



Azer, J. and Alexander, M. (2022) COVID-19 vaccination: engagement behavior patterns and implications for public health service communication. *Journal of Service Theory and Practice*, (doi: 10.1108/JSTP-08-2021-0184).

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Deposited on: 24 January 2022

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COVID-19 Vaccination: Engagement Behavior Patterns and Implications for Public Health Service Communication

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Abstract

Purpose – COVID-19 vaccinations face a backdrop of widespread mistrust in their safety and effectiveness, specifically via social media platforms which constitute major barriers for the public health sector to manage COVID-19 (and future) pandemics. This study provides a more nuanced understanding of the public's engagement behavior towards COVID-19 vaccinations.

Design/methodology/approach – Using Netnography, this study explores the public's interactions with vaccine communications by the WHO via Facebook. From WHO posts about the COVID-19 vaccination 23,726 public comments on Facebook were extracted and analyzed.

Findings – Building on crisis communication, health, and engagement literature, this paper identifies and conceptualizes seven patterns of engagement behavior toward the COVID-19 vaccination and develops the first framework of relationships between these patterns and the extant vaccine attitudes: vaccine support, hesitancy, and refusal.

Practical implications – This paper helps policymakers identify and adapt interventions that increase vaccine confidence and tailor public health services communications accordingly.

Originality/value – This research offers the first typology of patterns of engagement behavior toward COVID-19 vaccinations and develops a framework of relationships between these patterns and the existing understanding in health literature. Finally, the study provides data-driven communication recommendations to public health service organizations.

Keywords – COVID-19, Crisis Communication, Engagement Behavior, Public Health, Quantitative Text Analysis, Services, Social Media, Thematic Analysis, Vaccination, Vaccine Attitudes.

Paper type – Research paper

Introduction

The COVID-19 pandemic continues to have an unprecedented impact on the global population (Donthu and Gustafsson, 2020; Kabadayi *et al.*, 2020; Sajtos *et al.*, 2021). This exogenous shock has had severe economic and social consequences worldwide that are likely to continue for many months, if not years (Weforum.org, 2020; WHO.Int, 2019). The pandemic has amplified the role of social media as the main mode of contacting or socializing with others (Azer *et al.*, 2021; Chamberlain, 2020). Social media platforms have seen a 61% increase in usage during the current crisis, especially regarding vaccination (Donthu and Gustafsson, 2020; Holmes, 2020). According to the health literature, social media, while providing an unprecedented capacity for the public to communicate, has also been a major factor in the rise of fringe opinions which can be damaging to public health (Wilson and Wiysonge, 2020). Therefore, monitoring social media during a crisis can help public health services better understand public sentiment and reactions and identify potential shifts in their behavior toward the vaccination (Coombs and Holladay, 2012).

According to existing health studies, there are three vaccine attitudes: acceptance, hesitance, and refusal which, more recently, social media has witnessed around the COVID-19 vaccination program (Murphy *et al.*, 2021). In particular, vaccine hesitancy and refusal constitute a barrier to full population inoculation against this highly infectious virus (Dror *et al.*, 2020), hence, a tremendous global public health concern. The proliferation of anti-vaccination misinformation through social media has given it new urgency, especially considering the hopes for rapid vaccine deployment (Wilson and Wiysonge, 2020). More extreme propaganda relating to potential negative effects of the vaccine lead to a spiral of threat matched by public fear (Paul *et al.*, 2021). Vaccine refusers and hesitant groups on social media have an alarmingly large footprint, with studies showing that large proportions of vaccine content on social media sites are anti-vaccination messages (Larson *et al.*, 2014;

MacDonald *et al.*, 2015; Murphy *et al.*, 2021; Paul *et al.*, 2021; Wilson and Wiysonge, 2020). Therefore, it is important that public health services can identify and adapt interventions that increase vaccine confidence and tailor public health communications accordingly.

Despite a significant amount of work in the health literature on vaccine hesitancy and refusal, focus has mainly been on socioeconomic determinants (Dror *et al.*, 2020; MacDonald *et al.*, 2015; Mesch and Schwirian, 2015; Murphy *et al.*, 2021; Paul *et al.*, 2021) and general reasons for opposition to a particular vaccine or vaccination programs (Larson *et al.*, 2014; Schmid *et al.*, 2017; Siddiqui *et al.*, 2013). However, studies are limited regarding explanations of how individuals interact with public health service communication and any engagement behavior that may emerge based on these attitudes. According to crisis communication research, embracing social media's communal logic by understanding how people engage about the COVID-19 vaccine may help determine their sentiments and reactions reflected in their engagement behaviors (Coombs and Holladay, 2012; De Valck, 2020).

Similarly, although prior engagement research has paid specific attention to user's engagement behavior in online and social media contexts (e.g., Azer and Alexander, 2018; Blasco-Arcas *et al.*, 2020; Bowden *et al.*, 2017; Brodie *et al.*, 2013; Hollebeek *et al.*, 2014; Jaakkola and Alexander, 2014; Naumann *et al.*, 2020), existing typologies are typically brand-related; i.e. the engagement object is either a brand, service, or a product. Therefore, it is unclear which forms of engagement behavior will emerge when the focus of engagement is vaccination itself. Unique characteristics of the COVID-19 vaccination, such as high levels of uncertainty relating to the speed of its development (Dror *et al.*, 2020); relative lack of research time before administering it (Paul *et al.*, 2021), and the public's higher perceptions of immediacy and urge for updates (Wilson and Wiysonge, 2020) create a clear need to better

understand the public's engagement behavior toward vaccination which may prove relevant in future health crises (Donthu and Gustafsson, 2020; Karpen and Conduit, 2020).

This study builds on crisis communication, health, and engagement literature and utilizes an extensive netnography of public engagement interactions to Facebook vaccine communications by the prominent public health service organization -WHO. Ultimately, this study conceptualizes a typology of seven patterns of public's engagement behavior toward the COVID-19 vaccination and offers a framework of relationships between these patterns and the three vaccine attitudes acknowledged in health literature. This study contributes to theory by bridging a gap between engagement, crisis communication, and health research bases. Secondly, this study offers the first typology of the public's engagement behavior patterns toward the COVID-19 vaccination. Thirdly, this study offers a new framework that relates the conceptualized engagement patterns to existing vaccine attitudes in health literature. Finally, the study provides data-driven communication recommendations to public health service organizations.

Theoretical Background

Crisis Communication

Crisis communication is a significant area of multi-disciplinary research (Zhang *et al.*, 2018). It deals with crisis information disseminated to the public by governments, emergency management organizations, crisis responders, and crisis information created and shared by individuals (Fraustino *et al.*, 2012). In a crisis, people take in, process and act on information differently than during normal times (CDC.gov, 2019; Fraustino *et al.*, 2012). Consequently, communications during a crisis should consider that people may experience a wide range of emotions and psychological barriers that can interfere with how they react and behave during a crisis (CDC.gov, 2019).

Crisis communication literature highlights the central role of social media in the way crises are discussed, framed, and perceived (Azer *et al.*, 2021; Zhang *et al.*, 2018). Social media has changed how individual users experience a crisis, becoming an important communication channel for users to communicate (Jung *et al.*, 2018; Park, 2018). Crises are now framed by people's reactions, comments, and posts on social media (Azer *et al.*, 2021). For instance, vaccine-hesitant and refuser groups on social media have an alarmingly large footprint; according to prior literature, large proportions of vaccines on social media content are anti-vaccination messages, thus leading to a spiral of threat matched by public fear (Wilson and Wiysonge, 2020). This is in addition to the intentional spread of misinformation about the vaccination (Germani and Biller-Andorno, 2021). Given the increasingly important role social media play during a crisis, especially in shaping people's opinion about the vaccination, it is essential to understand and respond to people's real-time sentiments about the COVID-19 vaccine. Without such enhanced information, policymakers and public health services may make communication decisions based on intuition or inaccurate information.

Vaccination

Vaccines have a history that started late in the 18th century, and since then, vaccination policy has included numerous bouts of public resistance, often in the form of vaccine scares (Etzioni-Friedman and Etzioni, 2020; Plotkin, 2014). For example, in the United Kingdom, pertussis vaccine scares in the 1970s caused a decline in the level of vaccine coverage, resulting in substantial increases in morbidity and mortality from whooping cough (Baker, 2003). Currently, the measles–mumps–rubella (MMR) vaccine uptake is declining worldwide, with mounting concern that widespread measles outbreaks may recur (Bauch and Earn, 2004; Jansen *et al.*, 2003). In deciding whether to get vaccinated or not, people usually consider the risk of morbidity from vaccination, the probability of becoming infected, and the risk of morbidity from such an infection (Bauch and Earn, 2004; Plotkin, 2014). Their

decisions are indirectly influenced by the decisions of others, too (Gangarosa *et al.*, 1998). The sum of these decisions affects vaccine coverage levels in a population and hence the course of epidemics and pandemics (Murphy *et al.*, 2021)

Vaccines are widely recognized by health authorities and the medical community as a major tool for achieving public health successes (Yaqub *et al.*, 2014). Nevertheless, despite this recognition many individuals are increasingly doubtful of the benefits of vaccines, worry over their safety and question the need for them (Larson *et al.*, 2014; Wilson and Wiysonge, 2020). Previous health research indicates that vaccine compliance remains variable and inconsistent and refers to three main public attitudes towards vaccination: *vaccine acceptance, vaccine hesitancy, and vaccine refusal* (Baker, 2003; Jansen *et al.*, 2003; Plotkin, 2014). Vaccine hesitancy represents a delay to accept the vaccine despite its availability due to doubt regarding its benefits, worry over its safety, and question over the need for it (Yaqub *et al.*, 2014). Vaccine refusal is an explicit act of rejection of a specific vaccine or the vaccination concept in general (Paul *et al.*, 2021). Importantly, hesitancy differs from vaccine refusal (Murphy *et al.*, 2021); however, existing studies suggest that hesitancy can also soon become refusal (Salathé and Bonhoeffer, 2008), and unvaccinated clusters can emerge where disease outbreaks can (re)occur (Gangarosa *et al.*, 1998; Jansen *et al.*, 2003).

Recent research about the COVID-19 vaccination confirms presence of the three attitudes with Dror *et al.* (2020) suggesting that people who are not directly involved in taking care of COVID-19 positive patients not trusting the COVID-19 vaccine. Such hesitance may negatively impact the future vaccination compliance of individuals who coincidentally engage with vaccine-hesitant people professionally or personally (Dror *et al.*, 2020; Larson *et al.*, 2014). Therefore, hesitance manifested by those people via social media platforms could impact the future vaccination compliance of others (Wilson and Wiysonge, 2020). However, while coverage rates help identify genuine refusers, existing research lacks an understanding

of those hesitating (Paul *et al.*, 2021). According to prior research, the most common reason for the public's acceptance of vaccination is healthcare professionals' advice, while vaccine hesitancy, in general, is caused by safety concerns, lack of awareness, and low perceived severity of illness (Yaqub *et al.*, 2014).

Recent research advocates widespread public education campaigns regarding vaccine safety and efficacy for a successful inoculation against COVID-19 (Murphy *et al.*, 2021). Specifically, prior research points to the fruitfulness of monitoring social media during a crisis, which might help determine the public's reactions (here reflected in engagement patterns centered on the COVID-19 vaccine) (Coombs and Holladay, 2012). This will help public health organizations differentiate more clearly between the hesitant, refusers, and supporters in terms of their engagement patterns about the vaccination - thus far unclear. According to prior psychology studies, vaccine attitudes might affect individuals behaviors at a later stage (Maio *et al.*, 2018; Zimbardo and Leippe, 1991). According to engagement literature, attitudes are antecedents of engagement behavior (Van Doorn *et al.*, 2010; van Doorn and Verhoef, 2008). Therefore, understanding only vaccine attitudes limits explanations of how people interact with public health service communication and what engagement behavior can emerge based on their respective attitudes. Understanding the public's engagement behavior patterns alongside more general attitudes towards vaccination offers great value in understanding reactions to the COVID-19 vaccination and might support the identification and/or adaptation of interventions that increase vaccine confidence and tailor public health services communications.

Patterns of Engagement Behavior

Engagement encompasses an interactive relationship or disposition towards an engagement object which involves discretionary resource investments (Brodie *et al.*, 2019; Jaakkola and Alexander, 2014). Engagement is considered a multidimensional concept

comprising cognitive, emotional, and behavioral investment in specific interactions (Alexander *et al.*, 2018; Azer and Alexander, 2020b). This paper examines specific behavioral manifestations of engagement consistent with previous engagement examinations in a social media context (Azer *et al.*, 2021; Dolan *et al.*, 2016; Van Doorn *et al.*, 2010).

Prior engagement research has focused on conceptualizing behavioral manifestations of engagement (e.g., Azer and Alexander, 2018; Blasco-Arcas *et al.*, 2020; Bowden *et al.*, 2017; Brodie *et al.*, 2013; Hollebeek *et al.*, 2014; Jaakkola and Alexander, 2014; Naumann *et al.*, 2020) and identifying its various antecedents and outcomes (e.g., Azer and Alexander, 2020b; Blasco-Arcas *et al.*, 2016; Dessart *et al.*, 2016; Dolan *et al.*, 2019; Harrigan *et al.*, 2017; Hollebeek and Chen, 2014). However, engagement literature has, hitherto, generally focused on engagement interactions that occur between customers and brands (e.g., Brodie *et al.*, 2013; Hollebeek *et al.*, 2019) or interactions among customers but still retaining the brand as the main focal object of engagement (e.g., Azer and Alexander, 2018; 2020a; Vivek *et al.*, 2012). It is unclear how behavioral manifestations might differ when the engagement object is the Covid-19 vaccination.

According to recent crisis communication and health research, social media audiences are involved, occupied, and interested in creating, consuming, and responding to information about the COVID-19 vaccination (Wilson and Wiysonge, 2020), which aligns with the notion of engagement, being involved, occupied, and interested in something (Brodie *et al.*, 2019) and involves voluntary behavioral manifestations echoing actors' investments of resources (Azer *et al.*, 2021; Brodie *et al.*, 2019; Jaakkola and Alexander, 2014).

Prior research identifies user engagement patterns in social media platforms: co-creation, positive and negative contribution, consumption, dormancy, and detachment (Dolan *et al.*, 2016). In addition, while on online brand communities (OBCs), engagement behaviors such as constructive, learning, influencing, socializing, boycotting, recommending, and warning

behaviors are captured (Azer and Alexander, 2018; Bowden *et al.*, 2017; Brodie *et al.*, 2013; Jaakkola and Alexander, 2014; Naumann *et al.*, 2017). Notably existing typologies (see Table I) are typically based on research around brands or service providers as the engagement object. For example, engaging with OBCs by learning, sharing, advocating, recommending a product or service or brand to others, boycotting a brand community, warning, or mobilizing others against it (Azer and Alexander, 2018; Bowden *et al.*, 2017; Brodie *et al.*, 2013). Similarly, on social media, the typology of SMEBs reflects users' engagement behavior via social media about a focal brand (Dolan *et al.*, 2016). It is unclear which patterns of engagement behavior will emerge when the focus of engagement is vaccination while plausible to expect different patterns. For instance, on social media, sharing, warning, recommending, and in some instances, advocating are popular engagement behavioral manifestations however, how such manifestations might be when the vaccine is the focus of engagement is unclear.

Specifically, during and beyond a period of great uncertainty and social disruption, users' engagement behaviors are expected to differ (Azer *et al.*, 2021; Karpen and Conduit, 2020). According to crisis communication literature, social isolation may be harmful (Reeves *et al.*, 2020); feelings of loneliness have, among other things, been connected to poorer cognitive performance, negativity, depression, and sensitivity to social threats (Donthu and Gustafsson, 2020). Lessening these challenging impacts requires resources investment by actors during the crisis (Finsterwalder and Kuppelwieser, 2020), and such investment comprises individual interactions (Brodie *et al.*, 2021). These resources are cognitive (how an actor responds to the pandemic), psychological (elements of optimism and coping with the pandemic), physical (actor feeling energized in functional and instrumental activities of daily living), emotional (overcoming feelings of fear and insecurity), and social (the social networks available to an actor) resources (Brodie *et al.*, 2021; Finsterwalder and Kuppelwieser, 2020)

On top of that, despite wide acceptance of vaccination importance, specifically COVID-19 vaccination, as opposed to brands, people still doubt the benefits of vaccines, worry over their safety and question their need (Larson *et al.*, 2014; Wilson and Wiysonge, 2020). The decision to take the COVID-19 vaccination entails investing cognitive, emotional, and behavioral resources (Finsterwalder and Kuppelwieser, 2020; Muraven, 2012; van Grunsven, 2020), and such investment comprises individual dispositions to engage (Brodie *et al.*, 2021).

Prior research suggests engagement objects may include other customers, firms, or other non-human actors (Brodie *et al.*, 2019; Ng *et al.*, 2020; Storbacka, 2019). Recent research calls for studying engagement objects beyond those commonly investigated (Azer *et al.*, 2021; Ng *et al.*, 2020) as existing typologies are brand-related (Brodie *et al.*, 2011). Identifying specific forms of engagement behavior toward the COVID-19 vaccination is valuable, as it will help understand the public's state, reflected in their specific manifestations. The extant definition of customer engagement behavior by Jaakkola and Alexander (2014) was theoretically adapted to guide the empirical inquiry; thereby, the concept of public's engagement behavior toward vaccination in this study reflects their behavioral manifestations toward the COVID-19 vaccination focus, as it occurs in interactions with other actors.

Health literature currently suggests three attitudes toward vaccination: acceptance, hesitancy, and refusal; however, understanding how people engage with public health service communication messages about the vaccination and offer more nuance relating engagement patterns to each of the three attitudes toward vaccination would be of value to public health or crisis communication researchers and professionals, providing a comprehensive framework encompassing the underlying attitudes and engagement behaviors toward the vaccination and how these attitudes and patterns of engagement behaviors interrelate.

Authors, year	Concept	Context	Engagement Object	Key findings	Conceptualized typologies	Description
(Brodie et al., 2013)	Customer Engagement	Online Brand Communities	The brand	The Customer Engagement process comprises a range of sub-processes reflecting consumers' interactive experience within online brand communities, and value co-creation among community participants	Learning, sharing, advocating, co-developing	<i>Learning</i> : consumers apply to purchase and consumption decision making. <i>Sharing</i> : contributions to knowledge about a brand within the online community. <i>Advocating</i> : actively recommend specific brands <i>Co-developing</i> : consumers contribute to organizations by assisting in the development of new products, services, brands.
(Dolan et al., 2016)	Social Media engagement behavior	Social Media	The brand	A theoretical model to explicate the role of social media content in facilitating engagement behaviour within a social media context and A typology of social media engagement behaviour	Co-creation, contribution, consumption, dormancy, detachment	<i>Co-creation</i> : initiation of positive, active contributions and subsequent interaction with the brand, and other members. <i>Contribution</i> : active positive or negative contributions to existing content on the social media brand page <i>Consumption</i> : participation without actively contributing to or creating content. <i>Dormancy</i> : temporary state of inactive, passive engagement by consumers toward the brand <i>Detachment</i> : self-removal from the social media page and related content
(Bowden et al., 2017)	Engagement Behavior	Online Brand Communities (OBCs)	The brand and OBCs	Illustrating consumer expressions of consumers' positively and negatively valenced engagement with a brand, and with the OBC.	Recommending, Exiting brand community & Boycotting	<i>Recommending</i> : engaging in brand or OBC-related recommendations to other members. <i>Exiting</i> : negative behavioral engagement activities by exiting from the OBC & boycotting the brand.
(Naumann et al., 2017)	Engagement behavior in online brand communities	Online Brand Communities	The brand	Positive customer engagement is directed at the service community, whereas customer disengagement and negative engagement are directed at the service organisation object.	Destructive constructive behaviors	<i>Destructive</i> : Contempt towards a provider leads to display destructive actions to seek revenge from the service provider or brand. <i>Constructive</i> : actions directed at solving the problem
(Azer & Alexander, 2018)	Customer Engagement Behavior	Online Social Networks	Service Providers	A typology of how customers engage in negatively-valenced influencing behavior in online social networks and what triggers customers to use its different forms	Discrediting, regretting, deniding, endorsing competitors warning behaviors	<i>Discrediting</i> : Report of functional details of substandard service to discredit a service provider. <i>Regretting</i> : Communication of emotions of regret for choosing a service provider <i>Deniding</i> : Usage of sarcasm to denide a service provider <i>Disuading</i> : Explicit advice to convince other actors not to transact with a focal provider stressing on opposition to and the refusal of a focal provider <i>Endorsing Competitors</i> : Explicit recommendation of one or more competitors to other actors, over service providers <i>Warning</i> : Warning other actors of a probable risk based on a perilous service experience.
This paper	Public Engagement Behavior	Social Media	COVID-19 Vaccination	A typology of public engagement patterns toward the COVID-19 vaccination and a framework of relationships between these patterns and vaccine support, hesitancy, and refusal attitudes.	Advocating, Proposing, Inquiring, Skeptical, Sarcastic, Rebutting, Dispriting	<i>Advocating</i> : public's behavioral manifestations toward vaccination to publicly recommend and support the vaccination <i>Proposing</i> : public's behavioral manifestations toward vaccination to suggest actions to ensure an effective vaccination process. <i>Inquiring</i> : public's behavioral manifestations toward vaccination to ask questions about the vaccine. <i>Skeptical</i> : public's behavioral manifestations toward vaccination to question the reliability of the vaccines or motive of vaccine providers <i>Sarcastic</i> : the public's behavioral manifestations toward vaccination to denide the vaccination & or the source (e.g., WHO) <i>Rebutting</i> : public's behavioral manifestations toward vaccination to offer a contrary argument about vaccination & or vaccine side effects <i>Dispriting</i> : public's behavioral manifestations toward vaccination to spread depressing thoughts about the vaccine & or vaccination

Table 1: Key Engagement Behavior Typologies in Online Contexts.

Methods and Data Collection

Netnography was selected to provide a typology of the patterns of public engagement behavior toward the COVID-19 vaccination by collecting public engagement toward vaccine communication by the World Health Organization WHO on its official Facebook page. Compared to other qualitative research techniques, the unique value of netnography is that it excels at telling a story, understanding complex social phenomena, and assisting a researcher in developing themes from a user point of view (Kozinets, 2010). Importantly, it allows the researchers to rid themselves of measurement and scripted questions and analyze the information contained in textual data as it naturally occurs (Berger et al., 2020), which is specifically useful for understanding online users' behaviors (Hennig-Thurau *et al.*, 2013).

Facebook was selected in line with Kozinets (2010) recommendations for the site selection and to ensure diversity of contexts and robustness of findings. It is active and has recent and regular communications. Facebook is among the biggest social networks worldwide, with almost 2.5 billion monthly Facebook users (Statista.com, 2020). Moreover, it has a substantial and critical mass of communicators, in addition to the high levels of interactivity and flow of communications between users. Furthermore, the percentage of global populations using Facebook (26.3%) (Statista.com, 2020) satisfies the heterogeneity aspects of the chosen contexts for the study (Kozinets, 2010).

The World Health Organization (WHO) is a specialized agency of the United Nations responsible for international public health. Amid the COVID-19 pandemic, the WHO has been tracking the pandemic, advising on critical interventions, distributing vital medical supplies to those in need and racing to develop and deploy safe and effective vaccines. In addition, as of January 2021, the WHO has been engaging via Social Media with the public to raise awareness about available vaccines, vaccination processes, and vaccine side effects using a range of promotional material. The popularity of the WHO official page on Facebook

is exemplified in the number of followers (36,949,297) and active engagement on its shared posts.

Using the NCapture facility of NVivo pro software, 23,726 Facebook public comments on all WHO posts about the COVID-19 vaccination (January to June 2021) were extracted to strengthen the stability and validity of findings. Following recommendations for netnographic studies, it was deemed appropriate to copy publicly shared archival data and then filter this for relevance (Kozinets, 2010). Publicly communicated online messages are open to researchers, and, legally, it is the user's responsibility to identify what information to share publicly on social media (Kozinets, 2010; Langer *et al.*, 2005). The WHO page is followed by many different nationalities worldwide; accordingly, many interactions to were written in languages other than English. To avoid misinterpretation caused by Google translate, only interactions in English were included. The research focuses on individual users' interactions with vaccine communication posts by the WHO. Accordingly, ads and businesses' comments were all manually excluded. Additionally, this study focuses on textual content; therefore, image, memes, emojis comments were also excluded. Hence, we proceeded with 9,850 relevant interactions for analysis.

To ensure the relevance of the data to the stated research aim, the theoretically informed definition of the public's engagement behavior toward COVID-19 vaccination guided the study and informed the definitions given to the patterns conceptualized. Moreover, research papers that address textual discourse (e.g., Berger *et al.*, 2020; Broadbent, 1977; Giora, 2002; Polanyi and Zaenen, 2006) were consulted to aid in the lexical analysis of the engagement patterns. Furthermore, the extant conceptualization models of forms of engagement behavior (Azer *et al.*, 2021; Jaakkola and Alexander, 2014) were consulted and researched on crisis communication and social media consumption in times of a crisis COVID-19 vaccination.

Interpretation and Analysis

Thematic analysis on the data was conducted using open and axial coding (Corbin and Strauss, 2008). Open coding involves breaking data apart and considering all possibilities within, followed by coding conceptual labels on the respective data. Axial coding involves ‘crosscutting or relating concepts to each other’ (Corbin and Strauss, 2008 p. 195). The open/axial coding represented an iterative process of going back and forth between extant literature, data, and the emerging theory (Danneels, 2003). This study initially identified themes inductively from the raw data and deductively from the literature review on engagement, health, and crisis communication. Axial coding involves looking at how larger pieces of data fit, group, and cluster together (Corbin and Strauss, 2008). Therefore, themes initially emerged using open coding gained further scrutiny and linking to the three attitudes toward vaccines: vaccine acceptance, hesitancy, and refusal, during axial coding. This process corresponds to the analytical sequence of abstracting and comparing, followed by checking and refinement, which is also recommended for netnographic data analysis (Kozinets, 2010; Miles and Huberman, 1994). To illustrate, during data analysis, themes emerging from the netnographic study were compared for similarities and differences within the sets of data collected from different WHO Facebook posts about vaccination. Following Creswell's (2014) recommendations, crosschecking of coding was undertaken using a sample of the data and the codebook which includes the codes developed during analysis (Sweeney *et al.*, 2013). The research team reached an agreement on coding with a high overall consistency between coders. The analysis reveals seven patterns of the public’s engagement behavior toward the COVID-19 vaccination. Table II illustrates the percentage of each pattern and the three vaccine attitudes in the data.

Attitudes		Patterns of Engagement	
Acceptance	16%	Advocating	12%
Hesitancy	25%	Proposing	4%
Refusal	59%	Inquiring	12%
		Skeptical	13%
		Sarcastic	14%
		Rebutting	27%
		Dispiriting	18%
Total	100%	Total	100%

Table II: Overall coding percentages for Attitudes and Patterns

Following the thematic analysis, a quantitative text analysis (QTA) was conducted using NVivo's word frequency query facility to identify the top 20 frequently occurring words in each of the seven patterns (words such as vaccination, vaccine, Covid19, pandemic and their stemmed words were identified as stop words) (see Appendix A). The aim was to further enhance understanding the engagement patterns and contribute to creating public policy on communicating to different types of people. Additionally, prior linguistics and pragmatics studies were consulted to identify positive and negative language used in the seven patterns (see Appendix B) (e.g., Broadbent, 1977; Polanyi and Zaenen, 2006). The seven patterns are introduced and discussed in the following sections with exemplars (bold font is used in exemplars to highlight specific patterns).

Findings

Patterns of public engagement behavior toward the COVID-19 Vaccination

We introduce a typology of seven patterns of public engagement behavior toward the COVID-19 vaccination (see Figure 1).

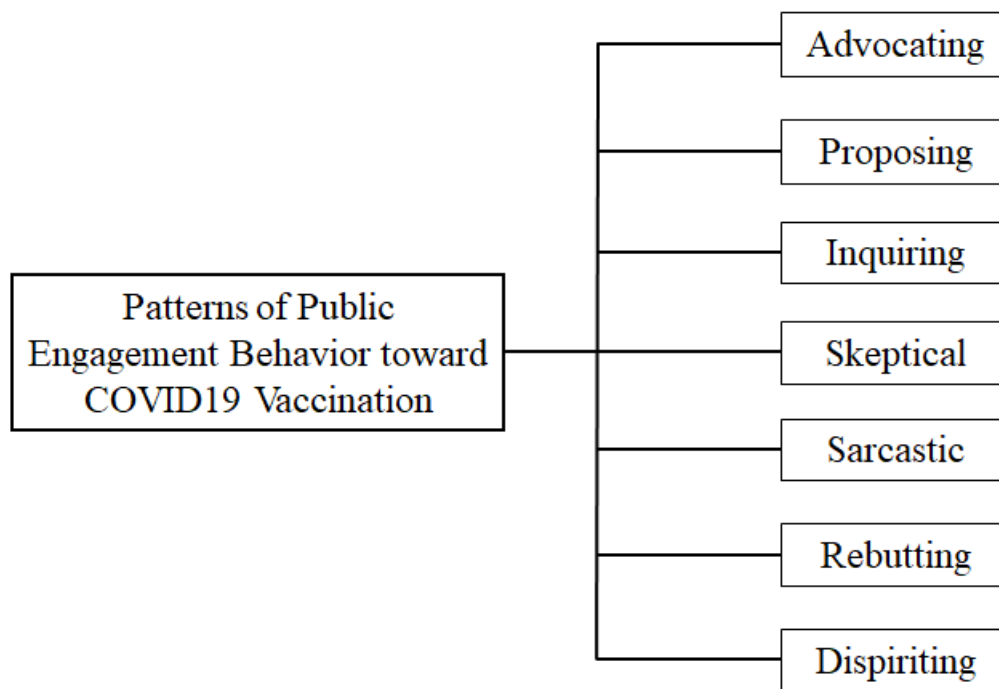


Figure 1: Patterns of Public Engagement Behavior toward COVID-19 Vaccination

Advocating

Advocating refers to the *public's behavioral manifestations toward vaccination to publicly recommend and support the vaccination*. In 12% of total analyzed comments, individuals engage toward the COVID-19 vaccination by providing advocative proof of the adequacy and the effectiveness of the vaccination. They share a general recommendation and provide evidence from their life experience after taking the vaccine. For example: *'I had no side effect after Moderna vaccinations except pain in the injection site.'* In other instances, they share their advocating view of the importance of taking the vaccine to encourage the reluctant ones, for example: *'The vaccine keeps us to control the effects of this virus and enable us to manifest great good health, creativity and originality. It also helps us to improve physical health and increases resistance and immunity, no need to be reluctant to be vaccinated'*. Also, by showing the detrimental consequences of avoiding the vaccination, for example: *'Although vaccination will bring us short-term pain, it will eventually end, but if we are infected with the virus, we may lose our lives. I think vaccination is necessary.'*

The QTA of this pattern shows that the advocates use more positive language such as ‘positive’, ‘healthy’, ‘hope’, ‘improve’, ‘safe’ ‘protect’, ‘fine’, ‘good’ and inclusive terms such as ‘people’, ‘everyone’, ‘families’, ‘world’, ‘entire’ which implies their proactivity and care about others. Engagement toward COVID-19 vaccination manifested in advocacy appeared to respond to the disruptive events caused by the COVID-19 crisis, misinformation, and conspiracy theories about the vaccination spread on social media (Wilson and Wiysonge, 2020). Particularly its relation to the crisis in the support individuals offer to others which is not brand-related advice to help others make a purchase decision (e.g., Azer and Alexander, 2018; Chang and Wu, 2014; Hennig-Thurau *et al.*, 2004). Instead, people voluntarily reach out to others by contributing their knowledge and experience, which aligns with prior literature about engagement and advocacy, suggesting that it involves a proactive initiation of discussions about the focal engagement object (Jaakkola and Alexander, 2014; Sweeney *et al.*, 2020).

However, while prior literature captures advocacy as an extreme form of positive word-of-mouth initiated by the customers with an explicit goal of influencing others about a brand, product or service (Brodie *et al.*, 2013; Sweeney *et al.*, 2020), this paper captures advocacy as a pattern of engagement behavior toward the COVID-19 vaccination. It shows that advocates do not wait to be asked for advice but rather mention the vaccination proactively using an active communication style exemplified in sharing details of experience with the vaccination, showing the positive outcomes for taking the vaccination.

Proposing

Proposing refers to the *public’s behavioral manifestations toward vaccination to suggest actions to ensure an effective vaccination process*. In 4% of total comments analyzed, individuals engage by offering suggestions to the WHO that involve, for instance, conducting more research on current COVID-19 patients and reasons for death caused by the

vaccination: *'I suggest that the WHO do more research on the different difficulties by comparing symptomatic and asymptomatic patients and also the reasons of death caused by the vaccines.'* In other instances, they suggest offering the vaccines to developing countries for free to ensure a worldwide vaccination: *'I think the WHO should help poor populations to receive vaccines antiCOVID-19, maybe the rich Nations give them free vaccines!'*. Moreover, they propose promotional suggestions about the vaccination for the WHO's consideration, for example: *'It is better to make more videos on different situations of COVID-19 vaccination of different countries, thanks'*. The QTA of this pattern shows that the proposers' language is also positive, with care about 'people,' 'developing countries', 'humans' and 'doctors' shown in a more specific way than the advocates. Unlike advocates, the proposers mainly suggest actions or alternatives using words such as 'give', 'help', 'suggest', 'kindly,' and 'please'.

Such a pattern has similarities to extra-role, or customer citizenship, commonly referring to customers seeking to benefit an organization rather than acting out of self-interest (Bowden *et al.*, 2017; Rosenbaum and Massiah, 2007). However, prior literature focuses on customer contributions to a firm's service quality through benevolent behaviors consistent with the provider's role assigned to the customers; the stance is that the customer is helping the firm according to the firm's plans (Jaakkola and Alexander, 2014). In this paper, and consistent with the engagement literature, people intend to offer suggestions proactively to the WHO instead of those originating from the firm and their behavioral manifestations could co-create value toward the WHO (Brodie *et al.*, 2013; Van Doorn *et al.*, 2010).

Inquiring

Inquiring relates to the *public's behavioral manifestations toward vaccination to ask questions about the vaccine*. In 12% of total comments, individuals engage by asking about probable side effects: *'Is it still safe for my baby if I breastfeed while feeling the side effects? Or should I wait until fever etc. goes away to breastfeed? Excited about giving antibodies to my baby, but I want to make sure I do it safely'*. They also ask about the assessment of the safety of the

vaccine: *'I would like to know how does WHO assess safety of COVID-19 vaccines?'*. In other instances, they inquire about the adequacy of the vaccines to protect from other diseases: *'Pls can u mention which kind of diseases will be protected by that vaccination, in addition to COVID-19?'*. The inquiring comments have common heuristic features: the question mark and the syntax of a question sentence which differs from proposing and advocating patterns. While engaging in the inquiring pattern, individuals are not advocating adopting the vaccines or offering suggestions to improve the vaccination process. Instead, they merely ask questions about the safety assessment, side effects, and effectiveness of the vaccines. These questions are directed to the credible source – WHO - that should have all the answers as perceived by the inquirers. The QTA of this pattern shows neutral language, mainly asking questions and using words such as 'ask', 'questions', 'inquire' and of course because they are asking about the safety of the vaccine, words such as 'death' 'die' 'blood' 'clots', and 'safety' appear in their questions, as well as uncertainty terms such as 'assure', 'seem', and 'appear'.

Prior marketing and service literature streams addressed customer inquiries suggesting the importance of creating online communities for customers, mainly for inquiries, in addition to access to other customers with similar interests and experiences (Jun *et al.*, 2004; Waltner, 2000). Customer inquiries play the main role in the primary information flow from buyers to sellers (Parasuraman and Grewal, 2000). However, crises often breed high levels of uncertainty among the public (Mitroff, 2004). It follows that, according to crisis communication research, social media users will engage in a heightened level of information seeking (Fraustino *et al.*, 2012). The vaccination situation is inherently unprecedented and consistently evolving. Such inquiring pattern assists the public in making an informed decision, regarding the vaccine.

Skeptical

Skeptical refers to *the public's behavioral manifestations toward vaccination to question the reliability of the vaccines or motive of vaccine providers*. In 13% of the total analyzed

comments, people question the underlying motives of the approving body of the vaccine. Skepticism has been captured in prior psychology literature as questioning motives that underlie a person's behavior or the genuineness of that behavior (Korsgaard, 1986; Taber and Lodge, 2006). Our study shows that people tend to suspect the behavior of the WHO approving such vaccines without enough research to back its success rate. The skeptical people's language is negative, and they use words such as 'doubt', 'suspect', 'untrusted', 'don't', 'liars', 'lying', 'fake'. In addition, they often suspect a financial agenda involving different parties such as businessmen, pharmaceutical companies, and the WHO. In their comments, people provide explicit red flags that trigger their skeptical behavior, for example: *'Having Bill Gates as the medical spokesperson, is the first red flag. Having an experimental mass-vaccination program with a 50/50 % chance of success rate, is the second red flag. I think I'll wait for the outcome before deciding on my future'*. This is consistent with theories of skepticism in psychology literature indicating suspicion of a person who is paid to say something (Hilton *et al.*, 1993). This also appeared in their words such as 'bill', 'gates', 'propaganda', 'money', 'China'.

In other instances, the skeptical pattern relates to the reliability of the available vaccines: *'I'm wondering that after the virus has been fully sequenced, and various vaccines have been created, why this virus is still wreaking havoc around the world and I doubt the vaccines are working.'* Theoretically, this represents rational skepticism that involves a doubt about the bearing of rational considerations on how the current situation has been evolving to give substantive guidance for choice and action (Korsgaard, 1986). In this study, people find contradictions associated with the expected results of the vaccination, hence, skepticizing its effectiveness and reliability.

Importantly, people's prior beliefs and attitudes- whether scientific or social—should “anchor” the evaluation of new information and then, depending on how credible is some piece of evidence, impressions should be adjusted upward or downward (Anderson, 1981).

Our study shows that prior understanding of how vaccines should work guides new information processing in skeptical terms (Taber and Lodge, 2006). Such skepticism increases in situations that may affect the individual's welfare detrimentally (Deutsch, 1958). For example, '*Vaccines either work or they don't and **the fact some are vaccinated and still need to follow the rules makes me doubt that these vaccines work***'

Sarcastic

Sarcastic refers to *the public's behavioral manifestations toward vaccination to deride the vaccination &/or the source (e.g., WHO)*. In 14% of overall comments, individuals engage using sarcasm, thereby deriding the concept of vaccination, actions taken by the WHO, specifically, its promotional content about the vaccination. For example: '*The virus is "smart".. The virus "Likes"... Hilarious, **I was waiting for them to tell us they actually had a bit of chat with the virus***'. '*What we know is that vaccines stop people dying!! **Wow! Finally the ultimate cure of death, yes keep us immortal***'.

Prior research captured the act of derision toward firms or service providers based on customers' negative experiences (Azer and Alexander, 2018). The language used cannot be presumed to be positive or negative, it is just sarcastic; sarcasm shifts the polarity of positive or negative speech to its opposite (Giora *et al.*, 2000; González-Ibáñez *et al.*, 2011). Sarcastic people used words such as 'Bravo' and 'LOL' while they are flipping the meaning to emphasize derision. According to social psychologists, people may choose to use sarcasm instead of speaking literally in order to additionally convey a negative attitude toward something (Filik *et al.*, 2016) using salient, incompatible meanings, specifically known to be more potent, retainable and memorable than literal comments (Colston, 1997; Giora, 2002). Words captured such as 'plandemic', 'Mafia', 'zombies', 'poison', 'Hoax', 'guinea pigs', 'rats', 'sheep' show how the sarcastic use salient incompatible meanings reflecting how they think about the vaccination process. For example: '*The World Hoax Organization (WHO) assessed the vaccine by **flipping a coin and checking the wind.***' Derision enhances the critical

effect, and, hence, negative comments are more condemning than literal ones (Bowes and Katz, 2011; Colston, 1997; Toplak and Katz, 2000).

Rebutting

Rebutting refers to the *public's behavioral manifestations toward vaccination to offer a contrary argument about vaccination &/or vaccine side effects*. In 27% of comments, individuals engage by offering a rebuttal to what is known about vaccines based on real facts via evidence and statistical reports. For example: *'Oh! What about nearly 800 deaths from both gene therapy jabs and over 441,000 adverse reactions reported on the yellow card scheme!! Figures are much higher as most reactions are not recorded on the scheme and folk are not being told about the scheme!! No, you can take mine and my family's too'*. Alternatively, based on their comprehension of the situation backed by scientific knowledge, *'The vaccines affect the enzyme P53 which is crucial to combat cancer. It also replaces the natural immune system. It produces inflammation and increases infection. Blood clotting problems show even in healthy people who have been vaccinated'*. *'No won't take it. The so-called COVID-19 "vaccines" don't work like vaccines. They're designed to lessen symptoms when the inoculated person gets infected, but they do not actually prevent them from getting infected in the first place, and they don't prevent the spread'*.

Engaging in this pattern specifically entails offering a contradicting argument; people not only manifest negatively about the vaccination but also offer a rebuttal to back their position. The language they use is negative with words such as 'never', 'no' are appearing, although there is an appearance of dark words such as 'die' and 'death' the difference is that the rebutting people emphasize facts using words such as 'stats', 'figures', 'percentages' and scientific terms such as 'genes', 'mutation', 'asymptomatic', 'carriers', 'side-effect' 'symptoms'.

According to prior marketing and engagement research, providing alternatives can affect other actors' evaluations toward the brand and their decisions (Azer and Alexander, 2020b;

Jones *et al.*, 2000; Lemon *et al.*, 2002). Regarding the vaccines, people explicitly manifest not only their opposition to the vaccine but also continue to promote the idea that vaccinations cause more harm than good which may affect the attitude of others toward vaccination. Such rebutting pattern is associated with the COVID-19 vaccines due to the plethora of social media already claiming the detrimental effects of the focal vaccines impacting everything from health to society and government (Etzioni-Friedman and Etzioni, 2020).

Dispiriting

Dispiriting relates to the *public's behavioral manifestations toward vaccination to spread depressing thoughts about the vaccine &/or vaccination*. In 18% of comments, individuals engage by spreading negative thoughts focusing only on the situation's very dark side, death, uncertainty. They tend to do so either metaphorically, for example: *'Covid vaccination will help depopulate/reduce the population on earth,'* or straightforwardly, for example: *'The covid vaccines will still let you transmit covid, not stop you getting sick or die from covid, you still have to wear masks and social distance'*. *'Sad to see what is happening, but no one has information of how people get the viruses. Sad changing people life.... So sad, life will never get back to normal as we know it'*.

The COVID-19 crisis has provoked feelings of loneliness (Donthu and Gustafsson, 2020), linked to negativity and depression (Azer *et al.*, 2021; Cacioppo and Hawkley, 2009). The uncertainty about the vaccination results and fear of death that the vaccines may cause increased the level of negativity and depression for some people (Etzioni-Friedman and Etzioni, 2020), which our findings around the dispiriting pattern support. The dispirited people's language is extremely negative with words such as 'sad', 'grief', 'destroyed', 'depressed', 'fear', 'death', 'worse' 'grave'. Unlike the rebutting pattern, using the dispiriting one does not involve any facts or stats or supporting information or sources, but rather dark depressing thoughts about the vaccine. According to social psychology, public health and

political literature streams, these shared dispiriting moods are likely to cause other actors to lose enthusiasm and hope (Warren *et al.*, 2005). Such a pattern provokes the fear of uncertainty, chaos, dark memories of wars, collapsing nations, and previous pandemics (Ostbo, 2016).

Relationship between the Patterns of Engagement and Attitudes toward COVID-19 Vaccination.

Health research acknowledges three main attitudes toward vaccination: vaccine acceptance, vaccine hesitancy, and vaccine refusal (Dror *et al.*, 2020; Murphy *et al.*, 2021; Yaqub *et al.*, 2014). Further QTA was applied to explore the relationships between the conceptualized engagement behavior patterns toward vaccination and the extant attitudes toward vaccination from the health literature. The matrix coding query function of NVivo pro (see Table III) shows the coverage of each engagement pattern and possible co-occurrence with the three attitudes toward vaccination by searching for data coded to multiple pairs of items simultaneously using a row percentage matrix (Hutchison *et al.*, 2010). This matrix considers the total number of coded words across all cells for each row, and then a percentage is given for each cell to represent its proportion compared to other cells in the same row (QSRInternational.com, 2016).

	Advocating	Proposing	Inquiring	Skeptical	Sarcastic	Rebutting	Dispiriting
Acceptance	70%	25%	5%	0%	0%	0%	0%
Hesitancy	0%	7%	68%	23%	0%	2%	0%
Refusal	0%	1%	0%	11.5%	22%	38%	28%

Table III: Matrix Coding Query – Row Percentages

Vaccine Acceptance

Vaccine acceptance, captured in 16% of all data analyzed, is mainly associated with two of the conceptualized patterns of engagement: *advocating*, and *proposing*. Vaccine acceptance, as per the health literature, represents an appreciation of the benefits of and the

need for vaccination (Yaqub *et al.*, 2014). Our data picked vaccine acceptance in quotes such as *'I accept,' 'we need the vaccines,' 'I do not object,' 'vaccines are necessary.'*

From the results of the table above, people with vaccine acceptance attitudes tend to engage in the advocating pattern of engagement. Their comments explicitly declare their acceptance of the vaccine, whether they are waiting for their turn to take it or they already have taken it. In all cases, they particularly advocate the vaccine publicly to others, sharing their personal experience as proof to reassure other actors. For example: *'I am a healthy 76yr old, no cancers of any sort. In my lifetime, since childhood have had numerous vaccines, thank God. Have had, smallpox, polio, mumps, hepatitis vaccines too. Covid vaccine is working very well. 2nd dose next week. Ready to party'*. In other instances, they focus on reminding others of the benefits of the vaccine, focusing on the detrimental consequences of the virus, which is consistent with recent views that accepting the vaccine entails acknowledging the severity of COVID-19 (Dror *et al.*, 2020). For example: *'The virus that has killed millions. We all deserve to live and that's why we have to take the vaccine to stay safe and healthy'*.

Furthermore, people with an accepting attitude toward vaccines tend to *propose* actions for the consideration of the WHO to ensure an effective vaccination process while also explicitly express their acceptance of the vaccine. For example: *'WHO, please start educating people about the benefits of the COVID vaccination. I accept the vaccine, but it seems many others are reluctant, I suggest the entire world should be vaccinated against COVID'. 'I don't oppose the vaccine, but I think the WHO should stop vaccinating healthy people and start with the vulnerable and those that work in the frontline.'*

Vaccine Hesitancy

Vaccine hesitancy, captured in this study in 25% of total data, is mainly associated with two of the conceptualized patterns of engagement: *inquiring and skeptical*. Prior vaccination literature refers to attitudes toward vaccination that involve doubt in the benefits of vaccines,

worry over safety and questioning the need for them (Dror *et al.*, 2020; Larson *et al.*, 2014; Yaqub *et al.*, 2014). Our data picked such hesitancy attitude in quotes such as '***I doubt***', '***would it be safe?***', '***I worry***', '***reluctant***', '***not sure***', '***hesitant***', '***how safety is assessed?***'.

Our study shows that people with vaccine hesitancy attitude tend to engage in the *inquiring* pattern, and they not only worry over the safety of the COVID-19 vaccines, but they also ask about its side effects. In their comments, they explicitly declare their hesitancy to take the vaccine while asking their questions. For example: '***How do I assess safety of COVID-19 vaccines? I am very reluctant and want to know more before taking it***'. '***I am a bit worried to take the vaccine, are there any long-term side effects?***'.

The second public engagement pattern that relates to vaccine hesitancy is *skeptical*. Prior research, as also our study, shows that vaccine hesitancy involves questioning the need for vaccines '***I am worried about messing with my natural immunity, I don't understand the need for vaccines***' and doubting their benefits '***I doubt the covid vaccine works while the virus is changing all the time, I am not sure taking the vaccine will change anything***'. Extending prior research, we captured questioning the underlying motives of the involved parties in administering the vaccination (e.g., Businessmen, WHO, & Pharmaceutical companies). For example: '***Vaccines, like other things have become big business! WHO assesses it by whichever pharma company is paying the most, I am worried about this ordeal and not sure what to decide***'.

Vaccine Refusal

Vaccine Refusal, captured in this study in 59% of total data, is mainly associated with three of the conceptualized engagement patterns: *rebutting*, *dispiriting*, and *sarcastic*. Prior vaccination literature refers to it as an explicit refusal of the concept of vaccination (Wilson and Wiysonge, 2020; Yaqub *et al.*, 2014). Our data picked such refusal attitude in quotes such as '***No, won't get it***', '***Nope!***', '***Not for me***', '***I refuse***', '***I don't want***', '***No, thanks***', '***No way***', '***Never would I***'.

According to our results, those with vaccine refusal attitude tend to explicitly show their refusal attitude while offering *rebuttals*. For example: *'Nope not getting that shot. I don't care if they promise I can live forever with it. I know people who died after that shot and many others broke out badly after the shot. Some neighbors are even called back for getting blood clots'*. Secondly, *dispiriting* where individuals show their refusal while spreading depressing thoughts is not based on any evidence or life experience, just focusing on the dark side of the situation. For example: *'No thank you! Cure is worse than the disease! We will die anyway'*. Finally, where individuals are sarcastically showing their refusal. For example: *'What I get from the talk of the Worst Health Organization (WHO) if I got robbed today, I can't be robbed again because I got Immunity from first robbery Jab, No thank you, not in a million years!'*

To summarize this paper's findings, Figure 2 illustrates the seven patterns and their relationships with the three vaccine attitudes. The next section discusses the research findings and their theoretical and practical implications and limitations.

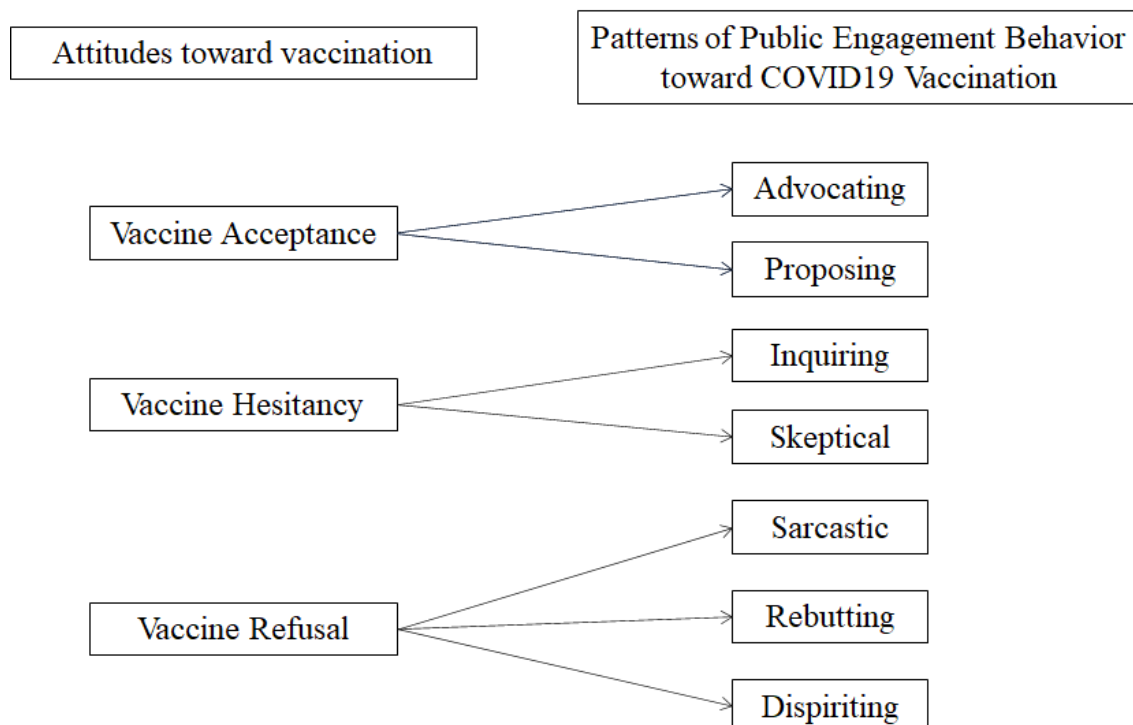


Figure 2: Relationships between attitudes toward vaccination and patterns of public engagement behavior toward COVID-19 vaccination

Discussion

Theoretical Implications

This study contributes to theory by bridging a gap between engagement, crisis communication, and health research streams. While recent research has studied vaccination attitudes, using the lens of engagement research brings additional insight and nuance. This paper explores the public's engagement behavior toward the COVID-19 vaccination and provides the first typology of its seven patterns. Thereby we contribute to engagement literature that has, to date, been limited to exploring engagement behavior with brand/product/service provider as the engagement object, here our typology of engagement behavior is based around COVID-19 vaccination as an engagement object and the conceptualized pattern differs from existing brand-related typologies. Hence, we respond to recent research calls to study engagement objects beyond those commonly investigated (Azer *et al.*, 2021; Ng *et al.*, 2020).

Despite the increasingly important role social media plays during a crisis according to crisis communication literature (Coombs and Holladay, 2012; De Valck, 2020; Jin *et al.*, 2012) and especially when shaping people's opinion about the vaccination as suggested by health studies (Cf. Dror *et al.*, 2020; Paul *et al.*, 2021; Yaqub *et al.*, 2014), the extant health literature focuses mainly on attitudes toward COVID-19 vaccination, specifically hesitancy and refusal (Dror *et al.*, 2020; Etzioni-Friedman and Etzioni, 2020; Murphy *et al.*, 2021) and has overlooked public interactions with social media communications by public health service, which our study explores. Other studies limited the role of social media to foreign disinformation campaigns on vaccination (Wilson and Wiysonge, 2020), while engagement toward vaccination received scant attention.

This paper contributes to the extant knowledge with new insights on how the public engage toward the COVID-19 vaccination via seven distinct engagement behavior patterns

(*Advocating, Proposing, Inquiring, Skeptical, Sarcastic, Rebutting, and Dispiriting*) and shows the type of language each pattern uses. For instance, advocates and proposers use positive language, inquirers use neutral language, while sarcastic shifts the polarity of positive or negative speech to its opposite. On the other hand, skeptical and rebutting use negative language while extreme negative language is used in dispiriting comments. This paper also provides the first framework of relationships that links each pattern to underlying vaccine attitudes that are prominent in the health literature: *vaccine acceptance, vaccine hesitancy and vaccine refusal* (Baker, 2003; Jansen *et al.*, 2003; Plotkin, 2014).

Understanding such relationships is necessary as it facilitates the development of public health service communication strategies about vaccines. Communications during a crisis should take into consideration that people act on information differently than during normal times (CDC.gov, 2019; Fraustino *et al.*, 2012), which is evident in the seven engagement behavior patterns toward the COVID-19 vaccination. Without such enhanced information, policymakers and public health services may make communication decisions based on intuition or inaccurate information. Our findings also contribute to the health literature by providing important differentiation between hesitancy and refusal vaccine attitudes in relation to engagement patterns toward the vaccination, which has been, hitherto, unclear (Paul *et al.*, 2021).

Importantly, the framework of relationships offered by this study provides a more nuanced view of the public's complex views on vaccination, which the three broader vaccine attitudes fail to achieve (Murphy *et al.*, 2021). To illustrate, vaccine acceptance relates to both advocating and inquiring patterns. Both use inclusive terms (see Appendix A) which implies their proactivity and care about others. However, those advocating proactively share their personal experience to recommend the vaccine publicly, while those proposing are not sharing any experience but rather share suggestions that are supposed to improve vaccination,

thereby co-developing with public health organizations (Jaakkola and Alexander, 2014). Vaccine hesitancy relates to both inquiring and skeptical patterns of engagement behaviors, yet each of these behaviors is distinct. Those inquiring are using neutral language, mainly asking questions about the safety of the vaccines and the probable side effects which they are uncertain about (see Appendix A). This is consistent with prior vaccination research relating a lack of awareness to vaccine hesitancy (Yaqub *et al.*, 2014). However, the skeptic does not ask questions, rather use negative language associated with doubting the reliability of the vaccines and the underlying motives of the WHO (see Appendix A). Importantly, this study extends findings in health literature, limiting vaccine hesitancy to doubting a vaccine's benefit and questioning its need (Dror *et al.*, 2020; Yaqub *et al.*, 2014) to introduce skepticizing the underlying motives of the vaccine source.

Finally, the vaccine refusal attitude relates to three engagement patterns, dispiriting, sarcastic, and rebutting, which, once again, are distinct forms. The dispiriting pattern appear to spread dark negative thoughts which are not necessarily backed up by any evidence or life experience, merely reflecting their own feelings in their comments that there is no hope (see Appendix A). This is consistent with recent research suggesting that social media may also bring out the worst in people during a crisis (Donthu and Gustafsson, 2020). Importantly, such a crisis provokes feelings of loneliness, which, in prior crisis communication research, has been linked to negativity and depression (Azer *et al.*, 2021; Cacioppo and Hawley, 2009), and the dispiriting pattern picked up in the refusers comments indicate this is happening when their engagement focus is the COVID-19 vaccination. This is different from vaccine refusal represented by rebutting pattern which sees people use negative language with evidence to back their counterargument, whether based on their scientific knowledge or personal judgment of the situation (see Appendix A). People explicitly manifest not only their opposition to the vaccine but also to promote the idea that vaccinations cause more harm than

good, which according to prior engagement may affect the commitment of others toward vaccination (e.g., Azer and Alexander, 2020b; Lemon *et al.*, 2002).

Similarly, the sarcastic form also relates to the broader vaccine refusal attitude and differs from the other two mentioned patterns. People tend to use sarcasm instead of speaking literally to convey a negative attitude toward something (Filik *et al.*, 2016). As captured in this study, they use salient, incompatible meanings, shifting the modality of speech to its opposite (see Appendix A). Compared to rebutting and dispiriting, which are literal in nature, derision is suggested to enhance the critical effect and, hence, the negativity of comments appears more condemning than literal ones (Azer and Alexander, 2020b; Bowes and Katz, 2011).

Finally, the focus on the public's engagement behaviors, elevated in vaccine communication, is a unique contribution of this study. The majority of extant contributions have mainly focused on the organizational side, looking at how public health organizations can communicate more effectively (Dror *et al.*, 2020; Paul *et al.*, 2021; Wilson and Wiysonge, 2020). This paper explains the public's engagement behavior toward the COVID-19 vaccination at a broader level. Therefore, aligns with recent research assertions that marketers and organizations should consider the people's state in their efforts to foster engagement during and beyond a global crisis (e.g., Azer *et al.*, 2021; Karpen and Conduit, 2020; Nabity-Grover *et al.*, 2020).

Managerial Implications

This paper provides insights for public health service organizations to better engage and communicate through social media about the COVID-19 vaccination. Specifically, the results offer a sense of the public's real-time sentiments reflected in their behavioral manifestations, which public health services should consider when delivering, and responding to, messages and engage in conversations that can be considered valuable and helpful (De Valck, 2020).

Based on the findings, public health organizations may need to improve their ongoing social media vaccine promotional posts &/or campaigns and embark on more active listening strategies to understand how their social media audiences and, through influencing behavior, the public reacts to the issue. While informing the public is crucial, our findings also offer insights regarding how the public may interact with the vaccines' existing campaigns and, subsequently, how messages may become adopted or subverted.

Based on the results, this paper provides public health service organizations with some data-driven recommendations as follows. Firstly, public health organizations may identify those engaging in the advocating pattern and encourage them to share their personal experience with the vaccination. According to prior service research, advocacy is a powerful positive WOM that positively influences other actors (Sweeney *et al.*, 2020). Similarly, shared personal experiences, which the advocates do as per this study, affect other actors' evaluations, perceptions, and attitudes toward vaccination (Azer and Alexander, 2020b). Therefore, nurturing advocates may help counter the misinformation and conspiracy theories about vaccination on social media (Wilson and Wiysonge, 2020). Secondly, it is recommended that public health organizations listen to the suggestions of those engaging in the proposing pattern. These are underpinned by vaccine acceptance attitude; they already show that in their comments and suggestions to improve the vaccination process. Public health organizations are recommended consider the proffered feedback, suggestions, and information to help improve the vaccination using specialized platforms for feedback or starting a campaign to collect suggestions.

Thirdly, public health organizations are recommended to respond to hesitancy forms. Those inquirers are not refusing the vaccine, they are hesitant to take it based on the findings, and they are asking questions to make an informed decision. Fortunately, they inquire and need an answer from a credible source such as the WHO rather than listening to the

misinformation abundant on social media. However, as suggested by theory and experience, hesitancy soon becomes a refusal (Salathé and Bonhoeffer, 2008). Therefore, responding to these inquiries is necessary to avoid leading them to switch from vaccine hesitancy to refusal attitude. Importantly, they post their inquiry publicly, which makes responding publicly crucial. No response strategies allows inquiries to stand unchallenged, thereby potentially damaging the reliability of the public health organization (Sparks *et al.*, 2016). Publicly answering these inquires may help to reduce the likelihood of other actors on social media drawing their negative inferences about the focal health organization (Azer and Alexander, 2020a).

As identified in this study, vaccine hesitancy is also related to the skeptical pattern; however, this may require a different treatment. The skeptical are still hesitant to take the vaccines; they are not asking questions but rather doubt the reliability of the vaccine and the genuineness of the vaccine approving body (WHO). Their comments refer to the misinformation and conspiracy theories that are massively spread on social media. Public health organizations are recommended to consider countering such misinformation via their social media campaigns specific to this purpose. Language should be scientifically sound, but also simple and understandable.

Finally, public health organizations are not recommended to ignore those with vaccine refusal attitudes. This study provides three engagement patterns that the refusers use, dispiriting, sarcastic, and rebutting. Nurturing the advocators may counter the rebutting pattern. Both are two extreme evidential forms, one evidencing a good experience and the other using scientific knowledge to negate that. Additionally, it is recommended that public health organizations be clearer and more specific in their social media campaigns with more scientific evidence to back the campaigns. At the same time, adopting a pro-active long-term strategy for increasing the general public's science literacy and ability to read and understand

at least basic scientific information will be an important complementary strategy. It is also recommended to focus on empathy, spreading hope and inspiring those engaging in the dispiriting pattern rather than just persuasion in public health campaigns. According to prior research findings, inspiring others serves as a health-promoting behavior and plays a significant role in enhancing actors' physical health (Azer *et al.*, 2021; Carver and Scheier, 2014). Finally, public health organizations may consider the derision comments to understand how the public picks on mistakes in the campaigns and try to avoid them in future campaigns.

Limitations and Future Research

Despite the contributions and implications indicated above, this study's limitations also offer future research directions in this area. Facebook was selected as the focus of this study for appropriateness rather than representativeness (Kozinets, 2010); however, this research's findings reveal a convergent pattern across multiple WHO vaccination posts. WHO is picked for being responsible for international public health and the leading credible source of public health service organizations. Despite this rigor, future research could consider a broader range of organizations.

This research provides empirically driven definitions of the public's engagement behavior patterns toward the COVID-19 vaccination. Future research can operationalize these definitions and test their impact on other actors in social networks (e.g., other individual receivers, firms, governments, and public health organizations), specifically, how these patterns differ in their impacts on other actors in online social networks. That would contribute to engagement literature with insights about the intensity levels of these patterns. It would also be worthy of investigating how different patterns relate to individuals' psychological characteristics. This is likely to contribute to the engagement and social psychology literature streams.

This paper provides a framework of relationships between vaccine attitudes and the public's engagement behavior patterns toward vaccination. Future research can use this framework to test these relationships quantitatively. Also, to test the interchanging relationships between categories of vaccine attitudes. The paper also provides percentages of each engagement pattern's frequency, which further research can investigate the mechanism behind such frequencies.

This paper focuses on the public's engagement behaviors, elevated in vaccine communication, which is a unique contribution. Future research can replicate this study by focusing on C2C communication or communications by governments toward vaccination and how they influence social media audiences. Finally, future research may investigate differences in the public's engagement behavior after vaccination is administered more broadly with the 'new normal' as a focus of engagement. Finally, this paper offers data-driven recommendations to public health organizations; future research may test the impact of these recommendations on shifting the public's attitudes and behaviors toward vaccination.

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Pattern	Word (weighted percentage %)
Advocating	People (3.40), feel* (1.05), well (1.05), world (1.05), family (0.87), immune* (0.87), live (0.87), protection* (0.87), everyone (0.70), expect* (0.70), health (0.70), healthy (0.70), safe (0.70), control* (0.52), entire (0.52), fine (0.52), good (0.52), hoping*(0.52), improve* (0.52), keeps (0.52)
Proposing	People (2.73), countries (1.82), developing (1.82), world (1.82), human*(1.36), kindly (1.36), please (1.36), research (1.36), spread*(1.36), stop (1.36), available (0.91), suggest*(0.91), back (0.91), best (0.91), confirm* (0.91), doctors (0.91), entire (0.91), free (0.91), give (0.91), help (0.91).
Inquiring	Ask*(1.86), safety (1.86), death (1.39), know (1.39), data (0.93), study* (0.93), appear* (0.70), blood (0.70), clots* (0.70), die (0.70), distancing* (0.70), questions (0.70), sanitizer (0.70), science (0.70), alter* (0.46), antibodies (0.46), inquire* (0.46), assess (0.46), assure* (0.46), seem* (0.46).
Skeptical	Liars (2.44), lying* (1.95), fake* (1.76), not (1.46), distrust* (1.07), really (0.98), gates (0.88), anything (0.78), doubt* (0.78), China (0.68), money (0.68), Chinese (0.59), don't (0.59), fail (0.59), know (0.59), suspect* (0.59), propaganda (0.59), news (0.59), spread (0.59), stop* (0.59)
Sarcastic	World (3.01), Mafia (1.41), Plandemic (1.41), sheep (1.20), experiment* (1.00), hoax (1.00), pharma* (1.00), organization (1.00), years (1.00), robbed* (0.80), poison* (0.80), Bravo (0.80), guinea (0.80), rats (0.80), lol (0.80), pigs (0.80), way* (0.80), agenda (0.60), anything (0.60), zombies* (0.60).
Rebutting	Died* (2.09), figures* (2.09), stats (1.46), asymptomatic (1.46), no* (1.26), never (1.05), side-effects (1.05), blood (0.84), enzymes* (0.84), clots (0.84), deaths (0.84), phase (0.84), symptoms (0.84), accountable* (0.63), mutations* (0.63), years (0.63), experimental* (0.63), percentage (0.63), carriers* (0.63), genes (0.63)
Dispiriting	Sad* (3.23), death* (1.56), grief* (1.32), freedom (1.20), sick* (1.20), fear (1.08), destroyed* (0.96), worse (0.84), die* (0.84), never (0.84), bad (0.84), away (0.72), chaos (0.72), warn (0.72), cause* (0.60), infection* (0.60), censored* (0.60), unfortunately (0.60), locked*(0.48), grave* (0.48)

Top 20 words per engagement pattern

*Stemmed words

Appendix B

Part of Speech	Positive Language	Negative Language
Simple Lexical Valence		
Verbs	Boost, Ease, Encourage, Delight,	Discourage, Fail, Haggle
Nouns	Benefit, Worth, Favor	Backlash, Catastrophe
Adjectives	Attractive, Better, Good	Annoying, Awry, Bad
Contextual Valence Shifters		
	Effect	Terms
Negatives	Flip the valence of a term	Not, never, nobody, neither, nothing..etc.
Intensifiers	Weaken a valence of a term	<i>Rather</i> efficient
	Strengthen a valence of a term	<i>Deeply</i> suspicious
Presuppositions	Shift the valence of evaluative terms	<i>Barely</i> sufficient
Connectors	Negate evaluations	Although, however, but, on the contrary, notwithstanding...etc.

Elements communicating positive and negative sentiments in text (Polanyi and Zaenen, 2006).