



Reply

Misconceptions, Misinformation, and Moving Forward in Theories of COVID-19 Risky Behaviors

Valerie F. Reyna* and Sarah M. Edelson

Human Neuroscience Institute, Center for Behavioral Economics and Decision Research, Cornell University, USA

David A. Broniatowski

Department of Engineering Management and Systems Engineering, Institute for Data, Democracy, and Politics, George Washington University, USA

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Imagine gathering together the most thoughtful scholars spanning the behavioral sciences to address the conceptual frontier as it pertains to human behavior and COVID-19, including risk communication, prevention, and vaccination. Imagine that this group had vast experience in understanding the mechanisms underlying behavior and in applying this understanding in policy and practice. This great gathering is within the pages of this journal. Collectively, they summarize key concepts that can be applied in programs to combat COVID-19 and provide a blueprint for future research, as discussed below.

A theme of these articles is that integrative interdisciplinary work is required to address this massive public health problem (e.g., Fischhoff, 2021; Jamieson, 2021; Scheufele et al., 2021; Wolfe, 2021). Many highlight how fuzzy-trace theory (FTT) accomplishes this goal by weaving together cognitive, social, emotional, and neuroscientific constructs to explain multiply determined decisions that involve risk (e.g., Edelson & Reyna, 2021), applying falsifiable models (e.g., Broniatowski & Reyna, 2018). Others encourage looking beyond cognition, and they raise questions about the efficacy of current behavioral theories, including FTT (Broomell & Chapman, 2021), and whether FTT should be combined with dual-process approaches to achieve greater explanatory and predictive power (Thompson et al., 2021).

To clarify, constructs such as mental representations of gist are not solely kinds of cognition; instead, they are new species

of causal factors that go beyond the confines of cognitive sciences and the computer metaphor of the mind (cf. Loewenstein et al., 2001). Moving forward and taking advantage of innovations requires thinking in new ways. That challenge of thinking in new ways is before us as nations struggle to defeat a viral disease whose spread depends on human behavior. Broomell and Chapman (2021), Fischhoff (2021), Jamieson (2021), Scheufele et al. (2021), Thompson et al. (2021), and Wolfe, (2021) each argue eloquently for the crucial role of human behavior in combatting the COVID-19 pandemic, and, by implication, for greater emphasis on theory.

With COVID-19 being a major problem and a focus of this journal being applied solutions, theories may seem impractical, but in the immortal words of Lewin (1952), “there is nothing more practical than a good theory” (p. 169). While some laboratory scientists wonder whether fuzzy-trace and other behavioral theories make clear predictions for practice and whether they can be implemented successfully in emotionally-driven and socially controversial contexts—with quantitative measures of success—experts in practice have done and are already doing this. Practical implications and low-cost programs have been developed in health domains such as HIV prevention and sexual risk-taking in teenagers, athletes reporting concussions in contact sports, and genetic testing for breast-cancer prevention, among other areas of risky decision making (e.g., Marti & Broniatowski, 2020; see Reyna et al., 2021). To be

* Correspondence concerning this article should be addressed to Valerie F. Reyna at Human Neuroscience Institute, Cornell University, Ithaca, NY, United States. Contact: vr53@cornell.edu (V.F.R.).

sure, programs to address prevention behavior and vaccine hesitancy in the context of COVID-19 have not been fully tested yet—but this is where validated scientific principles are useful in practice. Applications to the practice of scientific theories require domain-specific adjustments, but that does not mean that principles are not generalizable; indeed, generalizability has been demonstrated. To argue that the concept of the assembly line applies to Ford but cannot be generalized to General Motors or that the law of gravity applies to a feather but not to an anvil has been rejected in other areas of science—and so should it be in the behavioral sciences.

Specifically, to speed the development of effective practices, we must match the pace of innovations in disease prevention with rapid conceptual progress in understanding why so many people who have access to those innovations nevertheless resist taking advantage of them. To do that, we must (a) acquaint ourselves with research evidence that bears on understanding risky behaviors, including evidence that is outside our academic silos; (b) identify misconceptions in the literature; and (c) embrace an integrative perspective that combines cognitive, social, emotional, and neuroscientific factors in tested and testable theories of risky behavior. Here, we summarize progress on these three fronts and their implications, with the able assistance of leading scientists and rising stars in psychology, science education, and risk communication.

Current Controversies and Misconceptions

Suppose that, in response to a policy announcement about COVID-19 vaccinations, two people extracted the same gist of the announcement as “The government is forcing people to vaccinate.” One person applies a social value concerning the freedom to this mental representation of the message and feels angry, which is amplified by social media. Another person celebrates and signs up for vaccination to implement a social value of protecting others from disease. As can be easily discerned from these examples, the interpretation of the announcement—the gist—is not purely cognitive; it exudes social, cultural, and other contextual influences. Social values, represented as social norms in Theory of Planned Behavior (TPB) and as valenced affect in long-term memories in FTT, are discussed in social psychology textbooks and courses more often than in cognitive sciences. Indeed, social values are mentioned more than 25 times in the target article (in addition to much discussion of emotion) as integral parts of these so-called “purely cognitive” theories. Thus, characterizing these as solely cognitive theories (per Broomell & Chapman, 2021) is perplexing and seems to date back to early versions of the theories.

In addition, citing examples of failed interventions that did not involve the constructs we describe (i.e., not involving gist) is not evidence that gist-based interventions would fail. We agree that ineffective interventions are ineffective (though causes matter). However, interventions that did manipulate gist have been successful in related domains, as noted above (see Blalock & Reyna, 2016, for a review of gist-based interventions in health). FTT and other approaches are also not solely focused on risk perceptions; risk perceptions are only a part of the gist of information about risky decisions—the gist of

benefits, for example, often outweighs the gist of risk, and risk is not “one thing” but is represented in multiple ways (e.g., Mills et al., 2008). (The research on risk perception is not as indeterminate as portrayed; risk perceptions relate to behavior in predictable but sometimes counterintuitive ways.) The relevant gist might have nothing to do with risk, instead focus on government control or other relevant social meanings. In fact, we argue that the effect of emotions, such as fear appeals, is better understood in the context of how the gist of a message is interpreted. Conversely, changing that interpretation changes both the values that people see as relevant and changes how they feel (the latter effect is not unlike cognitive behavioral therapy; Introduction to CBT, 2021).

Moreover, there is no such thing as “direct” effects on behavior. Theories can focus on external or internal factors (or both). Nevertheless, the effects of any policy or intervention are always mediated through the minds of affected people. Behaviors can be influenced, nudged, or mandated, but the human mind still processes these experiences (consciously or unconsciously), and the mind rather than objective reality alone, as has been demonstrated for hundreds of years, guides behavior (e.g., Kahneman, 2003). Policymakers sometimes have to create mandates for public health, but repeatedly skipping individuals’ decision-making (or at least after-the-fact buy-in) creates political vulnerabilities and leaves populations ripe for exploitation. Taking a decision-making approach, in contrast, develops a capacity for the current crises and for subsequent ones. In this connection, the following statement was published on April 20, 2020: “Achieving insight is robust because it changes hearts and minds, whereas merely controlling behavior is fragile and can erupt in political disfavor.” (Reyna, 2021, p. 5). Political disfavor erupted on January 6, 2021, in the U.S. Capitol. Signs protesting vaccination were displayed, and one person was recorded saying “We have had enough! We’re not gonna take your (expletive) vaccines! We’re not going to take all your (expletive)! The people are rising up!” (Pulver et al., 2021). What we say here does not excuse violent protests, but neither does it excuse scientists from trying to understand their causes (Larson & Broniatowski, 2021).

As Fischhoff suggests, we should focus on “how capable (or rational or reflective) people can be, given the right conditions” (Fischhoff, 2021, p. 510). FTT provides mechanisms for changing seemingly irrational and risky behaviors, rather than just accepting them as inevitable; this encapsulates a major difference between FTT and developmental dual systems theory regarding adolescent and young adult risky decision making.

Broomell and Chapman concede that interventions targeted directly at behavior (e.g., nudges, reminders, and defaults) “are likely influential primarily among people who have positive attitudes” towards the target behavior (Broomell & Chapman, 2021, p. 515). Hence, they do not address the major problem of how to help people with negative attitudes towards the target behavior. Further, if trust in “official sources” is an important goal, would not forcing people to do something they do not want to do reduce trust? Surely in terms of policy tools, having people reach a decision because they agree it is the right thing

to do is not on equal footing with forcing someone to do something they do not want to do.

Jamieson provides a worked example of the practicality of this approach, building on the Annenberg Center's work on FactCheck.org. She and her team are already deploying bottom-line gists to "defang deceptions about how and what science knows" by gistifying their FactsCheck.org headlines (Jamieson, 2021, p. 517). Evidence that originated in memory research, but since replicated for many materials, buttresses the prediction that effectively conveying the gist should result in greater "staying power" of gist messages as well as potential virality when used as a public health tool.

It is important to address a potential misconception that memory for gist only refers to long-term memory. Memory representations operate at the beginning of information processing, at encoding, as well as later as information that has been encoded earlier is retrieved. When someone reads a message, there is no direct effect of the message; instead, mental representations of the message are formed at the moment that provide the inputs to reasoning and decision making. Although Thompson et al. (2021) assert that working-memory capacity must limit reasoning and point to excellent work indicating that memory accuracy is correlated with reasoning accuracy (e.g., Toplak et al., 2011), this conclusion is not correct. The test of whether working-memory capacity determines reasoning is not correlating performance on two different tasks. The correct test of necessity is whether reasoning performance in a specific task depends in any way on the accuracy of memory for specific items being reasoned about in that task. It does not. When tested properly, the working-memory capacity argument fails in scores of tasks (Reyna & Brainerd, 1995). So, it is true that people who remember better tend to also reason better (per correlational evidence). However, reasoning performance is often stochastically independent of memory performance under standard conditions. Testing the FTT explanation for this surprising phenomenon, one of the breakthroughs in theory development was subsequently showing that manipulating accessibility of verbatim memories and gist memories as bases for memory and reasoning performance could predictably produce all of the different possible relationships: negative dependence, independence, and positive dependence between memory and reasoning simply by changing what mental representation was used to perform a task (e.g., Reyna & Kiernan, 1994). Thus, reasoners typically do not rely on verbatim memory for information to reason about it; they bypass their working-memory for bits of information by relying primarily on gist, which is not as subject to capacity constraints. Individual and task differences modulate this effect lawfully, as predicted by FTT. These distinctions become crucial when one asks what people encode and retain in messages about COVID-19 and other public health threats.

Jamieson (2021) also highlights another feature of memory (mental representation) in FTT, namely, that the order in which information is encoded influences the gist that is extracted and retained (see also Lewandowsky & van der Linden, 2021). As Jamieson discusses, it is extremely important to provide the gist early in the process of encoding, ideally, simultaneously along-

side misinformation. For example, the meaning of the first words in a list colors the interpretation of later words, which alters memory for the gist of that list and subsequent false memories of it. Order effects also occur for sentences and sequential events, again reflecting the constant effort to interpret the gist or meaning of events as they are encoded. For example, many readers can think back to when they saw a plane crash into the first of the twin towers on 9/11; some concluded that perhaps a horrible accident had occurred. When a second plane crashed into the other twin tower, it was immediately obvious that this was intentional, not an accident. Only two dots needed to be connected to extract the gist that the U.S. was under attack. In contrast to humans, machine learning algorithms labor with verbatim representations of information and require many events to make such inferential leaps. Human's natural tendency to connect the dots to extract gist go awry when events are related coincidentally, as Jamieson so aptly illustrates with examples of spurious connections between adverse events and COVID-19 vaccinations (see also Reyna, 2012).

The changes in messaging undertaken by Jamieson also illustrate the difference between a gist-based approach and simply providing information to fill gaps. As Scheufele et al. (2021) argue (grounded in much research), the "knowledge deficit" approach to handling misinformation—that providing correct information will help improve decisions—does not by itself work. Knowledge of minutiae about a topic is not necessary to "usefully understand its 'gist,' or its bigger-picture meaning" and "perceptions of the gist influence decisions more than the specific details" (Scheufele et al., 2021, p. 525).

Moreover, as Wolfe's (2021) analysis suggests, the battle between information and misinformation is not merely a matter of contradictory facts: The earth is either round or flat. Rather, people may form conflicting gist representations of the same experience that are "actively contested"—a process that demands more research. Wolfe highlights the importance of context in this process, including social and cultural context, in eliciting specific gist representations—"[c]ompeting ideas may be mentally represented in this way and instantiated when their relevance is brought to the forefront by the context" (Wolfe, 2021, p. 628). In sum, we agree with multiple commentators that helping people develop an understanding of the simple bottom-line of key concepts, emphasizing depth and insight (rather than memorizing specific facts), is a better way to inoculate against misinformation.

Thus, FTT's approach prioritizes the deep understanding of top subject-matter experts when communicating with the lay public. Those who communicate risks, and message recipients, need to understand why the expert's gist of a message is the gist. For example, the gist of transmission of COVID-19 began on analogy with that of colds, another coronavirus; touching surfaces was assumed to be a major vector. As scientific knowledge progressed, respiratory droplets were thought to be a major mode of transmission. But interpretations of airborne transmission differed among experts in a way that illustrates the gist of transmission. Compared to respiratory droplets, aerosolized particles are infinitesimal (a fuzzy gist

concept but one that communicates the essential bottom line). Heavy droplets fall to earth quickly, but tiny aerosols float on air currents potentially for hours (Penn Medicine, 2020). We now know that transmission occurs mainly through inhaling the virus, either through droplets (within feet through sneezing, coughing, etc.) or aerosolized particles (over longer distances); the density and dosage of the virus determines transmission. With this context, wearing a mask makes more sense. Without some understanding of the gist of transmission, it is virtually impossible to make everyday judgments about risk (e.g., how risky an open-air volleyball game with masks is) because each instance varies in many ways and incorporates ambiguities (unknowns). In this chaotic sea of variability, as Wolfe discusses, developing the “right” gist representations (i.e., those that capture “critical features of experience”) is “useful in guiding decisions and action” (Wolfe, 2021, p. 628). Gist—because it is fuzzy and approximate—can help ride the waves of uncertainty when more precise approaches are impractical, as they often are (cf. Dhami & Mandel, 2021). However, a key difference between FTT and dual-process theories is that gist is not desirable only because of lower complexity or lower burden on working memory, but because it captures the meaningful essence of information—what it all boils down to when information is integrated and the trivia, minutiae, and superficial details are stripped away.

We close this section by endorsing Thompson et al.’s (2021) call for finding common ground among perspectives. We include expectancy-value perspectives (behavioral decision-making, TPB; Fischhoff, 2021), which seem to correspond to “just-the-facts” thinking closer to verbatim than gist processing. Space precludes in-depth discussion; in brief, we should not dismiss the variance that these approaches account for but acknowledge the critical tests that show where they fail.

Similarly, dual-process approaches might be reconciled with FTT per Thompson et al. (2021) but with caveats: FTT’s models of recognition, recall, reasoning, and decision-making spell out how gist and verbatim thinking unfold in parallel (typically unfolding to completion, except in speeded tasks) and both influences can be revealed by designing diagnostic tasks (e.g., confidence judgments per Thompson & Newman, 2018). We did away with the serial processing assumption of logicist and formalist approaches in favor of well-specified intuitionism (Reyna & Brainerd, 1995). Assumptions about differential time courses are not essential to FTT’s predictions, and results, in fact, contradict that interpretation of many effects. To take one example, people who think longer and harder can show larger gist-based biases under predictable conditions. For another, math models reveal evidence for both processes even when one process dominates answers; we have designed task variations to disclose these “hidden” processes.

Nevertheless, FTT acknowledges that thinking is sometimes lazy and metacognitive monitoring sometimes censors inconsistent responses; these tendencies do vary across individuals. In other words, impulsivity versus deliberation is a dimension of thinking that crosscuts verbatim versus gist thinking. System 1 (or Type 1) thinking, to the degree that it represents mere association, superficial details, or following rote rules, is not

gist-based thinking because the latter incorporates meaning and insight. Although knowledge can be lacking (e.g., numeracy and scientific literacy), typically, even children have the underlying competence to engage in normative reasoning; they have expected value, logical reasoning, class-inclusion, and probabilistic competencies, which makes it all the more surprising that these are not retrieved and applied by adults when lives are at stake, as in COVID-19. By embarking on the research program outlined by Thompson et al. (2021), as a field, we can ultimately understand these paradoxes and help the public make rational decisions about their health.

A Blueprint for the Future

The experts offer a clear prescription for future research on COVID-19 and related problems: Adopt an interdisciplinary framework that incorporates differences across age, individuals, and societies using bridging constructs such as gist representations of information that integrate inputs ranging from anthropology to engineering (Fischhoff, 2021). Move from questioning whether constructs are purely cognitive to asking how cognitive and non-cognitive factors interact, such as how gist is shaped by social identity and affiliation (Wolfe, 2021). Discard persistent misconceptions, such as a “novel” epidemic of misinformation, that interfere with understanding longstanding vulnerabilities in science education and how information can be interpreted differently by diverse people (Scheufele et al., 2021). Adopt the can-do success of real risk communication programs that have put the gist in the message while being attentive to the fundamental distinction that the gist in the mind is not necessarily the gist in the message (Jamieson, 2021). Work at the cutting-edge of the field by integrating contemporary theories of mental representations and dual processes in reasoning so that research on what people think and how they think can be brought together to support human welfare (Thompson et al., 2021). Finally, without ignoring research on mental processes that are always a mediator between policies and behaviors, insist on practical programs that show evidence of success in rigorous experiments (Broomell & Chapman, 2021).

Author Contributions

V.F.R., S.M.E., and D.A.B. discussed the manuscript, V.F.R. wrote the first draft, and all edited the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

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