Using a Conceptual Framework to Analyse Communicative Interventions that Address Vaccine Hesitancy

By

Lorraine Elizabeth Byerley

Submitted to the Faculty of Arts

University of Alberta

in partial fulfillment of the requirements for the degree of

Master of Arts in Communications and Technology

August 24, 2021

Abstract

Public health organizations are greatly interested in designing effective communication interventions to address vaccine hesitancy (i.e., delay or refusal to vaccinate) because under-immunized populations are more vulnerable to outbreaks of serious contagious diseases, such as measles and, more recently, COVID-19. Therefore, to understand why some such communicative interventions succeed while others fail, this paper examines two exemplary interventions that are manifestly similar yet they produced divergent outcomes. In doing so, this paper explores the interplay of communication theory, framing strategy, and message design model revealed by these two cases. Next, informed by this theoretical discussion, an analytical framework for communicative intervention, which categorizes interventions as using either a promotional approach or a communicative engagement approach, is proposed. This framework is then applied in a two-step process to scholarly discourse about interventions that address vaccine hesitancy. Comparative analysis of the pre-2020 discourse (before COVID-19) and the post 2020 discourse (during the COVID era) reveal a similar pattern which suggests that communicative interventions that display all attributes of the communicative engagement approach—dialogue within the narrative paradigm, use of strategic framing, and stakeholder engagement via the central route to processing—are far more likely to be successful than those that display attributes of the promotional approach. Furthermore, these results also suggest that the circumstances surrounding the pandemic have not affected these variables. The outcome is a validated theoretical application that sheds light on the essential dynamics of communicative interventions that address vaccine hesitancy.

Keywords: health risk communication, communicative interventions, vaccine hesitancy, discourse analysis, narrative paradigm, message framing, message design, COVID-19

Acknowledgements

On the surface, what it takes to complete a capstone research project seems simple enough—a good topic, a quiet work space, and time to write. For me, however, that is only the short list of many necessities. It turns out I also need a sense of urgency along with a well-ordered home, innumerable meals, some good friends, and a loving family. Indeed, the layers of support that undergird academic and other ostensibly solo creative pursuits are numerous. That's why I am especially grateful for all the empathy, generosity, and patience provided by my dear friends and extended family. And, finally, many thanks to Dr. Barker, a true-blue supervisor, who guided and encouraged me throughout this rewarding experience.

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"From a public health perspective, one should be no more willing to expose the public to an untested message than to an untested drug."

(Fischhoff, 1989, p. 115)

Introduction

Health risk communication is a well-established and vibrant field that has in recent years "shifted from an emphasis on health education towards behaviour and social change. The evidence that communication can help people adopt positive health behaviours and create demand for preventive and curative services is growing." (Goldstein et al., 2015, p. 4212). Indeed, scholars working within many disciplines have long recognized the power of communication to affect change at the individual, organizational and societal levels. Referring to organizational communication, Barbour et al. (2018) defines such communicative interventions as "efforts to solve problems with and through communication" (Barbour et al., 2018, p. 332). Put another way, a communicative intervention is a type of administrative mitigation strategy aimed at managing stakeholder and transactor responses to health hazards (Badri et al., 2012). Consequently, public health organizations have been greatly interested in designing and implementing effective communication interventions to address a variety of matters, such as dental hygiene practices, cancer screening, car seat usage, and childhood vaccination uptake (Block & Keller, 1995; Kaufman et al., 2018; A. J. Rothman & Salovey, 1997; Updegraff et al., 2015).

Among these public health topics, one highly visible area of communicative intervention has to do with vaccine hesitancy. In the context of safe, universally recommended vaccines, the concept of vaccine hesitancy (VH) has been defined as "delayed administration or refusal of vaccination, despite the availability of vaccination services and effective vaccines" (Bechini et al., 2019). VH is problematic because under-immunized populations are more vulnerable to outbreaks of serious contagious diseases, such as measles and, more recently, COVID-19. Within this context, many scholars have observed that some communicative interventions succeed and some fail (Brelsford et al., 2017; Dubé et al., 2015; Perrier & Martin Ginis, 2018; Resnicow et al., 2021; Rossen et al., 2016). And, still others, including Ryan and Malinga (2021) say, "There is heterogeneity in vaccine hesitant individuals and a diversity of situations in which vaccine hesitancy can arise, thus requiring that interventions to address vaccine hesitancy be context-specific and problem-specific" (page 89). For these reasons, there has been much interest in designing and implementing communicative interventions to address VH and increase timely vaccination uptake.

Therefore, using a systematic approach to understanding the attributes of effective communicative interventions, I will start by examining two exemplary interventions: one failed and the other succeeded. In doing so, I will explore the interplay of communication theory, framing strategy, and message design revealed by these communicative interventions. Next, informed by this theoretical discussion, I will propose an analytical framework. This framework will be applied to scholarly discourse about interventions that address vaccine hesitancy during two periods: pre-2020 (before COVID-19) and post 2020 (during the COVID-era). The result is a proof of concept or a theoretical application that can shed light on a thorny problem introduced

by Barbour: How to design communicative interventions to "navigat(e) the complex tensions and contradictions that permeate social life" (Barbour et al., 2018, p. 333).

Two Examples

The following discussion of communicative interventions, looks at two exemplary health communication programs that address VH: one was so unsuccessful that it sparked a backlash or negative reaction while the other was deemed successful. The first program, which was unsuccessful, called “I Immunise” is described by Attwell and Freeman (2015). I Immunise was a social marketing campaign run by the Immunisation Alliance of Western Australia, a not-for-profit pro-vaccination advocacy organisation in Fremantle, Western Australia (Attwell & Freeman, 2015). The second program, which was successful, was called “Immunity Community,” and is described by Schoeppe et al. (2017). Immunity Community was a three-year social marketing program run by a public–private partnership of health organizations in Washington State (Schoeppe et al., 2017). While many questions surround the issue of effectiveness and ineffectiveness of these two programs, a brief examination of the similarities and differences can help identify some of the more obvious distinctions.

The two exemplary interventions were alike in several ways. First, both were conceived as social marketing campaigns, a term coined by Kotler and Zaltman in the 1970s. According to Kotler (2017), although it would have been better named social *cause* marketing, social marketing uses marketing tools “to change behaviours that are counterproductive” (Kotler, 2017, p. 206), such as encouraging exercise and discouraging smoking. In this way, both interventions sought to improve awareness of vaccination “as social norm” (Schoeppe et al., 2017, p. 656), reduce vaccine hesitancy, and reduce exemption rates. Second, both interventions used a variety of message formats to convey pro-social messages as well as scientifically valid and accurate

information about vaccination. The associated print and digital messages were professionally designed and formatted. Third, the interventions both featured real people who shared personal stories. Fourth, the interventions employed various social media platforms (e.g., Facebook pages). Last, both interventions targeted local vaccine hesitant communities that had rates of childhood vaccination coverage that were lower than the national average.

As for differences, there were many. The I Immunise campaign, which was unsuccessful, assumed the ideological orientation of community members. According to Attwell and Freeman, the campaign addressed "ideologically loaded beliefs" (Attwell & Freeman, 2015, p. 6235) and sought to create ideological change. It attempted to do so by "leading with values instead of facts" and by using a combination of "information, values, identity, lifestyle and story-telling . . . [in] a social-identity theory based approach to (lasting) attitudinal change" (Attwell & Freeman, 2015, p. 6236). In contrast, the Immunity Community intervention, which was successful, explored ideological orientation. According to Schoeppe et al., "The intervention mobilized parents who value immunization and provided them with tools to engage in positive dialogue about immunizations in their communities" (p. 655). Furthermore, parent participants functioned directly as social-change agents by taking on the role of community advocates (Schoeppe et al., 2017, p. 655). Plus, the Immunity Community program "had an intentional focus on influencing organizational and/or local policies associated with communication about and monitoring of children's vaccination status, whether at participating sites or in the larger community" (Schoeppe et al., 2017, p. 656). The intention was to address how people communicated about vaccination.

The performance measures and outcomes of these programs were also markedly different. The I Immunise campaign, which was unsuccessful, reported on social media

engagement, earned media coverage, and results of an online survey. Its program evaluators reported that one testimonial poster was shared on Facebook as a meme which "went viral" and had been viewed 12,036 times as of August, 2014 (Attwell & Freeman, 2015, p. 6236). Evaluators also reported that state and national media covered the I Immunise campaign "after the billboards were vandalised by supporters of the Australian Vaccination Skeptics Network" (Attwell & Freeman, 2015, p. 6236). Unlike Attwell and Freeman's interpretation, I view this as evidence of a backlash against the campaign rather viewing it as a media success. And, more importantly, the I Immunise evaluation survey showed that, although 77% of all survey participants had a positive response to the campaign messages, more than two-thirds of self-identified vaccine hesitant survey participants (the target audience) viewed the campaign negatively—another backlash. Among the negative reactions, survey participants had

> *"a range of grievances teased out in qualitative analysis of their survey comments. Some rejected the perceived propaganda and emphasised the importance of their right to choose. Others emphasised their distrust with the information source and its links to government and pharma. There were also complaints that the material was one-sided and that it stereotyped people based on lifestyle and vaccine decisions" (Attwell & Freeman, 2015, p. 6237).*

In contrast, the Immunity Community program, which was successful, was evaluated using a mixed-methods process which included key informant interviews, parent (stakeholders) surveys at the intervention sites, and parent advocate activity logs.[1] Notably, the "surveys of parents in the intervention communities showed statistically significant improvements in

[1] Activity logs completed by the parent advocates tracked campaign-related social media posts, conversations, emails, planning, materials, meetings, and events.

vaccine-related attitudes: The percentage concerned about other parents not vaccinating their children increased from 81.2% to 88.6%, and the percentage reporting themselves as "vaccine-hesitant" decreased from 22.6% to 14.0%" (Schoeppe et al., 2017, p. 654). Furthermore, a state-wide policy-related outcome was also reported: The Organization of Parent Education Programs (OPEP), "revised its risk management manual to designate individuals at each cooperative to collect immunization records, calculate immunization rates, and maintain records…[which] has the potential to affect all cooperative preschools in Washington." (Schoeppe et al., 2017, pp. 658–659). In this way, the Immunity Community successfully fulfilled its mission to engage parent volunteers as immunization advocates to address VH within their communities and to make lasting policy changes (Schoeppe et al., 2017, p. 654).

Given these contrasting outcomes, how can we model the difference between these two interventions with respect to their success and failure? One way to characterize the difference is to see one as a public-relations campaign, and the other as a public-involvement campaign. This difference in approach has been noted in other scholarship. For example, Health Canada's *Strategic Risk Communication Framework and Handbook* distinguishes between one-way public-relations campaigns and two-way communication which focuses on supporting stakeholder decision-making (Thorne Butte: Decision Partners Inc., 2006, pp. 2–20). Furthermore, public-relations campaigns are generally designed to create awareness or interest in an issue which "can have an influence on people's motivation to change, but on their own, they rarely result in behaviour change" (Thorne Butte: Decision Partners Inc., 2006, pp. 2–20). Furthermore, such public-relations campaigns are often used to advocate a position that may not line up with stakeholder interests and thinking models. Although these two approaches share several characteristics, I assert that they are fundamentally different. For my purpose, which is to

create a conceptual framework that can be used to interpret and assess the effectiveness of communicative interventions, I will refer to these as the *promotional* approach and the *communicative engagement* (CE) approach.

In the following sections, I explore a theory of knowledge, a framing strategy, and a message design model to illustrate the distinction between the promotional approach and the CE approach.

Review of Communicative Interventions to Address Vaccine Hesitancy

As one might expect, communicative interventions (CIs) to address VH come in many shapes and sizes: from singular events, such as explainer videos (Witus & Larson, 2021), to large-scale, well-funded, multi-site communication campaigns (Gagneur et al., 2019). Some involve health care provider (HCP) protocols (Reno et al., 2018) while others are social marketing initiatives (Aya Pastrana et al., 2020). In all cases, the goal of these CIs is to motivate positive behaviour change which is often measured by compliance with vaccination schedules (Buer et al., 2017; Marti et al., 2017) or reduction of negative attitudes towards vaccination (Dubé et al., 2019; Roberts et al., 2015). Yet, despite conveying similar messages and using similar tactics and channels, systematic analysis shows certain interventions have worked as predicted while others have failed (Aya Pastrana et al., 2020; Brewer, 2021; Briss et al., 2000; Dubé et al., 2015; Gallagher & Updegraff, 2012; Kaufman et al., 2018; A. J. Rothman & Kiviniemi, 1999). In fact, as Ward et al. (2019) says, “exposing people to pro-vaccine messages and information on vaccination can do only so much and can even backfire. Many ways of communicating about vaccination have been found to have very limited effects and sometimes

even to be counterproductive" (p. 1259). Why do some ways of communicating about vaccination work as intended while others do not?

Theory: Rational or Narrative Knowledge Paradigm

Within the seven traditions of communicative thought envisioned by Craig (Craig & Muller, 2007; Griffin et al., 2015; Littlejohn & Foss, 2010) there are many theories of communication (Craig & Muller, 2007; Griffin et al., 2015; Littlejohn & Foss, 2010). Among them, a prominent theory that relates to health communication comes from Fisher. According to Fisher (1984), there are two paradigms of human communication: the *rational* and the *narrative*. The rational paradigm is a communicative form based on cognition and scientific evidence (i.e., collections of facts connected by reason). Put plainly, this approach sees people as thinkers who explain life events and experiences based on evidence and facts. The rational paradigm defines persuasion as a form of argument that convinces through presentation of quantitative, measurable evidence, and observations which leads to reasonable, logical conclusions (Fisher, 1984).

The narrative paradigm, on the other hand, is a communicative form based on sense and meaning abstracted from stories (i.e., sequences of events connected by causality) (Fisher, 1984). That is to say, this approach sees people as storytellers who "make sense of their lives and life events through the stories they hear and share with others" (Perrier & Martin Ginis, 2018, p. 1499). The narrative paradigm defines persuasion as a form of argument that convinces through an exchange of qualitative, subjective experience as well as values, beliefs, and attitudes using both reason and accounts of shared experience (Fisher, 1984). Fisher is not the only voice here. For example, Betsch et al. (2011) discusses the *narrative* paradigm in the health realm,

> *"narratives (also known as testimonials or anecdotes) are story-like, coherent prose pieces that describe a personally experienced event from a first- or third-person perspective. They provide appealing detail, characters, and some narrative plot. Narratives are frequently used to aid patients in health decisions, for example, by supporting their sense making and coping."(Betsch et al., 2011, p. 2).*

Although these are important distinctions, there is also a key difference between the role of the expert in the rational paradigm versus the role of the expert in the narrative paradigm. This is relevant because it relates to the role of the persuader acting within a communicative intervention. In the rational paradigm, the expert (the persuader) is the person with the most facts and reasoning. This person is often associated with scientific authorities with credentials and is often in a position of power.

On the other hand, in the narrative paradigm the expert (the persuader) is the person who narrates the story. This person is often an experienced individual, elder, and knowledgeable person who may not necessarily be in a position of power but who assumes a kind of power through their standing in the community. It is worth noting that sometimes within the *narrative* paradigm the persuader is an expert with a foothold in two worlds: a rational-world authority with credentials as well as an experienced narrator with standing in the community. In these cases, Fisher (1984) says the rational-world experts become counsellors once they "cross the boundary of technical knowledge into the territory of life as it ought to be lived" (1984, p. 13).

These distinctions can be seen in the two exemplary interventions we looked at earlier. The first campaign, I Immunise, had characteristics of the rational paradigm. For example, the logic presented in the promotional posters was clear: We share certain behaviours and values. I made a good choice to immunize. You should make a good choice too. Also, by virtue of being

featured in the posters, the spokespeople were authoritative persons. Interestingly, however, this authority was weak because it was represented within a campaign construct (i.e., an idealized marketing persona) created from certain community beliefs associated with a set of alternative life-style practices. Conversely, the second intervention, Immunity Community, had characteristics of the narrative paradigm. In this instance, the persuaders were actual community members (called parent advocates) with a genuine interest in exploring shared values. These parent advocates engaged in conversations with other parents about their immunization experiences so they might develop mutual understanding.

Framing Strategy: Informative Versus Strategic

It is arguable that all forms of human communication, whether it is in the rational or narrative paradigm, assume a frame be it socio-cultural, situational, or otherwise. As Entman (1993) says,

> *"To frame is to select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, casual interpretation, moral education, and/or treatment recommendation for the item described. Typically, frames diagnose, evaluate, and prescribe"(Entman, 1993, p. 52).*

Accordingly, within the health risk context, there has been much attention paid to frame effects particularly those produced by gain or loss framing (Abhyankar et al., 2008; Detweiler et al., 1999; Gallagher & Updegraff, 2012; Alexander J. Rothman et al., 1999; Salovey & Williams-Piehota, 2004; Updegraff et al., 2015; Updegraff & Rothman, 2013) and fear-based framing (Block & Keller, 1995; Coleman & Hatley Major, 2014; Jin et al., 2021; Witte, 1995). Much of this area of inquiry builds upon prospect theory, a descriptive model of behaviour proposed by

Kahneman and Tversky in 1979 that holds that how a message is framed (such as to suggest a gain or loss) can predict stakeholder decision-making behaviour. For example, in a series of experiments, they found that certain changes (such as suggestions of gain or loss) in the wording of choice problems (i.e., messages about risk-related information used in individual decision making) affected decision-making choices systematically (Tversky & Kahneman, 1981).

More recently, however, there is growing interest in neutralizing frame effects when informing people about risk (Garcia-Retamero & Galesic, 2010; van der Bles et al., 2019). Some scholars who suggest that risk communicators should "strive to inform, not persuade" (Blastland et al. 2020, page 362) have offered rules and tips for communicating about risk-related scientific evidence. Although it is debatable whether a CI can have a neutral frame, the concern here seems to be avoidance of undue influence on decision-making.[2] In this vein, there is also a growing body of scholarship on science literacy, health literacy, and numeracy (i.e., the ability to understand statistics and numeric representations of information) related to cognition of health information (Blastland et al., 2020; Brick et al., 2020; Cairo, 2019).

For my purpose here, I define two types of frames: the *informative* frame and the *strategic* frame. The informative frame is one that frames health messages as "educational" or "factual." That is to say, verifiable facts about health topics, such as safety and efficacy, are framed in an apparently neutral or value-free manner. In practice, informative persuaders use plain language, avoid jargon, use graphic-design techniques (e.g., fact boxes), and present messages in a clinical fashion so that the facts speak for themselves (Brick et al., 2020; Fagerlin

[2] Witte says, "any risk message, by virtue of presenting certain facts to the exclusion of others (because of time or other constraints), will influence its audience in some manner. There is no such thing as a neutral risk message."(Witte, 1995, p. 524).

et al., 2011; Garcia-Retamero & Galesic, 2010; Horne et al., 2015). With respect to addressing vaccine hesitancy, Olson et al., (2020) says, the majority of interventions "have been educational and focused on a 'knowledge-deficit' approach, assuming that vaccine-hesitant individuals will change their mind if given proper information" (Olson et al., 2020, p. 3/25).

Conversely, the strategic frame is one that frames health messages in support of (or against) a particular position. Additionally, messages within a strategic frame may associate health choices with matters of personal belief, attitudes, emotions, and identity. In practice, strategic persuaders often employ well-known techniques borrowed from rhetoric (i.e., amplification, use of analogy) and/or behavioural science techniques (i.e., gain/loss framing) to nudge people in the right direction.

The distinction between the informative and the strategic frame is visible in the exemplary interventions. While both appear to use a strategic frame, the I Immunise campaign, which was unsuccessful, uses an informative frame because of its emphasis on "good health choices" and "social responsibility," which are both predicated on verifiable facts about vaccine safety and efficacy. Meanwhile, the Immunity Community program, which was successful, spread positive stories about vaccination through parent advocates equipped with information gained through training from public-health experts. This strategic framing involves a persuader (a knowledgeable community member/parent advocate) sharing information (gained from expert medical authorities) but, more importantly, personal experience in a mutually constructed dialogue with stakeholders. The first intervention relies on factual constructs and benefits while the second intervention relies on information and strategic engagement.

Message Design Model: Peripheral Route versus Central Route

For more than a hundred years, social psychologists have been studying attitudes because they play a vital role "in the critical choices people make regarding their own health and security as well as those of their families, friends, and nations" (Petty & Wegener, 2010).[3] However, according to Petty and Cacioppo (1986), although there is abundant data and theory, "there was surprisingly little agreement concerning if, when, and how the traditional source, message, recipient, and channel variable affected attitude change" (p. 125). To address this gap, Petty and Cacioppo proposed the elaboration likelihood model (ELM), a general theory of attitude change, which has since been applied to psychotherapy, counselling, advertising, and marketing, as well as health-related communicative interventions (Jones et al., 2003; Schmid & Betsch, 2019; Updegraff & Rothman, 2013). Indeed, ELM "has been a leading, if not the leading, theory of persuasion and attitude change" (Griffin et al., 2015, p. 198).

ELM, which proposes two processing models for attitude change—*peripheral route* or *central route*—is especially relevant to decision-making associated with vaccination. In brief, persuasive messages that are perceived by the listener as irrelevant or lack need for complex thought, (i.e., a simple cue such as an attractive spokesperson) or are difficult to understand are often processed by something called the peripheral route. Under these conditions, ELM suggests these messages may succeed but this technique is likely to produce a short-lived attitude change that is unpredictive of behaviour.

Alternatively, persuasive messages that are perceived as personally relevant and require careful consideration (i.e., significant thought) are processed following the central route. This

[3] Petty and Cacioppo (1986) "regard attitudes as general evaluations people hold in regard to themselves, other people, objects, and issues." (Petty & Cacioppo, 1986, p. 127). Furthermore, these evaluations "are capable of influencing or guiding behavioral, affective, and cognitive processes" (Petty & Cacioppo, 1986, p. 127).

route involves elaboration which is "the extent to which a person carefully thinks about issue-relevant arguments contained in a persuasive communication" (Petty & Cacioppo, 1986, p. 7). Therefore, these messages can influence listener attitude in a way that is "relatively enduring, resistant, and predictive of behavior" (Petty & Cacioppo, 1986, p. 126). Thus, persuasive messages that are salient, prompt thought, and actuate personal responsibility take the *ce*ntral route wherein there is a change to the listener's cognitive structure such that there is a favourable (or unfavourable) attitude change (Petty & Cacioppo, 1986).

Again, I will turn to the exemplary interventions for illustration of this message design model. The unsuccessful I Immunise campaign used peripheral cues, namely attractive professional portraits of residents (experts) represented within posters, billboards, and advertisements. Additionally, these posters conveyed a very simple message that passersby likely required/spent little time to process. In this way, the message appealed to peripheral route processing, meaning initial attitudes about vaccination were likely retained or, at best, a relatively temporary attitude shift occurred.

Meanwhile the second intervention, Immunity Community, which was successful, used message design that employed central route processing. The parent advocates planned and hosted events about childhood immunization within schools and childcare settings. They also engaged in dialogue with other parents using social media, through email, and in conversations. These types of highly relevant exchanges are by their nature cognitively demanding while allowing for accommodation (i.e., adjustment of message) according to the needs of listeners. In this case, analysis of message design using ELM suggests that the attitude changes produced via the central route are more likely to be predictive of behaviour which is consistent with the outcomes of the Immunity Community intervention.

A Conceptual Framework for Analysis of Communicative Interventions

Taken together, the theory, framing strategy, and message design model described previously can be viewed as a conceptual framework for analysis of CIs that involve attitudinal and behavioural change. This framework, shown in Figure 1, allows for a structured characterization of the scholarly discourse about communicative interventions that address vaccine hesitancy.

Communicative Intervention Approach	**Promotional Approach**	**Communicative Engagement Approach**
Knowledge Theory	**Rational**: Generate awareness and interest in a topic within target audiences; increase conversions (a key performance indicator)	**Narrative**: Aid informed decision-making of stakeholders so they may protect themselves and others; keep people safer
Framing	**Informative**: Persuade based on certainty; problematize situations and offer solution; use social pressure to change behaviour; social marketing focus	**Strategic**: Address a risk issue or opportunity based on respectful engagement and curiosity; develop shared understanding and enable behaviours that align with values and beliefs
Message Design Model	**ELM peripheral route**: Call to action; one-way; audience is subject of intervention; authoritative speaker communicating to the "other"	**ELM central route**: Invitation to engage; two-way exchange among peers and with experts; collaborative; speaker and listener in empathic role within a relationship

Figure 1. A conceptual framework showing two approaches to communicative intervention

Methods

As the preceding review indicates, there is much uncertainty about why some communicative interventions are successful and others fail. To understand the dynamics of CIs, I propose to use the conceptual framework presented in Figure 1 to perform a qualitative analysis (process) of scholarly discourse (data) about CIs that address VH. The discussion that follows describes the data used, how the data was collected, and how the data was processed.

Data and Data Collection

As discussed, vaccine hesitancy is a complex phenomenon with a large and growing body of scholarly literature that attempts to define VH as well as understand reasons for VH (Dubé et al., 2015; Dubé & MacDonald, 2018; MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015). There are several reviews of empirical studies about parent's attitudes (Dyda et al., 2019; Moffatt & McNally, 2013; Smith et al., 2017), and there are many empirical studies of VH within various jurisdictions (Guay et al., 2019; Murphy et al., 2021) as well as particular socio-economic subgroups, such as California parents of kindergarten-aged children (Delamater et al., 2018), Black communities (Bogart et al., 2021; Callaghan et al., 2020), faith groups (Privor-Dumm & King, 2020; Williams et al., 2020), and many more. Notably, much of this scholarship has focused on parental VH in the context of childhood vaccination. Although these studies are not the focus of this analysis, understanding of this literature has been formative. In parallel, there is copious discourse about CIs that address VH (Durand et al., 2021; Lazić & Žeželj, 2021; Victor, 2020; Winograd et al., 2021). Notably, the "Communicate to Vaccinate" taxonomy of CIs by Kaufman et al. (2017) and a review of interventions addressing parental VH in the US by Olson et al. (2020), have contributed significantly to my understanding of this multi-dimensional topic as well as many of the central themes of the scholarly discourse.

Thus, the discourse (data) to be analysed are peer-reviewed articles published in academic journals by scholars in disciplines such as nursing, pediatrics, public health, communication, risk communication, and psychology. Additionally, the data are empirical studies, meaning the methods of observation, units of measurement, analysis, results, and discussion are described in a systematic manner, which will allow for comparison and extraction of meaning. Lastly, studies that report the effectiveness of CI as measured in at least one of the

following ways have been included: changes in attitude toward vaccination, changes in intention to be vaccinated, changes in level of vaccine hesitancy, and/or changes in vaccination behaviour.

Two-step Process

Informed by this review of the topic and awareness of the general characteristics of the data, I will evaluate a purposive sample of empirical studies about CIs to address VH from two time periods: Pre COVID-19 and post COVID-19. The decision to define the data collections in this manner is intentional. Since the World Health Organization (WHO) announcement that "COVID-19 could be characterized as a pandemic,"(World Health Organization, 2021) and the development of vaccines that are highly efficacious as well as safe for use by adults (*COVID-19: Vaccine Safety and Side Effects*, 2021), VH and how to address it, has become commonplace in public discourse.[4] Thus, I propose that a dividing line—pre-and post-January 2020—demarcates distinct socio-cultural and socio-physiological eras with respect to the VH phenomena, and, therefore, application of the conceptual framework to discourse from these two eras will allow any attendant differences in effectiveness of CIs to be readily observed. For this reason, the analysis will be performed in a two-step process. First, I will analyse historic discourse published before 2020. Second, I will analyze scholarly discourse published during the COVID-19 era from January 2020 to June 2021. This two-step process will also allow for two levels of validation: Validation of the conceptual framework pre-pandemic and a secondary validation based on data published during the pandemic.

[4] Every mainstream current affairs magazine and news outlet has run countless features, opinion pieces, podcasts and audience Q&A segments about persuading vaccine hesitant and vaccine resisters. This includes public and private media outlets such as The Atlantic, the Economist, Maclean's, L'express, PBS, NPR, CNN, BBC, France Info, CBC/SRC, the New York Times, the Guardian, le Monde, the Globe & Mail, and many more.

Sampling and Inclusion Criteria

The purposefully sampled empirical studies have been published in English with full text available through the University of Alberta Library. Studies that are representative of diverse CI methods (e.g., HCP interventions, social marketing campaigns, rebuttal techniques), diverse study populations (e.g., mothers, parents of infants, parents of school-aged children, parents of adolescents, and faith/ethnic communities), diverse illness (e.g., measles, seasonal influenza, and COVID-19) and used diverse research methods (e.g., qualitative, quantitative, and mixed methods) have been selected for inclusion. When studies appeared substantially similar (i.e., shared two or more of these attributes), I included the most recently published study of its type while the older, similar studies were excluded. My goal was to collect empirical studies that are representative of a range of CIs used in such situations.

Search Strategies

The data was collected using two search strategies:

(1) **Keyword search**: Google Scholar advanced searches within the specified time periods were for "vaccine hesitancy" (exact phrase) and "communication intervention" (all the words) keywords appearing anywhere in the text. For convenience, the pre-COVID search was limited to 2018 and 2019. Among the 1,540 results, the top 300 studies were screened (i.e., read the title and abstract). After application of the criteria mentioned previously, 12 studies were included. This process was repeated for the COVID-era period from January 1, 2020 to June 30, 2020. In this instance, the Google Scholar search returned far fewer results: 124. All these studies were screened and 11 were included.

(2) **Pearl reference**s: Several reviews, a meta review, and numerous commentaries about interventions to address vaccine hesitancy were identified using the first search strategy for the pre-COVID period. These became a jumping off point for a supplemental data collection effort which yielded eight more empirical studies.

Data Processing

According to Miles and Huberman (1984), qualitative (textual) analysis involves three concurrent activities—data reduction, data visualization, and drawing conclusions—which flow back and forth in a loop. For its part, data reduction "refers to the process of selecting, focusing, simplifying, abstracting, and transforming the raw data that appear in edited field notes. . . it continues throughout the life of any qualitatively-oriented project" (Miles & Huberman, 1984, p. 23). This short description accurately depicts the way in which the representations of scholarly discourse were sampled and collated.

The collation process entailed three phases: (1) characterisation of CI; (2) categorization of CI according to a conceptual framework; (3) manipulation of coded analysis for visual display. This three-phase process was applied first to the pre-2020 historical data and then it was applied secondarily to the post 2020 data.

Phase 1: Characterization of CI

To start, the empirical studies published before 2020 that were screened for inclusion were read in their entirety. At this time, their salient characteristics were recorded in a tabular form. Each unit of analysis (a representation of a study and an associated CI) is recorded in a row while the characteristics of each unit are ordered in columns. Each unit was assigned a uniquely identified number (ID#) and nickname (lead author last name, year of publication). Additionally,

in subsequent columns, the salient characteristics of the study were recorded. The complete list of characteristics includes:

- Column A: ID number
- Column B: Study nickname (lead author last name, year)
- Column C: Purpose and context of study
- Column D: Study methodology
- Column E: Outcome/behaviour measured
- Column F: Description of communicative intervention
- Column G: Author's key findings
- Column H: Population (e.g., adults, parents, students)
- Column I: Format (e.g., HCP-lead, text/video message, online resource center, social marketing campaign)
- Column J: Configuration: Single CI or multiple CIs evaluated as a unit

This phase one analysis revealed instances of studies with multiple overlapping defining characteristics. In these instances, duplicate studies were removed. Also, gaps, such as a lack of studies that employed qualitative methods, were identified. In these instances, search strategy two, mentioned previously, was used to locate suitable studies that presented these characteristics. Furthermore, studies whose findings were poorly articulated or otherwise unclear were excluded.

Once complete, the first phase of the collation process for the historical period (pre-2020) yielded a collection of 20 empirical studies. Among them, the most recent were published in 2019 and the oldest was published in 2011. Meanwhile the post 2020 discourse includes representations of 11 English-language empirical studies of communication interventions to

address vaccine hesitancy. Notably, six of 11 studies represented in this collection address COVID-19-related VH.

Phase 2: Categorization of CI According to Framework

The second phase of the collation process entailed careful inspection of each CI tested. Several studies reported on more than one CI. In these cases, each CI has been assigned a unique ID number suffix (e.g., A03-01). Using the conceptual framework (see Figure 1), each intervention was categorized according to effectiveness (CI effect) and according to the bi-modal distinctions as follows:

- Column K: CI effect: Yes=positive effect No=negative effect or no effect
- Column L: Knowledge paradigm: Rational or Narrative
- Column M: Framing: Informative or Strategic
- Column N: Message design model: Peripheral Route or Central Route
- Column O: Observations

This process revealed that some CIs produced no measurable effect. These instances were categorized as "No." Furthermore, in other instances, although the study author stated that the CI was successful, close inspection indicated otherwise—the CI was not effective because the VH population did not change its vaccination attitude/behaviour or there was a negative effect. Categorization according to the knowledge paradigm and framing was comparatively straightforward. The message design model, however, proved more challenging in instances where the description of the CI tested, including the circumstances surrounding the intervention, was incomplete or lacked detail. In these instances, I recorded my assumptions in the

"observations" field. In this way, instances with similar circumstances and characteristics were categorized in a consistent fashion.

Phase 3: Manipulation of Coded Tabular Records for Visual Display

Lastly, phase three involved three manipulations of the outputs of previous processes. The first manipulation consolidated the tabular records from phases 1 and 2. This produced a unified detailed view of the CI characteristics combined with the CI coding according to the attributes of the conceptual framework.[5] The outputs of this process are:

- Appendix A. Representation of discourse pre-2020
- Appendix B. Representation of discourse post 2020

The second manipulation involved reducing the type of information displayed. Specifically, columns B, C, D, E, F, and G were eliminated from Appendix A and Appendix B.

The third manipulation involved creation of a colour-coded representation of the CI categorization according to the conceptual framework. The tabular records produced by the second manipulation were sorted according to CI effect with "Yes" displayed in green and "No" displayed in red. The outputs of this last manipulation are:

- *Figure 2*. Pre-2020 colour-coded representation of CI effect
- *Figure 3*. Post 2020 colour-coded representation of CI effect

[5] Column O: Observations which includes researcher coding notes is not displayed.

Results

The results of the analyses described in the methods section will be presented in two parts. The first part looks at the pre-2020 discourse and then the second part looks at the post 2020 discourse.

Pre-2020 Discourse

Once the data was processed using the methods described previously, the outcome is a representation of the pre-2020 discourse in tabular form (see Appendix A). This tabular presentation allows for a fine-grained view of each CI and its characteristics. Inspection of Appendix A shows the 20 studies represented in the pre-2020 discourse include representation of 34 CIs. Among these CIs, 22 of 34 (65%) were effective and 12 of 34 (35%) were ineffective. Although there are many ways to view this representation of the discourse, I will begin by examining the following aspects: the population (column H), the format (column I), and the configuration (column J).

Based on inspection of Appendix A, it might be argued that CI effectiveness depends upon the population. The populations subjected to these CIs include parents, students, and adults. Among the interventions with parents, 15 of 19 (79%) were effective. This is the highest success rate among the three populations. However, each population is associated with at least one ineffective CI, so presence of this attribute offers an incomplete understanding of the CI mechanisms associated with effectiveness.

At the same time, it might also be argued that CI effectiveness depends upon the intervention format. The CI formats represented in the pre-2020 discourse include HCP-lead interventions, text or video-based messages, online resource centres, and social marketing

campaigns. Among the HCP-lead interventions, nine of 11 (82%) were effective. This is the highest success rate among the CI formats. However, at least one CI of each format was ineffective. Much like the population, the presence of the format attribute offers an incomplete understanding of the CI mechanisms associated with effectiveness.

Additionally, it might also be argued that CI effectiveness depends upon the configuration of the intervention: whether it is a single event or a multi-component CI. Among the multi-component studies, five (83%) were effective while one was ineffective. Accordingly, the presence of this attribute offers an incomplete understanding of the CI mechanisms associated with effectiveness.

Lastly, it might be argued that CI effectiveness depends upon a combination of population, format, and configuration. Among the CIs in the intersection of the HCP-lead set, the parent set, and the multi-component set, four of four were effective. Although this proposition—that CI effectiveness depends upon a combination of format, population, and configuration—may add to our understanding of CI mechanics, it does not suggest why no discernible pattern was observed in the 30 remaining CIs.

To recap, within this sample of 20 studies which includes representation of 34 CIs, the association of the CI characteristics with CI effect appears somewhat diffuse. Indeed, HCP-lead CIs, which have been acknowledged as the most "potent intervention" (Brewer, 2021, p. S13) are not uniformly effective. This reading of the situation also aligns with other scholarly commentary from Dubé et al. (2015), who says "there is no strong evidence to recommend any specific intervention to address vaccine hesitancy/refusal" (p. 4191) and Rossen et al. (2016) among others. Clearly, this depiction of the CIs offers an incomplete understanding of the mechanics of CI effectiveness.

For this reason, I will now examine the CIs at a higher level of abstraction using the conceptual framework (Figure 1) which distinguishes between CIs that are aligned with the promotional approach or the communicative engagement (CE) approach. Using this framework, each CI is coded according to its attributes: rational or narrative, informative or strategic, peripheral or central (see columns K, L and M of Appendix A). Admittedly, this data display is cumbersome. To remedy this problem, Figure 2 presents a simplified, colour-coded visualization. Each CI that was effective (marked "yes") is highlighted in green and each ineffective CI (marked "No") is highlighted in red. Alongside the Yes/No field, there are columns of checkboxes that indicate the coded attributes.

ID#	CI Effect	Rational	Informative	Peripheral Route	Narrative	Strategic	Central Route
A01	Yes	☐	☐	☐	☑	☑	☑
A05	Yes	☐	☐	☐	☑	☑	☑
A10	Yes	☐	☐	☐	☑	☑	☑
A17	Yes	☐	☐	☐	☑	☑	☑
A02	Yes	☐	☐	☐	☑	☑	☑
A06-01	Yes	☐	☐	☐	☑	☑	☑
A07-01	Yes	☐	☐	☐	☑	☑	☑
A08	Yes	☐	☐	☐	☑	☑	☑
A15-01	Yes	☐	☐	☐	☑	☑	☑
A15-02	Yes	☐	☐	☐	☑	☑	☑
A14	Yes	☐	☐	☐	☑	☑	☑
A16-01	Yes	☐	☐	☐	☑	☑	☑
A18	Yes	☐	☐	☐	☑	☑	☑
A11-01	Yes	☐	☐	☐	☑	☑	☑
A11-02	Yes	☐	☐	☐	☑	☑	☑
A19-01	Yes	☐	☐	☐	☑	☑	☑
A19-04	Yes	☐	☐	☐	☑	☑	☑
A20-03	Yes	☐	☐	☐	☑	☑	☑
A12-01	Yes	☐	☑	☑	☑	☐	☐
A09	Yes	☑	☐	☐	☐	☑	☑
A03-01	Yes	☑	☐	☐	☐	☑	☑
A03-02	Yes	☑	☐	☐	☐	☑	☑
A19-02	No	☐	☐	☑	☑	☑	☐
A19-05	No	☐	☐	☑	☑	☑	☐
A20-01	No	☐	☐	☑	☑	☑	☐
A07-02	No	☐	☑	☐	☑	☐	☑
A12-02	No	☐	☑	☑	☑	☐	☐
A04-02	No	☑	☐	☐	☐	☑	☑
A20-02	No	☑	☐	☑	☐	☑	☐
A06-02	No	☑	☑	☐	☐	☐	☑
A13	No	☑	☑	☑	☐	☐	☐
A04-01	No	☑	☑	☑	☐	☐	☐
A16-02	No	☑	☑	☑	☐	☐	☐
A19-03	No	☑	☑	☑	☐	☐	☐

Figure 2. Pre-2020 colour-coded representation of CI effect

The pattern revealed in Figure 2 is striking. Among the successful interventions (shown in green), 18 of 22 (82%) of CIs display all three attributes of the CE approach. That is to say, CIs using the CE approach operate within the narrative paradigm, use strategic framing, and employ a message design model that is likely to engage cognitive processing via the central route. In contrast, the unsuccessful interventions (shown in red) are aligned predominantly with

the promotional approach. These promotional-style interventions typically operate within the rational paradigm, use informative framing, and employ a message design model that is likely to engage peripheral route processing. Among the 12 unsuccessful interventions, four display all the promotional approach attributes, two display two attributes of the promotional approach and the remaining six CIs display one of the promotional approach attributes. These results strongly suggest that CIs that are in alignment with all attributes of the CE approach construct—its theory, framing, message design model—are far more likely to be successful than CIs that display one or more attributes of the promotional approach. Consequently, this application of the conceptual framework to the pre-2020 discourse appears to increase our understanding of some of the attributes associated with effective CIs.

Post 2020 Discourse

Moving on to step two of data processing, the conceptual framework will be applied now to a representation of the discourse from the post 2020 era. By replicating the processing method from step one, the validity of the framework will be tested a second time.

To replicate the process, we will start by examining some distinguishing features of the post 2020 discourse shown in Appendix B. Among the CIs represented, 12 of 25 (48%) were effective. When compared to the pre-2020 discourse, this is a 17% reduction in CIs that were effective. Also, the population most commonly addressed in the post 2020 discourse is adults (21 of 25 CIs involve adults) whereas parents were the subject of the majority of CIs in the pre-2020 discourse. Additionally, the predominant CI format is text/video message, whereas in pre-2020 discourse, it was HCP-lead interventions.

Now let us examine the population, the format, and the configuration of CIs within the representation shown in Appendix B. Much like the previous discourse, it might be argued that

during the post-2020 era CI effectiveness depends upon the population. This time the populations subjected to the CIs include parents, adults, and soldiers. Among the interventions with parents, three of three were effective. Meanwhile, in contrast, only eight of 21 (38%) of the adult-directed CIs were effective.

At the same time, it might also be argued that CI effectiveness depends upon the intervention format. The CI formats represented in the post 2020 collection include HCP-lead interventions, text or video-based messages, and a community outreach initiative. Among the HCP-lead interventions, nine of 11 (82%) were effective while the lone community outreach initiative was effective too.

Additionally, it might also be argued that CI effectiveness depends upon the configuration of the intervention. Among the multi-component studies, four of four were effective.

Lastly, it might be argued that CI effectiveness depends upon a combination of population, format, and configuration. In this case, there are no CIs in the intersection set of all three characteristics.

In summary, within this small sample of 11 studies which includes representations of 24 CIs, CI effectiveness is clustered around discrete characteristics. Put another way, all the interventions with parents were successful, the majority of the HCP-led interventions were effective, and all the multicomponent CIs were effective. Yet, a thread that joins parents with HCP-lead and multicomponent interventions is not apparent. This diffuse pattern is similar to the observation of the pre-2020 discourse. So, although these propositions—that CI effectiveness

depends upon the format, population, and/or its configuration—may add to our understanding of the situation, they are again insufficient.

Now let us apply the conceptual framework to the post 2020 studies. Shown in Figure 3, this colour-coded table displays a clear pattern that resembles the pre-2020 discourse. The 13 successful CIs (in green) display one or more of the attributes associated with the CE approach. Specifically, 5 CIs display three such attributes, 6 CIs display two such attributes and the remaining CI displays one such attribute. As for the unsuccessful interventions (in red), all line up with the promotional approach. Among the 13 unsuccessful interventions, two display all attributes associated with the promotional approach, 10 display two such attributes and the remaining CI displays one such attribute.

Much like the application of the conceptual framework to the pre-2020 discourse, this analysis strongly suggests that CIs that display all attributes of the CE approach construct—its theory, framing, message design model—are far more likely to be successful than CIs that display attributes of the promotional approach. Furthermore, these results also suggest that the circumstances surrounding the pandemic—six of the studies including 19 CIs represented in the post 2020 discourse addressed COVID-19 VH—have not affected the essential dynamics of this conceptual framework. Therefore, this second application confirms the association of CE-approach attributes with successful communicative interventions while the attributes of the promotional approach are associated with unsuccessful interventions. In other words, if the analysis and coding are sound, the presence of these three variables is sufficient to describe the dynamics of CI to address VH.

ID#	CI Effect	Rational	Informative	Peripheral Route	Narrative	Strategic	Central Route
B08*	Yes	☐	☐	☐	☑	☑	☑
B05*	Yes	☐	☐	☐	☑	☑	☑
B09*	Yes	☐	☐	☐	☑	☑	☑
B03	Yes	☐	☐	☐	☑	☑	☑
B04*	Yes	☐	☐	☐	☑	☑	☑
B06-03	Yes	☑	☑	☐	☐	☑	☑
B06-04	Yes	☑	☐	☐	☐	☑	☑
B07-02*	Yes	☑	☐	☐	☐	☑	☑
B11-05	Yes	☑	☐	☐	☐	☑	☑
B11-07	Yes	☑	☐	☐	☐	☑	☑
B11-10	Yes	☑	☐	☐	☐	☑	☑
B01-01	Yes	☑	☐	☑	☐	☑	☐
B11-09	No	☑	☐	☐	☐	☑	☑
B01-02	No	☑	☐	☑	☐	☑	☐
B02	No	☑	☐	☑	☐	☑	☐
B06-01	No	☑	☐	☑	☐	☑	☐
B06-02	No	☑	☐	☑	☐	☑	☐
B07-01*	No	☑	☐	☑	☐	☑	☐
B11-02	No	☑	☐	☑	☐	☑	☐
B11-03	No	☑	☐	☑	☐	☑	☐
B11-04	No	☑	☐	☑	☐	☑	☐
B11-06	No	☑	☐	☑	☐	☑	☐
B11-08	No	☑	☐	☑	☐	☑	☐
B10	No	☑	☑	☑	☐	☐	☐
B11-01	No	☑	☑	☑	☐	☐	☐

*Discourse not related to COVID-19 vaccine hesitancy.

Figure 3. Post 2020 colour-coded representation of CI effect

Discussion

As Miles and Huberman rightly said, “No social phenomena, we believe, is wholly idiosyncratic, nor is any overarching social pattern noncontingent” (1984, p. 23). In other words, as much as this discourse analysis has revealed a pattern, its validity has limitations. Accordingly, the discussion that follows addresses limitations of the research, some open questions, and possible next steps.

Limitations

Though fruitful, I must acknowledge that this research project has several limitations including:

- **Small sample size**: More data, especially studies focused on certain underrepresented populations (e.g., adults who are non-parents) may allow for emergence of other patterns and additional communicative forms. Also, more data would increase the generalizability and the validity of the results.
- **Reliance on Google Scholar**: This tool, though convenient, does not make known its relevance-ranking method. Consequently, the highest-ranked scholarly studies, which were screened preferentially, may not be the studies of greatest merit. For this reason, the secondary search strategy was an attempt to identify additional studies worthy of inclusion. Also, identifying representative characteristics and including studies with these characteristics was an additional attempt to minimize vulnerability to potential Google Scholar biases.
- **Keyword selection**: The search strategy, which employed "vaccine hesitancy" and "communication intervention" as keywords, could have been expanded to include alternative keywords such as vaccination, immunization, immunisation, inoculation, resistance, refusal, denial, anti-, acceptance, adoption, communicative, strategies, campaigns, programs, and so on. Certainly, a larger-scale research project of this type would benefit from this more inclusive approach to keyword searching.
- **Non-standard measures of effectiveness:** As discussed, there are many empirical studies of CI and VH, and, at the same time, there are multiple units of analysis or criteria to measure effectiveness. Also, these studies of CI are generally conducted in the field rather

than in a laboratory setting. For these reasons, comparative analysis is difficult. To minimize this problem, only studies that reported effectiveness measured by changes in attitude toward vaccination or intention to be vaccinated or level of vaccine hesitancy or vaccination behaviour were included. Even so, among these studies, definitions of VH vary as do methods of evaluating effectiveness. For this reason, a systematic discourse analysis rather than a Cochrane review (a method of systematic review used to assess medical interventions) is an appropriate methodological approach to address this multi-dimensional research question.

- **Potential category mistake**: Incomplete descriptions of certain communicative interventions necessitated reliance on working assumptions informed by careful observation of other CIs as well as clues drawn from the review of the literature. Although these instances were treated systematically, these subjective judgements may have been unknowingly biased.

Lastly, at the highest level, there are methodological limitations built into a discourse analysis of scholarly literature about communicative interventions that prescribe the discussion. Namely, this analysis attempts to interpret discourse which is one or more steps removed from the intervention experience. This distance from the communicative interaction—among HCPs and parents, health advocates and community members—constrains understanding. Certainly, it would be better to witness CIs first hand. This would allow for genuine openness to alternative modes of seeing that could shed more light on CIs that successfully address VH.

Open Questions

Vaccine hesitancy in particular and health risk communication in general are such complex topics that there are many more open questions than can be listed here. For instance,

does the effectiveness of CIs to address VH change depending on life stage and illness? Although there is a growing body of knowledge about CIs to address parental VH related to childhood vaccination, are the same CI approaches effective for youth and young adults (e.g., HPV), mid-life adults (e.g., seasonal influenza, COVID-19) and senior-stage populations (e.g., COVID-19, seasonal influenza, pneumococcal pneumonia, and shingles)? And, although this research suggests that a communicative engagement approach is associated with attitude change, this effect is far from universal. So, what is going on with stakeholders for whom this communicative engagement approach is ineffective? Plus, are there CI formats and configurations whose effectiveness can be improved or better tuned to the needs of stakeholders by using the communicative engagement approach described here? And what effect does misinformation or disinformation, especially during the pandemic, have on CI that align with the CE approach? And, to what degree does misinformation negatively affect trusted relationships with HCPs and community authorities? Surely, the scholarly discourse on these issues and others related to vaccine hesitancy deserve our attention too.

Lastly, one area of inquiry that was touched on in this discussion but was not addressed sufficiently, relates to backfire effects. An intervention is said to backfire when, for example, rather than changing a VH parent's attitude for the better and/or parental vaccination intentions remain unchanged, the CI is associated with a negative attitude change. Other ways of saying backfire may include "a negative reaction," "a backlash," "a negative effect" or "an unfavourable reaction" Within the pre-2020 discourse, there were several instances of backfire effects (see Appendix A: A04, A06, A07, A13). Although these instances do not share any of the characteristics identified in this analysis (e.g., CI form, population, configuration), according to the conceptual framework they all use the promotional approach to CI. For this reason,

systematic analysis of backfire effects and the conditions that provoke them would be beneficial to enrich our broad understanding of the dynamics of communicative interventions in a health risk context while at the same time gaining a more nuanced understanding of the conceptual framework proposed here.

Next Steps

Although discourse analysis of a larger sample of CIs conducted in the same manner would definitely be helpful, I suggest that the conceptual framework should be carefully applied to more exemplary CIs for which fulsome descriptions, including mixed-methods evaluations, are available. One way to do this is by analysing the discourse about ostensibly similar CIs that are clash pairs—one effective the other ineffective. Indeed, close scrutiny of the dynamics of intervention pairs with particular characteristics of interest (e.g., adults with an online resource centre in a single component configuration addressing COVID-19 VH) would be particularly revealing. Suitable clash pairs could be easily identified within the existing discourse represented here or through a new search for additional texts.

Conclusion

Gagneur et al. (2019) says, “Traditional educational methods (e.g. information pamphlets, communication interventions aiming to provide information) have proven inefficient in addressing VH. It is known that merely providing additional factual information to vaccine-hesitant parents is counter productive” (p. 2). In other words, purely informative interventions work within very limited circumstances. This discourse analysis supports Gagneur’s assertion, however, I argue this depiction of the studies seen through the lens of a conceptual framework offers a more nuanced understanding of the role of information within communicative interventions such as these. In fact, the analysis presented in Figures 2 and 3 shows that

information (e.g., scientifically derived facts) conveyed within the one-way, promotional approach is ineffective. Yet, substantially similar scientific information shared within a two-way, communicative engagement approach is effective. This suggests that, when attempting to persuade the vaccine hesitant, scientific information though vital is insufficient because it is not relational. Indeed, as illustrated by the exemplary Immunity Community social marketing initiative described earlier, by acting within the communicative engagement approach, expert counsellors, such as parent advocates, contextualize these facts within narrative interventions. Meanwhile, within these exchanges, the scientific information is framed in a strategic manner to nudge the stakeholder towards health behaviours that are protective. And, perhaps most importantly, by designing messaging that meets the stakeholder's particular needs, their thinking is stimulated via central route processing such that a more enduring and predictive attitude change is likely to occur.

In conclusion, speaking to risk communicators, Fischhoff says, "It takes two to communicate. If we have not gotten our message across, then we ought to assume that the fault is not with our receivers" (Fischhoff 1989, page 112). This places the responsibility for the design of effective communicative interventions to address vaccine hesitancy right where it belongs, on public health communicators. For this reason, it is incumbent upon health communicators to be well-informed about the stakeholder's situation and to design and rigorously test messages guided by a framework for communicative interventions such as this.

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Appendix A. Representation of Pre-2020 Discourse

ID#	Nickname/link	Purpose and Context of Study	Study Methodology	Outcome measured	Description of Communicative Intervention	Population	Format	Configuration: Single or Multiple	CI Effect	Knowledge Theory	Framing	Message Design Model	Key Finding
										Rational or Narrative	Informative or Strategic	Peripheral Route or Central Route	
A01	Dempsey, 2019	Parent-reported outcomes from a RCT of a HCP CI aimed at improving adolescent HPV vaccination; parents	Paper survey; random sample of 777 parents of adolescents from 8 control and 8 intervention clinics; 47% overall response rate to post-visit survey.	Improving adolescent HPV vaccination rate	Presumptive recommendation and MI conducted by MI-trained HCP	Parents	HCP-lead	Multiple	Yes	Narrative	Strategic	Central Route	"Receipt of a 'very strong' recommendation was associated with greater perceived urgency for getting vaccinated, greater trust in the information received from the provider, decreased vaccine hesitancy, and increased vaccine receipt....and does not seem to have significant negative impacts, even among parents who are vaccine hesitant."
A02	Lemaitre, 2019	Quebec-based study (PromoVac) of maternal attitudes toward infant immunization; parents	Individual educational information session with MI techniques for immunization of infants; during postpartum stay in a quasi-experimental cohort study	Increase vaccination	Postpartum, one-on-one maternal information session (20 minutes) wherein HCP used MI techniques	Parents	HCP-lead	Single	Yes	Narrative	Strategic	Central Route	"parental education intervention using MI techniques improves immunization status at 3, 5, and 7 months of life."
A03-01	Schmid, 2019	Effective strategies for rebutting science denialism in public discussions Study population adults, German and US-based, undergraduate students	In six online experiments (N=1,773). Experiments 1–4 and 6: vaccination; Experiment 5: taking action against climate change	Intention to perform behaviour	Technique - Rebuttal presented in response to science denial text/speech	Students	Text/video message	Single	Yes	Rational	Strategic	Central Route	"Uncovering the techniques of science denial had a mitigating effect on the influence of the denier."
A03-02				Intention to perform behaviour	Topic - Corrective information presented in response to science denial text/speech	Students	Text/video message	Single	Yes	Rational	Strategic	Central Route	Providing the facts about the topic had positive effects and "there was no evidence that topic rebuttal led to a backfire effect; instead, topic rebuttal reduced the denier's influence on individuals' intention and attitude."
A04-01	Nyhan, 2016	US survey of adults about influenza vaccination intentions.	A nationally representative survey experiment of US adults conducted in two waves. Randomly assigned to (1) control (2) danger information message (3) corrective information message	Intention to perform behaviour	Survey with (1) danger information about influenza vaccines	Adults	Text/video message	Single	No	Rational	Informative	Peripheral Route	"information about the dangers of the flu had no significant effect on beliefs about the vaccine or intent to vaccinate."
A04-02				Intention to perform behaviour	Survey with (2) corrective information (myth-busting) about influenza vaccines	Adults	Text/video message	Single	No	Rational	Strategic	Central Route	"Corrective information was found to be generally effective at reducing misperceptions that the flu vaccine causes the flu as well as concerns about its safety... However, the effects of corrective information on intent to vaccinate did vary significantly depending on side effect concerns. While corrective information about the flu vaccine had no effect on vaccination intention among respondents with low side effects concern, it significantly decreased the self reported likelihood of receiving a flu vaccine among respondents with high side effects concern."
A05	Reno, 2018	Improving HCP communication about HPV vaccines for VH parents using MI (Colorado); parents	Year-long study; HCPs and staff at 8 pediatric and family medicine clinics received MI technique training. Process evaluation with serial surveys plus focus groups with HCP and staff	HCP-perceived levels of vaccine acceptance	Presumptive recommendation with MI	Parents	HCP-lead	Multiple	Yes	Narrative	Strategic	Central Route	"Use of communication components (combined use of the presumptive approach [PA] with all patients, and motivational interviewing and a fact sheet with vaccine hesitant parents) contributed to HCP in the intervention group reporting higher perceived levels of parental HPV vaccine acceptance than control providers, and increased vaccination rates in the intervention arm in the main RCT."
A06-01	Opel, 2013	Characterize HCP-parent vaccine communication and determine the influence of specific HCP communication practices on parent resistance to vaccine recommendations; parents	Cross-sectional observational study; videotaped HCP-parent vaccine discussions during health supervision visits	Vaccination acceptance	Presumptive recommendation + follow-up recommendation	Parents	HCP-lead	Single	Yes	Narrative	Strategic	Central Route	"Among parents who voiced resistance to provider initiation (41%), significantly more were VHPs than non-VHPs. When parents resisted, 50% of providers pursued their original recommendations (eg, "He really needs these shots"), and 47% of initially resistant parents subsequently accepted recommendations when they did....This number included 27% of VHPs (3 of 11) and 75% of NVHPs (6 of 8)."
A06-02				Vaccination acceptance	Participatory frame	Parents	HCP-lead	Single	No	Rational	Informative	Central Route	"Parents had significantly higher odds of resisting vaccine recommendations if the provider used a participatory rather than a presumptive initiation format." This is a backfire effect because the CI (participatory frame) is associated with reduced vaccine acceptance. [LB]
A07-01	Opel, 2015	Investigated how HCP vaccine communication behaviors influence parental vaccination acceptance and visit experience; parents	Cross-sectional observational study; videotaped HCP-parent vaccine discussions during health supervision visits	Vaccination acceptance, patient satisfaction	Presumptive recommendation	Parents	HCP-lead	Single	Yes	Narrative	Strategic	Central Route	"Using presumptive formats that assume vaccination seems to increase acceptance but decrease visit experience, whereas using participatory formats that provide parents more decision-making latitude appears to do the opposite"
A07-02				Vaccination acceptance, patient satisfaction	Participatory frame	Parents	HCP-lead	Single	No	Narrative	Informative	Central Route	Participatory (vs presumptive) initiation formats were associated with decreased odds of accepting all vaccines at visit's end and increased odds of a highly rated visit experience. This is a backfire effect because the CI (participatory frame) is associated with reduced vaccine acceptance. [LB]

Part 1 of 3

ID#	Nickname/link	Purpose and Context of Study	Study Methodology	Outcome measured	Description of Communicative Intervention	Population	Format	Configuration: Single or Multiple	CI Effect	Knowledge Theory	Framing	Message Design Model	Key Finding
										Rational or Narrative	Informative or Strategic	Peripheral Route or Central Route	
A08	Gilkey et al. 2019	PromoVac is based on a face-to-face intervention with parents conducted postpartum in maternity wards; parents	Non-controlled pre-/post intervention study; using results from parents enrolled in the intervention arm of the PromoVAQ RCT; Quebec; n=1,223	Level of hesitancy, vaccination intention, vaccination completion	Individual patient educational information session delivered in hospital setting by trained research assistants using MI techniques	Parents	HCP-lead	Single	Yes	Narrative	Strategic	Central Route	"Compared with pre-intervention status, participants who received the MI-based intervention on immunization displayed lower hesitancy and greater intention to vaccinate their infant at 2 months of age." "Children from experimental group had 9% more chance at a complete vaccination status between 3 and 24 months compared to children from control group."
A09	Bechini, 2019	Study of vaccination attitudes and knowledge of pregnant women in Italy; parents	Pre and post CI questionnaire; descriptive and statistical analysis; n=214	Intention to perform behaviour	Prenatal course for women (lecture with slide handout)	Parents	HCP-lead	Single	Yes	Rational	Strategic	Central Route	"After the intervention, the number of women who rated their level of knowledge of vaccinations as poor or insufficient had decreased by 30% and the number of "hesitant" respondents had decreased with respect to all aspects of the study; especially the decision to be vaccinated during pregnancy"
A10	Dempsey, 2018	Large-scale HCP training program re: HPV CI with parents of adolescents in Colorado; parents	Cluster RCT using covariate-constrained randomization; intent-to-treat protocol; conducted in 16 primary care practices; participants included 188 HCPs and 43,132 adolescents.	HPV vaccine series initiation and completion	Five CI HCP training programs: 1) HPV fact sheet library 2) parent education website 3) HPV-revised disease images 4) HPV vaccine decision aid (patient/parent) 5) 2¼ hours of CI training (presumptive recommendation) + MI if parent VH.	Parents	HCP-lead	Multiple	Yes	Narrative	Strategic	Central Route	"Adolescents in the intervention practices had significantly higher odds of HPV vaccine series initiation and completion than those in the control practices."
A11-01	Bettoch, 2011	Influence of online information on decision-making re: childhood vaccination; 72 undergraduate students	A simulated bulletin board (a bookish) provided participants with statistical information and authentic narratives about the occurrence and nonoccurrence of adverse events.	Risk perceptions and vaccination intentions	Reading narrative accounts (including adverse events) about vaccination with (and without) statistical evidence	Students	Text/video message	Single					"Experiment 1 shows an inverse relation between the number of narratives reporting adverse-events and vaccination intentions, which was mediated by the perceived risk of vaccinating. Probability perceptions decreased when narratives were provided (v. not provided), which could be an effect of the large number of narratives. Reading narratives (v. not reading narratives) increased the perception of the severity of adverse effects, potentially by providing an idea of what side effects might look like."
A11-02	Oi Leng, 2012	Web-based intervention to address VH with pregnant women in Colorado; parents	RCT of web-based CI with third-trimester women as part of health care system. Two studies: Influenza and TDAP	Risk perceptions and vaccination intentions	Reading narrative accounts (frequency adverse events: 20% or 40%; "emotionality" high v low; narrative richness high v low) about vaccination	Students	Text/video message	Single					
A12-01				Vaccination behaviour	Online resource centre including social media functions (influenza)	Parents	Online Resource Center	Single	Yes	Narrative	Informative	Peripheral Route	"For influenza (n=289), women in both the website with vaccine information and interactive social media components and website with vaccine information only arms had higher vaccine uptake than the usual care arm."
A12-02				Vaccination behaviour	Online resource centre including social media functions (TDAP)	Parents	Online Resource Center	Single	No	Narrative	Informative	Peripheral Route	"For Tdap (n=173), there were no significant differences in vaccine uptake between study arms."
A13	Attwell, 2015	Evaluation of the "I immunise" campaign run by the Immunisation Alliance of WA; adults	Qualitative and quantitative survey; n=305	Alternative lifestyle resident attitude towards vaccination	Six testimonials featuring WA parents "I immunise" included posters, billboards, large signs, newspaper print advertisements and social media meme on Facebook.	Adults	Social Media Campaign	Multiple	No	Rational	Informative	Peripheral Route	Analysing just those respondents who reported an impact from the campaign, significant differences were found between hesitant and non-hesitant, indicating that negative thoughts and feelings were more likely to be generated by this campaign for vaccine hesitant participants." This is a backfire effect because the CI is associated with negative feelings among VH population. [L8]
A14	Schroeder, 2017	Evaluation of three-year community engagement programme for VH#'s in Washington State (US); parents	Qualitative and quantitative methods, including focus groups, interviews, and pre and post online surveys of parents	Vaccine-related attitudes and knowledge of parents	Multi-faceted three-year programme called the "Immunity Community." CI mobilized parents who value immunization and provided them with tools to engage in positive dialogue about immunizations in their communities.	Parents	Social Media Campaign	Multiple	Yes	Narrative	Strategic	Central Route	"The program successfully engaged parent volunteers to be immunization advocates. Surveys of parents in the intervention communities showed statistically significant improvements in vaccine-related attitudes. The percentage concerned about other parents not vaccinating their children increased from 81.2% to 88.6%, and the percentage reporting themselves as 'vaccine-hesitant' decreased from 22.6% to 14.0%."

ID#	Nickname/link	Purpose and Context of Study	Study Methodology	Outcome measured		Description of Communicative Intervention	Population	Format	Configuration: Single or Multiple	CI Effect	Knowledge Theory	Framing	Message Design Model	Key Finding
											Rational or Narrative	Informative or Strategic	Peripheral Route or Central Route	
A15-01	Dillip_2018	Reduce parental vaccine hesitancy. Prenatal (expectant) parents recruited at a Colorado maternity hospital; parents	Three-arm RCT conducted during a 15-month period. (1) usual care (2) vaccine information on website (3) vaccine information on website with social media components	Vaccine-related attitudes	Vaccine-related attitudes	Online resource centre with vaccine information	Parents	Online Resource Center	Single	Yes	Narrative	Strategic	Central Route	"Comparing baseline with Time Point 1 among vaccine-hesitant parents, the VSM and VI arms were associated with significant improvements in attitudes regarding vaccination benefits compared to usual care. Comparing baseline with Time Point 2 among hesitant parents, the VSM and VI arms were also associated with significant reductions in parental concerns about vaccination risks compared to usual care. Self-efficacy around vaccine decision making also improved among vaccine-hesitant parents. No intervention effect was observed among parents not vaccine-hesitant at baseline."
A15-02														
A16-01	Ittoop_2018	Change parental vaccination-related attitudes; parents	Presentation of online information and a series of surveys conducted during two days with US-based respondents; N=315; A three-pronged RCT	Parental attitudes about vaccination	Vaccine-related attitudes	Online resource centre with interactive social media components	Parents	Text/video message	Single	Yes	Narrative	Strategic	Central Route	"Our results suggest that parents are likely to be responsive to warnings (in the form of graphic pictures and anecdotes) of the severity of these diseases, and that heightened awareness of the risks associated with failure to take preventive action will improve attitudes toward vaccinations."
A16-02				Parental attitudes about vaccination		CI about research showing that vaccines do not increase the risk of autism in children.	Parents	Text/video message	Single	No	Rational	Informative	Peripheral Route	"This manipulation did not meaningfully alter people's existing attitudes about vaccinations."
A17	Lockhart_2018	Evaluation of CI for VH parents re HPV conducted at 8 primary care intervention clinics in Colorado (see Dempsey, 2018, IDBA10); parents	HCP staff and parents of adolescent boys and girls ages 11 to 17 years; Focus groups with medical staff; and in-depth interviews with VHPIs; qualitative methods.	Effectiveness at countering VH		Five-part CI using precaution -adoption-process model 1) HPV fact sheet library 2) parent education website, 3) HPV-related disease images 4) an HPV vaccine decision aid (patient/parent) 5) 2¼ hours of CI training (presumptive recommendation) + MI	Parents	Online Resource Center	Single	Yes	Narrative	Strategic	Central Route	"Twenty parents and 48 medical staff participated. All parents and medical staff felt that the overall intervention was beneficial and should continue to be used and preferred the HPV vaccine fact sheet component. Medical staff reported that communication trainings (intervention component) that taught a presumptive approach and motivational interviewing were the most beneficial for introducing the HPV vaccine and for countering HPV vaccine hesitancy, respectively."
A18	Lee_2018	Narrative health intervention to increase HPV vaccination behavior among Cambodian Americans; parents	Pilot RCT (participatory research) with 19 dyads of Khmer mothers and daughters aged from 14 to 17 years	Attitude toward vaccination		Narrative intervention videos which focused on a series of HPV vaccination-related messages	Parents	Text/video message	Single	Yes	Narrative	Strategic	Central Route	"The acceptability of the intervention was high, as reflected by the number of positive comments on the narrative videos. Preliminary data indicate that vaccine uptake at one-month follow-up was the same (2 vs. 2) between intervention and control groups. However, daughters in the narrative intervention group reported higher intention to receive HPV vaccination within one month compared to the control group."
A19-01	Nan_2015	Examine how the type of evidence provided and the type of narrative message affects risk perception and intention to receive HPV vaccine; students	174 unvaccinated college students; controlled experiment where participants read an unformatted text containing passages that varied according to text construct	Intention to receive the HPV vaccine (free)		Narrative intervention - first person text Narrative intervention - third person text Statistical intervention text Hybrid intervention - first person text Hybrid intervention - third person text	Students	Text/video message	Single	Yes	Narrative	Strategic	Central Route	"It appears that messages highlighting both statistical evidence and people's stories of contracting HPV are most effective in eliciting risk perceptions about HPV." "narrative messages are more effective when reported in the first person (rather than in the third person.... This finding remains regardless of the presence or absence of statistical information."
A19-02							Students	Text/video message	Single	No	Narrative	Strategic	Peripheral Route	
A19-03							Students	Text/video message	Single	No	Rational	Informative	Peripheral Route	
A19-04							Students	Text/video message	Single	Yes	Narrative	Strategic	Central Route	
A19-05							Students	Text/video message	Single	No	Narrative	Strategic	Peripheral Route	
A20-01	Bogdic_2022	Development and evaluation of a narrative intervention aimed at increasing HPV vaccination among college women; students	Four-arm RCT, longitudinal study on the sources of narrative messages (peer-only, medical expert only, combination) in a communicative intervention.	Vaccination status 2 months after intervention		Peer-only video message (3 to 4 min) Medical expert-only video message (1.25 min) Combination video message (5 min)	Students	Text/video message	Single	No	Narrative	Strategic	Peripheral Route	"The combined peer-expert narrative intervention nearly doubled vaccination compared to controls (22% vs. 12%)" "Among participants receiving the combined peer-expert narrative intervention, the odds of vaccinating 2 months later was twice as likely compared to controls." "The vaccination rate of the medical expert-only participants was lower (6%) than the control group (11.8%)."
A20-02							Students	Text/video message	Single	No	Rational	Strategic	Peripheral Route	
A20-03							Students	Text/video message	Single	Yes	Narrative	Strategic	Central Route	

Part 3 of 3

Abbreviations

CI=Communicative intervention
CR=Central route
HCP=Healthcare provider
MI=Motivational interview
PR=Peripheral route
RCT=Randomized controlled trial
VH=Vaccine hesitant
VI=Vaccination intention
VR=Vaccine resistant

Tabulation of Results

The 20 studies represented in the pre-2020 discourse include 34 CIs. Among these CIs, 22 of 34 (65%) were effective and 12 of 34 (35%) were ineffective.

Three populations were subject to the CIs:

- **Parents**, including expectant mothers, mothers of infants, parents of young children, parents of adolescents
  [14 studies = A01, A02, A05, A06, A07, A08, A09, A10, A12, A14, A15, A16, A17, A18]
  [19 CIs = 15 Yes/effective, 4 No/ineffective]
- **Students**, including college and university students
  [4 studies = A03, A11, A19, A20]
  [12 CIs (all text/video message interventions) = 7 Yes/effective, 5 No/ineffective]
- **Adults**
  [2 studies = A04, A13]
  [3 CIs = 0 Yes/effective, 3 No/ineffective]

Among the interventions with parents, 15 of 19 (79%) were effective. This is the highest success rate among the three populations. In contrast, three of three (100%) of the adult-directed CIs were ineffective.

These CIs were delivered in one of four formats:

- **HCP-lead interventions** delivered face-to-face in a clinical setting
  [9 studies = A01, A02, A05, A06, A07, A08, A09, A10, A17]
  [11 CIs = 9 Yes/effective, 2 No/ineffective]
- **Text or video-based messages** delivered online
  [6 studies = A03, A04, A11, A16, A19, A20]
  [17 CIs = 9 Yes/effective, 8 No/ineffective
- **Online resource centres** recommended by HCP
  [2 studies = A12, A15]
  [4 CIs = 3 Yes/effective, 1 No/ineffective]
- **Social marketing campaigns** multi-component CIs delivered online, in print or in person
  [2 studies = A13, A14]
  [2 CIs = 1 Yes/effective, 1 No/ineffective]

Among the HCP-lead interventions, nine of 11 (82%) were effective. This is the highest success rate among the four CI formats. Among the remaining CIs which were in a mediated (print or online) format, the breakdown is: 13 of 23 (57%) effective and 10 of 23 (43%) ineffective. Notably, at least one CI of each format was ineffective.

Among the six multi-component studies [A01, A05, A10, A13, A14, A17] five were effective and one [A13] was ineffective.

Meanwhile, looking at the intersections of the CI population sets and the format sets, a few more observations stand out. Among the CIs in the intersection of the HCP-lead-format set with the parent-population set, nine of 11 (81%) were effective.

Appendix B. Representation of Post 2020 Discourse

ID#	Nickname	Purpose and context of study	Study methodology	Outcome measured	Description of Communicative Intervention	Population	Format	Configuration: Single or Multiple	CI Effect	Knowledge Theory Rational or Narrative	Framing Informative or Strategic	Message Design Model Peripheral Route or Central Route	Key Finding
B01-01	Wilks, 2021	Study investigates whether communicating the science behind new COVID-19 vaccines can increase people' s willingness to get vaccinated	Randomized controlled trial (n=1184) of Mechanical Turk online participants based in the US	Intention to be vaccinated	8-minute animated YouTube video (male narrator)	Adults	Text/video message	Single	Yes	Rational	Strategic	Peripheral Route	For viewers of video with male narrator a "statistically significant effect" was observed such that vaccination intentions increased.
B01-02					8-minute animated YouTube video (female narrator)	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	For viewers of video with female narrator the effect on vaccination intentions was not significant.
B02	Sprengholz, 2021 (Money vs. participation)	Study of the impact of payments and the communication of individual benefits on the acceptance of high-risk COVID-19 vaccination and on vaccination intentions.	N=1349 individuals from a German non-probabilistic sample, quota-representative, were randomly assigned to a 2 (payment vs no payment condition) × 2 (communication vs no communication condition) factorial between-subjects design	Vaccination intention	Communication about individual benefits of vaccination (pro-social message) along with monetary incentive	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	"Our results challenge the suggestion that monetary incentives can foster the willingness to get vaccinated against COVID-19. Communicating the individual and pro-social benefits of high vaccination rates, payments and social benefits of high vaccination rates, payments and social benefits of both strategies did not increase vaccination intentions."
B03	Talmy, 2021	On-site COVID-19 vaccine rollout to 511 Israeli soldiers in a military unit	Anonymous survey of vaccination intentions followed by primary care interventions (lecture with Q&A, on site consultation, office visit)	Vaccine uptake	Three CI in series: (1) group lectures, (2) on-site consultations and (3) primary care (HCP) office visits	Soldiers	HCP-lead	Multiple	Yes	Narrative	Strategic	Central Route	"Of the 90 soldiers initially refusing, 38 (42.2%) had agreed to be vaccinated."
B04*	Haase, 2020	Three online-experiments about vaccine adverse effects (VAE)	Study investigated whether narrative bias is moderated by disease risk, n=564	Perceived risk of vaccination and intention to get vaccinated	Narratives about vaccine adverse effects (VAE) - Single-case stories about the likelihood of infection, severity of disease and perceived susceptibility to the disease.	Adults	Text/video message	Single	Yes	Narrative	Strategic	Central Route	"Compared to the control condition (20%), narratives reporting VAE increased (35%) and decreased (5%) risk perceptions, which affected vaccination intentions respectively. People's vaccination decisions are reliably affected by small samples of single-case vaccination experiences. As this influence works in either direction, health communicators should provide people with many examples of safely completed vaccinations."
B05*	Qiazi, 2020	Community-based study of an underimmunized community in Srinagar	Small-scale qualitative study; 7 parent households (9 children) VR from a population of 744 children	Vaccine acceptance	In-depth interview with parents plus (1) education (2) reminder/recall (3) praise, support (4) MI	Parents	HCP-lead	Multiple	Yes	Narrative	Strategic	Central Route	"All participated in the CI motivated interviews and all agreed to have their child(ren) vaccinated."
B06-01	Jin, 2021	Online study of adult Pakistani nationals studying the potential effects of public service messages about COVID-19 vaccination	Cross-sectional experimental factorial 2 X 2 between-subject design; multistage sampling; convenience and random sampling; N=320	Willingness to be vaccinated	Traditional media public service message - safety benefits	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	"The perceived threat of COVID-19, perceived benefits of COVID-19 vaccines, and perceived self-efficacy positively influences the willingness to take a COVID-19 vaccine more favorably for fear appraisal framed public service messages than safety benefits framed public service messages."
B06-02				Attitudes towards vaccination and their intention to vaccinate	Digital media public service message - safety benefits	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	
B06-03					Traditional media public service message - fear appraisals	Adults	Text/video message	Single	Yes	Rational	Strategic	Central Route	
B06-04					Digital media public service message - fear appraisals	Adults	Text/video message	Single	Yes	Rational	Strategic	Central Route	
B07-01*	Schmid, 2020 (Doctoral thesis)	Tested the efficacy of outhunkering and forewarning as weight-of-evidence strategies to mitigate science deniers' influence on individuals' attitudes towards vaccination and their intention to vaccinate.	Three pre-registered laboratory experiments. A total of N = 887 individuals indicated their attitudes towards vaccination and their intention to vaccinate before and after watching a television (TV) discussion.		TV discussion - rebuttal of science deniers' outhunkering	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	"We found no evidence that inoculating more advocates for science than science deniers mitigates damage from denialism."
B07-02*					TV discussion - rebuttal of science deniers' forewarning	Adults	Text/video message	Single	Yes	Rational	Strategic	Central Route	"Forewarnings about the false-balance effect can mitigate the damage from denialism."
B08*	Marcus, 2020	In an Orthodox Jewish community in Brooklyn, Bilma Marcus, a public health nurse and community member, spearheaded an outreach program (EMES).	Qualitative research, case study of participatory community engagement	Intention to be vaccinated	Community outreach initiative; 1) Workshops for care providers 2) Print materials in a magazine 3) Sidebitows delivered in-home 4) Telephone support (100+ calls received) 5) Email support (500+ email requests) 6) Vaccine Fairs	Parents	Community Outreach Initiative	Multiple	Yes	Narrative	Strategic	Central Route	Most effective CI: 2-hour training in-home sessions supported by fact sheets written at grade-eight level and copies of studies cited.

ID#	Nickname	Purpose and context of study	Study methodology	Outcome measured	Description of Communicative Intervention	Population	Format	Cinfiguration: Single or Multiple	CI Effect	Knowledge Theory	Framing	Message Design Model	Key Finding
										Rational or Narrative	Informative or Strategic	Peripheral Route or Central Route	
B09*	Kaufman, 2020	For Australian midwives to optimise antenatal vaccine discussions and improve maternal and childhood vaccine uptake.	Pilot project Recruited midwives (vaccine champions) Provided midwives vaccine communication training and materials Post intervention survey of midwives and mothers	Midwives and mothers satisfaction with interventions and vaccination uptake	CI at three levels: 1. Practice: 'vaccine champions' stickers for immunization records 2. Provider (midwives) website with vaccine communication training; learning exercise; fact sheets; links to child vaccination resources; 3. Parent (SMS reminders; website; fact sheets).	Parents	HCP-lead	Multiple	Yes	Narrative	Strategic	Central Route	"All midwives were satisfied with the intervention and 17/18 reported feeling more confident discussing vaccines following the intervention. Women were very satisfied with SMS content (50/56; 94%) and timing (49/55; 89%), and with their vaccine discussions in general (34/56; 63%). However, 16/54 (30%) wanted more discussion about childhood vaccines. Self-reported maternal vaccine uptake was 82% (45/55) and 93% (51/55) for influenza and pertussis (baseline 2017–2018: 43% influenza, 60% pertussis) and 96% (50/52) of infants were fully vaccinated at 12 weeks."
B10	Kerr, 2021	Online study to understand how transparency of messages about COVID-19 that are uncertain affect perception and intentions	Two large pre-registered experimental studies on quota-sampled UK public participants: Study 1 (n = 2097) Study 2 (n = 2217)	Attitude toward vaccination and behavioural intentions	Online message - information about vaccine efficacy results "None of the messages were directly persuasive regarding vaccination, that is, none explicitly stated that the reader should accept a vaccine if offered"	Adults	Text/video message	Single	No	Rational	Informative	Peripheral Route	"The results of both studies suggest that transparently informing people of the limitations of vaccinations does not reduce intentions to be vaccinated"
B11-01	Freeman, 2021	In UK, test which types of written information about COVID-19 vaccination. Online study of exposure to written materials from the National Institute of Health - 10 information conditions	Single-blind, parallel-group, randomised controlled trial , 15000 adults in the UK who were quota sampled to be representative. Participants were randomly assigned equally across ten information conditions stratified by level of vaccine acceptance (willing, doubtful, or strongly hesitant)	Willingness to be vaccinated	NHS safety and effectiveness statement (control)	Adults	Text/video message	Single	No	Rational	Informative	Peripheral Route	Information conditions did not alter COVID-19 vaccine hesitancy in those willing or doubtful. In those strongly hesitant (approximately 10% of the population), COVID-19 vaccine hesitancy was reduced, in comparison to the control condition by: personal benefit information, directly addressing safety concerns about speed of development, and a combination of all information.
B11-02					Collective benefit statement (condition 2)	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	
B11-03					Collective benefit statement (condition 3)	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	
B11-04					Collective benefit statement (condition 4)	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	
B11-05					Personal benefit (condition 5)	Adults	Text/video message	Single	Yes	Rational	Strategic	Central Route	
B11-06					Seriousness (condition 6)	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	
B11-07					Safety, direct (condition 7)	Adults	Text/video message	Single	Yes	Rational	Strategic	Central Route	
B11-08					Safety, indirect (condition 8)	Adults	Text/video message	Single	No	Rational	Strategic	Peripheral Route	
B11-09					Collective and personal benefit (condition 9)	Adults	Text/video message	Single	No	Rational	Strategic	Central Route	
B11-10					Full combination (condition 10)	Adults	Text/video message	Single	Yes	Rational	Strategic	Central Route	

Abbreviations

CI=Communicative intervention
CR=Central route
HCP=Healthcare provider
HPV=Human papillomavirus
MI=Motivational interview
PACV=Parent attitudes to childhood vaccination
PR=Peripheral route
RCT=Randomized controlled trial
TDAP=Tetanus, diphtheria, and acellular pertussis
VH=Vaccine hesitant
VHP=Vaccine hesitant parent
VI=Vaccination intention
VR=Vaccine resistant

Tabulation of Results

The 11 studies in this post 2020 collection represents results from 25 CIs. Among these CIs, 12 (48%) were effective and 13 (52%) were ineffective.

Three populations were subject to the CIs:

- **Parents**, including expectant mothers, mothers of infants, parents of young children, parents of adolescents
  [3 studies = B05, B08, B09]
  [3 CIs = 3 Yes/effective, 0 No/ineffective]
- **Adults**
  [8 studies = B01, B02, B04, B06, B07, B10, B11]
  [21 CIs = 8 Yes/effective, 13 No/ineffective]
- **Soldiers** (male and female, average age 21)
  [1 study = B03]
  [1 CI = 1 Yes/effective, 0 No/ineffective]

Among the interventions with parents, three of three (100%) were effective. This is the highest success rate among the populations. In contrast, only eight of 21 (38%) of the adult-directed CIs were effective while 13 of 21 (62%) were ineffective.

These CIs were delivered in the following formats:

- **HCP-lead interventions** delivered face-to-face in a clinical setting
  [3 studies = B03, B05, B09]
  [3 CIs = 3 Yes/effective, 0 No/ineffective]
- **Text or video-based messages** delivered online or in a laboratory setting
  [7 studies = B01, B02, B04, B06, B07, B10, B11]
  [21 CIs = 8 Yes/effective, 13 No/ineffective

- **Community outreach initiative** multi-component CIs delivered online, in print or in person
  [1 study = B08]
  [1 CI = 1 Yes/effective, 0 No/ineffective]

Among the three HCP-lead, face-face interventions, three of three (100%) were effective. This is the highest success rate among the three CI formats used in the post 2020 studies. Among the CIs in the text/video message format, only eight of 21 (38%) were effective and 13 of 21 (62%) were ineffective.

Among the multi-component interventions [B03, B05, B08, B09] four of four (100%) were effective.