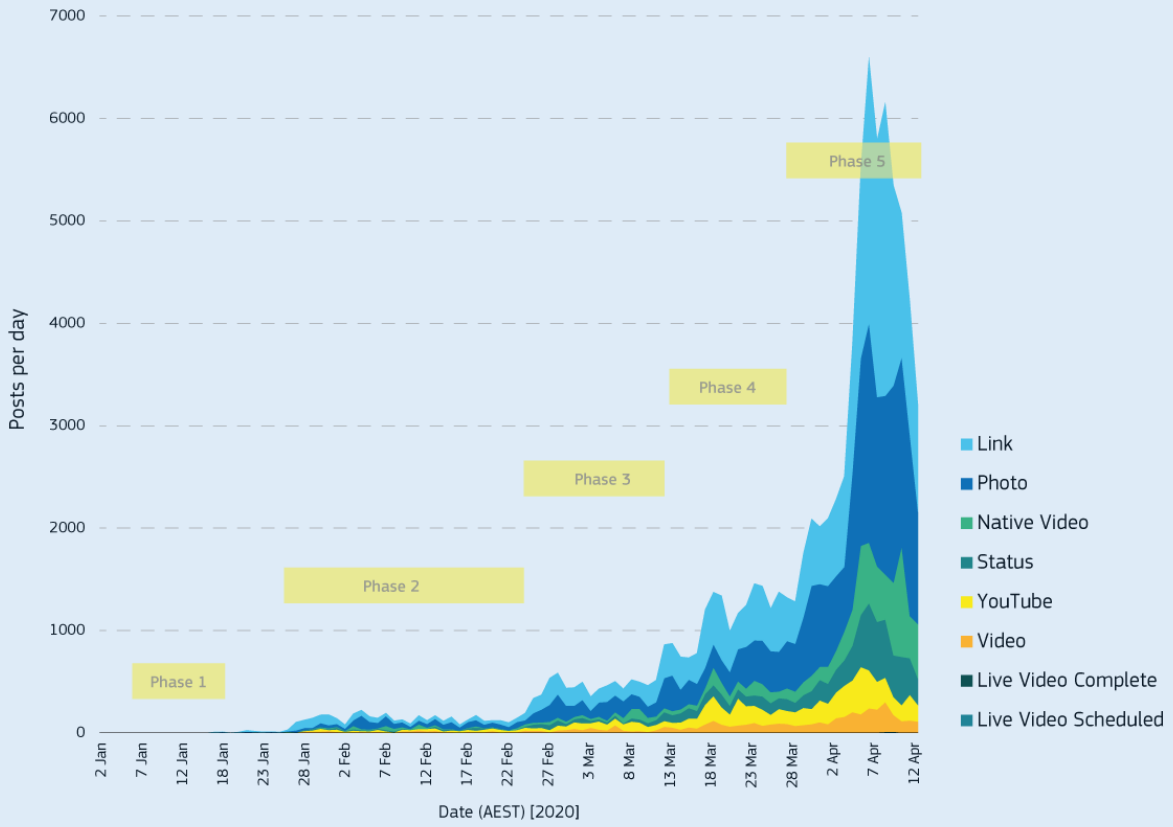
Phase 4 (12–28 March 2020) coincided with the increasing imposition of lockdown and quarantine measures. Furthermore, it was linked to celebrities picking up and spreading the narrative. Between 1 000 and 2 000 daily posts mentioned different variants of the COVID-19 and 5G conspiracy theory. One variant claimed that 5G radiation reduced the ability of the human body to absorb oxygen.

During Phase 5 (29 March to mid April 2020), there were actual physical attacks on 5G masts and towers in the EU. During this period, up to more than 6 500 daily related posts circulated in various spaces. Some posts specifically called for arson attacks on 5G equipment.

There are four aspects common to most of the phases outlined above. First, the COVID-19 and 5G conspiracy theory was often intermixed with other conspiracy theories. For example, it was often linked to conspiracy theories claiming that mass depopulation was initiated by an elite group led by George Soros and Bill Gates. Second, the specific narratives changed over time, as they were shared in different communities and were

adjusted to real-world developments. Third, while the above analysis focused on Facebook content, this frequently referred to articles from other websites, including YouTube. Fourth, in some instances, articles and videos were deleted by the platforms on which they were posted (Bruns, Harrington, and Hurcombe, 2020).

Figure 6. Volume of COVID-19 and 5G conspiracy theory posts on Facebook over time, by post type



Source: Bruns, Harrington, and Hurcombe (2020).

5. To what extent do people believe COVID-19 misinformation?

Takeaways

COVID-19 misinformation is mainly a problem if people believe it.

The level of belief in COVID-19 misinformation was highly variable; it depends on the topic and on when and where the survey was conducted.

The level of belief in some COVID-19 topics was very low (less than 2 %). It was high (more than 25 %) for some other topics at the beginning of the pandemic.

The most endorsed topics of misinformation seemed to relate to the non-natural origin of the pandemic.

From a policy perspective, the extent to which people believe COVID-19 misinformation is probably more important than the prevalence of misinformation in the media. After all, the extent to which people believe misinformation – rather than their mere exposure to it – is what matters for influencing their behaviour. For instance, the false claim that drinking bleach would cure COVID-19 is a concern if people believe this misinformation and act upon it. Studies revealed that COVID-19 misinformation has been somewhat prevalent in people's minds during the pandemic. However, there is quite some variance in the prevalence across studies, samples and different points in time. Therefore, we present the evidence separately for each selected country.

In the **United Kingdom**, a small but considerable part of the population appeared to believe in at least one COVID-19 misperception. For example, in April and May 2020, around 22 % of British respondents and 26 % of Irish respondents considered the claim that a Wuhan laboratory engineered the coronavirus to be reliable (Roozenbeek et al., 2020). Another UK survey, from May 2020, reported even higher levels of endorsement. One quarter of the respondents showed some degree of endorsement and 10 % showed high levels of endorsement of the included conspiracy theories. For instance, almost one in two people endorsed the claim that COVID-19 was a bioweapon designed by China to destroy the West, and around one in five believed to some degree that the pandemic is a conspiracy by Jews or Muslims (Freeman et al., 2020). However, this study received a lot of criticism. Box 3 provides vital information on the challenges of interpreting this type of data.

Similar proportions were revealed for the **United States** population. One study found that the percentage of US respondents who, in April and May 2020, believed the 'COVID-19 engineering theory' (22 %) was similar to the UK percentage (Roozenbeek et al., 2020). Another representative survey, of 2 023 US adults from March 2020, showed that 29 % of US respondents believed that the virus was exaggerated in order to damage then-President Donald Trump (Uscinski et al., 2020). Using a slightly different methodology, another study showed that in May 2020 the uptake and retention of misinformation narratives in the United States were modest, albeit varying for different categories of misinformation (Kreps and Kriner, 2020). In that study, participants read both true headlines and fake headlines and were later asked whether they recalled them. While respondents' correct recall of misinformation on the origins of COVID-19 was modest, misinformation about alleged treatments and the effectiveness of the governmental response appeared to be better remembered by people. While most false claims were quickly forgotten and became no longer salient and accessible, 14–19 % of participants could recall previously encountered misinformation but failed to identify it as false. At the same time, many people also failed to identify correct information as true.

Similar percentages were revealed in an **Australian** study (Pickles et al., 2021). Myths such as 'hot temperatures kill the virus' and 'ibuprofen exacerbates COVID-19' were endorsed by 22 % and 13 % of respondents, respectively, in June 2020. In April 2020, 10.6 % of respondents agreed with the statement that 'herd immunity would be beneficial for COVID-19 and this fact is covered up'. Agreement with other myths was lower. For example, only 0.6 % of the respondents believed in the COVID-19 and 5G conspiracy theory. According to the same study, believing that the threat of COVID-19 was 'greatly exaggerated' increased slightly over the

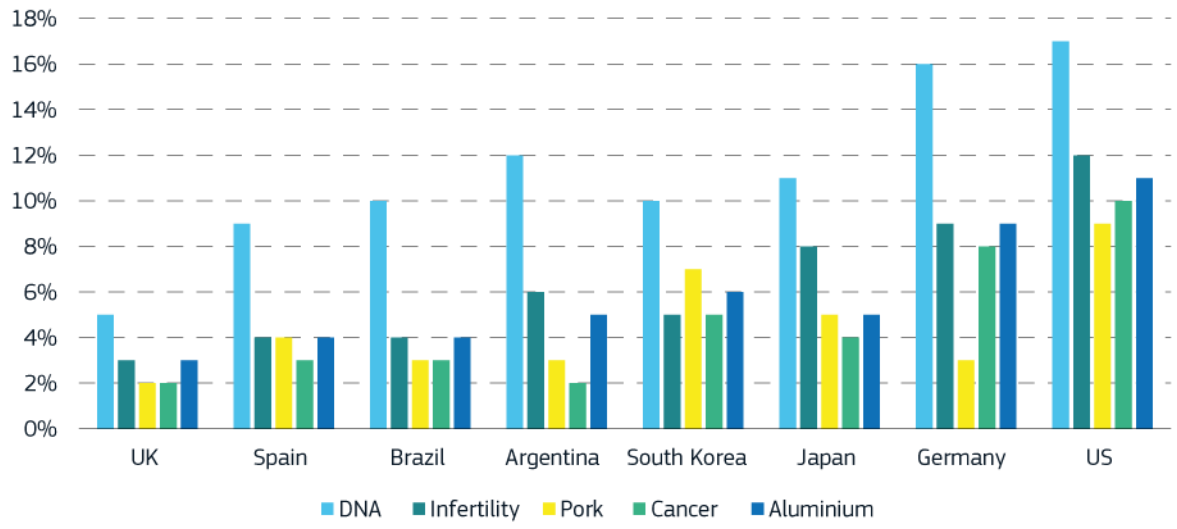
period of initial lockdown in Australia. The belief that herd immunity benefits were being covered up decreased slightly over that period.

Higher percentages of belief in misperceptions were observed in **Mexican and Spanish** samples. In April and May 2020, around 33 % of Mexican and 37 % of Spanish respondents believed the 'COVID-19 engineering theory' (Roozenbeek et al., 2020). A more recent survey, from April 2021, on belief in COVID-19 vaccine misinformation, was rather reassuring (Figure 7). In Spain, more than 85 % of people did not believe any of the five false claims they were exposed to (e.g. that COVID-19 vaccines caused infertility or altered people's deoxyribonucleic acid (DNA)) (Nielsen, Schulz, and Fletcher, 2021). Another large survey, based on a **Spanish** convenience sample, conducted in late April and early May 2020, revealed that belief in some COVID-19 misinformation narratives was substantial. Between 10 % and 20 % of the respondents agreed with statements such as 'the origin of COVID-19 is not natural', 'COVID-19 was spread on purpose' and 'COVID-19 is the result of a covert war' (Galais and Guinjoan, 2022).

The findings for **Germany** were similar. Levels of belief in different narratives seemed to be rather low. Only one claim exhibited great temporal variability. Between mid March and mid September 2020, approximately 10 % of German respondents considered several conspiracy theories as likely or very likely to be true (Rieger and He-Ulbricht, 2020). The conspiracy theories included claims that 5G was the cause of the virus; that the virus originated in a Wuhan laboratory, in US secret service operations or as a Chinese bioweapon; or that pharmaceutical companies caused the pandemic. The only theory that a relatively large group of respondents viewed as likely or very likely was that a laboratory in Wuhan created the virus. Only 3 % believed this in March 2020, rising to 18.8 % in April 2020 and up to 21.2 % between May and June 2020. According to studies conducted between October 2019 and February 2020 and between August and September 2020, 5 % of German respondents considered the statement that coronavirus was a pretext to oppress people to be certainly true, and 9 % considered it likely to be true (Roose, 2021). Another survey, from July 2020, reports that 7 % and 13 % of German respondents assessed the COVID-19 and 5G conspiracy theory and the Chinese bioweapon claim as true, respectively (Statista, 2022). Data from July 2021 indicate that 32 % of German respondents agreed that the pandemic could be used by the elite to enforce the interests of the rich and powerful. At the same time, 20 % could imagine an elite behind the pandemic, with the goal of creating a new world order (Hövermann, 2021). Furthermore, in March 2020, 18 % of German respondents believed that a 'foreign power' purposefully created the coronavirus. In July 2020, between 12 % and 27 % of Germans who knew of Bill Gates considered various conspiracies connecting him to the COVID-19 outbreak as true (Statista, 2022).

In **Germany and German-speaking parts of Switzerland**, between 3 % and 12 % of respondents to a survey in July 2020 completely agreed with conspiracy theories, depending on the specific theory. Between 4 % and 18 % agreed a lot. One of the more endorsed statements claimed the virus was man-made (28 % agreed a lot or completely) and another declared the spread of COVID-19 to be a deliberate attempt of governments to gain political control (16 % agreed a lot or completely) (Kuhn et al., 2021).

Figure 7. Proportion of people who think each false coronavirus vaccine claim is true



Source: Nielsen, Schulz and Fletcher (2021).

In a large survey conducted in **France** in late March 2020, 26 % of respondents said they believed that the coronavirus had been developed in a laboratory. Notably, 19 % believed it had been developed intentionally, and 7 % believed it had been developed accidentally (Fondation Jean-Jaurès, 2020).

In a survey conducted among Dutch-speaking **Belgians** between late March and early April 2021, 9 % of respondents believed that the statement 'the new mRNA (messenger ribonucleic acid) vaccine against the coronavirus alters the DNA' was credible. Notably, 24 % of respondents believed the claim that 'Vitamin C can decrease the chances that you become infected with the coronavirus' (Lefevere and Walgrave, 2021).

In another survey, 28 % of **Greek** respondents appeared to believe that the truth about the side effects of vaccines was deliberately hidden from the public (YouGov, 2021).

A study conducted in various **Portuguese-speaking countries** including Portugal found that the share of people who believed COVID-19 misinformation ranged from 1.3 % ('Avocado tea, hibiscus, perfume and whiskey would be some of the substances capable of preventing SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) infection') to 17 % ('Social isolation can reduce immunity and facilitate infection by the new Coronavirus') (Sousa et al., 2022).

A survey in **Austria** from early August 2020 asked respondents if they judged the truth of various COVID-19 claims as 0 % or as greater than or equal to 1 %. There was considerable variance between claims. The least believed claim was that alcohol and nicotine protect people from the virus (20 % of respondents rated it ≥ 1 % true). The most believed claim was that the coronavirus is not worse than the flu. Two out of three respondents rated it ≥ 1 % true (Marketagent, 2020).

6. How does COVID-19 misinformation spread?

Takeaways

Initially, COVID-19 misinformation often spread within fringe groups. Their members often believed other pieces of misinformation.

Public figures and mainstream media played a role in amplifying COVID-19 misinformation. They sometimes brought narratives from fringe groups to the general public.

COVID-19 misinformation was more likely to spread through certain specific social media platforms and messaging services.

Researchers have debated whether COVID-19 misinformation spreads like a virus.

6.1. Small groups and echo chambers on multiple platforms

It has been argued that misinformation narratives and conspiracy theories often originate in small, tightly knit fringe groups. Members of such groups are often predisposed to believing in and endorsing conspiracy theories (Bruns, Harrington, and Hurcombe, 2020) ([10]). Such groups played a central role in spreading hate and anti-vaccination narratives both before and during the COVID-19 pandemic (Johnson et al., 2020a; Larson, 2018). They discussed misinformation before it gained prominence among the general public (Cinelli et al., 2020). Some groups also spread racist sentiment. Related narratives attributed the virus to bioweapon-related activities by the Chinese, encouraging physical attacks against people of Asian origin (Coates, 2020; Pei and Mehta, 2020).

Two mechanisms could explain why such small (online) groups constituted particularly fertile ground for creating and spreading COVID-19 misinformation. First, members of these groups tend to already believe in other conspiracy theories and pieces of misinformation. This makes them especially likely to believe new COVID-19-related misinformation. The cognitive mechanism underlying this vicious circle is called confirmation bias. This bias describes the tendency to seek, accept and interpret evidence in line with existing beliefs, expectations and hypotheses (Guess, Nyhan, and Reifler, 2020; Nickerson, 1998). Second, belief in misinformation and conspiracy theories may serve as a bonding mechanism among members of these groups (van Prooijen and Douglas, 2018). The similarities of values, ideologies and beliefs of members of these groups can make them even more extreme. This concept, called echo chambers, describes how (mis)information can be amplified and 'echoed' within relatively closed networks of individuals (Farrell, McConnell, and Brulle, 2019). Such echo chambers have the potential to lead to more extreme and self-secure views regarding a specific topic (Sunstein, 2014).

Some data also suggested that characteristics of the platform on which information was shared, for instance the engagement patterns among its users and its group dynamics, affected how unreliable information spread. For example, Gab – a platform like Twitter, but with a right-leaning user base – was identified as more conducive to the diffusion of misinformation than more 'conventional' platforms (Cinelli et al., 2020).

Naturally, the spread of online COVID-19 misinformation is not limited to online social networks. Private and encrypted instant messaging apps, such as WhatsApp and Telegram, are increasingly being used as platforms for people to communicate within social groups (Pasquetto et al., 2020), including members of (far-right) fringe groups (Statista, 2021). Furthermore, there appears to be a strong association between using mobile instant messaging apps and belief in COVID-19 misinformation (Baum et al., 2020). People create closed or open groups to share (mis)information, exemplifying the problematic phenomenon of echo chambers (Quattrociocchi, Scala, and Sunstein, 2016).

([10]) The extent to which social network platforms function as echo chambers has recently been challenged (Dubois and Blank, 2018).

Lastly, the video-sharing platform YouTube has also played an important role in the spread of COVID-19 misinformation (Knuutila et al., 2020; Li et al., 2020). A video called 'Plandemic' containing false information on COVID-19 became viral on YouTube, not only among many conspiracy theorists, but also among the wider public. By the end of June 2020, the video had 3.15 million shares, 9.94 million comments and 8.82 million reactions (Knuutila et al., 2020). While YouTube attempted to take the video off its platform, it continued to proliferate across the internet, through users' accounts that had not (yet) been suspended (Dean, 2020; Knuutila et al., 2020).

6.2. Mainstream media and public figures

It has been argued that the lack of traditional gatekeepers, such as journalists or editors, in online environments facilitates the spread of online misinformation (Lewandowsky et al., 2012). Naturally, this applies to the context of COVID-19 (Ball and Maxmen, 2020). Sometimes, however, it is the mainstream media, politicians or other prominent figures who actively pick up these narratives and further disseminate them. This happened in the case of the COVID-19 and 5G conspiracy theory, as outlined in Box 4 (Ball and Maxmen, 2020; Bruns, Harrington, and Hurcombe, 2020; Johnson, et al., 2020a). Due to their large reach, public figures sharing misinformation can increase engagement with and accelerate the spread of the misinformation (Brennen et al., 2020; Freeman et al., 2020). This process allows misinformation to 'survive'. Even when it has stopped proliferating on one platform, it might continue to do so on another (Johnson et al., 2020a).

Analysing views regarding vaccination on Facebook suggests that anti-vaccination groups, although relatively small, are better connected to undecided groups than pro-vaccination groups are (Johnson et al., 2020b). These connections can convince undecided groups and negatively affect their sentiment regarding COVID-19 vaccination, thus posing a significant threat to pro-vaccination communication campaigns.

6.3. Viral spread

It has been argued that the spread of misinformation resembles the spread of a virus, and that both processes can be traced using similar models (Cinelli et al., 2020; Johnson et al., 2020a). An analysis of 8 million comments and posts related to COVID-19 on Twitter, Instagram, YouTube, Reddit and Gab created between January and February 2020 indicated the existence of an 'infodemic'. The term 'infodemic' describes an overabundance of inaccurate or only partially accurate information (Cinelli et al., 2020). At least temporarily, one person sharing a COVID-19-related false article led on average to more than one other person resharing this content. On the social network Gab, interactions (e.g. commenting, 'liking' and sharing) with COVID-19 misinformation posts were almost three times higher than with reliable posts (Cinelli et al., 2020). Tweets containing COVID-19 misinformation were often shared within hours (Sharma et al., 2020). The algorithmic-driven distribution of information on social media means that users are especially likely to be exposed to pieces of (mis)information that members of their social network have 'liked', which further fuels the diffusion of the (mis)information (Martens et al., 2018).

While this evidence supports the notion of an 'infodemic', it is not unequivocal. An online dashboard analysed the spread of COVID-19 misinformation on Twitter (Sharma et al., 2020). It suggests that unreliable and conspiratorial content was interacted with to a smaller degree than other content categories were. This suggests that false information about COVID-19 was less likely to be shared or commented on than true information. Relatedly, an analysis of a small set of tweets (1 000) showed that false information was tweeted more but retweeted less than evidence-based truthful information. This suggested that false information generated less engagement (Pulido et al., 2020).

In short, while the spread of misinformation is often viewed as resembling that of a virus, the current evidence does not necessarily attest to the existence of an 'infodemic'. While this metaphor of misinformation as a virus may be intuitively appealing, one should use it with caution as it may not necessarily reflect reality (Simon and Camargo, 2021).

7. Who is more or less likely to believe or share COVID-19 misinformation?

Takeaways

Sociodemographic variables seem to be bad predictors of believing and sharing COVID-19 misinformation.

Some of the most consistently reported antecedents of believing and sharing COVID-19 misinformation include intuitive thinking (as opposed to analytical thinking), political conservatism, sense of powerlessness and perceived lack of control, distrust of science and use of and trust in social (as opposed to traditional) media.

The specific topic of COVID-19 misinformation and the national context matter. They can affect whether an association between antecedents and belief in or sharing of COVID-19 misinformation exists.

Several studies have set out to explain why some people more than others believe or share COVID-19 misinformation. This section is structured by the following categories of antecedents of COVID-19 misinformation (Figure 8).

- Sociodemographic variables.
- Personality and general beliefs, including aspects relating to conservativism, religiosity and self-control.
- Cognitive factors, mainly related to how people think (intuitively or more analytically), and their knowledge and literacy.
- Social variables – that is, factors that relate to the way people (want to) present themselves to others (i.e. social signalling) and their social identity.
- Political variables, including political ideology and trust in and attitudes towards institutions and governments.
- Antecedents related to media preferences and information search.
- Perceptions of COVID-19, for instance how risky COVID-19 is perceived to be, and emotions evoked by COVID-19.

Figure 8 provides a schematic depiction of the antecedents of COVID-19 misinformation. We outline the available evidence for each antecedent below. Each subsection is introduced by a table outlining the evidence. In each table, we highlight the direction of the association in the following way.

Antecedents associated with being **more** likely to believe (left) or share (right) COVID-19 misinformation

Antecedents associated with being **less** likely to believe (left) or share (right) COVID-19 misinformation

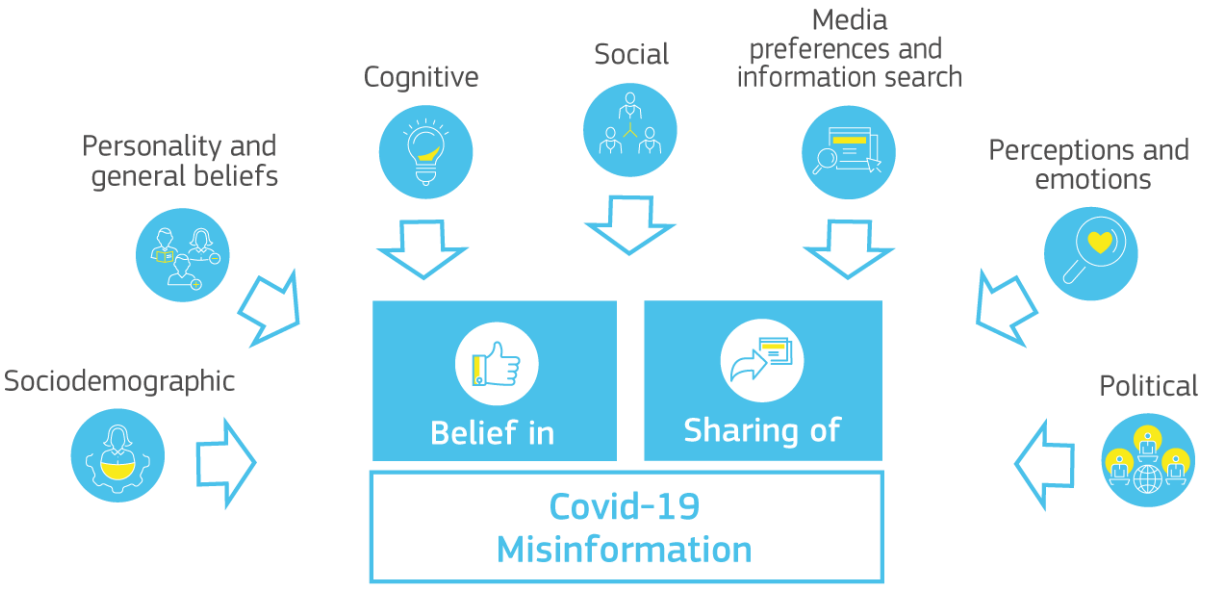
Antecedents not associated with believing COVID-19 misinformation ([11])

Note that most of the evidence presented below came from correlational studies. These studies checked whether a higher level of each antecedent was associated with a higher or lower likelihood of believing or

([11]) There are no such cases for sharing of misinformation.

sharing COVID-19 misinformation. Correlational data do not allow us to say that the antecedent is actually **causing** more/less likelihood of believing or sharing COVID-19 misinformation. Therefore, we talk about 'associations' or 'correlations' between the antedecents and believing or sharing COVID-19 misinformation. Box 5 provides pointers to assist in correctly identifying and interpreting correlational and causal evidence.

Figure 8. Mapping and classifying the antecedents of believing and sharing COVID-19 misinformation



Source: Created by the authors.

Box 5. Key aspects of identifying and interpreting the presented evidence

Correlational evidence usually describes evidence showing whether two variables change together. For example, when conservatism is higher (meaning people are more conservative), belief in misinformation may also be higher (than among people who are less conservative). This is about as much as we can learn from correlational data. The variables of interest go up or down together (or are independent of one another). What we cannot infer from correlational data is whether a change in one of the variables causes a change in the other variable. We describe correlational evidence using statements such as 'A predicts B', 'A is correlated with B' and 'A is associated with B'.

A **causal relationship**, by contrast**,** describes a situation in which a change in one variable causes a change in another variable. We describe causal evidence using phrases such as 'A causes B', 'A has an impact on B' or 'A changes B'.

Note that there are situations in which it appears obvious that a relationship is causal. For example, age might correlate positively with the tendency to believe in COVID-19 conspiracy theories. There can be only one direction, since age can cause belief in COVID-19 conspiracy theories but the opposite cannot be true. However, there might still be the issue of other, unmeasured variables (called mediators), which could mean that the causation is not direct. Going back to the previous example, older people might be more likely to read newspapers that spread COVID-19 conspiracy theories. In turn, this greater exposure could make people more likely to believe in the theories. In this case, the information source, not age, would be the cause.

For the correlational evidence presented in this section and in Section 8, we often rely on theoretical arguments to explain why we consider a factor as an antecedent or as a consequence. For example, we frame 'analytical thinking' as an antecedent. It describes people's tendency to be reflective and analytical, instead of spontaneous and intuitive. We judge it unlikely that people's belief in or sharing of misinformation affects how analytical or intuitive they are. Nevertheless, only causal evidence can really establish the direction of this purported relationship (for causal evidence related to general misinformation topics, see, for example, Bago et al., 2020). Sometimes, the direction is less clear. For instance, mistrust of the government can cause people to be more likely to believe COVID-19 misinformation. COVID-19 misinformation can also decrease trust in the government. When interpreting the evidence, these aspects should be taken into account.

Lastly, the report presents the direction (i.e. positive or negative) of the association when it is statistically significant, but it also reports non-significant associations. An association is statistically significant if it is unlikely to be due to chance. However, statistical significance does not say anything about the size of the association. Therefore, an association can be statistically significant but at the same be insignificant in practical terms as its real-life consequences will be minimal.

7.1. Sociodemographic antecedents

Here, we provide evidence on sociodemographic variables that have been investigated with respect to their association with whether people believe or share related COVID-19 misinformation (Table 1). These include gender, age, education and income.

Table 1. Evidence on sociodemographic variables as antecedents of believing or sharing COVID-19 misinformation

Antecedent	Association with believing or sharing COVID-19 misinformation
Age	Roozenbeek et al., 2020; Šrol, Mikušková and Čavojová et al., 2021; Stoica and Umbres, 2020
	De Coninck et al., 2021; Duplaga, 2020; Meyer, Alfano and de Bruin, 2021; Pickles et al., 2021; Roozenbeek et al., 2020; Uscinski et al., 2020
	Alper, Bayrak and Yilmaz, 2020; Tonković et al., 2021
Gender (= male)	De Coninck et al., 2021; Meyer, Alfano and de Bruin, 2021; Pickles et al., 2021; Roozenbeek et al., 2020
	Laato et al., 2020
	Alper, Bayrak and Yilmaz, 2020
	Duplaga, 2020; Roozenbeek et al., 2020; Šrol, Mikušková and Čavojová, 2021; Stoica and Umbres, 2020; Tonković et al., 2021; Uscinski et al., 2020
Education	Meyer, Alfano and de Bruin, 2021; Stoica and Umbres, 2020
	De Coninck et al., 2021; Duplaga, 2020; Pickles et al., 2021; Romer and Jamieson, 2020; Šrol, Mikušková and Čavojová, 2021; Tonković et al., 2021; Uscinski et al., 2020
	Alper, Bayrak and Yilmaz, 2020; Georgiou, Delfabbro and Balzan, 2020; Roozenbeek et al., 2020; Uscinski et al., 2020

Income		Meyer, Alfano and de Bruin, 2021; Romer and Jamieson, 2020
		Duplaga, 2020; Uscinski et al., 2020

NB: The table shows antecedents (left), their associations with believing or sharing COVID-19 misinformation (symbols) and references (right). 'Thumbs up' symbol: believing misinformation. 'Arrow' symbol: sharing misinformation. Green-coloured upwards arrow: positive association. Blue-coloured downwards arrow: negative association. Grey equals sign: no association.

The relationships between most sociodemographic variables and believing or sharing COVID-19 misinformation are not straightforward. There is often evidence for positive, negative and null effects. We argue that it is necessary to examine psychological antecedents to better identify people who are more or less likely to believe or share misinformation. Thus, we concentrate on these types of factors in the following sections.

7.2. Personality and general beliefs

In this category, we include factors that describe people's personalities and general beliefs. Much of the evidence relates to being conservative in the non-political sense. Conservatism is defined as 'an attitude characterised by a positive regard for the past or the status quo (e.g. established principles and procedures) and [...] by dislike or distrust of change' (American Psychological Association, 2022). Taking a broader perspective, we refer here to factors such as the degree to which someone is open-minded, the degree to which they are willing to explore, the degree to which they are religious and the degree to which they are tolerant of uncertainty. The evidence is summarised in Table 2.

Table 2. Evidence on personality and general beliefs as antecedents of believing or sharing COVID-19 misinformation

Antecedent	**Association with believing or sharing COVID-19 misinformation**	
Exploration		Islam et al., 2020
Open-mindedness		Meyer, Alfano and de Bruin, 2021; Stoica and Umbres, 2020
Uncertainty avoidance/intolerance		Alper, Bayrak and Yilmaz, 2020; Hartman et al., 2021; Larsen et al., 2021
Impulsivity		Alper, Bayrak and Yilmaz, 2020
Sense of control		Oleksy et al., 2021 (government-related COVID-19 misinformation topics); Šrol, Mikušková and Čavojová, 2021
		Oleksy et al., 2021 (general COVID-19 misinformation topics)
Self-regulation		Islam et al., 2020
Honesty		Meyer, Alfano and de Bruin, 2021

Self-esteem		Meyer, Alfano and de Bruin, 2021
Religiosity		Alper, Bayrak and Yilmaz, 2020; Meyer, Alfano and de Bruin, 2021; Tonković et al., 2021 (religious fundamentalism); Uscinski et al., 2020
		Islam et al., 2020
		Agley and Xiao, 2021 (religious commitment)

NB: The table shows antecedents (left), their associations with believing or sharing COVID-19 misinformation (symbols) and references (right). 'Thumbs up' symbol: believing misinformation. 'Arrow' symbol: sharing misinformation. Green-coloured upwards arrow: positive association. Blue-coloured downwards arrow: negative association. Grey equals sign: no association.

The personality characteristics of being open to novelty and challenges (i.e. '**exploration**') appeared to go hand in hand with less sharing of COVID-19 misinformation. Likewise, being more **open-minded** decreased a person's chance of believing COVID-19 misinformation.

The evidence on the tendency to avoid uncertainty or being **intolerant of uncertainty** is quite clear. People who tended to avoid uncertainty also tended to endorse COVID-19 misinformation. Intolerance of uncertainty has been shown to positively predict belief in non-COVID-19 conspiracy theories. However, evidence on this relationship for non-COVID-19 misinformation narratives is mixed (see van Prooijen and Jostmann, 2013). Fittingly, some evidence presented here indicates that the relationship might depend on the specific narrative. Uncertainty intolerance predicted beliefs in the Wuhan meat market misinformation narrative, but not the Wuhan laboratory conspiracy narrative or the COVID-19 and 5G conspiracy narrative (Hartman et al., 2021).

Sense of control comprises people's perceptions of individual and collective control. It extends to their capability to regulate their emotions, thoughts and behaviour. Sense of individual control consists of the extent to which people feel in control of their life. People perceptions about whether their country is able to deal with issues (such as the COVID-19 pandemic) is their sense of collective control. Sense of control, whether people feel in control or feel that they lack control, is an important antecedent to whether people believe in non-COVID-19-related conspiracy theories (Douglas, Sutton, and Cichocka, 2017; van Prooijen and Acker, 2015). The idea is that people turn to conspiracy theories as compensation for their lack of sense of control. The evidence of the association between factors related to sense of control and belief in COVID-19 misinformation is relatively sparse. However, the patterns are largely consistent with what one would expect based on previous studies. Lower sense of control and being more **impulsive** tended to go hand in hand with higher belief in COVID-19 misinformation. In other words, if people felt they or their country were unable to cope with events in general, they were more likely to resort to believing COVID-19 misinformation. In line with that, a higher capacity to **self-regulate** predicted a lower likelihood of sharing COVID-19 misinformation.

The association between having a sense of control and believing COVID-19 misinformation depended on the specific misinformation topic. In addition, it mattered whether sense of control refers to the perception of individual or collective control. Feeling personally in control appeared to predict lower average belief in both general and government-related conspiracy theories. However, those with a high sense of collective control were less likely to believe in COVID-19 conspiracy theories about their government. They were more likely to believe in conspiracy theories about COVID-19 in general (Oleksy et al., 2021).

Honest people appeared to be less likely to believe COVID-19 misinformation. **Self-esteem** (i.e. feelings of self-worth) appeared to also be negatively associated with belief in COVID-19 misinformation. Finally, more **religious** people generally appeared to believe more in COVID-19 misinformation. A study among Polish Roman Catholics suggests that only the most dogmatic and fundamentalist types of religiosity were associated with COVID-19 conspiracy beliefs. Those who were moderately religious may have been even less likely to believe in COVID-19 conspiracy theories than the other groups (Łowicki et al., 2022). In addition, one study reports a negative association between religiosity and sharing of misinformation in a Bangladeshi sample (Islam et al., 2020), and another study found no such association in a US sample (Agley and Xiao, 2021). Consequently, there appear to be important limitations to this relationship.

7.3. Cognitive antecedents

Cognitive factors include various aspects of how people acquire, use and understand knowledge. These factors fall into two categories: (1) people's specific thinking style (such as intuitive vs. deliberative thinking) and (2) aspects of their thinking capacity, their literacy and their intellect. We also include extra factors, such as epistemic vice, dogmatism, tendency to engage in pseudoscientific practices and tendency to engage in conspiracy thinking. The evidence is summarised in Table 3.

Table 3. Evidence on cognitive factors as antecedents of believing or sharing COVID-19 misinformation

Antecedent	Association with believing or sharing COVID-19 misinformation	
Analytical thinking		Alper, Bayrak and Yilmaz, 2020; Cavojova, Šrol and Mikušková, 2020; Meyer, Alfano and de Bruin, 2021; Nurse et al., 2022; Stanley et al., 2021; Stoica and Umbres, 2020; Swami and Barron, 2020
Faith in intuition		Alper, Bayrak and Yilmaz, 2020
Need for cognition		Meyer, Alfano and de Bruin, 2021
Cognitive sophistication		Pennycook et al., 2020a
Epistemic vice		Meyer, Alfano and de Bruin, 2021
Dogmatism		Meyer, Alfano and de Bruin, 2021
Engagement in pseudoscientific practices		Teovanović et al., 2020
Viewing major events as product of conspiracies		Uscinski et al., 2020
Numeracy		Roozenbeek et al., 2020
Health literacy		Duplaga, 2020; Pickles et al., 2021
Scientific reasoning		Cavojova, Šrol and Mikušková, 2020
Intellect		Meyer, Alfano and de Bruin, 2021

NB: The table shows antecedents (left), their associations with believing or sharing COVID-19 misinformation (symbols) and references (right). 'Thumbs up' symbol: believing misinformation. 'Arrow' symbol: sharing misinformation. Green-coloured upwards arrow: positive association. Blue-coloured downwards arrow: negative association. Grey equals sign: no association.

There have been many investigations of whether **thinking or deciding analytically or intuitively** makes people more likely to believe or share COVID-19 misinformation. Mostly, both of these styles are seen as opposite ends of a spectrum. The evidence is clear that people who tended to think analytically were less likely to believe COVID-19 misinformation. Those who tended to trust their instincts and hunches (including those who have strong '**faith in their intuition**') were more likely to believe COVID-19 misinformation. This research builds on efforts by scholars investigating non-COVID-19-related misinformation (e.g., Pennycook and Rand, 2021). **Cognitive sophistication**, understood as scientific knowledge, disposition to engage in analytical thinking, numeracy and general 'receptivity to bullshit' (Pennycook et al., 2020a; Pennycook and Rand, 2020), predicted lower levels of misperceptions regarding COVID-19.

One piece of evidence (Meyer, Alfano, and de Bruin, 2021) suggests that people with a higher **need for cognition** were prone to believing COVID-19 misinformation. Need for cognition is a measure of people's inclination to engage in reflective thinking. Individuals with a high need for cognition actively seek information and think about arguments presented to them, and enjoy doing so. The authors do not discuss this counterintuitive association, and we can only speculate about the reasons for it. It is unclear to what extent need for cognition predicts belief in general conspiracy theories (Swami et al., 2014). A negative association is not straightforward to explain. A possible explanation might involve the method of measuring need for cognition being based on self-assessments (Cacioppo, Petty, and Feng Kao, 1984). In the previously cited source, participants stated to what extent statements such as 'I prefer my life to be filled with puzzles that I must solve' applied to themselves. These self-perceptions might be poor predictors of actual cognition styles in some situations. Another possible explanation is that need for cognition may accentuate people's motivated reasoning, which may in turn make them more prone to believing misinformation that aligns with their pre-existing beliefs.

There is evidence for strong positive links between **epistemic vice** and endorsement of COVID-19 misinformation. Epistemic vice was measured using people's agreement with various unorthodox epistemic beliefs. These included statements such as 'I am not very interested in understanding things' and 'It's more important to have a stable worldview than to be open-minded'. Relatedly, higher tendencies to believe in and share COVID-19 conspiracy theories were also associated with **dogmatism**. Dogmatism is the tendency to consider one own's views undeniably true (Meyer, Alfano, and de Bruin, 2021).

Likewise, there was a positive association between COVID-19 misinformation endorsement and the tendency to **engage in pseudoscientific practices**. The same relationship held with the tendency to **view major events as products of conspiracies**.

Finally, the evidence on the relationship between COVID-19 misinformation endorsement and **numeracy**, **health literacy**, **scientific reasoning** and **intellect** is straightforward. Higher values for these variables predicted lower likelihood of endorsing COVID-19 misinformation. However, distinguishing between different types of literacy is important. While health literacy predicted lower levels of COVID-19 conspiracy beliefs, digital health literacy predicted higher levels of these beliefs, on average (Duplaga, 2020).

7.4. Social antecedents

Social factors can influence people's tendencies to believe or share COVID-19 misinformation. On the one hand, these social factors describe people's perceptions of the social groups to which they feel they belong, and the relationships between these groups and with other groups. These antecedents refer to social identity. On the other hand, they include people's motivation to present themselves to others in a specific way. These variables refer to social signalling.

7.4.1. Social identity

Here, we outline the links between belief in or sharing of COVID-19 misinformation and factors that pertain to people's (perception of their) position in a group, their belonging to specific groups and their attitudes towards that group or other groups. The evidence is summarised in Table 4.

Table 4. Evidence on social identity variables as antecedents of believing or sharing COVID-19 misinformation

Antecedent	Association with believing or sharing COVID-19 misinformation
Collective narcissism	 Sternisko et al., 2020
	 Stoica and Umbres, 2020
Ethnocentrism	 Hartman et al., 2021
Endorsement of xenophobic policies	 Oleksy et al., 2021
Perceived minority status	 Roozenbeek et al., 2020
Feeling socially included	 Stoica and Umbres, 2020
Social dominance orientation	 Lobato et al., 2020
	 Hartman et al., 2021; Tonković et al., 2021
White racial identity	 Romer and Jamieson, 2020; Uscinski et al., 2020
	 Meyer, Alfano and de Bruin, 2021; Uscinski et al., 2020
Subjective social class	 Alper, Bayrak and Yilmaz, 2020; Stoica and Umbres, 2020

NB: The table shows antecedents (left), their associations with believing or sharing COVID-19 misinformation (symbols) and references (right). 'Thumbs up' symbol: believing misinformation. 'Arrow' symbol: sharing misinformation. Green-coloured upwards arrow: positive association. Blue-coloured downwards arrow: negative association. Grey equals sign: no association.

Collective narcissism describes a belief in the greatness of one's nation that others do not appreciate (Sternisko et al. 2020). Such belief has been found to be positively correlated with believing and intending to share COVID-19 misinformation. This was also the case for the related concept of **ethnocentrism**. Ethnocentrism describes the extent to which people believe their nation to be superior to others.

Somewhat related, the likelihood of believing or sharing COVID-19 misinformation increased as people's **social dominance orientation** increased. Social dominance orientation is the tendency to view out-groups (i.e. groups to which one does not belong) as inferior. It includes preference for a society that is hierarchically structured. However, the relationship between social dominance orientation and believing COVID-19 misinformation was not straightforward. It appeared to depend to some extent on traditionalism, but also on the specific content of misinformation (Lobato et al., 2020). Traditionalism refers to people's valuations of traditional moral systems and lifestyles, including their resistance to modern challenges to these.

Endorsement of xenophobic policies and perceiving oneself as belonging to a **minority group** were both found to be positively associated with belief in COVID-19 conspiracies. However, this was only the case for general COVID-19 conspiracy theories, and not for government-related COVID-19 conspiracy theories (Oleksy et al., 2021).

The degree to which people feel they are part of a social group can also affect the likelihood that they engage in COVID-19-related conspiratonal ideation. For example, **feeling socially included** has been linked with lower levels of belief in COVID-19-related conspiracy theories.

White racial identity and **subjective social class** have also been investigated as possible antecedents. White racial identity was found to decrease the likelihood of believing in COVID-19 conspiracy theories and in myths about COVID-19 vaccine harms. However, other studies failed to find a significant link between white racial identify and belief in COVID-19 misinformation. Lastly, people's self-perceived social class appeared to be unrelated to belief in COVID-19 misinformation.

7.4.2. Social signalling

People may share misinformation to bond with, ridicule or troll others. In other words, people have social signalling motives for sharing misinformation (Ren, Dimant, and Schweitzer, 2021). Under this category, we subsume factors that relate to how one is seen by others and to how one wants to be seen by others. The evidence is summarised in Table 5.

Table 5. Evidence on social signalling variables as antecedents of believing or sharing COVID-19 misinformation

Antecedent	Association with believing or sharing COVID-19 misinformation
Social gratification	 Apuke and Omar, 2021
Altruistic gratification	 Apuke and Omar, 2021
Self-promotion	 Islam et al., 2020

NB: The table shows antecedents (left), their associations with believing or sharing COVID-19 misinformation (symbols) and references (right). 'Thumbs up' symbol: believing misinformation. 'Arrow' symbol: sharing misinformation. Green-coloured upwards arrow: positive association. Blue-coloured downwards arrow: negative association. Grey equals sign: no association.

Although limited to two studies, the evidence points towards an association between social signalling and the sharing of COVID-19 misinformation. Specifically, motives such as sharing information for **altruistic and social purposes** have been identified as positive predictors of self-reported COVID-19 misinformation sharing in a Nigerian sample. Somewhat related is the motivation of **promoting oneself** by means of sharing such misinformation; this association was identified in another study.

7.5. Political antecedents

Political factors relate to people's political ideologies and the beliefs associated with them. They extend to trust in institutions and organisations. There is a political dimension to conspiracy mentality and misinformation beyond COVID-19 (Imhoff et al., 2022). The main reason is that misinformation narratives frequently focus on political topics (Allcott and Gentzkow, 2017). In fact, we showed in Section 3 that misinformation often includes a political element. Likewise, trust in institutions such as the media, health institutions and international organisations predicts whether people engage in or share misinformation unrelated to COVID-19 (Halpern et al., 2019; Zimmermann and Kohring, 2020). Here, we outline the evidence that relates specifically to COVID-19 misinformation.

7.5.1. Political ideology

In this subsection, we gather antecedents of belief in or sharing of COVID-19 misinformation, which encompass a political conservative ideology, self-identification with political parties, right-wing ideology, populism and perception of political powerlessness. The evidence is summarised in Table 6.

Table 6. Evidence on political ideology variables as antecedents of believing or sharing COVID-19 misinformation

Antecedent	Association with believing or sharing COVID-19 misinformation	
Political conservatism		Havey, 2020; Lobato et al., 2020
		Calvillo et al., 2020; Pennycook et al., 2020a; Romer and Jamieson, 2020; Roozenbeek et al., 2020; Uscinski et al., 2020
Republican in the United States		Freiling et al., 2021; Miller, 2020b, 2020a; Roozenbeek et al., 2020; Uscinski et al., 2020
		Freiling et al., 2021
Right-wing ideology and authoritarianism		Alper, Bayrak and Yilmaz, 2020; Hartman et al., 2021; Sternisko et al., 2020
		Stoica and Umbres, 2020
Liberal ideology in the United States		Romer and Jamieson, 2020
Political ideology		Agley and Xiao, 2021; Meyer, Alfano and de Bruin, 2021
Populism		Eberl, Huber and Greussing, 2021
Perceived political powerlessness		Tonković et al., 2021

NB: The table shows antecedents (left), their associations with believing or sharing COVID-19 misinformation (symbols) and references (right). 'Thumbs up' symbol: believing misinformation. 'Arrow' symbol: sharing misinformation. Green-coloured upwards arrow: positive association. Blue-coloured downwards arrow: negative association. Grey equals sign: no association.

The evidence on **political conservatism** and COVID-19 misinformation is straightforward. Politically conservative people were more likely to believe and share COVID-19 misinformation ([12]). This aligns with the evidence suggesting that **Republicans** in the United States were more likely to believe COVID-19 misinformation. Conversely, **liberals** in the United States tended to be less likely to do so. We identified two studies from the United States that did not find a clear relationship between people's political ideology and the extent to which they believed COVID-19 misinformation.

([12]) Notably, however, Roozenbeek et al. (2020) find no evidence of this effect in the United Kingdom or the United States. This could be explained by mediating variables, such as trust in the government and in politicians.

In line with some effects presented under social identity, holding a **right-wing ideology** tended to be associated with stronger beliefs in COVID-19 misinformation. However, there is evidence that Romanians with a left-wing ideology showed more pronounced COVID-19 conspiracy ideation than those with a right-wing ideology. Hence, it is unclear to what extent findings from the United States on political ideology apply to a European context.

Austrians who hold **populist** attitudes have been found to be more likely to believe in COVID-19 conspiracy theories. Populist attitudes refer to the opposition to political and societal elites, the blaming of these elites for betraying normal people and a Manichaean vision of the world.

Lastly, the perception of **political powerlessness** has been associated with higher average levels of COVID-19 misinformation beliefs. This finding is linked to the role of feelings of control outlined above.

7.5.2. Trust in and attitudes towards institutions and governments

Here, we present evidence regarding the role of trust in and mistrust of different types of institutions, including the media and health, political and scientific institutions. The evidence is summarised in Table 7.

Table 7. Evidence on trust in and attitudes towards institutions and governments as antecedents of believing or sharing COVID-19 misinformation

Antecedent	Association with believing or sharing COVID-19 misinformation
Political and institutional trust	Eberl, Huber and Greussing, 2021; Pickles et al., 2021; Šrol, Mikušková and Čavojová, 2021
Trust in WHO's response	Roozenbeek et al., 2020
Trust in science and in scientists	Agley and Xiao, 2021; Constantinou, Kagialis and Karekla, 2020; Eberl, Huber and Greussing, 2021; Hartman et al., 2021; Pickles et al., 2021; Roozenbeek et al., 2020; Tonković et al., 2021
	Lobato et al., 2020
Trust in government	Pickles et al., 2021
	Roozenbeek et al., 2020
Negative attitude towards government	Georgiou, Delfabbro and Balzan, 2020
Trust in politicians' response to COVID-19	Roozenbeek et al., 2020
Trust in journalists	Roozenbeek et al., 2020

		
Denialism		Uscinski et al., 2020

NB: The table shows antecedents (left), their associations with either believing or sharing COVID-19 misinformation (symbols) and references (right). 'Thumbs up' symbol: believing misinformation. 'Arrow' symbol: sharing misinformation. Green-coloured upwards arrow: positive association. Blue-coloured downwards arrow: negative association. Grey equals sign: no association.

The evidence on trust is partly straightforward, and partly in need of further investigation. **Political and institutional trust**, **trust in the government**, **trust in the WHO response** and **trust in science and in scientists** all predicted, on average, lower levels of endorsement of COVID-19 conspiracy theories ([13]). In fact, trust in science has been identified as a particularly strong predictor (Hartman et al., 2021). Surprisingly, **trust in politicians' response** to the COVID-19 threat predicted higher susceptibility to COVID-19 misinformation among people from Mexico, Spain and the United States (but not among people from Ireland and the United Kingdom) (Roozenbeek et al., 2020). The same study showed that, in the United States, the more people trusted the Trump government that was in place in 2020, the more they tended to believe COVID-19 misinformation. In Mexico, Spain and the United Kingdom, higher levels of **trust in journalists** were (weakly but significantly) associated with more profound beliefs in COVID-19 misinformation. These contradictory findings may be explained by the fact that governments and journalists differed across and within countries in terms of how they treated and dealt with COVID-19. Another study provides some evidence that having negative attitudes towards the governmental response to the pandemic predicted higher average levels of belief in COVID-19 misinformation.

Denialism is an umbrella disposition consisting of believing that most information people receive is wrong, often disagreeing with conventional worldviews and distrusting official government accounts of events (Uscinski et al., 2020). People who scored high on denialism were more likely to believe that the threat posed by COVID-19 was exaggerated and that the virus was spread on purpose.

7.6. Social media use and information search

This category subsumes factors describing people's patterns of using social media and retrieving information. Social media, online video platforms and private messenging services have played an important role in the spread of misinformation during the COVID-19 pandemic. The evidence is summarised in Table 8.

Table 8. Evidence on social media use and information search as antecedents of believing or sharing COVID-19 misinformation

Antecedent	Association with believing or sharing COVID-19 misinformation	
Social media use		De Coninck et al., 2021; Romer and Jamieson, 2020; Roozenbeek et al., 2020
Use of aggregators		Romer and Jamieson, 2020
Social media fatigue		Islam et al., 2020
Perceived information overload		Laato et al., 2020

([13]) However, having more trust in the WHO response, at the time the survey was conducted, predicted lower susceptibility to misinformation only in Mexico, not in other countries (Ireland, Spain, the United Kingdom and the United States) (Roozenbeek et al., 2020).

Consultation of WHO information/health experts		De Coninck et al., 2021; Roozenbeek et al., 2020
Mainstream/traditional media use		Allington et al., 2020; De Coninck et al., 2021; Romer and Jamieson, 2020
Rejection of information from expert authorities		Uscinski et al., 2020
Trust in information shared on social media		Laato et al., 2020
Information from political actors		De Coninck et al., 2021

NB: The table shows antecedents (left), their associations with believing or sharing COVID-19 misinformation (symbols) and references (right). 'Thumbs up' symbol: believing misinformation. 'Arrow' symbol: sharing misinformation. Green-coloured upwards arrow: positive association. Blue-coloured downwards arrow: negative association. Grey equals sign: no association.

Using **social media** and using **news aggregators** such as Google News both predicted higher average levels of misperceptions around the pandemic (i.e. perceptions of vaccine harm). Using news aggregators simultaneously predicted higher likelihood of perceptions of COVID-19 as a personal threat. In one study, the positive correlation between using social media to obtain news and the susceptibility to COVID-19 misinformation was found in Ireland, the United Kingdom and the United States, but not in Mexico or Spain. This suggests that the connection is, again, context-specific (Roozenbeek et al., 2020). Likewise, people who tend to **trust in information shared on social media** were more likely to believe COVID-19 misinformation than those who do not.

Social media fatigue describes the psychological exhaustion resulting from information and communication overload from social media, leading sufferers to avoid using social media (Islam et al., 2020). Being associated with both this concept and perceived **information overload** positively predicted unverified information sharing regarding COVID-19.

Preferences for retrieving **information from WHO** and from the **mainstream media** (as opposed to conservative and social media) have been associated with lower average levels of belief in COVID-19 misinformation. The rejection of information from **expert authorities**, as expected, was associated with stronger COVID-19 misinformation beliefs. Exposure to information from **political actors** was associated with stronger beliefs regarding COVID-19 conspiracy theories and misinformation in some countries, but not in others.

7.7. Perceptions of and emotions evoked by COVID-19

Here, we discuss factors that describe how people perceive and experience the pandemic and how these were related to their likelihood of believing or sharing COVID-19 misinformation. Specifically, these antecedents encompass perceptions of the pandemic and their related negative emotional reactions. The evidence is summarised in Table 9. Here, in particular, we remind the reader that these associations do not imply causal relationships.

Table 9. Evidence on perceptions of and emotions evoked by COVID-19 as antecedents of believing or sharing COVID-19 misinformation

Antecedent	Association with believing or sharing COVID-19 misinformation	
Anger about COVID-19		Han, Cha and Lee, 2020; Jolley and Paterson, 2020
Stress about COVID-19		Constantinou, Kagialis and Karekla, 2020
		Georgiou, Delfabbro and Balzan, 2020
Anxiety about COVID-19		Freiling et al., 2021; Hartman et al., 2021
		Freiling et al., 2021
		Šrol, Mikušková and Čavojová, 2021
COVID-19 risk perceptions		Šrol, Mikušková and Čavojová, 2021
		Alper, Bayrak and Yilmaz, 2020; Bridgman et al., 2020; Pennycook et al., 2020a; Pickles et al., 2021
		Roozenbeek et al., 2020
Psychological distance		Kwon et al., 2022
Feeling uncertain		Miller, 2020a, 2020b

NB: The table shows antecedents (left), their associations with believing or sharing COVID-19 misinformation (symbols) and references (right). 'Thumbs up' symbol: believing misinformation. 'Arrow' symbol: sharing misinformation. Green-coloured upwards arrow: positive association. Blue-coloured downwards arrow: negative association. Grey equals sign: no association.

Of the emotional reactions to the COVID-19 situation, **anger** triggered by the pandemic was positively associated with both belief in and sharing of COVID-19 misinformation. **Stress** appeared to be unrelated in one case, and a positive predictor in another. The evidence on the link between **anxiety** and belief in COVID-19 misinformation is also mixed, but there is a slight tendency towards a positive relationship.

The evidence on **risk perceptions** is mixed as well. One study showed that perceiving COVID-19 as risky goes hand in hand with lower average levels of believe in COVID-19 misinformation. Risk perceptions predict lower

levels of belief in three studies, and suggest no significant association in two studies. Under specific circumstances, it appears that perceiving COVID-19 as risky can protect people against misinformed beliefs. Intuitively, this relationship makes particular sense for misinformation theories downplaying the severity of the virus. If people perceive COVID-19 as risky, it is logical that they will not believe misinformation saying that the virus is benign. People who **felt uncertain** about their lives during the pandemic were also more likely to believe COVID-19 misinformation (for instance, that 5G caused the virus).

Lastly, one study investigated the role of **psychological distance**. Usually, this concept measures the extent to which people rate an event or other phenomenon as close to them in the widest sense. In this case, it measured how near people thought they were to the economic and health-related consequences of COVID-19 (Kwon et al., 2022). Findings suggest that the more distant people felt from COVID-19 as a health threat, the less likely they were to believe two particular COVID-19 misinformation narratives. Psychological distance from the economic threats of COVID-19 did not correlate with belief in COVID-19 misinformation.

8. What are the consequences of being exposed to and believing COVID-19 misinformation?

Takeaways

Being exposed to and believing COVID-19 misinformation predominantly leads to less protective behaviour, including compliance with official guidelines and intentions to socially distance.

COVID-19 misinformation has negative consequences for vaccination take-up.

COVID-19 misinformation can affect how people seek and trust information. However, the evidence is scarce.

As for the antecedents, the associations partially depend on the specific misinformation narratives.

Being exposed to and, even more so, believing COVID-19 misinformation can lead someone to further spread such narratives. Ultimately, COVID-19 misinformation can undermine people's trust in governments and other institutions, and cause fear, cynicism, apathy and extremism. These consequences can threaten societies' social cohesion (Lazer et al., 2018). During a health crisis such as the COVID-19 pandemic, exposure to and belief in misinformation can literally threaten lives – one's own life and the lives of others (see, e.g., Bursztyn et al., 2021; Gallotti et al., 2020). People might not have socially distanced at the beginning of the pandemic because they were exposed to (and believed) misinformation that downplayed the severity of the disease. As a consequence, they could become infected and die. The consequences of misinformation may not only affect those who consume it. Ultimately, misinformation can also have consequences for those who do not believe it. For instance, people put their co-workers' health at risk if they decide to go to work even though they are suffering from COVID-19 symptoms. The decision to go to work despite showing symptoms could be attributable to the consumption of misinformation regarding the contagiousness of the virus. Thus, pandemic misinformation undermines a collective response and creates a public health risk (Larson, 2018).

In this section, we outline the available evidence on the association between COVID-19 misinformation and variables that can be perceived as consequences. Specifically, we categorise the evidence by differentiating between the following types of consequences.

- **Preventive measures**, including behaviours and attitudes relating to how people (intend to) protect themselves. This category includes how people perceive the importance of these measures.
- **Vaccination**, pertaining to intentions of getting vaccinated against COVID-19, and the willingness to recommend vaccination to others.
- **Information search**, meaning people's preferences and routines for seeking and using information.
- **General consequences**, such as those for institutional trust, support for regulations and attitudes towards countries and political figures.

Where the available evidence is correlational, we construe variables as 'consequences' based on theoretical grounds (Box 5). Figure 9 provides a schematic depiction of the potential consequences of believing and being exposed to COVID-19 misinformation.

Similar to the previous section, each subsection is introduced by a table outlining the evidence. In each table, we specify the following.

Consequences of **believing** COVID-19 misinformation

Consequences of **exposure to** COVID-19 misinformation

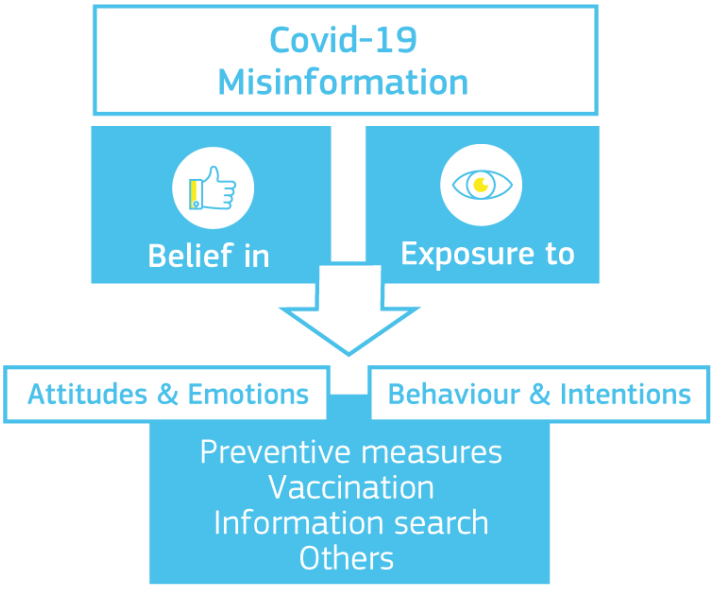
We highlight the direction of the association in the following way.

Consequences associated with **higher** tendency to believe or be exposed to COVID-19 misinformation

Consequences associated with **lower** tendency to believe or be exposed to COVID-19 misinformation

Consequences not associated with believing COVID-19 misinformation ([14])

Figure 9. Mapping and classifying consequences of COVID-19 misinformation



Source: Created by the authors.

8.1. Consequences for preventive measures

COVID-19 misinformation can affect people's perceived importance of individual and collective preventive actions. It can also affect how well they protect themselves or others. Several misinformation narratives directly question the effectiveness of effective measures or suggest ineffective ones. Other narratives affect compliance with preventive measures more indirectly (e.g. by instilling doubt about the severity of the virus). The evidence is summarised in Table 10.

([14]) There are no such cases for sharing of misinformation.

Table 10. Evidence on the consequences of belief in or exposure to COVID-19 misinformation for preventive measures

Antecedent: belief in or exposure to COVID-19 misinformation	**Consequence**		
		Policy preferences for responding to the pandemic	Kreps and Kriner, 2020
		Compliance with official guidelines	Hameleers, van der Meer and Brosius, 2020
		Protective behaviour	Bursztyn et al., 2021
			Hornik et al., 2021
		Intentions to socially distance	Pummerer et al., 2021
		Drinking coffee to protect against COVID-19	Greene and Murphy, 2021
		Intentions to download contact-tracing app	Greene and Murphy, 2021
		Eat spicy food to fight COVID-19	Greene and Murphy, 2021
		Societal engagement related to pandemic	Pummerer et al., 2021 [1]
		Compliance with official guidelines	Banai, Banai and Mikloušić, 2020; Constantinou, Kagialis and Karekla, 2020; Freeman et al., 2020; Roozenbeek et al., 2020; Teovanović et al., 2020
		Protective behaviour	Sternisko et al., 2020
			Allington et al., 2020; Barua et al., 2020; Biddlestone, Green and Douglas, 2020; Jovančević and Milićević, 2020; Oleksy et al., 2021
			Alper, Bayrak and Yilmaz, 2020

		Intentions to socially distance	Bierwiaczonek, Kunst and Pich, 2020; Bridgman et al., 2020; Imhoff and Lamberty, 2020; Sternisko et al., 2020
		Support for COVID-19 public health policies	Earnshaw et al., 2020
		Self-centred prepping	Imhoff and Lamberty, 2020

([1]) The negative association holds only to some extent.

NB: The table shows whether belief in or exposure to COVID-19 misinformation (left), is associated (symbols), with specific consequences (middle), and references (right). 'Thumbs up' symbol: believing misinformation. 'Eye' symbol: exposure to misinformation. Green coloured upwards arrow: positive association. Blue coloured downwards arrow: negative association. Grey equal sign: no association.

Available evidence suggests that **exposure** to COVID-19 misinformation has undesirable consequences. Two studies showed that being exposed to COVID-19 misinformation had negative causal effects on **protective behaviour** and on **intentions to socially distance**. Additional evidence showed that exposure to misinformation on a contact-tracing app put people off considering **downloading the app**. However, the same study found no impact of misinformation claiming that **eating spicy food** could help combat COVID-19 on the desire to eat spicy food. In the same study, exposure to COVID-19 misinformation was found not only to reduce endorsement of effective preventive measures, but also to increase the adoption of ineffective behaviour. Specifically, exposure to misinformation on the healing effect of coffee led to more intended **coffee intake** to fight COVID-19. In essence, this study finds that two out of four fabricated news stories about COVID-19 affected how people intended to behave. While both statistically significant effects were minuscule at the individual level, they could be quite substantial if scaled up to a global level: when millions of people are exposed multiple times to misinformation, this can possibly increase its perceived truthfulness and convince a significant number of people (Pennycook, Cannon, and Rand, 2017).

Notably, one study did not find that belief in COVID-19 misinformation correlated with more or less protective behaviour ([15]). Another study even suggested that those being exposed to such misinformation were more likely to comply with official guidelines ([16]).

Two studies investigated the causal impacts of exposure to COVID-19 misinformation on **policy preferences** for responding to the pandemic, on **support for governmental regulations** and on people's **societal engagement** related to the pandemic. These studies did not find an effect of misinformation exposure on policy preferences but detected negative effects on support for governmental regulations and societal engagement.

More studies investigate the associations between **belief** in COVID-19 misinformation and behaviour than investigate the associations between **exposure** to COVID-19 misinformation and behaviour. Most of these studies provide relatively clear evidence. They suggest that belief in COVID-19 misinformation predicts lower rates of **compliance** with official guidelines, lower reported levels of intending to **socially distance** and less **protective behaviours**. Only two studies did not report an association between believing COVID-19 misinformation and intentions to comply with public health recommendations and protective behaviour more generally. Notably, one study found that belief in COVID-19 misinformation correlated positively with protective behaviour ([17]). Another study reported a positive association between belief in the conspiracy theory of COVID-19 being created by humans and **self-centred prepping** behaviour, including hoarding and relying on 'alternative' remedies. The overwhelming evidence leads to the conclusion that belief in misinformation

([15]) In more detail, the study showed that belief in misinformation was associated with less self-reported face mask wearing and social distancing, only if the respondent's beliefs regarding the consequences of these behaviours were not controlled for (Hornik et al., 2021). This indicates that what people believed regarding the effectiveness of protective behaviours better predicted their behaviour than belief in misinformation.

([16]) This finding illustrates that whether we are looking at believing or at being exposed to misinformation can make an important difference. Notably, the latter does not necessarily mean that people believe the misinformation they encounter. In this study, being exposed to misinformation might make people more vigilant of the possibly harmful effects of COVID-19. This could lead them to comply with official guidelines instead of unofficial and potentially misinformed guidelines.

([17]) The positive association was found between belief in deflection conspiracy theories (believing that the COVID-19 pandemic was created or spread by a powerful group of people) and handwashing (Sternisko et al., 2020).

regarding COVID-19 has negative consequences. Lastly, belief in COVID-19 misinformation has been associated with lower levels of **support for COVID-19 public health policies**.

8.2. Consequences for vaccination

Vaccination can be seen as a specific, and arguably central, preventive measure. Naturally, COVID-19 misinformation, in addition to having an impact on people's intentions to get vaccinated, can also have an impact on their attitudes towards vaccines. We reviewed the early literature on COVID-19 misinformation at a time when vaccines were still in the development phase. Nevertheless, there were already many investigations of the consequences of misinformation for vaccination. These investigations mostly looked at misinformation beliefs instead of exposure. The evidence is summarised in Table 11.

Table 11. Evidence on the consequences of belief in or exposure to COVID-19 misinformation for vaccination

Antecedent: belief in or exposure to COVID-19 misinformation		**Consequence**	
		Intentions to get COVID-19 vaccine	Loomba et al., 2021
			Greene and Murphy, 2021
		Intentions to get COVID-19 vaccine	Bertin, Nera and Delouvée, 2020; Earnshaw et al., 2020; Freeman et al., 2020; Jennings et al., 2021; Newman, Lewandowsky and Mayo, 2022; Roozenbeek et al., 2020; Soveri et al., 2021; Teovanović et al., 2020
		Willingness to recommend COVID-19 vaccine to vulnerable friends and family	Roozenbeek et al., 2020

NB: The table shows whether belief in or exposure to COVID-19 misinformation (left), is associated (symbols), with specific consequences (middle), and references (right). 'Thumbs up' symbol: believing misinformation. 'Eye' symbol: exposure to misinformation. Green coloured upwards arrow: positive association. Blue coloured downwards arrow: negative association. Grey equal sign: no association.

Exposure to misinformation made people less likely to **intend to get vaccinated** according to one study ([18]). Another study found no significant relationship between the two.

Regarding the association between belief in COVID-19 misinformation and intentions to receive a COVID-19 vaccine, the evidence is clear. **Belief** in COVID-19 misinformation predicted **not intending to get vaccinated** against COVID-19. One study also found that the more respondents agreed with false statements about the coronavirus, the less willing they were to **recommend COVID-19 vaccines** to vulnerable friends and family.

8.3. Consequences for information search

COVID-19 misinformation can affect how and if people look for more information. Several misinformation narratives question the trustworthiness of information and their sources. This can lead those who are exposed to or believe it to look for confirming evidence. This can in turn create a vicious circle of misinformation. The evidence is summarised in Table 12.

([18]) Data from this randomised controlled trial in the United Kingdom and the United States (in September 2020) indicate that exposure to misinformation instead of factual information induced a decrease of around 6 percentage points in the number of respondents indicating that they would 'definitely' receive a COVID-19 vaccine, either to protect themselves or to protect others (Loomba et al., 2021).

Table 12. Evidence on the consequences of belief in or exposure to COVID-19 misinformation for information search

Antecedent: belief in or exposure to COVID-19 misinformation		Consequence	
		Perceived need for additional (accurate) information	Kim et al., 2020
		Internet searches for purchasing chloroquine and hydroxychloroquine	Liu et al., 2020
		Willingness to seek further information	Hameleers, van der Meer and Brosius, 2020
		Calls to the Regional Centre for Poison Control and Prevention	Chary et al., 2020

NB: The table shows whether belief in or exposure to COVID-19 misinformation (left), is associated (symbols), with specific consequences (middle), and references (right). 'Thumbs up' symbol: believing misinformation. 'Eye' symbol: exposure to misinformation. Green coloured upwards arrow: positive association. Blue coloured downwards arrow: negative association. Grey equal sign: no association.

Being **exposed** to COVID-19 misinformation has been associated with the perception that one is less in **need of additional accurate information**. The more respondents had encountered different COVID-19 misinformation claims, the more they avoided correct information. They then also tended to process information heuristically (i.e. quickly and superficially) rather than systematically (i.e. attentively and thoroughly). Notably, such associations between COVID-19 misinformation exposure/belief and information search exacerbate the problem. People who are exposed to COVID-19 misinformation and/or believe it are then, because of the way they (do not) search for additional information, more likely to be further exposed to other pieces of misinformation and less likely to be exposed to 'true' information.

However, exposure to COVID-19 misinformation was also associated with more **willingness to seek further information**. Exposure to certain misinformation narratives was also associated with more **internet searches** for purchasing chloroquine and hydroxychloroquine. These two unproven COVID-19 therapies were temporarily endorsed for their purported efficacy by public figures in the United States. This aligns with the finding that COVID-19 misinformation exposure has also been associated with more **calls to a US regional centre for poison control and prevention**. However, people called the centre due to only minor injuries, and these appeared to be mainly unintentional. This limits the conclusions with respect to the hypothesised link between misinformation and consequent deliberate attempts to use household cleaners as COVID-19 cures ([19]).

8.4. General consequences

We identified some consequences that were of a more general nature. They were not necessarily related to COVID-19. These describe attitudes towards and trust in institutions, governments, political leaders and whole countries. One piece of evidence regarding mental health and well-being is also included here. The evidence is summarised in Table 13.

([19]) The data from this study are not based on tweet content being coded as misinformation or as not. Rather, the study looks at the general set of related tweets and time frames in which misinformed narratives prevailed. In addition, use of the content is severely semantically limited. Irony, for example, could not be identified.

Table 13. Evidence on the consequences of belief in or exposure to COVID-19 misinformation for general factors

Antecedent: belief in or exposure to COVID-19 misinformation		**Consequence**	
		Institutional trust	Pummerer et al., 2021
		Support for governmental regulations	Pummerer et al., 2021
		Assessment of political leaders and the federal government	Kreps and Kriner, 2020
		Attitudes towards China	Kreps and Kriner, 2020
		Mental health and well-being	Chen et al., 2020

NB: The table shows whether belief in or exposure to COVID-19 misinformation (left), is associated (symbols), with specific consequences (middle), and references (right). 'Thumbs up' symbol: believing misinformation. 'Eye' symbol: exposure to misinformation. Green coloured upwards arrow: positive association. Blue coloured downwards arrow: negative association. Grey equal sign: no association.

One study that investigated the impact of **exposure** to COVID-19 misinformation found a negative impact on people's **institutional trust**. A second study detected no impact on people's **assessment of political leaders** and the federal government, and no effect on their **attitudes towards China**.

Lastly, there is also evidence that **belief** in COVID-19 misinformation is associated with poorer **mental health** and well-being.

Box 6. How the media can influence behaviour during a pandemic: an example from the United States

Bursztyn et al. (2021) argued that COVID-19 misinformation broadcast on mass media increased the number of COVID-19 cases and deaths in the United States. They examined the two most popular cable news programmes in the United States, both airing on Fox News. Both programmes are quite similar, but their COVID-19 communication contrasted sharply early on in the pandemic. One programme warned viewers about the serious threat posed by COVID-19. The other programme initially ignored the topic and later dismissed the risks and insisted that Democrats were using the virus as a political weapon to undermine then-President Donald Trump. By the end of March 2020, their stances converged. The audiences of the two programmes were assumed to be relatively similar. Thus, eventual differences in COVID-19-related behaviour of both audiences could be attributed to the distinct narratives expressed in the two programmes.

Below are some examples of narratives from the respective programmes (Bursztyn et al., 2021).

The 'downplaying' programme, *The Sean Hannity Show* (27 February 2020): 'And today, thankfully, zero people in the United States of America have died from the coronavirus. Zero. Now, let's put this in perspective. In 2017, 61,000 people in this country died from influenza, the flu. Common flu. Around 100 people die every single day from car wrecks.'

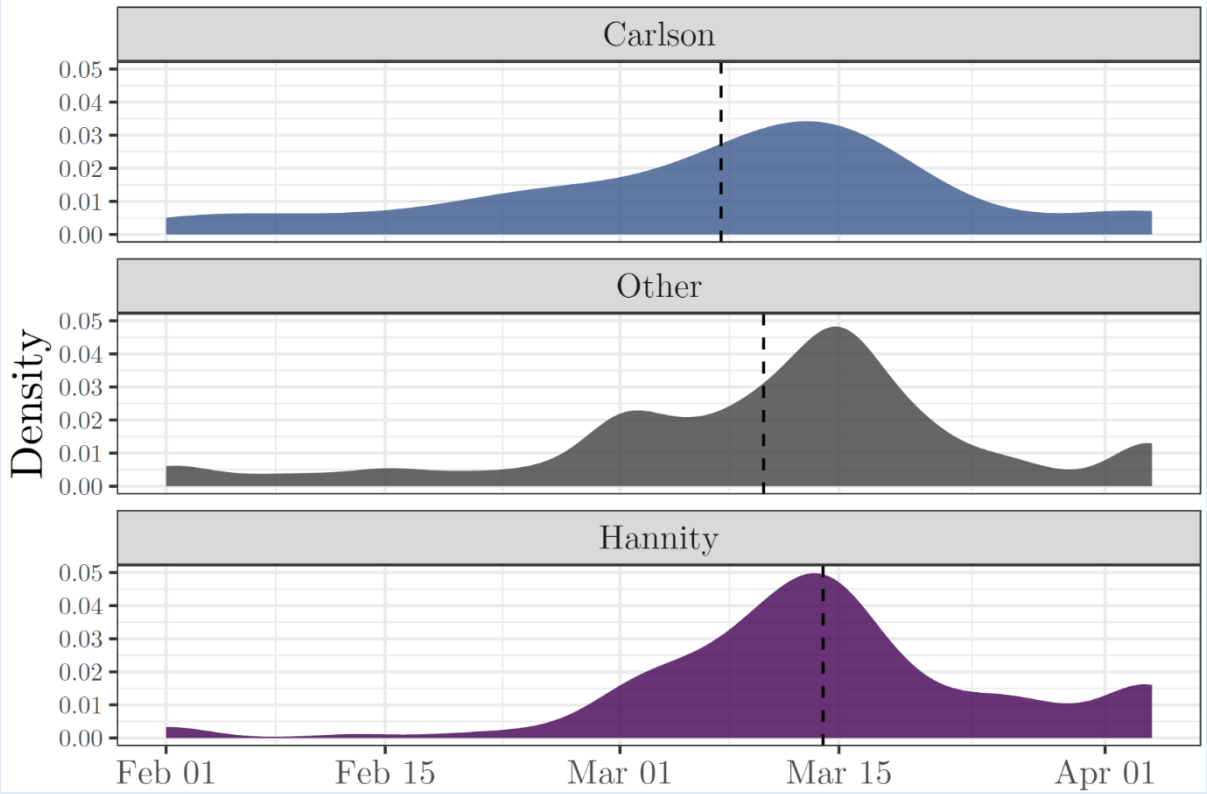
The 'warning' programme, *Tucker Carlson Tonight* (25 February 2020): 'Currently, the coronavirus appears to kill about two percent of the people who have it. [...] In this country, more than a million would die' ([20]).

In the study, 1 045 Fox News viewers aged 55 or older were surveyed. Viewers of the 'downplaying' programme ('Hannity' group) exhibited behaviour change in response to the risks posed by the coronavirus on average 4 days later than Fox News viewers who did not watch either of the two programmes: the latter group served

([20]) These quotations are taken from an earlier version of the paper by Bursztyn et al. (2021), titled *Misinformation During a Pandemic*.

as the control group ('other'). Viewers of the 'warning' programme ('Carlson' group) changed behaviour on average 3 days earlier than the 'other' group (Figure 10). Behavioural change, at this early stage of the pandemic, consisted of, for example, cancelling travel plans, practising social distancing or washing hands more often.

Figure 10. Densities of timing of behavioural change by programme viewership



NB: Dates are in 2020.
Source: Bursztyn et al. (2021).

These differences had significant consequences for health-related outcomes. Country-level data indicated that a greater US viewership of the 'downplaying' programme relative to the 'warning' programme was associated with a greater number of COVID-19 cases and a greater number of COVID-19-related deaths, both in early March 2020. More precisely, an increase of 1 standard deviation in the relative viewership of the 'downplaying' programme, relative to the 'warning' programme, led to roughly 34 % more cases on 14 March 2020 and roughly 24 % more COVID-19 deaths on 28 March 2020 (Bursztyn et al., 2021) ([21]).

([21]) Other research provides corroborating evidence of similar effects due to consumption of Fox News in the United States (Ash et al., 2020; Simonov et al., 2020).

9. Which behavioural interventions can tackle COVID-19 misinformation?

Takeaways

Interventions can be applied before ('prebunking'), during ('nudging') or after ('debunking') people are exposed to COVID-19 misinformation.

Educating people before exposure to COVID-19 misinformation (i.e. 'prebunking') may be effective. While there is not much COVID-19-specific evidence, broader evidence suggests these interventions are effective, especially in the longer term.

Some nudges, such as accuracy reminders, can make people more vigilant to misinformation and decrease its spread.

Debunks are important, especially when falsities have been identified and can be replaced with facts.

If there is information, there will probably also be misinformation. The primary goal is to make the latter spread less far and less fast (Ball and Maxmen, 2020). Several studies have investigated behavioural interventions designed to reduce the impact and spread of misinformation. Overall, we note that there is not as much information on interventions to fight COVID-19 misinformation as there is on antecedents. This is probably to do with the fact that experimental studies are needed to evaluate the effectiveness of interventions. Most often, such experiments take more time to be implemented than surveys probing for antecedents of COVID-19 misinformation. Notably, however, there is quite a lot of evidence on the effectiveness of these interventions in mitigating non-COVID-19 misinformation (i.e. prebunks (Basol, Roozenbeek, and van der Linden, 2020; Cook, Lewandowsky, and Ecker, 2017; Lewandowsky and van der Linden, 2021; Maertens et al., 2020; Roozenbeek and van der Linden, 2019; van der Linden, Leiserowitz, et al., 2017; van der Linden, Maibach, et al., 2017; Williams and Bond, 2020), nudges (Bago, Rand, and Pennycook, 2020; Jahanbakhsh et al., 2021; Nekmat, 2020; Pennycook et al., 2020b; Pennycook et al., 2021; Tsipursky, Votta, and Roose, 2018), and debunks (Chan et al., 2017; Walter et al., 2020; Walter and Murphy, 2018).

In February 2020, Dr Mike Ryan, Executive Director of WHO's Health Emergencies Programme, said that 'we need a vaccine against misinformation' (WHO, 2020). This vaccine analogy suggests that the public needs to be empowered to adequately deal with pieces of misinformation. Empowering people to identify and shield themselves against misinformation is also a major goal of the European Commission in its response to misinformation, including that on COVID-19 (European Commission, 2020). We label interventions that empower people to better detect, process, comprehend or correct misinformation as 'behavioural interventions'. Behavioural interventions against COVID-19 misinformation improve societal resilience – that is, our capacity as a social system to function in the face of an external shock, such as misinformation ([22]).

In general, we differentiate between three types of behavioural interventions to counter misinformation (Figure 11). We differentiate them with respect to when they are most often applied. However, it is important to acknowledge that there are other ways to differentiate these interventions, and that the boundaries are not always clear.

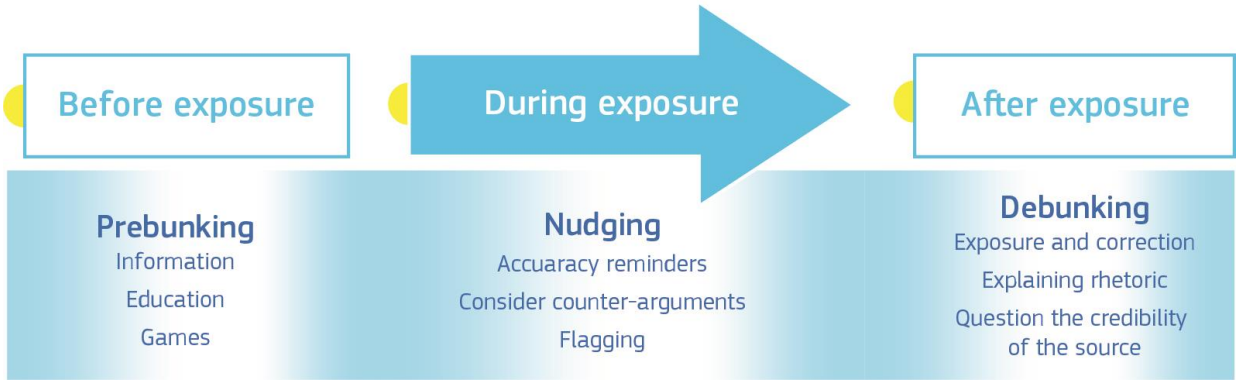
([22]) Several types of interventions to fight misinformation are outlined in the European Commission's action plan on disinformation (European Commission, 2020). These include (1) improving the capabilities of institutions to detect, analyse and expose disinformation; (2) setting up alert systems for governments to identify and coordinate responses to disinformation campaigns in real time; (3) mobilising online platforms to combat the spread of misinformation through codes of conduct; and (4) improving societal resilience. Technical means, such as algorithms, can identify misinformation and help governments and online platforms to prevent its spread.

The following list provides a brief description of each intervention.

- **Prebunking** consists of educating people to better detect misinformation **before they are exposed to it**. This can happen through a forewarning that misinformation might follow, or a pre-emptive refutation of arguments supporting misinformation. One common form of prebunking is **psychological inoculation**. This technique consists of exposing people to weakened misinformation stimuli to build up their resistance to misinformation (van der Linden, Roozenbeek, and Compton, 2020). We include education interventions in the prebunking section below, although they can be more general than prebunking.
- **Nudging** affects behaviour, frequently by changing the decision context without significantly changing incentives or forbidding options (Thaler and Sunstein, 2008). In the present context, nudges additionally refer to interventions that take effect **during** or **immediately before exposure**. Types of nudges include messages that encourage people to read a piece of information or to take accuracy into account before deciding whether to share it.
- **Debunking** strives to correct beliefs in misinformation by establishing that a prior message was misinformation (Chan et al., 2017). This happens **after** people have been exposed to misinformation. Debunking messages should follow a certain structure and include supporting content in addition to the facts (Lewandowsky et al., 2012).

We present the evidence on interventions against COVID-19 misinformation below. Compared with the evidence presented above, we provide more background information on the methodology used. This is because these studies predominantly use experimental methods. Compared with surveys, which underlie the findings presented above, it is more important to understand the design of an experiment to correctly interpret and weigh the findings it produced.

Figure 11. Behavioural interventions to address misinformation by timing with respect to exposure to misinformation



Source: Created by the authors.

9.1. Prebunking

Increasingly, actions against misinformation include education and empowerment campaigns that 'prebunk' people against it ([23]). These pre-emptive strategies address misinformation before people encounter it. They are often linked to the broader concept of media literacy. Psychological inoculation or prebunking warns people of the potential existence of misinformation, refutes flawed arguments in advance or exposes the flawed strategies employed in misinformation (Cook, Lewandowsky, and Ecker, 2017; Roozenbeek and van der Linden, 2019; van der Linden, Leiserowitz, et al., 2017). For instance, misinformation frequently argues that scientists support a (false) claim, without stating that these scientists clearly form a minority. This is a deceitful strategy commonly employed by misinformation spreaders. Exposing people to examples of such strategies and educating them about them has been found to neutralise the persuasiveness and believability of this misinformation technique (Cook, Lewandowsky, and Ecker, 2017). Importantly, prebunking takes a preventive

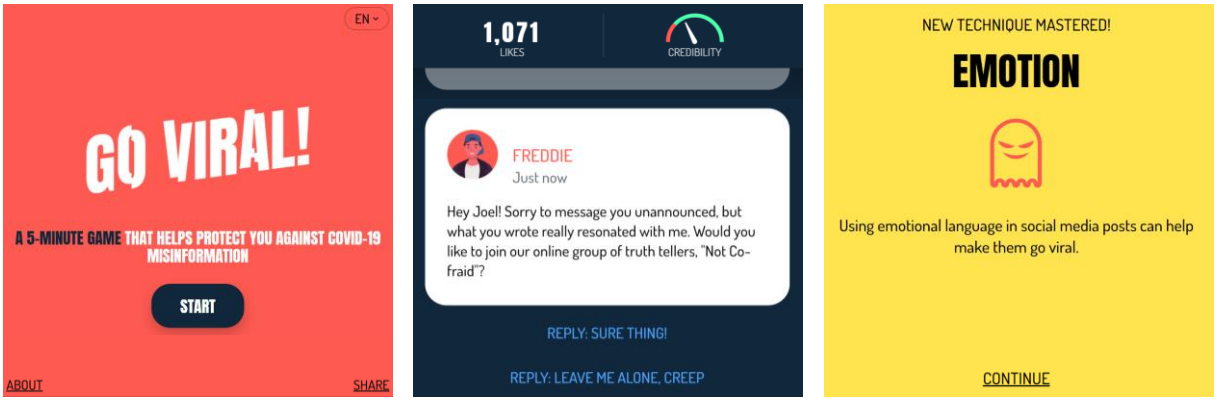
([23]) Prebunking interventions could be considered 'boosts', which are defined as behavioural interventions that target competences rather than immediate behaviour (Grüne-Yanoff and Hertwig, 2016).

approach and does not necessarily rely on a third party deciding which information is false or misleading and which is not. Rather, it increases people's capabilities of making this decision themselves ([24]).

There have been a few articles discussing the potential of prebunking against COVID-19 misinformation. Early in the pandemic, the potential of psychological inoculation (van der Linden, Roozenbeek, and Compton, 2020) and of 'literacy support tweetorials' (Graham, 2020) to confer psychological resistance against COVID-19 misinformation circulating in the media was discussed.

Some empirical studies provided evidence for the potential of prebunking and psychological inoculation to reduce misinformation belief in the context of the pandemic. *Go Viral* (Figure 12) is a game designed to expose participants to three main manipulation techniques used in relation to COVID-19 misinformation (fearmongering, reference to fake experts and spreading conspiracy theories). It was shown that playing this game increased people's perceptions of the manipulativeness of COVID-19 misinformation, and their confidence in their perceptions. It also reduced people's intentions to share COVID-19 misinformation to some extent (Basol et al., 2021). Similar but smaller effects were detected after a more passive prebunking intervention, whereby people viewed a series of infographics designed with a similar purpose. While the effects of *Go Viral* appeared to last, the infographic effects started to fade after a week.

Figure 12. Screenshots from the *Go Viral* psychological inoculation game



Source: Created by the authors based on Basol et al. (2021).

Another study failed to detect prebunking effects on the impact of COVID-19 misinformation (Greene and Murphy, 2021). It found that warnings did not reduce the impact of misinformation on pandemic-related behavioural intentions. They investigated positively framed warnings that emphasised the social benefits of careful engagement. They also looked at negatively framed warnings emphasising the negative consequences of irresponsible online behaviour.

9.2. Nudging

Nudges systematically affect behaviour, frequently by changing the decision context without significantly changing incentives or forbidding options (Thaler and Sunstein, 2008). For example, nudges do not prevent anyone from sharing (mis)information, nor do they provide monetary incentives for sharing only true information. Instead, nudges frequently change the context in which a decision takes place, and provide people with simple and actionable information. To be effective, they build on insights into how people usually make decisions, about the cognitive shortcuts they use and about the mistakes they make. Some nudges, such as pledges (Tsipursky, Votta, and Roose, 2018), deliberation prompts (Bago, Rand, and Pennycook, 2020) and accuracy reminders (Pennycook et al., 2021), have been shown to reduce people's willingness to read and share misinformation beyond the specific context of COVID-19. For example, asking people if they want to read a piece of information, thereby prompting people to actually read it before sharing it, can be considered a nudge (Nolan and Kimball, 2020).

([24]) Note that the criteria for classifying an intervention as prebunking are rather narrow. We include evidence on prebunking interventions only if they directly refer to misinformation and how to deal with it. Notably, we do not include evidence on interventions that (1) aim to persuade people to believe true information regarding COVID-19 (e.g., Egan et al., 2021), (2) improve people's abilities in interpreting scientific information (e.g., Agley et al., 2021; van Stekelenburg et al., 2021), (3) look at other outcome variables related to belief in or sharing of COVID-19 misinformation (e.g., Vivion et al., 2022) or (4) correct misperceptions of exponential growth that could lead people to believe misinformation (Lammers, Crusius, and Gast, 2020). However, these interventions can still be important and effective in the overall attempt to reduce belief in or sharing of COVID-19 misinformation.

Prompting people to reflect on whether pieces of information they read are true or false is a typical nudge that has been tested in the context of COVID-19 misinformation. Pennycook et al. (2020b) measured the effect of such an 'accuracy reminder' nudge. This nudge primed people to reflect on the accuracy of information, before encountering COVID-19 misinformation (Figure 13). In the first study, they found that some people shared pieces of COVID-19 misinformation even though they recognised them as false after they had shared them. This suggested that people shared misinformation in part because they failed to think about whether what they were about to share was true or false. In the second study, the authors measured participants' willingness to share true and false information on social media. Prior to this 'sharing' task, half of the participants had to rate the accuracy of a headline unrelated to COVID-19. This was the accuracy nudge. Nudged participants were almost three times less likely to share COVID-19 misinformation.

Another study replicated the findings on accuracy reminders, and explored seven additional, similar ways to fight COVID-19 misinformation (Epstein et al., 2021). In addition to testing the intervention used by Pennycook et al. (2020b), this experiment tested (1) a longer version (including multiple accuracy reminders), (2) a version asking people how important they found it to share accurate information on social media, (3) an intervention providing digital literacy tips, (4) an intervention informing participants that over 80 % of past participants found accuracy considerations important, (5) an intervention informing participants that over 80 % of past participants, both Republicans and Democrats, found accuracy considerations important, (6) the tips and the norm under (5), and (7) an intervention combining (2) and (5). Notably, all interventions except for the norm interventions ((4) and (5)) were effective in increasing the quality of shared headlines.

Another nudge did not apper to be as effective. Participants in an online experimental survey were instructed to consider counterarguments against unfounded beliefs about COVID-19 (Erceg, Ružojčić, and Galić, 2020). Specifically, they were informed that psychological research showed that people were more accurate in their conclusions (about whether a claim was true or false) when they took the time to reflect on opposing arguments with respect to their current beliefs, before arriving at a final conclusion. This intervention did not successfully reduce misperceptions about COVID-19 misinformation, for instance regarding conspiracies and false treatments.

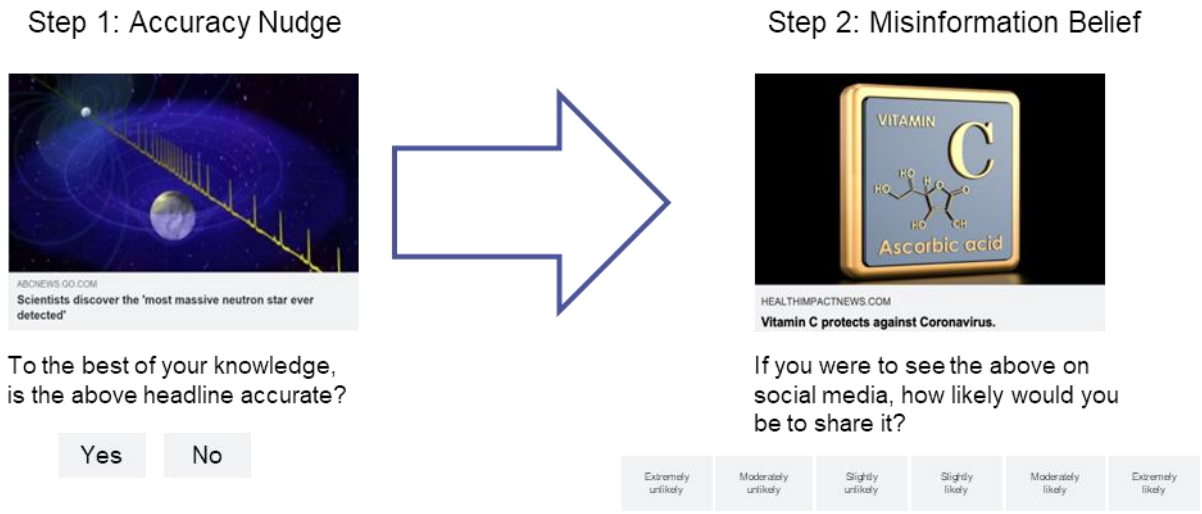
On Twitter, flagging tweets as coming from bot accounts (i.e. a program used to produce automated posts) and as misinformation is another type of nudge. In an experimental survey (Lanius, Weber, and MacKenzie, 2021), participants were asked to first judge the accuracy of the number of COVID-19 cases reported by the US federal government. They could judge them as accurate, lower than the actual number or higher than the actual number, or indicate that they were unsure. Experimenters then presented a tweet confirming these prior false beliefs of under-/over-reporting of COVID-19 cases by the US federal government to those who thought the reported number was inaccurate. Participants then rated various aspects of the tweet's credibility. To evaluate the effects of flagging, participants saw the tweet twice more, once with the bot-flagging ('Caution: Suspected Bot Account. Learn More.') and once with the misinformation-flagging ('Caution: Tweet contains misinformation about the novel coronavirus. Learn more.'). After each instance, they rated the tweet's credibility once more. The pattern of both types of flagging on the tweets' credibility was largely consistent. Flagging a tweet as coming from a bot reduced intentions to follow, retweet, like or rate as useful, trustworthy, etc. Flagging a tweet both as coming from a bot account and as misinformation further reduced these intentions. However, ratings remained identical for perceptions of the tweet as biased ([25]). In sum, this study offers encouraging insights on the potential of flagging as an intervention against misinformation. Flagging misinforming tweets can reduce their credibility even among people who initially believe the misinformation.

Kreps and Kriner (2020) tested the effectiveness of false information 'corrections' on people's accuracy assessments of false headlines and their intentions to share them on social media. These 'corrections' consisted of tagging a false headline with the text 'Fake News Headline Correction'. This text preceded the headline and included a red 'X' next to the headline. The authors found that the intervention was effective for only one of the three tested misinformation topics: the claim that the United States had the highest coronavirus death rate in the industrialised world. The claims for which this intervention was ineffective stated that a US Army laboratory created the coronavirus, and that essential oils were an effective treatment for COVID-19. The effect was stronger in reducing belief in the misinformation topic in which initial belief was quite high. The effects on less strongly held beliefs were very small. The authors also investigated the effect of corrections on whether people 'liked' the article or reported it to the social media platform. Here, the 'corrections' had the intended effects.

([25]) Importantly, the flags did not specify what aspect of the content was false. Consequently, respondents who changed their view on the case reports with respect to their initial beliefs did so in all directions. This was especially the case for people who were unsure from the start. For the other two groups, opinions changed both in the direction of the tweet they encountered and in the opposite direction (with proportions of people changing their views in response to the flags not exceeding 12 %) (Lanius, Weber, and MacKenzie, 2021).

They increased the fractions of respondents most likely to report the articles and reduced the fractions most likely to endorse them. This was the case for all three misinformation topics.

Figure 13. Sequence and example of an accuracy nudge



Source: Pennycook et al. (2020b).

9.3. Debunking

Many actions against misinformation rely on debunking false claims (Funke and Flamini, 2021). Debunking consists of explaining that misinformation is false after people have been exposed to it. The debunking strategy uses credible information from trustworthy sources to refute false information and to replace it with facts (Lewandowsky, Cook, and Lombardi, 2020).

Specifically, debunking strategies can include one or more of the following elements (Schmid and Betsch, 2019; Walter and Murphy, 2018).

- Exposing and correcting false content.
- Explaining the rhetoric of misinformation.
- Questioning the credibility of the source of misinformation.

Debunking is especially important when a fast response to misinformation is needed. For example, Donald Trump's public pondering about injecting 'disinfectant' as a treatment for COVID-19 was quickly debunked by health specialists and doctors (Clark, 2020). Notably, debunking requires that people have already been exposed to misinformation. It also relies on a clear classification of information as false or misleading. Most studies that test interventions against COVID-19 misinformation rely on some form of debunking.

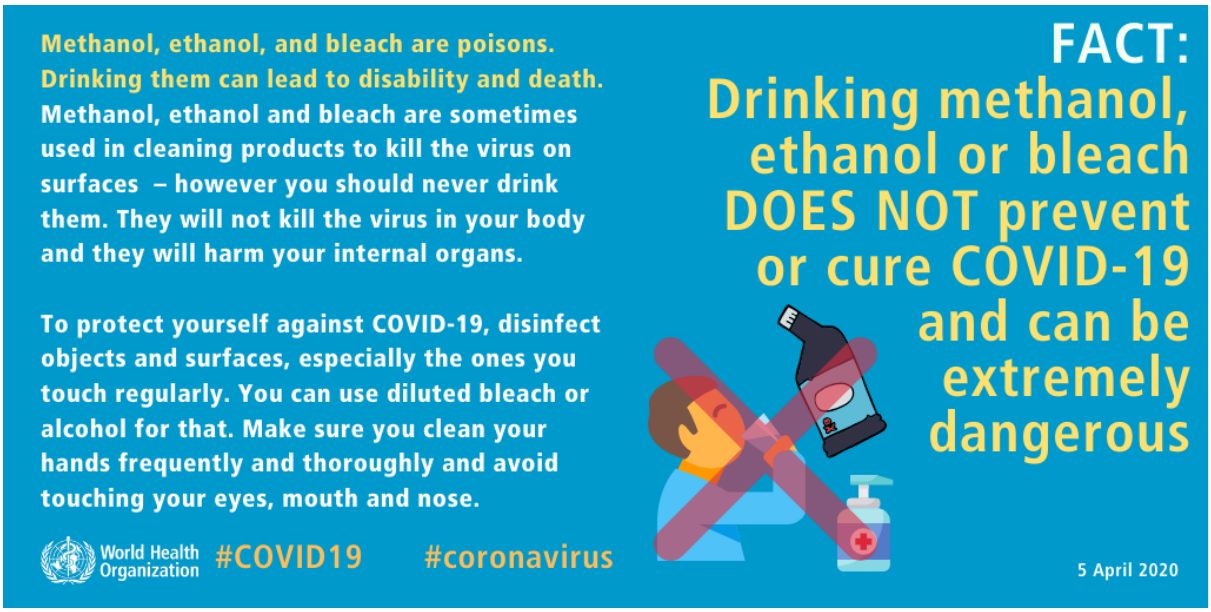
One experiment found that both a basic debunk and an enhanced debunk reduced belief in misinformation concerning an alleged COVID-19 cure: vitamin E supplements (MacFarlane et al., 2021). The basic debunk highlighted the lack of evidence in support of the misinformation that participants were previously exposed to. The enhanced debunk pointed towards the techniques associated with the misinformation, highlighted the trustworthiness of the debunking source, etc. Both debunks were effective in reducing participants' intentions to seek the treatment, and to like and share the misinformation. However, the enhanced debunk was most effective. Likewise, Yousuf et al. (2021) found that debunking (provided in the form of videos presenting authoritative scientific sources such as scientists and government officials) reduced vaccine-related misperceptions among elderly Dutch participants, possibly by increasing trust in the government.

Debunking through WhatsApp text messages has been investigated as a means of combatting COVID-19 misinformation in a field experiment in Zimbabwe (Bowles, Larreguy, and Liu, 2020). Participants received a text message providing accurate information on COVID-19 in week 1, and another text message debunking a viral piece of COVID-19 misinformation on alleged cures in week 2. Around 27 000 individuals received the messages. Of these individuals, 868 filled out a survey afterwards. The survey revealed that debunking improved knowledge of and adherence to guidelines on COVID-19 mitigation. In another study, WhatsApp debunks led to back-fire effects. Older people in the United Kingdom often appeared to believe that garlic cured

COVID-19 more after receiving the debunking intervention. The debunking still had a desired effect regarding misinformation as it reduced people's intentions to share it (Vijaykumar et al., 2021). Such back-fire effects could be attributed to the repetition of false claims while debunking them. Repeating a claim makes it more familiar, and familiar information is generally perceived as more truthful than novel information (this is called the illusory truth effect). Notably, the evidence on such an effect from debunking is scarce. Repeating a myth within a debunk is generally found to be safe in many circumstances (Lewandowsky, Cook, and Lombardi, 2020). The evidence here suggests, however, that elderly people might be prone to the illusory truth effect.

Another study tested whether a WHO infographic was effective in either debunking or prebunking against the misperception that hot baths can prevent COVID-19 (Vraga and Bode, 2021). Figure 14 shows a similar debunk from WHO. The infographic was presented either before or after the piece of misinformation. Both exposures reduced the erroneous belief that hot baths can significantly increase body temperature. This effect persisted after a week. However, it did not reduce the misperception around COVID-19 (i.e. that hot baths can prevent COVID-19).

Figure 14. WHO myth-buster graphic similar to those used by Vraga and Bode (2021)



Source: WHO (2022).

Concerning the long-term effects of debunking messages, a multiwave experiment run in Canada, the United Kingdom and the United States found that debunking (in the form of fact-checks) reduced misperceptions around COVID-19. However, these effects had completely disappeared a few weeks later (Carey et al., 2022).

One study set out to compare the long-term efficacy of tags appearing before (similar to prebunking), after (similar to debunking) or while people read headlines (Brashier et al., 2021). The authors showed participants true and false headlines under four conditions. Under one condition, participants did not receive any information about the headlines' truthfulness, while under the three other conditions participants saw 'true' and 'false' tags before, after or while reading the headlines. The authors tested participants' perceived credibility of the headlines 1 week later. They found that debunking and contemporaneous tags decreased belief in fake news relative to the control or prebunking group, which in turn did not differ from the control condition. When looking at the ability to discern true from false headlines, the debunking intervention was more effective than either of the other interventions, thus suggesting that debunking may be more effective in the long run.

The above studies suggest that debunking and prebunking may be promising solutions to COVID-19 misperception. However, a meta-analysis including some studies that were reviewed here found that the average effect of these interventions was not significant. It also found evidence of publication bias (Janmohamed et al., 2021). The latter evidence suggests that studies that found no evidence supporting the interventions tended not to be published in scientific journals. According to this meta-analysis, interventions against COVID-19 misinformation tended to be more effective if they were in a textual format (as opposed to other formats) and if they targeted issues in which people were highly engaged. This shows that issues people care about are more likely to benefit from interventions. This is probably because people tend to update their knowledge of issues more when they care about them.

Box 7. Optimal design of debunks

Scientifically informed debunking incorporates knowledge of the individual cognitive processes involved when people evaluate misinformation (Ecker et al., 2022; Lewandowsky et al., 2012). This knowledge has been condensed into practical advice on debunking misinformation in general (see Lewandowsky, Cook, and Lombardi, 2020) and specific to COVID-19 misinformation (see Lewandowsky et al., 2021).

Figure 15 is an example of debunking a misinformation article claiming that COVID-19 vaccines are dangerous. It puts emphasis on exposing common misinformation strategies that are being used in the misinformation article. It loosely follows the proposal offered in *The Debunking Handbook 2020* (Lewandowsky, Cook, and Lombardi, 2020). The handbook suggests that the components of effective debunks should be ordered in the following way:

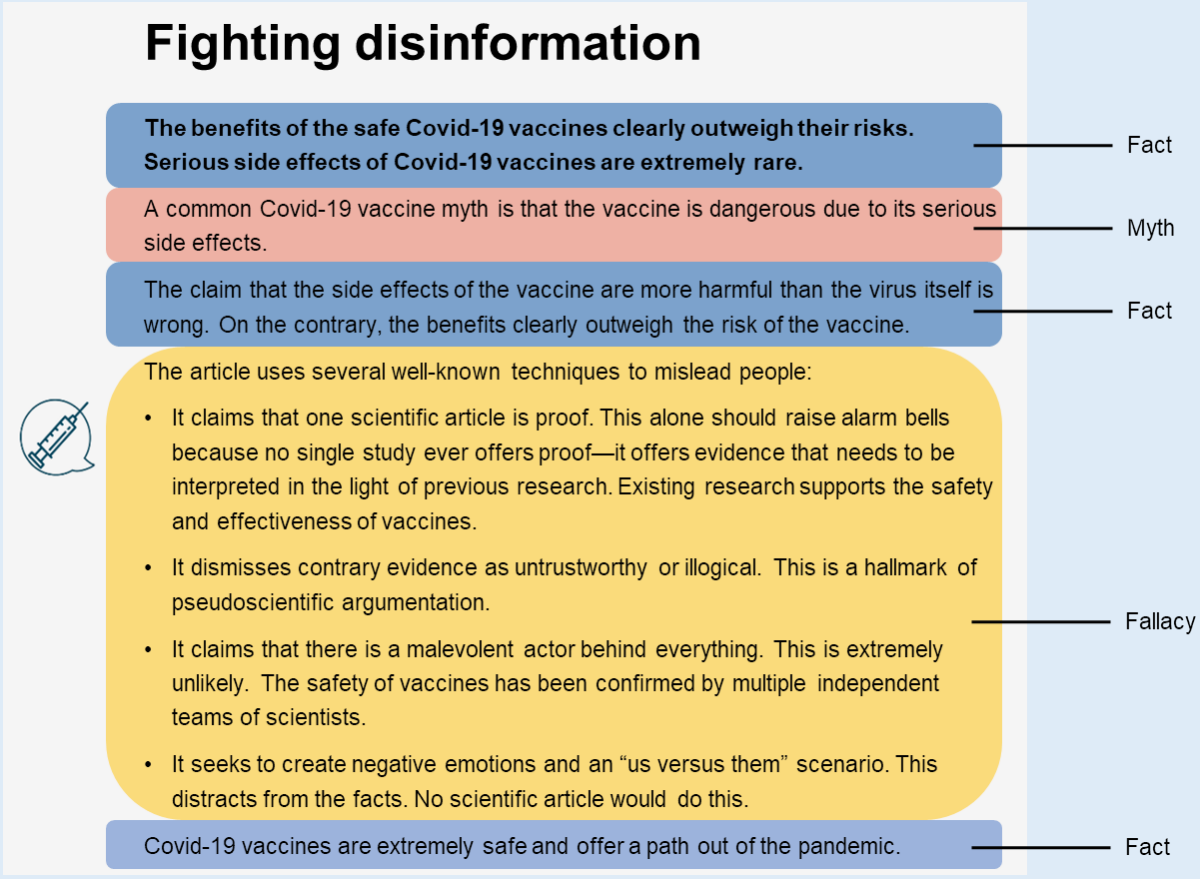
— statement of the fact,

— warning about the myth,

— explanation of the fallacy,

— statement of the fact.

Figure 15. Optimal debunk of COVID-19 misinformation



Source: Created by the authors.

9.4. Choosing the right intervention

There are three main types of interventions against COVID-19 misinformation. The evidence in support of their effectiveness is not always straightforward and easily comparable. Moreover, there is not yet that much evidence that we could include here. This may make it difficult to use this information in order to choose the best intervention.

There are good reasons to expect that interventions that have been tested and shown to be effective for other misinformation narratives (e.g. on climate change or vaccination) should also work for COVID-19

misinformation. While context-specific evidence is desirable, testing interventions in different contexts is costly (time, money). To some extent, findings from experiments can be generalised to other contexts. If there are no convincing reasons for us to believe that aspects of COVID-19 misinformation that differ from those of other misinformation narratives reduce the effectiveness of any of the interventions, we can assume that these interventions work for COVID-19 misinformation as much as they do for other types of misinformation. Especially at the beginning of a situation that spawns misinformation, it might be advisable to rely on previously evaluated interventions, even if they have been tested in slightly different contexts. This would frequently be more advisable than waiting for new evidence, which, as we outlined above, might take some time. Systematic literature reviews and meta-analyses can be especially important for making an informed assessment of how probable effects translate to different contexts.

As revealed by the volume of reviewed studies, debunking (i.e. refuting the misinformation after people have been exposed to it in some form or another) is the most studied intervention. One reason is that this intervention is more targeted than nudging or prebunking. However, debunking mostly does not lead to increased resilience against misinformation. The reason is the same, namely that debunking focuses on specific misinformation narratives or topics. Therefore, it lacks a central advantage of prebunking and nudges, namely that they increase resilience against various forms and topics of misinformation.

An advantage of increasing resilience against misinformation by prebunking or nudging is that such interventions are not restricted to any specific topic of misinformation. Besides, prebunking and nudging do not rely so much on a prior decision on what is misinformation and what is not. Thus, prebunking and nudging can be viewed to some extent as less prescriptive. Their advantages can be especially important in situations such as the COVID-19 pandemic. Especially at the beginning of the pandemic, information validity, harmfulness and falsity were not always clear-cut and assessable. During a new pandemic, emerging but unverified information might constitute invaluable informational trends (Larson, 2020). However, the benefits of spotting such trends should more than offset the looming danger of people not being able to assess the credibility of this information.

All three interventions have their advantages and disadvantages. The best solution to COVID-19 misinformation, and to health misinformation in general, will probably rely on a clever combination of all three types (Roozenbeek and van der Linden, 2022). In the future, research on the effect of combinations of these interventions will be helpful for holistic policy approaches to misinformation.

10. Policy messages

The COVID-19 pandemic struck globally in early 2020. Everyday conversations, the internet, social media, newspapers, television programmes and public discourse were soon flooded with misinformation related to COVID-19.

The early months of the pandemic were characterised by a high degree of uncertainty and a lack of clear information. At the same time, scientists from various disciplines, including the behavioural sciences (see, e.g., Lunn et al., 2020; van Bavel et al., 2020), adapted quite swiftly to a sudden need for scientific insights.

The goal of this report was to take stock of the early research on COVID-19 misinformation, focusing particularly on findings from the behavioural sciences. In doing so, we hoped to provide lessons to help policymakers become better prepared for future waves of misinformation that will inevitably accompany future crises. In this section, we draw overarching policy messages from the findings presented in the previous sections. We connect the dots between the different sections of the report to present a more integrated view of what is required for policymaking to address misinformation.

Policy Message 1: research on COVID-19 misinformation can inform responses to future crises

The COVID-19 pandemic and the associated infodemic were very peculiar.

There was a lot of **uncertainty** at the beginning of the pandemic. This uncertainty was both scientific and political (i.e. related to the most appropriate response to COVID-19) (see Section 4). This uncertainty during the initial stages of the COVID-19 pandemic contrasts with the scientific consensus on many other topics on which misinformation circulates. Two examples are **climate change** and **vaccination**. The scientific evidence regarding climate change is largely unequivocal (Cook et al., 2016; Powell, 2019) and the benefits of vaccination are well documented (Berman, 2020).

During the pandemic, people have been able to **assess first-hand the falsity of misinformation**. For instance, many people knew someone who was hospitalised, or even someone who died, due to COVID-19. To some extent, this experience undermined false claims that COVID-19 was merely akin to the flu. In contrast, people do not always have a first-hand experience of other topics of misinformation. For instance, personally experiencing global warming is more difficult since it is a relatively slow process. Similarly, for most people it is almost impossible to check individual pieces of misinformation regarding the Russian invasion of Ukraine that started at the end of February 2022 unless they have witnessed the events under discussion first-hand.

However, there are also **similarities between COVID-19 misinformation and other topics of misinformation**.

Many of the identified **antecedents** of COVID-19 misinformation (presented in Section 5) also drive people's beliefs in and sharing of other false narratives. For instance, thinking intuitively instead of being reflective predicts the sharing of misinformation narratives not only about COVID-19, but also on other topics (Pennycook and Rand, 2021). Similarly, political ideology determines people's likelihood of believing both COVID-19 misinformation and climate change misinformation (McCright, Dunlap, and Marquart-Pyatt, 2016). Ethnocentrism is a strong predictor of believing COVID-19 misinformation, but also of negative **attitudes regarding immigration and refugees** (Hainmueller and Hopkins, 2014). Being inattentive makes people particularly likely to unwittingly share both COVID-19 misinformation and misinformation about other topics (Pennycook and Rand, 2021).

Numerous **policy interventions** that worked for COVID-19 misinformation can also be effective irrespective of the misinformation topic. For example, accuracy reminders (i.e. asking people to evaluate the accuracy of a misinformation headline) have been found to be effective in curbing sharing of misinformation about COVID-19 and misinformation on other topics (Pennycook et al., 2020b, 2021). Educating people about COVID-19 misinformation, for instance by having them play a game presenting the manipulative techniques associated with such misinformation, can lead them to be more suspicious of false narratives beyond COVID-19, since these frequently use the same techniques.

All in all, we believe that **we do have lessons to draw from research on COVID-19 misinformation for the challenges posed by misinformation beyond this crisis**. Lessons learned from COVID-19 are probably more relevant for misinformation about similar events – that is, events occurring suddenly, developing rapidly, with a lot of uncertainty, and threatening health or security. These include, for instance, other pandemics, but perhaps also armed conflicts and sudden influxes of refugees.

Policy Message 2: all policymakers should worry about misinformation

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COVID-19 misinformation did not only concern health.

Many topics of COVID-19 misinformation concerned non-health issues (see Section 1). They also revolved around political issues, such as governmental action and geopolitical responsibilities and social issues, including false narratives about certain minorities. Many of the COVID-19 misinformation built on, and modified, pre-existing misinformation and conspiracy theories that did not concern health. For instance, false stories claimed a 'new world order' or the roll-out of 5G was behind the coronavirus.

The consequences of COVID-19 misinformation went beyond health. As outlined in Section 8, in certain countries, people who were exposed to COVID-19 misinformation were more likely to distrust institutions and to oppose governmental regulations in general. Furthermore, exposure to COVID-19 misinformation affected how and to what extent people looked for further information, including information unrelated to COVID-19. This had the potential to cause a vicious circle, with initial exposure to misinformation about a certain topic leading to more exposure to misinformation in other domains. To our knowledge, there is no research causally connecting COVID-19 misinformation to social unrest. However, it is sensible to assume that those who destroyed 5G masts and those who participated in demonstrations against COVID-19 vaccines believed COVID-19 misinformation. For example, there is evidence of a positive correlation between conspiracy thinking and willingness to participate in demonstrations in Germany (COSMO, 2022).

These interwoven topics and consequences show that tackling misinformation about a specific policy area (e.g. COVID-19 vaccination) should not be a concern of only policymakers working in that specific field (e.g. public health). In the case of COVID-19 misinformation, addressing this issue has also been important for maintaining social cohesion and democracy.

Policy Message 3: misinformation and its antecedents should be monitored

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Monitoring misinformation requires a threefold approach.

First, once misinformation is out there, it is important to **measure its prevalence**, for three reasons: (1) to assess the severity of the problem, (2) to identify the topics that are gaining the most currency and (3) to ultimately target policy interventions on these most endorsed topics of misinformation. One way to assess misinformation prevalence is to **ask people how often they think they have encountered misinformation**. Another possibility is to scan information about a particular topic and **measure the actual prevalence of misinformation** about this topic. Scientists used both methods to quantify COVID-19 misinformation (see Section 4). However, measuring the prevalence of misinformation is challenging, in part because of social media platforms' data-sharing policies. Policymakers should therefore seek more transparent data on misinformation prevalence from social media platforms (see Box 3).

Second, **measuring the extent to which people believe misinformation** is another approach to assess the situation. For instance, a lot of people believed, at some stage, that COVID-19 originated from intentional rather than accidental actions. A significant number of people also believed misinformation about the alleged dangers of COVID-19 vaccines (see Section 5). From a policy perspective, belief in misinformation is more worrying than its prevalence. For instance, if no one believes that drinking bleach will cure COVID-19, misinformation on this topic is less problematic. Thus, policymakers might make better-informed decisions if they had more data on people's level of belief in misinformation narratives. Future waves of the European Social Survey will include a module dedicated to obtaining these data (Gemenis and Littvay, 2020).

Finally, one needs to **monitor the antecedents** of belief in and sharing of misinformation. People's ethnocentrism, sense of control, social dominance orientation and trust in science and other institutions are all associated with belief in COVID-19 misinformation and belief in other false narratives (see Section 7). Policymakers can monitor these variables through regular surveys. Detecting an increase in these variables should alarm policymakers because this would mean that people are becoming even more vulnerable to misinformation. Such red flags can highlight the need to take appropriate preventive actions before misinformation appears.

Policy Message 4: the malleable antecedents of misinformation should be addressed

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Some antecedents can be tackled through adequate policy interventions.

Section 7 outlines the many factors influencing whether people are more or less likely to believe or share COVID-19 misinformation. Addressing these antecedents is a preventive rather than a curative approach, and can therefore be more promising than addressing misinformation itself.

For example, the tendency to engage in intuitive thinking is an antecedent associated with higher levels of belief in and share misinformation. Policy interventions can address this antecedent. Before people are exposed to misinformation, interventions can aim to **increase people's capacities to engage in analytical thinking**, for instance through educational materials and games.

Other relatively 'malleable' antecedents of belief in or sharing of misinformation include, for example, trust in information shared on social media and numeracy. Education is key here to **teach people that social media is not always a trustworthy source of information**.

Crucially, distrust of government and institutions, a consistent predictor of vulnerability to misinformation, is another antecedent that policymakers could seek to decrease, for example by supporting a more transparent political decision-making process.

Other antecedents are less suitable for policy interventions. For instance, open-minded, honest and curious individuals are less likely to believe or share COVID-19 misinformation. Impulsive and fundamentalist religious individuals tend to do so more. Arguably, these antecedents are less suitable targets for policy interventions for practical or ethical reasons. Political ideology would not be a sensible target for change campaigns, especially for ethical reasons. Education in schools may be able to promote open-mindedness, honesty and curiosity, but this is a long-term process.

Policy Message 5: interventions should be targeted and/or tailored

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Targeting policy interventions towards the right groups seems fundamental.

Targeting policy interventions to people with extreme viewpoints is difficult. COVID-19 misinformation, like many other false narratives, often emerged in tightly knitted fringe groups. Members of such groups nurtured each other's defiance of official sources of information, leading to a vicious circle (see Section 6). Extremism was also found to be a good predictor of believing COVID-19 misinformation (see Section 7). Examples of such extremist views that are clearly connected to believing COVID-19 misinformation include religious fundamentalism, far-right political ideology, support for xenophobic policies and denialism. Policy interventions will have the greatest difficulties tackling belief in misinformation among people belonging to these groups.

In contrast, **targeting policy interventions to the 'hesitant people' seems worthwhile**. These people neither systematically believe nor reject misinformation. They are likely to believe relatively plausible narratives, but not fringe misinformation. Evidence from the COVID-19 infodemic (see Section 6) shows that, frequently, these middle-ground hesitant people were unfortunately sometimes connected to those fringe groups with extreme views that were at the root of COVID-19 misinformation. Targeting misinformation-countering policy interventions precisely to those who are hesitant is likely to pay off, because they are vulnerable yet doubtful.

Tailoring interventions – that is, adapting them to the target audience – might also be a good strategy. For example, debunking interventions (i.e. messages that refute the false claims in misinformation) can use different messengers for different target groups according to the institutions that people trust. Research has already shown that messages to convince people to get vaccinated are more effective when tailored to people's characteristics (Lunz Trujillo et al., 2021). More intuitive (instead of deliberative) people could benefit more from accuracy nudges. More reflective people might be more willing to engage in and consider the information provided in properly designed debunks.

Finally, **peddlers of misinformation speak the language of those they are trying to convince**. **Likewise, they target those who they think they can convince. Interventions can do the same.** To some extent, misinformation draws on people's limited attention span and their responsiveness to emotional content. Governments countering misinformation could in principle do so as well. They could adapt debunking campaigns to people's limited attention and their responsiveness to emotional content. This could make debunks more effective. For example, debunks could be designed in a simple and emotionally appealing way, in which case they would be less easily dismissed by those they are trying to reach.

Policy Message 6: different types of interventions should be combined

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In Section 9, **we outlined prebunks, nudges and debunks that policymakers can use to address misinformation**.

Prebunking interventions educate people. They pre-emptively refute misinformation or psychologically 'inoculate' people by exposing them to weakened doses of misinformation. An example is the *Go Viral* game, which exposes users to common strategies and narratives of misinformation (Basol et al., 2021). The European Commission has made efforts to educate people against misinformation. The EU digital competence framework includes the competence 'Information and data literacy', which learners should acquire. This competence aims to help learners 'detect the credibility and reliability of common sources of data, information and their digital content' (European Commission, 2016).

Nudges change the context in which people see misinformation without forbidding or financially encouraging or discouraging any behaviour. For example, accuracy reminders implicitly remind people of the importance of accuracy by asking them to rate the accuracy of an article, with the aim of encouraging them to do so before deciding whether to share other articles (Pennycook et al., 2020b).

Debunks correct misinformation and frequently also the techniques associated with it and the underlying sources. For example, both WHO (Vraga and Bode, 2021) and the European Commission (European Commission, 2022) debunk misinformation online.

Many of these **interventions can be combined**. Empowering people to spot misinformation using prebunks, designing contexts in which people consume information such that they are vigilant and attentive to falsities using nudges, and debunking already identified misinformation narratives can go hand in hand. All of this combined creates an information consumption environment that is conducive to the proliferation of truth and facts.

11. Limitations of this literature review

For readers to make the most of this literature review, it is important to acknowledge its limitations. We highlight some of them here.

First, the included literature is not restricted to evidence from the EU. Throughout the report, we highlighted situations in which findings appeared to be context-sensitive. On some occasions, findings appeared to be sensitive to the geographical context. Specifically, this means that findings from one country do not necessarily hold for other countries.

Second, the literature we included is not exhaustive. We focused primarily on the early literature on COVID-19 misinformation. Some of this literature is not yet peer reviewed. Some findings specific to the COVID-19 context are consistent with prior findings from different contexts. However, some evidence needs to be replicated in order to be completely convincing.

Third, our categorisations of the antecedents, consequences and interventions are subjective. Their primary purpose was to guide the reader throughout this report. The purpose was not to suggest a theoretically grounded categorisation.

Finally, much of the evidence presented here is correlational. In some cases, more than in others, readers should abstain from making causal inferences. We also highlighted the implications with respect to the categorisations of antecedents and consequences in Box 5. The shortcomings of correlational evidence should not be underestimated. Many of the antecedents of COVID-19 misinformation are related, which makes it impossible for observational studies to disentangle their impacts. Without experiments or quasi-experiments, it is very hard to understand the reasons for COVID-19 misinformation and to create solutions for such misinformation.

12. Summary and conclusions

This review provided an account of the early literature on COVID-19 misinformation, mainly from the behavioural sciences. Its **goal was to take stock of these findings and to make sense of them in terms of policy implications**. Doing so can help policymakers prepare for future waves of misinformation that are likely to accompany new crises.

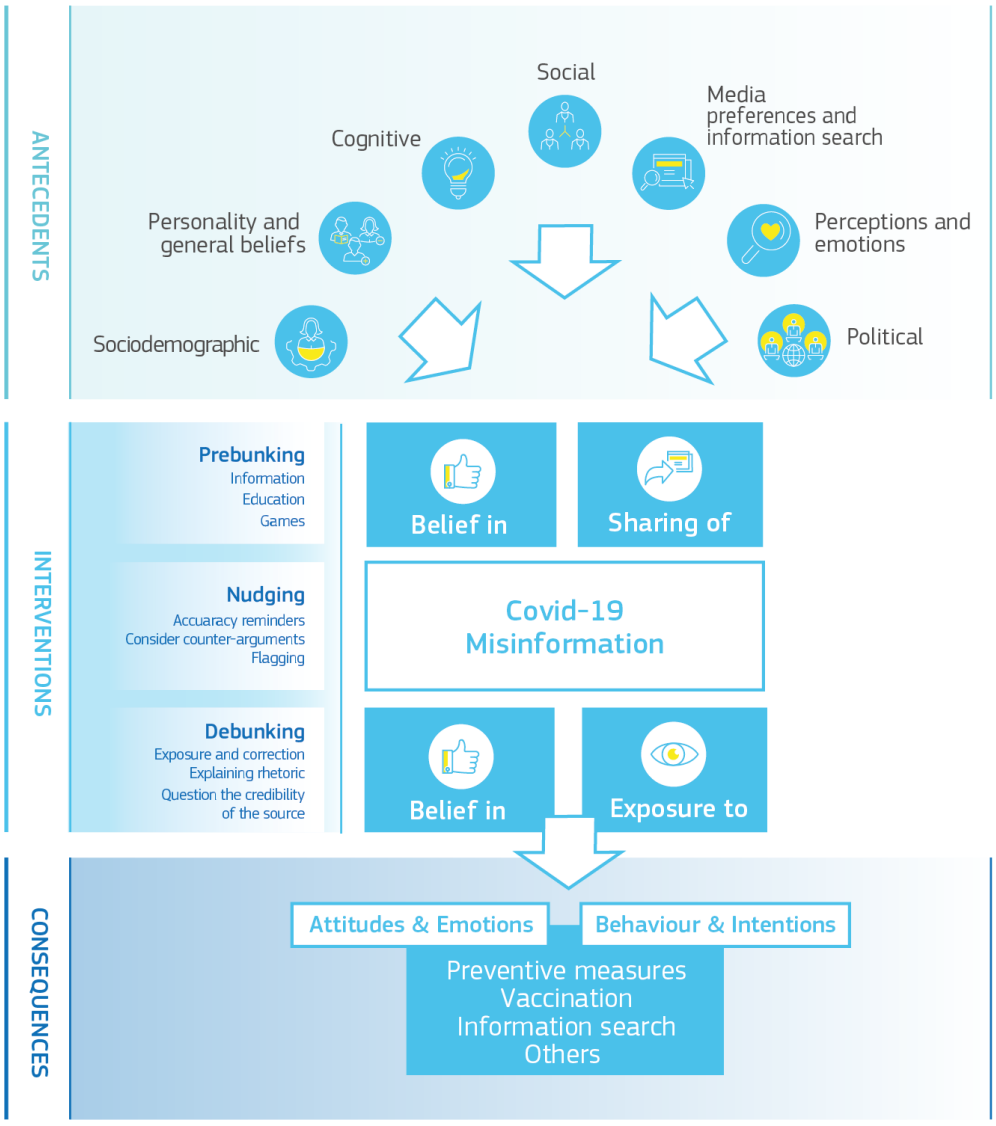
We focused first on the antecedents. Some people are more likely than others to believe COVID-19 misinformation, or misinformation more generally. Knowledge about these antecedents is important to design effective policies to limit their stickiness, prevalence and spread.

Understanding the consequences of COVID-19 misinformation for attitudes, emotions and behaviours is also crucial in assessing the breadth of the effects of this phenomenon, which go well beyond health issues.

Finally, outlining the empirical evidence on effective policy interventions regarding COVID-19 misinformation helps provide ideas to tackle future waves of misinformation. Taking this COVID-19-related evidence into account will prepare policymakers for future crises, which are likely to also be accompanied by misinformation.

Figure 16 provides an integrated overview of the main elements presented in this review. These are the **antecedents, interventions and consequences** related to COVID-19 misinformation.

Figure 16. Integrated mapping and classification of the antecedents, interventions and consequences related to COVID-19 misinformation



Source: Created by the authors.

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Annexes

Annex 1. Search terms used in the literature search

Table 14. Search terms used for the different topics and literature databases

	Google Scholar	Web of Science	COVIDScholar
Focus	**Terms**	**Terms**	**Terms**
COVID-19 misinformation	(Covid* OR corona*) AND (misinformation OR disinformation OR "fake news" OR "conspiracy theories" OR "conspiracy theory" OR "science denial")	AB=((Covid* OR corona*) AND (misinformation OR disinformation OR "fake news" OR "conspiracy theories" OR "conspiracy theory" OR "science denial"))	+(Covid Covid-19 corona coronavirus) +(misinformation disinformation "fake news" "conspiracy theories" "conspiracy theory" "science denial")
Interventions to tackle misinformation	(strategy OR strategies OR instrument* OR intervention*) AND (rebutt* OR refut* OR combat* OR debunk* OR fight* OR inoculat*) AND (misinformation OR disinformation OR "fake news" OR "conspiracy theories" OR "conspiracy theory" OR "science denial")	(AB=((strategy OR strategies OR instrument* OR intervention*) AND (rebutt* OR refut* OR combat* OR debunk* OR fight* OR inoculat*) AND (misinformation OR disinformation OR "fake news" OR "conspiracy theories" OR "conspiracy theory" OR "science denial")))	+(strategy strategies instrument intervention) +(rebut rebuttal refute refutation combat debunk fight inoculat inoculation) +(misinformation disinformation "fake news" "conspiracy theories" "conspiracy theory" "science denial")
Interventions to tackle misinformation (meta-analyses)	(strategy OR strategies OR instrument* OR intervention*) AND (rebutt* OR refut* OR combat* OR debunk* OR fight* OR inoculat*) AND (misinformation OR disinformation OR "fake news" OR "conspiracy theories" OR "conspiracy theory" OR "science denial") AND (overview OR meta analysis OR meta-analysis OR review)	AB=((strategy OR strategies OR instrument* OR intervention*) AND (rebutt* OR refut* OR combat* OR debunk* OR fight* OR inoculat*) AND (misinformation OR disinformation OR "fake news" OR "conspiracy theories" OR "conspiracy theory" OR "science denial") AND (overview OR meta analysis OR meta-analysis OR review))	+(strategy strategies instrument intervention) +(rebut rebuttal refute refutation combat debunk fight inoculat inoculation) +(misinformation disinformation "fake news" "conspiracy theories" "conspiracy theory" "science denial") +(overview meta analysis meta-analysis review)
Factors affecting how people deal with misinformation	(predictor* OR (factor* AND predict*)) AND (believ* OR shar* OR accept* OR attitude*) AND (misinformation OR disinformation OR "fake news" OR "conspiracy theories" OR "conspiracy theory" OR "science denial")	AB=((predictor* OR (factor* AND predict*)) AND (believ* OR shar* OR accept* OR attitude*) AND (misinformation OR disinformation OR "fake news" OR "conspiracy theories" OR "conspiracy theory" OR "science denial"))	+(predictor predict (+factor +predict)) +(believe share sharing accept accepting attitude) +(misinformation disinformation "fake news" "conspiracy theories" "conspiracy theory" "science denial")

Annex 2. List of included studies

Table 15. List of studies included in the literature review (in Sections 7–9), categorised by factor, outcome and evidence type, and study characteristics

Study	Year	Categorisation			Study characteristics		
		Factor	Outcome	Evidence type	Country	Time	Number of participants
Jolley and Paterson, 2020	2020	Antecedent	Belief	Correlational	United Kingdom	April 2020	601
Teovanović et al., 2020	2020	Antecedent	Belief	Correlational	Unclear	April 2020	754
Šrol et al., 2021	2021	Antecedent	Belief	Correlational	Slovakia	March 2020	783
Meyer et al., 2021	2021	Antecedent	Belief	Correlational	United States	Unclear	998
Tonković et al., 2021	2021	Antecedent	Belief	Correlational	Croatia	August–September 2020	1 060
Łowicki et al., 2022	2022	Antecedent	Belief	Correlational	Poland	Unclear	361; 394
Agley and Xiao, 2021	2021	Antecedent	Belief	Correlational	United States	May 2020	660
Hartman et al., 2021	2021	Antecedent	Belief	Correlational	United Kingdom	March–May 2020	1 406
Stoica and Umbres, 2020	2020	Antecedent	Belief	Correlational	Romania	May 2020	500
Miller, 2020a, 2020b	2020	Antecedent	Belief	Correlational	United States	April 2020	3 019
Swami and Barron, 2020	2020	Antecedent	Belief	Correlational	United Kingdom	April 2020	520
Cavojova et al., 2020	2020	Antecedent	Belief	Correlational	Slovakia	March 2020	976

Pennycook et al., 2020a	2020	Antecedent	Belief	Correlational	Canada, United Kingdom United States	March and December 2020	1 339; 644; 1 283
Duplaga, 2020	2020	Antecedent	Belief	Correlational	Poland	June 2020	1 002
Pickles et al., 2021	2021	Antecedent	Belief	Correlational	Australia	April–June 2020	4 362; 1 882; 1 369
Romer and Jamieson, 2020	2020	Antecedent	Belief	Correlational	United States	March 2020	1 050
Georgiou et al., 2020	2020	Antecedent	Belief	Correlational	Multiple	April 2020	660
Calvillo et al., 2020	2020	Antecedent	Belief	Correlational	United States	March 2020	526; 464
Eberl et al., 2021	2021	Antecedent	Belief	Correlational	Austria	May 2020	823
Kwon et al., 2022	2022	Antecedent	Belief	Correlational	United States	May 2020	621
Freiling et al., 2021	2021	Antecedent	Belief	Correlational	United States	May 2020	719
De Coninck et al., 2021	2021	Antecedent	Belief	Correlational	Belgium, Canada, Hong Kong, New Zealand, Philippines, Switzerland, United Kingdom, United States	May–June 2020	8 806
Han et al., 2020	2020	Antecedent	Belief/sharing	Correlational	South Korea	April 2020	513
Islam et al., 2020	2020	Antecedent	Sharing	Correlational	Bangladesh	April 2020	433
Lobato et al., 2020	2020	Antecedent	Sharing	Correlational	United States	Unclear	404
Laato et al., 2020	2020	Antecedent	Sharing	Correlational	Bangladesh	March 2020	294

Apuke and Omar, 2021	2021	Antecedent	Sharing	Correlational	Nigeria	February–May 2020	385
Havey, 2020	2020	Antecedent	Sharing	Correlational	Multiple	April 2020	5 501
Alper et al., 2020	2020	Antecedent; impact	Belief	Correlational	Turkey	Unclear	1 088
Allington et al., 2020	2020	Antecedent; impact	Belief; belief	Correlational	United Kingdom	April–May 2020	949; 2 250; 2 254
Bridgman et al., 2020	2020	Antecedent; impact	Belief; belief	Correlational	Canada	April 2020	2 500
Constantinou et al., 2020	2020	Antecedent; impact	Belief; belief	Correlational	Greece	April 2020	1 001
Roozenbeek et al., 2020	2020	Antecedent; impact	Belief; belief	Correlational	Ireland, Mexico, Spain, United Kingdom, United States	April–May 2020	1 050; 700; 700; 700; 700
Oleksy et al., 2021	2021	Antecedent; impact	Belief; belief	Correlational	Poland	March 2020	1 046; 1 000
Uscinski et al., 2020	2020	Antecedent; impact	Belief; belief	Correlational	United States	March 2020	2 023
Sternisko et al., 2020	2020	Antecedent; impact	Belief; sharing	Correlational	United Kingdom, United States, multiple others	March 2020	950; 51 707
Banai et al., 2020	2020	Impact	Belief	Correlational	Croatia	May 2020	1 882
Barua et al., 2020	2020	Impact	Belief	Correlational	Bangladesh	Unclear	483
Bierwiaczonek et al., 2020	2020	Impact	Belief	Correlational	United States	March 2020	403
Bertin et al., 2020	2020	Impact	Belief	Correlational	France	March 2020	409; 396

Biddlestone et al., 2020	2020	Impact	Belief	Correlational	Multiple	April 2020	704
Chen et al., 2020	2020	Impact	Belief	Correlational	Ecuador	April–May 2020	252
Earnshaw et al., 2020	2020	Impact	Belief	Correlational	United States	April 2020	845
Freeman et al., 2020	2020	Impact	Belief	Correlational	United Kingdom	May 2020	2 501
Imhoff and Lamberty, 2020	2020	Impact	Belief	Correlational	United Kingdom, United States,	March 2020	220; 288; 298
Jovančević and Milićević, 2020	2020	Impact	Belief	Correlational	Serbia, Latin America	April 2020	412
Soveri et al., 2021	2021	Impact	Belief	Correlational	Finland	April 2020	1 325
Hornik et al., 2021	2021	Impact	Belief	Correlational	United States	May–July 2020	1 074
Jennings et al., 2021	2021	Impact	Belief	Correlational	United Kingdom	December 2020	1 476
Newman et al., 2022	2022	Impact	Belief	Correlational	United States	April 2021	418
Bursztyn et al., 2021	2021	Impact	Exposure	Causal	United States	February–April 2020	1 045
Chary et al., 2020	2020	Impact	Exposure	Correlational	United States	January–May 2020	14 433
Gallotti et al., 2020	2020	Impact	Exposure	Correlational	Multiple	January–March 2020	2 246
Greene and Murphy, 2021	2021	Impact	Exposure	Causal	Ireland	May–June 2020	3 746
Hameleers et al., 2020	2020	Impact	Exposure	Correlational	Germany, Netherlands, United Kingdom, United States	March 2020	1 321
Kim et al., 2020	2020	Impact	Exposure	Correlational	Singapore, South Korea, United States,	February–March 2020	419; 1 023; 1 500

Kreps and Kriner, 2020	2020	Impact	Exposure	Causal	United States	May 2020	2 050
Pummerer et al., 2021	2021	Impact	Exposure	Causal	Denmark	March 2020	425; 242; 150
Loomba et al., 2021	2021	Impact	Exposure	Causal	United Kingdom, United States	September 2020	8 001
Liu et al., 2020	2020	Impact	Exposure	Correlational	United States	February–March 2020	N/A [1]
MacFarlane et al., 2021	2021	Intervention	Belief	Causal	United States	Unclear	678
Bowles et al., 2020	2020	Intervention	Belief	Causal	Zimbabwe	Unclear	864
Greene and Murphy, 2021	2021	Intervention	Belief	Causal	Ireland	May–June 2020	3 746
Vraga and Bode, 2021	2021	Intervention	Belief	Causal	United States [2]	May 2020	1 453
Carey et al., 2022	2022	Intervention	Belief	Causal	Canada, United Kingdom, United States	June 2020 / March 2021	N/A [3]
Yousuf et al., 2021	2021	Intervention	Belief	Causal	Netherlands	October 2020	980
Lanius et al., 2021	2021	Intervention	Belief	Causal	United States	September 2020	332
Erceg et al., 2020	2020	Intervention	Belief	Causal	Croatia	March 2020	1 439
Vijaykumar et al., 2021	2021	Intervention	Belief/sharing	Causal	Brazil, United Kingdom	May–June 2020	1 454
Basol et al., 2021	2021	Intervention	Belief/sharing	Causal	France, Germany, United Kingdom	October–November 2020	1 771; 1 777
Pennycook et al., 2020b	2020	Intervention	Sharing	Causal	United States	March 2020	856
MacFarlane et al., 2021	2021	Intervention	Sharing [4]	Causal	United States	Unclear	680

Epstein et al. 2021	2021	Intervention	Belief/sharing	Causal	United States	April–May 2020	9 070
Brashier et al. 2021	2021	Intervention	Belief	Causal	Amazon Mechanical Turk	Unclear	2 683

([1]) Different level of analysis.
([2]) Not explicitly mentioned; US-based researchers recruited through Amazon Mechanical Turk.
([3]) Various numbers of participants per wave/country.
([4]) Willingness to pay for a product contained in an article, and engagement with misinformation.

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