Research Article

Savannah Schaufler*

Vaccine/Vaccination Hesitancy: Challenging Science and Society

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Abstract: How disasters (e.g., disease, war, and natural disasters) affect people is reflected in their behavior; in the face of a disaster, people are likely to act out of fear, anxiety, uncertainty, and panic in terms of self-preservation. Following more than 2 years of living amidst a global pandemic, issues of human behavior, and especially individual and societal resilience in response to disasters, are increasingly gaining focus. The theories of planned behavior and cognitive dissonance can help explain behavioral changes and underlying intrinsic conflicts. Especially in relation to global health, such phenomena as discrimination and exclusion are identified as having a negative impact on efforts to contain infectious diseases. In this context, the question arises of how to encourage members of a global society to behave cohesively in terms of quarantine, social distancing, and vaccination. This article demonstrates the existence of disbelief and misrepresentations in the context of vaccine fatigue and skepticism. While vaccinations have helped improve public health, skepticism, and resistance toward their efficacy are increasing. Looking specifically at the relatively new vaccines inoculating against the coronavirus, this article explores factors contributing to vaccine skepticism, especially with regard to Western Europe and the United States.

Keywords: vaccine, human behavior, cognitive dissonance, COVID-19

1 Introduction

How disasters such as disease outbreaks, wars, and natural catastrophes affect people is evidenced in their behavior. In the face of a disaster, people are likely to act out of fear, anxiety, uncertainty, and panic in search of self-preservation, as seen in the context of the COVID-19 pandemic through rampant, global panic buying (Karni & Schmeidler, 1986, pp. 71–81; Yuen et al., 2020, pp. 1–14). In historical research on previous pandemics, social division appears as a recurring issue. Especially in relation to global health, such phenomena as prejudice, discrimination, exclusion, interpersonal hatred, and hostility are identified as having a negative impact on attempts to contain infectious diseases (Brandt, 2021, pp. 409–410; Peters, 2021, pp. 755–759). In this context, medical historian Riva and colleagues (2014) mention the Greek historian Thucydides, who used the example of the plague to explore the ethical values of human behavior and described the increase of discord, jealousy, and greed in times of public uncertainty (p. 1753). The discussion of pandemics and human behavior seems to be of interest when considering literary texts. In their article, Riva and colleagues (2014) examined the novel *The Scarlet Plague*, written by Jack London in 1912, which portrays a post-apocalyptic scenario (p. 1755). This novel serves as an example of how pandemics and the appearance of new diseases can evoke profound fears and significantly transform human behavior (p. 1753). As Illing (2020) writes, citing Albert Camus' novel *The Plague,* one of the biggest problems in difficult times is the rise of individualism and personal freedom (para. 15). Arguably, the fear of possible contagion is precisely responsible for bringing misguided

*** Corresponding author: Savannah Schaufler,** Department of English and American Studies, Faculty of Philological and Cultural Studies, University of Vienna, Spitalgasse 2-4/Hof 8.3, 1090 Vienna, Austria; Vienna Doctoral School of Ecology and Evolution (VDSEE), University of Vienna, Djerassiplatz 1, 1030 Vienna, Austria, e-mail: savannah.schaufler@univie.ac.at

and self-serving behaviors to light. In her book on the history of disease, Wald (2008) argues that the concept of contagion has influenced societies throughout history, often with detrimental effects (pp. 1–28). In times of uncertainty, particularly in the midst of disease outbreaks, Wald (2008) asserts that outbreak narratives often distort or exaggerate the truth, perpetuate stigma, and can reinforce ableist and racist narratives (pp. 1–28).

Against the backdrop of these debates surrounding the topic of epidemics and pandemics, this article examines factors contributing to vaccine skepticism and vaccination fatigue regarding the relatively new coronavirus vaccines (SARS-CoV-2). Thus, the goal of this article is to take an interdisciplinary look through the lens of culture and behavior to develop an understanding of the underlying behavioral patterns toward vaccines and vaccine fatigue, particularly with regard to social media and specific behavioral aspects. This review subsequently provides an assessment of vaccine and vaccination fatigue and human behavioral theories, setting an agenda for future research.

2 Emerging Viruses and Vaccines

Accelerated by wars, the global economy, international air travel, and other forms of global exchange, microbes can spread across geographic boundaries (Baker et al., 2022, pp. 193–205; Morse, 1995, p. 9). In this context, an epidemic is defined as a temporally and spatially limited increased incidence of disease with a single cause in human populations. In contrast to an epidemic, a pandemic is not spatially limited. In this case, it usually involves viruses that suddenly appear in another species due to close contact (Morse, 1993, p. IX). Precisely due to the proximity of humans to livestock or wild animals that can serve as virus reservoirs, pathogens continue to find new ways to enter the human body (Morse, 1993, p. 31). Thus, the worldwide dissemination of microorganisms has been hastened by climate change, globalization, and extensive urbanization.

Over time, as the global spread of microbes intensified, vaccine research underwent significant advancements to combat the growing threats posed by the microorganism. British physician Edward Jenner paved the way in 1796 by demonstrating that the *Vacciniavirus* could protect against smallpox (Plotkin, 2003, p. 1349; 2014, pp. 12283–12287). Mainly, the outstanding achievement of the twentieth-century immunology, led by the concepts and discoveries of Louis Pasteur to produce vaccines that helped eradicate various infectious diseases, maximized the potential of the human immune system (Berche, 2012, pp. 1–6; Cavaillon & Legout, 2022, p. 2; Plotkin, 2003, pp. 1349–1359). This achievement pertains to the efficacy of vaccination in treating viral infections by leveraging the human immune system's ability to identify the vaccine as foreign and retain a memory of it (Nicholson, 2016, pp. 275–301). As a result, when a virulent form of a pathogen appears, the body recognizes the protein coat that triggers an immune response, thereby priming itself to react (Nicholson, 2016, pp. 275–301). First, the immune system recognizes the target pathogen once again before it can invade cells, and second, the immune system identifies and eliminates infected cells before the pathogen can replicate in large numbers (Nicholson, 2016, pp. 275–301). Emerging from this scientific background, presently there is a broad scientific consensus that vaccines are safe and effective means of controlling and eradicating infectious diseases. Although vaccines have contributed and continue to contribute to improving public health and have led to declines in mortality and morbidity rates for several infectious diseases (e.g., eradication of smallpox, declines in measles, mumps, rubella (MMR), diphtheria, and polio), skepticism and resistance to their effectiveness are increasing (Bauer et al., 2021, pp. 703–713; Dubé et al., 2013, pp. 1763–1773). To successfully reduce the prevalence and incidence of vaccine-preventable diseases, vaccination programs rely on high vaccination coverage rates.[1] However, as history shows, there has always been resistance and skepticism about vaccination (Wolfe & Sharp, 2002, pp. 430–432).

1 For insight into global vaccination coverage, data from the WHO Global Health Observatory (https://immunizationdata.who.int/listing.html?topic=coverage&location=) are highly useful. Vaccination coverage varies by vaccination, geographic location, and access to vaccination services. To provide an example, the measles vaccination data (first and second doses) will be used. Based on the WHO data, globally, the vaccination rate for the first vaccine dose was above 50% vaccination coverage in 2021. However, a significant percentage decrease can be observed for the second dose in 2021; in the African Region, the Eastern Mediterranean Region, the European Region, the Region of America, the South-East Asia Region, and the Western Pacific Region, the vaccination rate remains the same for the first and second dose.

The publication of an article in *The Lancet* by Andrew Wakefield and his colleagues in 1998 voiced presumptions that the MMR vaccine may cause behavioral regression and developmental problems in children (Rao & Andrade, 2011, pp. 95–96). The authors claimed that "possible environmental triggers" (i.e., the vaccine) were associated with the onset of both the gastrointestinal disease and developmental regression (Rao & Andrade, 2011, pp. 95–96). Despite the fact *The Lancet* retracted the published article and Wakefield was held accountable for his misrepresentations and misstatements, the article continues to be cited and referenced when questioning vaccines. Both *The Lancet* article and many other misrepresented facts in certain media outlets can greatly influence vaccination decisions. The choice to receive a vaccination or not extends beyond personal impact and carries societal implications, influencing both individual and collective well-being (Giubilini, 2021, p. 5; Korn et al., 2020, pp. 14890–14899). Consequently, understanding the societal implications of individual vaccination decisions requires an exploration of ethics, which involves the consideration of values and principles that are intended to govern behaviors that are not only or not exclusively in one's own interest and societal expectations (Korn et al., 2020, pp. 14890–14899). Vaccination is considered a social act precisely because it provides indirect protection by reducing the transmission of infectious diseases (Böhm et al., 2016, pp. 183–195; 2019, pp. 381–391; Korn et al., 2020, pp. 14890–14899). Due to this rationale, choices regarding vaccination are often referred to as an illustration of the social contract, given that the potential risks linked to vaccination are generally outweighed by the risks posed by the disease in question (Korn et al., 2020, pp. 14890–14899; Weinstein, 2000, pp. 65–74). Nevertheless, the social contract presents a conundrum, as it requires trust in the relevant agencies and the government (Korn et al., 2020, pp. 14890–14899). However, due to the occasional lack of trust, the social contract frequently comes under scrutiny and serves as a platform for various groups and individuals to advance their own opinions and fuel fears (Kates et al., 2022, pp. 1445–1447; Korn et al., 2020, pp. 14890–14899). Therefore, aversion to vaccination may be seen as the result of biased information processing or inadequately informed decision-making, e.g., due to distorted and exaggerated portrayals of risks associated with vaccination or due to conspiracy theories (Betsch et al., 2011, 742–753; Brewer et al., 2007, pp. 136–145; Hollmeyer et al., 2009, pp. 3935–3944).

3 A Concept of Vaccine/Vaccination Hesitancy

As vaccination hesitancy becomes more of a global issue in the fight against various infectious diseases, the Special Advisory Group of Experts and Canadian physician Noni MacDonald (2015), who study global health and vaccination hesitancy, defined vaccine and vaccination hesitancy (p. 4161). Anthropologist Heidi Larson and colleagues (2022) position hesitancy toward vaccines as "a state or attitude of indecision and uncertainty about vaccination before a decision is made to act (or not act)" (p. 58). However, there appears to be a slight distinction between vaccine and vaccination hesitancy (MacDonald, 2015). According to MacDonald (2015), vaccine hesitancy refers to the reluctance or refusal to be vaccinated, not the vaccine itself (p. 4161). On the other hand, vaccination hesitancy is a multifactorial issue that is highly influenced by "[specific contexts], varying across time, place and vaccines" (MacDonald, 2015, p. 4161). It encompasses a wide array of "factors, [including access to] immunization services, … fear of needles, [and] a lack of concern [regarding] vaccine preventable diseases" (MacDonald, 2015, p. 4161). According to the article published by Larson and colleagues (2022), vaccination is facing increased "levels of volatility," which has been notably amplified by social media platforms and networks during the COVID-19 pandemic (pp. 58–65).

However, Peretti-Watel and colleagues (2015) argue that the concepts of vaccine and vaccination hesitancy are inherently "ambiguous," as they encompass varying levels of uncertainty and indecisiveness regarding specific vaccines or vaccination in general (para. 2). While the majority of the world's population accepts vaccination and acknowledges scientific progress; nevertheless, there are increasing voices of smaller groups who are hesitant about certain vaccines and raise skeptical opinions, especially due to the coronavirus pandemic (Dubé et al., 2013, pp. 1763–1773; MacDonald, 2015, p. 4161). This can range from complete acceptance to complete rejection (Larson et al., 2014, p. 2151; MacDonald, 2015, p. 4161). Changes in vaccination hesitancy frequently align with the emergence of "new information, [revised] guidelines, or [the disclosure of] newly

reported vaccine risks" (Larson et al., 2022, p. 58). These fluctuations, according to Larson and colleagues can stem from various factors, including diminished public trust in experts, political views, and extreme religious beliefs, which collectively contribute to evolving attitudes toward vaccines and vaccination (Larson et al., 2022, pp. 58–65).

In this context, social psychologist Milošević Đorđević and colleagues (2021) defined four possible behaviors based on previously published studies by health scientists Kumar and colleagues (2016) and MacDonald (2015) (p. 2). These can be defined using the proposed hesitancy continuum and range from "cautious immunization," "hesitating to vaccinate, being late with some vaccines," "selective vaccination," and "complete rejection of all vaccines" (Kumar et al., 2016, p. 2; MacDonald, 2015, p. 4161; Milošević Đorđević et al., 2021, p. 2). Given those identified behaviors toward vaccines and vaccination, the high variability and nuances between absolute acceptance to complete rejection is recognized (Milošević Đorđević et al., 2021, p. 2). For this reason, behavioral research, considering interdisciplinary approaches, may lend help to understand the underlying factors such as aversion and uncertainty. With increased understandings, especially on the part of academia and policy actors, new context-, community-, and vaccine-specific strategies can be developed to address hesitancy. This will require broad collaboration among different scientific fields and extensive discourse among many experts, as well as a better understanding of science denialism and why individuals display certain attitudes and intentions.

4 Theory of Cognitive Dissonance

Cognitive dissonance theory, developed by social psychologist Festinger (1957, pp. 1–32), explains conflicting information and its impact on attitudes and behaviors. Festinger posits that when an individual holds two or more contradictory cognitions, which encompass acquired knowledge, attitudes, norms, or beliefs from experiences, education, or other (media) outlets, cognitive dissonance can arise (Festinger, 1957, pp. 1–32; Harmon-Jones & Mills, 2019, p. 3). Cognitive dissonance can stem from logical inconsistencies, cultural values, specific opinions, or shifts resulting from experiences, necessitating the establishment of some form of balance (Festinger, 1957, pp. 1–32). Achieving this balance can be attained by either modifying behaviors or acquiring additional knowledge (Festinger, 1957, pp. 1–32). Overcoming cognitive dissonance can, therefore, be challenging as established beliefs are often resistant to reflection and change (Festinger, 1957, p. 6). The experience of cognitive dissonance varies in its impact and can influence decision-making and other behaviors.

Festinger's work on cognitive dissonance, particularly through his study of doomsday cults, demonstrates how individuals navigate conflicting beliefs and behaviors (Festinger, 1957, pp. 1–32). This study, in which Festinger and his colleagues insinuated themselves as believers, aligns seamlessly with his theory of cognitive dissonance and reveals intriguing reactions when prophecies fail (Festinger et al., 2008).[2] Cognitive dissonance theory, based on the premise that people seek consistency between thoughts, feelings, and actions, therefore, provides profound insights into the intricacies of belief systems and the challenges of cognitive dissonance in the face of contradictory beliefs. Festinger's research addresses the pressures for consistency in human cognition and behavior and lays the groundwork for future investigations that can further explore the complexities of cognitive dissonance in various contexts. By making connections to diverse fields such as apocalyptic thinking, environmental discourse, consumer behavior, and vaccination behavior, among others, future studies can illuminate the processes of human decision-making and cognition.

2 This method is considered ethically problematic by some researchers. Ethical concerns about covert research often stem from the deception involved, as researchers sometimes conceal their activities from participants. Covert research is conducted without disclosing to subjects that research is being conducted. Examples include researchers attending public events and writing about them, or observing people in public spaces, such as noting how many individuals are jaywalking. Deception occurs when researchers mislead subjects about the nature of their activities, as in the Milgram experiments or the Stanford prison experiment. Although covert research may be necessary to avoid influencing participants' behavior, it is crucial to engage in discussions about ethical research practices and to find a balance between overt and covert methods (for more, see Alves da Costa, 2020; Lugosi, 2006; Spicker, 2011; Van Deventer, 2009).

5 Theory of Planned Behavior

The theory of planned behavior (TPB), proposed by Icek Ajzen and extended by Martin Fishbein, builds upon the theory of reasoned action and incorporates elements of Festinger's dissonance theory. TPB offers a framework for predicting and understanding attitudes and intentions related to specific activities in a given context (Ajzen, 1991, p. 181). According to Ajzen, behavior is "a function of salient information, or beliefs" (p. 189). TPB asserts that human behavior is guided by an individual's beliefs, which in turn determine their intentions and actions (Ajzen, 1991, pp. 181–191; Fishbein & Ajzen, 2010, p. 223). These beliefs encompass information acquired through experience, observation, or external sources such as media and friends (Ajzen, 1991, pp. 181–191; Fishbein & Ajzen, 2010, p. 223; Madden et al., 1992, pp. 3–9). The authors identify three distinct categories of belief: behavioral beliefs, normative beliefs, and control beliefs (Fishbein & Ajzen, 2010, p. 223; Madden et al., 1992, pp. 3–4). Behavioral beliefs influence one's attitude toward a specific behavior and lead to favorable or unfavorable attitudes toward a particular behavior. Normative beliefs shape an individual's subjective norm regarding a behavior and lead to a "perceived social pressure to perform or not perform a behavior," and control beliefs contribute to perceived behavioral control and "provide the basis for perceptions of behavioral control" (Fishbein & Ajzen, p. 321; Ajzen, pp. 189). It is important to note that these beliefs may not always be accurate or truthful as they can be influenced by external factors or biases (Ajzen, 1991, p. 191). Despite their potential inaccuracies, these beliefs are considered valid by the individuals acting upon them. The combination of behavioral, normative, and control beliefs exerts pressure on an individual's intention to engage in a behavior (Ajzen, 1991, p. 181). Higher intention levels correspond to a greater likelihood of performing a behavior (Ajzen, 1991, p. 181). However, the execution of the behavior may also depend on external factors unrelated to motivation, such as time or financial constraints. Attitudes, subjective norms, and perceived behavioral control all play a role in influencing the intention to engage in a specific behavior.

These studies demonstrate that intentions can be predicted by factors such as attitudes, subjective norms, and perceived behavioral control. In a recent study conducted by Seddig and colleagues (2022), data were collected in April 2021 through an online questionnaire involving adults aged 18–74 in Germany (n = 5044), with the aim of predicting attitudes toward vaccination intentions (pp. 1–10). The findings revealed that personal beliefs, whether positive or negative, significantly influenced the intention to engage in a specific behavior (Seddig et al., 2022, p. 7). Moreover, the data collected supported the notion that trust in science plays a role in vaccine uptake (Seddig et al., 2022, p. 7). These findings suggest that an individual's attitude toward a behavior is shaped by their behavioral beliefs, which encompass the perceived likelihood of certain outcomes and experiences resulting from performing a behavior (Seddig et al., 2022, p. 7). The study concludes by suggesting the need for further research to gain a deeper understanding of individuals' decision-making regarding vaccination, particularly in relation to the application of theoretical frameworks such as the one discussed.

In light of the research presented, the TPB emerges as a relevant framework for understanding the complexities of human decision-making. The TPB's focus on an individual's beliefs, including behavioral, normative, and control beliefs, provides a foundation for analyzing how attitudes and intentions influence behavior. The study conducted by Seddig and colleagues (2022) serves as an example, identifying trust in science as a significant factor in influencing vaccine uptake and highlighting the central role of behavioral beliefs in shaping attitudes (pp. 1–10). Moving forward, research efforts can explore the dynamic interplay between attitudes, beliefs, and behavioral intentions. Examining the multiple factors that influence these aspects will not only enhance our understanding of human decision-making but also pave the way for the development of more effective strategies to promote informed behavior. Future research could explore the effectiveness of interventions tailored to address individuals' behavioral beliefs and their influence on attitudes, providing valuable insights for promoting positive behaviors and informed decisions in different contexts.

6 Conclusion

The COVID-19 pandemic has led to increased polarization, particularly in relation to vaccines, vaccination, and science, resulting in the spread of fears and uncertainties (Rosenbaum, 2021, pp. 1367–1371). Existing skepticism

toward vaccines has been amplified, and extreme views and opposition have become more prevalent. The abundance of information from various (digital) media platforms, particularly social media such as Twitter™ and TikTok™, has made it difficult to distinguish between accurate and false information. The media coverage has included misinformation, including conspiracy theories, fake experts, selective reporting, misrepresentations, rumors, and false prevention methods, among others (Dentith, 2014, p. 125; Liu & Li, 2021, pp. 1–17; Diethelm & McKee, 2009, pp. 2–4; Douglas et al., 2019, p. 4; Liu, 2012, pp. 129–134). This highlights how (new) information, when taken out of context, can shape narratives that align with individual worldviews (Jamison et al., 2020, pp. 1–10). It is therefore critical to address these challenges with transparency and public engagement. It is important to bridge the gap between experts from different scholarly fields and the public to build trust and understanding.

Engaging citizen science holds promise for advancing research in this field, contributing to democratizing policymaking, and investigating the reasons behind vaccine and vaccination hesitancy in societies. Beyond simply disseminating research findings to the public, citizen science fosters direct collaboration between scientists and nonexperts, providing a platform for meaningful interaction throughout the research process (Silvertown, 2009, pp. 467–471). This inclusive approach goes beyond communication, offering nonexperts the opportunity to actively participate in scientific endeavors, enhancing their understanding (Silvertown, 2009, pp. 467–471). Recognizing the diverse perspectives shaped by individual experiences, citizen science becomes a valuable way for scientists to understand the world through the eyes of citizens, acknowledging and respecting differing opinions (Del Savio et al., 2016, pp. 1–3, 12–13). Far from challenging the authority of science, citizen science opens new avenues for participation and is closely linked to learning itself (Bonney et al., 2014, pp. 1436–1437).

The development of a COVID-19 vaccine triggered global anxiety, with social media platforms playing a significant role in polarizing and homogenizing groups around health issues (Del Vicario et al., 2016a, pp. 554–559; 2016b, pp. 1–12; Milošević Đorđević et al., 2021, p. 2; Puri et al., 2020, pp. 2586–2593). Individuals often gravitate toward information that aligns with their preexisting beliefs, exhibiting a cognitive phenomenon known as confirmation bias. Assistant Professor of Medicine Lisa Rosenbaum contends that this growing polarization of science has led to an increase in antiscientific sentiments and heightened disdain for science denial (Rosenbaum, 2021, pp. 1367–1371). These sentiments are often misconstrued as manifestations of fear of the unknown (Rosenbaum, 2021, pp. 1367–1371). Right-wing political parties and figures in Europe and the United States have promoted conspiracy theories and opposition to the COVID-19 vaccine, influencing their followers (Dolman et al., 2022, pp. 1–4; Puri et al., 2020, pp. 2586–2593). In doing so, alternative media outlets and right-wing populism often offer simplistic solutions that challenge the authority of the state, science, and scientific consensus (Cascini et al., 2022, p. 44; Swami et al., 2011, pp. 443–463). This may be accompanied by a general tendency to oppose state efforts to contain the pandemic (including the vaccination campaign). The term “science denial” refers to the use of pseudoscience and rhetorical arguments to create the illusion of legitimate debate, despite scientific consensus on certain issues such as the effectiveness of vaccines (Diethelm & McKee, 2009, pp. 2–4). The goal is to refute a claim for which there is scientific consensus, such as that vaccinations help eradicate infectious diseases. Underlying science denial are economic, political, or psychological interests that lead to biased beliefs (Diethelm & McKee, 2009, pp. 2–4; Hornsey & Fielding, 2017, pp. 459–473). Science deniers are driven by their skepticism of a particular scientific account or theory, for example, by a lack of trust in political actors, experts, or the media (Diethelm & McKee, 2009, pp. 2–4; Hornsey & Fielding, 2017, pp. 459–473). It is important to distinguish here, however, between denial and skepticism, as skepticism can contribute positively to scientific progress by encouraging further research and debate (Ecker et al., 2022, pp. 13–29). Skepticism is one of the foundations for advancing science by examining, questioning, and scrutinizing the facts (Schmid & Betsch, 2019, pp. 931–939).

The theories of cognitive dissonance and planned behavior can explain how individuals’ attitudes, values, norms, beliefs, and emotions based on their experiences influence their decisions to get vaccinated or not. The COVID-19 pandemic has demonstrated yet again the impact of emotions, beliefs, and worldviews on people’s behavior. The uncertainty surrounding the disease has created risk awareness and can lead to the devaluation of scientific knowledge, reducing cognitive tension (Sachdeva, 2022, pp. 1–20). People may create new realities and truths to resolve cognitive contradictions, even if those beliefs are not based on evidence. This provides an

opportunity for opponents and political parties to spread false information and influence individuals' beliefs in times of (extreme) uncertainty. Therefore, cognitive dissonance theory and the theory of planned behavior highlight how belief systems can influence human behavior, which is complex and dependent on various factors. Beliefs are often based on information from others and faulty reasoning, leading to inaccurate behavioral, normative, and control beliefs. These theories provide valuable insights for understanding dissonance behaviors and their influences in social, political, economic, and ecological discourses, particularly in the context of decisions that impact societies, such as vaccinations. Opinions and views can evolve or change over time based on experience, increased knowledge, and cultural factors, but this requires self-reflection and the willingness to live with cognitive dissonance instead of immediately justifying it.

Poor communication between science and society is also a contributing factor to vaccine hesitancy, which needs to be improved. It is crucial to communicate knowledge in a credible, accurate, and easily understandable manner, particularly in public debates where scientists and scholars should be involved to support knowledge transfer. The public health benefits of high vaccination rates should be emphasized, and it should be understood why people reject certain vaccines or immunizations. Heidi Larson argues that the pandemic highlights the need for science to understand the public, going beyond simply promoting scientific excitement (Rosenbaum, 2021, pp. 1367–1371). This view is consistent with the inclusion of theories regarding human behavior to reduce the discrepancy between science deniers and science proponents. The COVID-19 pandemic has underscored that the well-being of societies hinges not only on scientific knowledge but also on the comprehension of why people exhibit skepticism and lack trust, particularly in the context of vaccines and immunization. Researchers and scholars should actively participate in public debates, providing credible and accurate information in an easily understandable manner. It is time for interdisciplinary and transdisciplinary research across academic and nonacademic fields to bridge the gap between science deniers and proponents. Transparency and open discussions are key in this endeavor. While discussions may become heated, it is essential that they remain respectful and nondiscriminatory, avoiding whataboutisms and talking down to people. By promoting transparency, open discussions, and understanding, vaccine hesitancy can be reduced.

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