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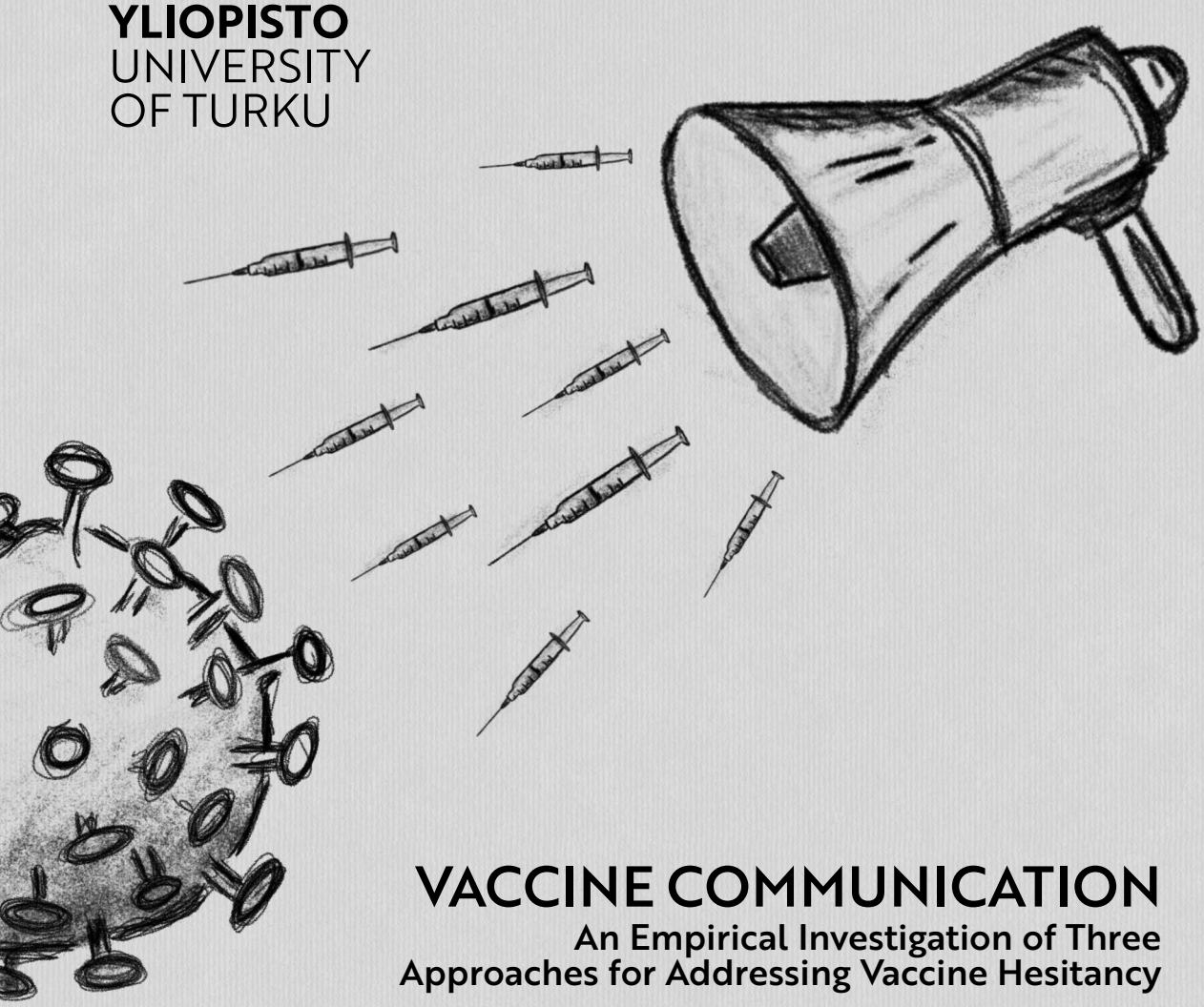

VACCINE COMMUNICATION

An Empirical Investigation of Three Approaches for Addressing Vaccine Hesitancy

Otto Mäki

TURUN YLIOPISTON JULKAISUJA – ANNALES UNIVERSITATIS TURKUENSIS
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To my dear Astrid

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ABSTRACT

Decreasing vaccine hesitancy has proven to be difficult, with most vaccine-communication approaches showing modest effects at best. Nevertheless, approaches that focus on identifying subgroups for targeted messages, tailoring messages to match recipient preferences, or training healthcare professionals' (HCPs') communication skills have been shown to reduce vaccine hesitancy.

The present thesis aimed to explore these approaches by 1) identifying and describing COVID-19 and influenza vaccine-hesitancy subgroups, 2) developing and investigating the efficacy of statistically and anecdotally tailored vaccine messages, and 3) evaluating the efficacy of an Empathetic Refutational Interviewing (ERI) training intervention intended for HCPs tasked with discussing vaccines with patients. Hierarchical cluster analysis was used to identify COVID-19 and influenza vaccine-hesitancy subgroups in two general population samples, the efficacy of statistical and anecdotal vaccine-promoting messages was experimentally tested in said general population samples, and the ERI training intervention was experimentally evaluated in two samples consisting of HCPs working in Finland and in the UK.

COVID-19 and influenza vaccine-hesitancy subgroups were found to share similar vaccine-hesitancy patterns, ranging from people that are more positive toward these vaccines to people that are strongly against vaccines, and with COVID-19 vaccine-hesitancy subgroups exhibiting greater variability. Statistical and anecdotal vaccine messages were found to have small to no effects on participants' vaccine attitudes and their vaccination intentions even when the type of message matched participants' preferences. The short ERI training scenarios showed modest yet encouraging results, suggesting that HCPs may be able to quickly learn and implement empathetic affirmations into their communication approach.

Future research is needed on the combined effects of different vaccine-communication approaches as no single vaccine-communication approach is likely to be sufficient to address vaccine hesitancy.

KEYWORDS: vaccine hesitancy, vaccine attitudes, communication, audience segmentation, message tailoring, healthcare professional, format preference, empathetic refutational interviewing, COVID-19, influenza

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TIIVISTELMÄ

Rokote-epäröinnin vähentäminen on osoittautunut haastavaksi, ja erilaisten rokoteviestintästrategioiden tulokset ovat useimmiten olleet vaatimattomia. Viestintästrategiat, jotka keskittyvät yleisösegmentointiin, viestinnän räätälöimiseen, tai terveydenhuollon ammattilaisten vuorovaikutustaitojen kehittämiseen, ovat osoittautuneet toimiviksi rokote-epäröinnin vähentämiseksi.

Tämän väitöskirjan tarkoituksena oli 1) tunnistaa ja kuvailla erilaisia COVID-19- ja influenssarokote-epäröiviä ryhmiä, 2) kehittää ja tutkia tilastollisesti ja anekdoottisesti räätälöityjen rokoteviestien tehokkuutta, ja 3) arvioida terveydenhuollon ammattilaisille suunnatun Empaattinen vasta-argumentoiva haastattelu (EVH) -koulutusintervention tehokkuutta. Tavoitteiden saavuttamiseksi hyödynnettiin hierarkkista klusterianalyysia, jolla tunnistettiin COVID-19- ja influenssarokote-epäröiviä ryhmiä kahdessa yleisväestöaineistossa, samassa aineistossa arvioitiin tilastollisten ja anekdoottisten rokoteviestien tehokkuutta, ja EVH-koulutusintervention tehokkuutta tarkasteltiin kahdessa aineistossa, jotka koostuivat suomalaisista ja isobritannialaisista terveydenhuollon ammattilaisista.

COVID-19- ja influenssarokote-epäröivillä ryhmillä oli samankaltaiset rokote-epäröintiprofiilit. Profiilit vaihtelivat rokotemyönteisistä ryhmistä täysin rokotteita vastustaviin ryhmiin. COVID-19-rokote-epäröivissä ryhmissä havaittiin kuitenkin suurempaa vaihtelevuutta influenssarokote-epäröiviin ryhmiin verrattuna. Tilastollisten ja anekdoottisten rokoteviestien vaikutukset osallistujien rokotemielipiteisiin ja rokotusaikomuksiin olivat vähäiset. Viestien vaikutus oli pieni tai olematon myös silloin, kun viestien esitystapa vastasi osallistujien esitystapapreferenssiä. EVH-koulutusintervention tulokset olivat lupaavat. Tulokset viittasivat siihen, että terveydenhuollon ammattilaiset pystyvät nopeasti oppimaan soveltamaan empaattista lähestymistapaa rokotekeskusteluissaan.

Lisää tutkimusta tarvitaan erilaisten rokoteviestintästrategioiden yhdistelmistä, sillä mikään yksittäinen rokoteviestintästrategia ei todennäköisesti tule vähentämään kaikkea rokote-epäröintiä.

ASIASANAT: rokote-epäröinti, rokotemielipiteet, viestintä, yleisösegmentointi, viestinnän räätälöinti, terveydenhuollon ammattilainen, esitystapapreferenssi, empaattinen vasta-argumentoiva haastattelu, COVID-19, influenssa

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Turku, January 2025

Otto Mäki

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List of Original Publications

This dissertation is based on the following original publications, which are referred to in the text by their Roman numerals:

I Mäki, K. O., Karlsson, L. C., Kaakinen, J. K., Schmid, P., Lewandowsky, S., Antfolk, J. & Soveri A. (2024). COVID-19 and influenza vaccine-hesitancy subgroups. *PLOS ONE*, *19*(7): e0308159. https://doi.org/10.1371/journal.pone.0308159

II Mäki, K. O., Karlsson, L. C., Kaakinen, J. K., Schmid, P., Lewandowsky, S., Antfolk, J. & Soveri A. (2023). Tailoring interventions to suit self-reported format preference does not decrease vaccine hesitancy. *PLOS ONE 18*(3): e0283030. https://doi.org/10.1371/journal.pone.0283030

III Holford, D., Mäki, K. O., Karlsson, L. C., Lewandowsky, S., Gould, V. C. & Soveri A. A Randomized Controlled Trial of Empathetic Refutational Learning with Health Care Professionals. Manuscript submitted.

1 Introduction

Vaccination is often seen as one of the greatest achievements in public health (Shattock et al., 2024). It is among the safest and most cost-effective methods to combat infectious diseases (Utami et al., 2023), and since their inception, vaccines have saved countless lives. For example, it has been estimated that COVID-19 vaccines have prevented over 1.6 million deaths in Europe alone (Meslé et al., 2024).

Despite their benefits, and the widely held view among experts that vaccines are a vital part of modern healthcare, some people hold vaccination concerns or refuse to take certain or all vaccines (Brewer et al., 2017). This phenomenon has been labelled *vaccine hesitancy*. Vaccine hesitancy has most commonly been defined as either a delay in or a refusal to take some or all vaccines (MacDonald et al., 2015). However, the World Health Organization (WHO) has later come to define vaccine hesitancy as a motivational state, in which a person is either conflicted about or opposed to taking vaccines (World Health Organization, 2022). More broadly, the term vaccine hesitancy has also been used to encompass any thoughts or feelings that show uncertainty about vaccines as well as other negative vaccine attitudes and sentiments (Dudley et al., 2020). In such, the term vaccine hesitancy today tends to be a catch-all term for anything related to vaccine doubts and negative attitudes, as well as to behavioral aspects such as unwillingness to take vaccines. In this thesis, vaccine hesitancy will refer to a motivational state, including intention to get vaccinated.

Vaccine hesitancy poses a threat to public health (World Health Organization, 2019), as avoidable diseases get a chance to spread in the unvaccinated public. Moreover, people that are unable to get vaccinated—for example due to health conditions—are made even more vulnerable to infections if vaccination rates decrease. On a broader level, holes in vaccination coverages not only enable diseases to spread to unvaccinated individuals, but these holes also increase the risks of diseases mutating, leading to new vaccine-resistant strings that can then spread to the entire public (Jing et al., 2023). Furthermore, vaccine hesitancy also indirectly increases the risk of antibiotic-resistant diseases by giving diseases opportunities to spread and mutate over time (Jansen et al., 2021).

Understanding vaccine hesitancy and finding effective communication strategies to address it is important, considering the negative implications vaccine hesitancy can have for public health. Thus, the overarching theme of this thesis is the exploration of different vaccine-communication strategies. In order to familiarize the reader with and contextualize the present thesis within the broader body of literature on vaccine hesitancy, the remainder of the introduction is structured to first outline theoretical models on vaccine hesitancy in general, followed by a more detailed exploration of COVID-19 and influenza vaccine hesitancy, and concluding with the presentation of contemporary vaccine-communication strategies and research.

1.1 Theoretical Models and Frameworks Related to Vaccine Hesitancy

Due to the negative consequences vaccine hesitancy can have on public health, a substantial body of research has attempted to explain why people hesitate to take vaccines. The most cited and used explanatory theories and models of vaccine hesitancy are, in no particular order, the Theory of Planned Behavior (TPB; Ajzen, 1985), the Health Belief Model (HBM; Green et al., 2020), the 3C model of vaccine hesitancy (MacDonald et al., 2015), and the 5C model of vaccine hesitancy (Betsch et al., 2018). More recently, a novel anti-vaccination attitude-roots framework has been proposed as a different way to understand vaccine hesitancy (Fasce et al., 2023; Hornsey et al., 2018). While the aforementioned theoretical models are not the focus of the current thesis and will not be directly explored in the presented studies, the said models played a major role when the studies were designed. These models will be briefly described in the following sections.

1.1.1 Theory of Planned Behavior

The TPB is a widely used psychological theory that attempts to explain the relationship between beliefs and behavior (Ajzen, 1985). While originally developed to predict behaviors in general, the TPB has also been widely used in vaccine-hesitancy research (Limbu, Gautam, & Zhou, 2022). The TPB posits that attitudes, social norms, and perceived control over one's own behavior predict people's intentions, which in turn predicts their behavior. Studies have found that the TPB variables are significant predictors of vaccination behavior (Limbu, Gautam, & Zhou, 2022).

1.1.2 Health Belief Model

The HBM was developed to explain health-related behaviors and has been widely used in research to gain a clearer understanding of people's health behaviors and to develop more effective health interventions (Green et al., 2020). It has gained widespread traction in the vaccine-hesitancy research field and has played an important role in the development of several vaccine-hesitancy interventions (Li et al., 2022). The HBM posits that demographic variables and psychological characteristics indirectly play a role in people's vaccination behaviors through five main factors, namely perceived susceptibility to and severity of disease, perceived benefits and barriers of taking vaccines, and an individual's health motivation. These factors, together with a cue to action, have been found to reliably predict vaccine hesitancy (Limbu, Gautam, & Pham, 2022).

1.1.3 3C Model of Vaccine Hesitancy

The 3C model was developed by the SAGE Working Group on Vaccine Hesitancy and attempts to explain the three most essential factors of vaccine hesitancy, namely confidence, complacency, and convenience (MacDonald et al., 2015). In this context, confidence relates to people's confidence in the safety and efficacy of vaccines as well as their trust in the system that delivers them, like authorities and health professionals tasked with developing and distributing vaccines. Complacency relates to the perceived risk of diseases, including beliefs about the probability of catching diseases as well as the perceived seriousness of contracting a disease. Convenience relates to structural and psychological barriers such as perceived availability of vaccines as well as economic and time costs. Since its development, the 3C model has been a staple of vaccine hesitancy research and is still widely used to explain and describe vaccine hesitancy across the globe (see for example Gerretsen et al., 2021).

1.1.4 5C Model of Vaccine Hesitancy

The 5C model was developed as an extension to the 3C model to incorporate two theoretically and empirically relevant factors of vaccine hesitancy, namely calculation and collective responsibility (Betsch et al., 2018). Calculation refers to the finding that people search for information about vaccines and weigh the perceived pros and cons of vaccination against each other. Collective responsibility refers to the perceived importance of taking vaccines to protect others than oneself. While not yet as widely implemented as the 3C model, the 5C model has been increasingly adopted in contemporary vaccine-hesitancy research (see for example Tostrud et al., 2022).

1.1.5 Anti-Vaccination Attitude Roots

Research suggests that vaccine hesitancy can be rooted in underlying psychological factors, also known as attitude roots (Fasce et al., 2023; Hornsey et al., 2018; Hornsey & Fielding, 2017). In a recent systematic literature review, Fasce and colleagues categorized common themes found in anti-vaccination arguments (Fasce et al., 2023). This categorization resulted in eleven attitude roots for why people may oppose vaccinations, namely: conspiracist ideation, distrust, religious concerns, unwarranted beliefs, worldview and politics, fear and phobias, moral concerns, reactance, distorted risk perception, perceived self-interest, and epistemic relativism. This framework was developed especially for creating more effective vaccine-hesitancy communication that could focus on the underlying causes of vaccine hesitancy instead of trying to directly affect people's vaccination views (Fasce et al., 2023).

1.2 COVID-19 and Influenza Vaccines

Considering that vaccine hesitancy varies between contexts and vaccines, it is important to explore the determinants of hesitancy toward specific vaccines. As a large portion of this thesis is focused on COVID-19 and influenza vaccine hesitancy specifically, the next sections will present the Finnish context for COVID-19 and influenza vaccines, as well as briefly review the literature on the key COVID-19 and influenza vaccine-hesitancy determinants.

1.2.1 The Finnish Context for COVID-19 and Influenza Vaccines

COVID-19 and influenza are both infectious respiratory diseases, and while they share a similar symptomatology (Centers for Disease Control and Prevention, 2024b; World Health Organization, 2024), their history and contexts differ significantly.

Influenza is a common disease with a long-standing history and well-established vaccines (World Health Organization, 2023c). In Finland, influenza vaccines are recommended for people belonging to specific risk groups and they are compulsory for certain healthcare professionals (HCPs) working with people vulnerable to diseases like influenza (Finnish Institute for Health and Welfare, 2023). In 2023, the influenza vaccination rate was approximately 38.1% in Finland (Finnish Institute for Health and Welfare, 2024d). Although influenza has caused pandemics in the past (Centers for Disease Control and Prevention, 2024a), and the influenza vaccines have been controversial (Centers for Disease Control and Prevention, 2020, 2021), the acute societal impact of influenza and its vaccines have not been as wide-reaching as the COVID-19 pandemic (Hosseinzadeh et al., 2022).

In 2020, the COVID-19 pandemic ravaged the world, impacting millions of lives (World Health Organization, 2020). The COVID-19 pandemic affected people in various ways, ranging from topics such as health and welfare problems to social and political problems (Hosseinzadeh et al., 2022). To combat the spread of the disease, governments resorted to quarantines and travel restrictions (Mathieu et al., 2020). Then, by the end of 2020, COVID-19 vaccines started to become available. While the Finnish Institute for Health and Welfare recommended three COVID-19 vaccine doses for all adults (Finnish Institute for Health and Welfare, 2024b), only 64.9% of Finnish adults received all three doses as of 1.1.2024 (Finnish Institute for Health and Welfare, 2024c).

1.2.2 COVID-19 and Influenza Vaccine-Hesitancy Determinants

1.2.2.1 Vaccine and Disease Attitudes

In line with the TPB, HBM, 3C, and 5C models of vaccine hesitancy, research has found that people's levels of COVID-19 and influenza vaccine hesitancy are associated with their attitudes toward vaccines and diseases (Kumar et al., 2022; Schmid et al., 2017; Terry et al., 2022). More specifically, results from meta-analytic studies and systematic reviews suggest that people are less hesitant toward COVID-19 and influenza vaccines when they perceive these vaccines to be safe, efficient, and convenient, when they perceive the diseases as threatening, and when they think that it is important to take these vaccines to protect others (Kumar et al., 2022; Schmid et al., 2017; Terry et al., 2022).

1.2.2.2 Trust in Health Authorities

Considering that health authorities are generally involved in approving and regulating vaccines, it seems likely that the way in which people view health authorities could be related to people's views on vaccines. In line with this premise, trust in health authorities has been identified as a key aspect of both COVID-19 and influenza vaccine hesitancy (Kumar et al., 2022; Schmid et al., 2017). To be more specific, studies have found that the less people trust health authorities, the more hesitant they are toward both COVID-19 and influenza vaccines (Kumar et al., 2022; Schmid et al., 2017).

1.2.2.3 Conspiracy Mentality

Studies have found that vaccine hesitancy can be rooted in conspiracist beliefs (Bierwiaczonek et al., 2022; Fasce et al., 2023)—i.e., beliefs that events or phenomena are orchestrated by malevolent actors who are conspiring to gain some form of benefit (Douglas et al., 2019). In fact, both vaccine-specific and non-vaccine-related conspiratorial beliefs have been associated with vaccine hesitancy (Pilch et al., 2023). Also, a growing body of literature shows that individuals who believe in one conspiracy theory are more likely to endorse other conspiracy theories as well (see for example, Sutton & Douglas, 2020; Swami et al., 2010). This finding has resulted in the theory of a general conspiratorial mindset which suggests that some people have a higher tendency to believe in conspiracy theories in general (Imhoff et al., 2022). In the present thesis, this conspiratorial mindset will be referred to as *conspiracy mentality* (Bruder et al., 2013). Conspiracy mentality has also been studied in the context of vaccines, and people with a higher conspiracy mentality have been found to be more hesitant toward COVID-19 vaccines specifically (Jennings et al., 2023). However, the findings concerning the relationship between conspiracy theory beliefs and influenza vaccine hesitancy are mixed (Sallam et al., 2022; Winter et al., 2022).

1.2.2.4 Reliance on Anecdotal Testimonies

It is well-known that anecdotal testimonies can influence individual decision making (Allen & Preiss, 1997; Braddock & Dillard, 2016). However, attempts to address vaccine hesitancy more often involve presenting statistical information about the risks of diseases and the benefits of vaccines (Brewer et al., 2017; Shelby & Ernst, 2013). Whether anecdotal testimonies are more or less persuasive than statistical information has been debated, and the large body of research on this topic is mixed (Freling et al., 2020; Winterbottom et al., 2008; Zebregs et al., 2015). For example, in a systematic literature review on the biasing effects of anecdotal testimonies on people's decision making, it was found that anecdotal testimonies influenced people's health decisions more than no or statistical information only in a third of the reviewed studies (Winterbottom et al., 2008). In a meta-analysis comparing the effectiveness of statistical and anecdotal health interventions, it was found that anecdotal testimonies had a greater influence on people's behavioral intentions, whereas statistical information affected people's attitudes more (Zebregs et al., 2015). Furthermore, another meta-analysis found that anecdotal testimonies tend to be more persuasive than statistical information in situations where people are more emotionally engaged, for example in situations that concern health topics (Freling et al., 2020).

Considering that vaccination is a health-related topic, it could be expected that anecdotal testimonies would influence people's vaccination intentions. Indeed, studies have found that anti-vaccination sentiments often revolve around singular stories of vaccine adverse events (Fasce et al., 2023; Kata, 2010, 2012; Moran et al., 2016; Ward et al., 2015; Wolfe et al., 2002). Studies have also repeatedly shown that when presented with anecdotal testimonies and statistical information about vaccines, people put unreasonable weight on the anecdotal testimonies (Betsch et al., 2011, 2013; Betsch, Haase, et al., 2015; Haase et al., 2015, 2020). In line with these findings, communication strategies involving anecdotal testimonies have been found to decrease vaccine hesitancy (Olson et al., 2020).

That said, research has revealed individual differences in cognitive styles, showing that some people are more prone to rely on analytical thinking while others on intuitive thinking (Epstein, 2014; Evans, 2008; Martinelli & Veltri, 2021). Furthermore, people who are more prone to rely on intuitive thinking are also more likely to be influenced by anecdotal testimonies (Berger, 2007). In other words, some individuals might rely more on anecdotal testimonies when making health-related decisions, whereas others might rely more on statistical information. However, no study has, to the best of my knowledge, investigated reliance on anecdotal testimonies as a personal characteristic directly, nor how it might affect the persuasiveness of vaccine communication. Exploring reliance on anecdotal testimonies as a personal characteristic could provide a more nuanced understanding of people's health behaviors and may even aid the development of personalized vaccine communication. In this thesis, the tendency to rely on—or prefer—either statistical or anecdotal information will be referred to as *format preference*.

1.3 Vaccine Communication

Effectively communicating about vaccines has proven to be difficult, considering that vaccine communication strategies and programs tend to show modest effects at best (Dubé et al., 2015; Ryan & Malinga, 2021; Singh et al., 2022). However, strategies that focus on *audience segmentation*, *message tailoring*, or *HCP communication training* have been shown to reduce vaccine hesitancy (Batteux et al., 2022; Dubé et al., 2015; Jarrett et al., 2015; Kafadar et al., 2024; Olson et al., 2020). These strategies will be described in the following three sections.

1.3.1 Audience Segmentation

Audience segmentation—i.e., the process of dividing people into distinct segments based on demographic and/or psychographic variables—has become commonplace in health communication and is widely accepted as a necessary practice (Noar et al.,

2009; Thompson & Schulz, 2021). This is because audience segmentation can enable more efficient dissemination of messages to intended recipients, help to effectively meet the needs of recipients, provide greater satisfaction to recipients, and increase the likelihood of the desired outcomes (Thompson & Schulz, 2021). In other words, audience segmentation makes message tailoring more feasible, a topic that will be explored in more detail in section 1.3.2.

The literature on COVID-19 and influenza vaccine-hesitancy subgroups is both extensive and heterogenous, with different studies having used various methods and variables to identify unique audience segments (Benham et al., 2021; Börjesson & Enander, 2014; Falcon et al., 2023; Holford, Fasce, et al., 2023; Kleitman et al., 2023; Lamot et al., 2022; Lindvall & Rönnerstrand, 2022; Liu et al., 2022; Minzenberg & Yoon, 2022; Ryu et al., 2023). Nonetheless, a common finding in the majority of these studies has been that vaccine-hesitancy subgroups tend to differ in their level of hesitancy (for examples, see Börjesson & Enander, 2014; Holford, Fasce, et al., 2023).

Despite the large body of research on COVID-19 and influenza vaccine-hesitancy subgroups, no prior study has, to the best of my knowledge, investigated such subgroups based on vaccine-hesitancy determinants that relate to both how receptive the subgroups are to authority communication and to themes that could be presented in vaccine-promoting messages. The present thesis attempted to fill this gap by exploring such subgroups in the general population.

1.3.2 Tailored Vaccine Messages

A growing body of literature suggests that health interventions have a greater effect on people's health behaviors when the interventions are tailored to fit the needs and preferences of target audiences (Noar et al., 2009). This finding has also been consistent in the vaccine-hesitancy literature (Jarrett et al., 2015; Olson et al., 2020). For example, in a systematic literature review by Olson and colleagues, it was found that tailored vaccine-hesitancy interventions decrease vaccine hesitancy more than non-tailored ones (Olson et al., 2020).

A significant amount of research has investigated the underlying mechanisms of message tailoring. This body of research suggests that tailored interventions more efficiently grab a recipient's attention, which in turn makes the tailored messages easier to remember (Hawkins et al., 2008). Furthermore, tailored interventions are more likely to be perceived as personally relevant and are processed more thoroughly than non-tailored messages (Hawkins et al., 2008).

It is worth to note, that although some scholars differentiate between tailored (individual level) and targeted (group level) messaging (Hawkins et al., 2008;

Kreuter & Wray, 2003), in this thesis, tailoring will refer to both levels of message customization since the term is well-established in the literature.

To the best of my knowledge, no prior studies have investigated the efficacy of format-preference tailored vaccine-hesitancy interventions. To address this gap, the present thesis evaluated the efficacy of statistical and anecdotal vaccine messages in relation to individual format preference.

1.3.3 The Role of Healthcare Professionals

HCPs are in a key position to consult patients that hesitate vaccines (Brewer et al., 2017), and patients often report that HCPs are one of their most important sources of vaccine information (Charron et al., 2020; Eller et al., 2019). In fact, studies have found a clear link between HCP vaccine recommendations and vaccination uptake (Kessels et al., 2012; Lu et al., 2018; Oh et al., 2021), highlighting the pivotal role of HCPs for addressing vaccine hesitancy.

However, while HCPs are generally well-educated on vaccination topics, some studies have found that many HCPs feel underprepared to address the concerns of vaccine-hesitant patients (Garrison et al., 2023; Lucas Ramanathan et al., 2022; Paterson et al., 2016), and crave more training in and tools for addressing patients' vaccination worries (Lucas Ramanathan et al., 2022). Not only does communication training help HCPs feel more prepared to discuss vaccines with patients (World Health Organization, 2023b), but such training for HCPs can increase vaccine uptake in patients (Dempsey & O'Leary, 2018; Gagneur, 2020). While several training programs have been developed and tested in the past, there exists a gap in current HCP vaccine-communication training, namely, how to effectively refute anti-vaccination arguments (Lip et al., 2023).

As previously mentioned, contemporary research proposes that people may be motivated to hold negative vaccine attitudes, and that the anti-vaccination arguments people present may stem from underlying attitude roots (Fasce et al., 2023; Hornsey et al., 2018). Grounded in the attitude-roots framework, the Empathetic Refutational Interviewing approach (ERI) was developed as a tailored communication approach for HCPs to use to refute anti-vaccination arguments (Holford et al., 2024). The ERI consists of four steps, namely: 1) eliciting patients' vaccination concerns, 2) affirming the patient, 3) tailoring the refutation, and 4) providing patients with vaccination facts.

The first step of e*liciting concerns* serves two purposes. First, asking patients to explain their vaccine concerns can help in the identification of underlying attitude roots, and second, having to explain one's position on an issue can in itself reduce the strength of one's conviction (Fernbach et al., 2013; Fisher & Keil, 2014). *Affirmations* are important because they can help build rapport and make patients

more receptive to messages. For example, studies have found that empathetically acknowledging patients' misconceptions can make patients feel heard and cared for (Dainton & Wong, 2022; Larson & Broniatowski, 2021; Scales et al., 2021). Patients have also been found to be more receptive to messages from HCPs when the patients perceive that the HCP cares about them (Zlatev, 2019), and rapport building has even been found to improve patient outcomes (Birkhäuer et al., 2017; Chandra et al., 2018; Zachariae et al., 2003). Concerning the third step, studies suggest that *refutations* are more effective when they target the underlying attitude roots of vaccine hesitancy, when they replace misconceptions with facts, and when they provide explanations to why the newly presented information is in fact true (Ecker et al., 2020; Holford, et al., 2024; Rapp & Braasch, 2014; Seifert, 2002). The fourth and final step is to provide additional *information* about vaccines, as knowledge about vaccines and diseases can help to decrease vaccine hesitancy (Betsch et al., 2017; Horne et al., 2015).

While the ERI is a promising tool for addressing vaccine hesitancy in patients, little is known about how to effectively teach ERI techniques to HCPs. Thus, the present thesis sought to address this issue by evaluating the efficacy of an ERI training intervention.

2 Aims

The overarching goal of this thesis was to provide health authorities and communicators with more information and tools to tackle vaccine hesitancy by 1) identifying and describing distinct COVID-19 and influenza vaccine-hesitancy subgroups in the general population, 2) by developing and investigating the efficacy of format-preference tailored vaccine messages aimed at reducing COVID-19 and influenza vaccine hesitancy, and 3) by evaluating the efficacy of an ERI training intervention intended for HCPs tasked with discussing vaccines with patients. To achieve these aims, three studies were conducted. Whereas the first study only pursued exploratory research questions, specific hypotheses were formulated in the subsequent studies.

2.1 Aims of Study I

In Study I, hierarchical cluster analysis was utilized in two general population data sets consisting of survey responses relating to COVID-19 and influenza vaccine hesitancy. The first sample consisted of participants who were hesitant toward COVID-19 vaccines, and the other sample consisted of participants hesitant toward influenza vaccines. This allowed the investigation of the following research questions:

RQ1. What types of COVID-19 and influenza vaccine-hesitancy subgroups exist in the general population?

RQ2. Are there meaningful (dis)similarities between the vaccine-specific hesitancy subgroups and between COVID-19 and influenza vaccine-hesitancy subgroups in relation to vaccine communication?

2.2 Aims of Study II

In Study II, the efficacy of statistical and anecdotal vaccine messages in decreasing vaccine hesitancy were evaluated in two general population samples. The two message conditions were compared to control conditions, in which participants were presented with messages unrelated to vaccines. Moreover, participants' format

preference was measured to examine how it mediates the response to and the effects of vaccine messages. This approach enabled the investigation of the following research questions:

RQ3. How do statistical and anecdotal vaccine messages affect people's COVID-19 and influenza vaccine attitudes and vaccination intentions?

RQ4. Does format preference moderate the effects statistical and anecdotal vaccine messages have on people's vaccine attitudes and vaccination intentions?

Based on previous literature, we hypothesized that:

H1. Statistical and anecdotal messages about COVID-19 and influenza vaccines would increase participants' positive vaccination attitudes and vaccination intentions compared to the control conditions.

H2. Statistical messages would increase positive vaccine attitudes and vaccination intentions more in participants that prefer statistical information.

H3. Anecdotal messages would increase positive vaccine attitudes and vaccination intentions more in participants that prefer anecdotal information.

H4. Messages that are congruent with participants' format preference are perceived as more relevant, more helpful, and less frustrating than noncongruent ones.

2.3 Aims of Study III

In Study III, an ERI training intervention was evaluated in a sample consisting of HCPs in Finland and in the UK. Participants in the ERI condition were presented with ERI text scenarios in which fictitious HCPs utilized ERI techniques to discuss vaccines with patients. The ERI condition was compared to a control condition, where participants were presented with similar scenarios in which fictitious HCPs used a common facts-focused approach. Doing so allowed the investigation of the following research questions:

RQ5. Do ERI scenarios increase HCPs' communication confidence and likelihood of using ERI techniques when responding to hypothetical patients?

RQ6. How do HCPs respond to the ERI scenarios (e.g., what emotions do HCP experience in relation to the ERI scenarios)?

Based on previous literature, we hypothesized that:

H5. HCPs in the ERI condition would exhibit a higher vaccine-communication confidence at posttest compared to HCPs in the control condition.

H6. HCPs in the ERI condition would be more confident in their ability to refute anti-vaccination arguments at posttest compared to HCPs in the control condition.

H7. HCPs in the ERI condition would be more likely to use ERI techniques when responding to hypothetical patients compared to HCPs in the control condition.

H8. HCPs in the ERI condition would rate the performance of the fictitious HCP higher compared to participants in the control condition.

H9. HCPs in the ERI condition would not have a different emotional response to the scenarios compared to HCPs in the control condition.

3 Methods

For an overview of the study aims, samples, measures, and analyses, see Table 1.

3.1 Participants and Procedures

This thesis is based on data collected from three samples, two of which were collected from the general public and used in Studies I and II and one from HCPs used in Study III. The samples and procedures are briefly summarized below.

3.1.1 General Public (Studies I and II)

In the fall of 2021, two electronic surveys were marketed on Facebook, Messenger, and Instagram to people aged 18 or older in Finland. The only difference between the two surveys was that one of the surveys consisted of COVID-19 vaccination-related items, and the other of influenza vaccination-related items. The surveys consisted of three parts: pretest measures, intervention, and posttest measures. While both the pre- and posttest measures were used in Study II, only pretest measures were used in Study I. The pretest measures included questions concerning demographic variables such as age and gender, as well as questions regarding trust in health authorities, conspiracy mentality, vaccination intention, and vaccine attitudes. For the intervention, participants were randomized into one of three conditions: 1) statistical condition, 2) anecdotal condition, or 3) control condition. In the statistical and anecdotal conditions, the participants were instructed to read vaccine messages relating to the safety and efficacy of the vaccine in question and the threat of the corresponding disease that were either presented in a statistical format or as anecdotal testimonies. The control condition consisted of texts unrelated to vaccines. The posttest measures again included measures for vaccination intention and vaccine attitudes, and additionally a measure of format preference. For more details on the measures and the materials, see sections 3.2 and 3.3.

In total, 1,942 people responded to the survey and provided informed consent to participate. In Study I, only participants that were less than 80% likely to take either a COVID-19 vaccine or the influenza vaccine and who did not have any missing values for the items used for cluster analyses were included in the study. Thus, the

Table 3. Summary for the aims, samples, measures, and analyses of Studies I–III.

STUDY	AIMS	SAMPLES	MEASURES	ANALYSES
I	Identify and describe COVID-19 and influenza vaccine-hesitancy subgroups in the general population	COVID-19: *N* = 554 Influenza: *N* = 539	Conspiracy Mentality Questionnaire Format Preference Scale Trust in health authorities Vaccination intentions Vaccine and disease attitudes	AHCA
II	Develop and investigate the efficacy of format-preference tailored vaccine messages	COVID-19: *N* = 559 Influenza: *N* = 540	Conspiracy Mentality Questionnaire Format Preference Scale Message reception Subjective influence of vaccine messages Trust in health authorities Vaccination intentions Vaccine and disease attitudes	LR CFA
III	Evaluate an ERI training intervention intended for HCPs tasked with discussing vaccines with patients	HCP: *N* = 347	Emotional response to Empathetic Refutational Interviewing scenarios Perceived difficulty of refuting anti-vaccination arguments Perceived performance of fictitious healthcare professionals Use of Empathetic Refutational Interviewing techniques Vaccine-communication confidence	LR TT CS

Note. AHCA = agglomerative hierarchical cluster analysis, LR = linear regression, CFA = confirmatory factor analysis, TT = independent-samples t-test, CS = Pearson's chi-squared test

final sample for Study I consisted of 1,093 participants, of which 554 had answered the COVID-19 survey (COVID-19 sample) and 539 had answered the influenza survey (influenza sample). In Study II, the only inclusion criterion was that participants were less than 80% likely to take either a COVID-19 or influenza vaccine. The final sample for Study II consisted of 1099 participants, of which 559 had answered the COVID-19 survey and 540 had answered the influenza survey.

3.1.2 Healthcare Professionals (Study III)

Between the months of June and October in 2022, HCPs from Finland and UK were recruited to partake in an online survey experiment. In Finland, nurses from the Ostrobothnia region as well as 5th- and 6th-year medical students from across Finland were invited to participate in an online survey experiment. The invitations were sent by email to the head nurses in the county and to university mailing lists. In the UK, nurses were invited to participate through partner healthcare organizations. The survey consisted of three parts: pretest measures, intervention, and posttest measures. The pretest measures included questions relating to participants' vaccine-communication confidence and the perceived difficulty of refuting anti-vaccination arguments (see section 3.2 for more details on the measures). For the intervention, participants were randomly assigned to one of two conditions: 1) ERI condition, or 2) control condition. In the ERI condition, the participants were presented with six text scenarios exemplifying how HCPs can use ERI techniques to address patients' vaccine concerns. In the control condition, participants were presented with six text scenarios where HCPs only provided vaccine facts in response to patients' vaccine concerns. For each scenario, participants responded to the Epistemic Emotions Scale (Pekrun et al., 2017) and rated how well the fictitious HCP in the scenario had handled the situation. The posttest measures again contained measures for participants' vaccine-communication confidence and the perceived difficulty of refuting anti-vaccination arguments. Also, participants explained in writing how they would address patients' vaccine concerns.

In Finland, 120 medical students and 26 nurses participated in Study III. In the UK, 201 HCPs participated in the study. Thus, in total 347 participants completed the questionnaire and provided informed consent to participate, of which 167 were randomized into the ERI condition and 180 to the control condition.

3.2 Measures

For an overview of the measures used in the studies, see Table 1. In the following sections, all measures will be described in detail in alphabetical order.

3.2.1 Conspiracy Mentality

Participants' conspiracy mentality was measured with the Conspiracy Mentality Questionnaire (Bruder et al., 2013). The questionnaire consisted of five statements, such as "I think that government agencies closely monitor all citizens.", which were answered on a fully labelled Likert scale ranging from 1 – "0% (Certainly not)" to 11 – "100% (Certain)". Conspiracy mentality was measured in Studies I and II.

3.2.2 Emotional Response to Empathetic Refutational Interviewing Scenarios

Participants' emotional responses to the ERI scenarios were measured with the short version of the Epistemic Emotions Scale (Pekrun et al., 2017) with two additional items, namely anger and irritation. Participants were asked to rate how strongly they experienced the nine emotions (surprise, curiosity, excitement, confusion, anxiety, boredom, frustration, anger, and irritation) when reading the text. Participants rated the strength of their emotional response separately for each emotion on a fully labelled Likert scale ranging from 1 – "Not at all" to 5 – "Very strongly". Participants' emotional responses to the ERI scenarios were only measured in Study III.

3.2.3 Format Preference

Participants' format preference was measured with the novel Format Preference Scale, which was specifically developed for this thesis. The Format Preference Scale was developed and validated across three studies, in which it showed good validity and reliability (see Mäki et al., 2023). The scale consisted of six statements, such as "I mostly make decisions about my health based on the statistical information available.", which were answered on a Likert scale ranging from 1 – "Strongly disagree" to 7 – "Strongly agree". Higher scores indicate a stronger reliance on anecdotal testimonies in contrast to statistical information. Format preference was measured in Studies I and II.

3.2.4 Perceived Difficulty of Refuting Anti-Vaccination Arguments

Perceived difficulty of refuting anti-vaccination arguments was measured with the question "How difficult would it be for you to refute this argument if you would encounter it from a patient?", which was answered on a fully labelled Likert scale ranging from 1 – "I would find it very easy" to 5 – "I would find it very difficult". Perceived difficulty of refuting anti-vaccination arguments was measured separately

for 18 anti-vaccination arguments. Perceived difficulty of refuting anti-vaccination arguments was only measured in Study III.

3.2.5 Perceived Disease Threat

Perceived threat of COVID-19 and influenza was measured with the statement "How big of a threat is [disease] to your health?", which was answered on a visual slider ranging from "Not at all threatening" to "Very threatening". Answers on the visual slider were automatically coded on a scale from 0 – "Not at all threatening" to 100 – "Very threatening" by the survey software. Perceived disease threat was measured in Studies I and II.

3.2.6 Perceived Performance of Fictitious Healthcare Professionals

Perceived performance of the fictitious HCPs in the ERI and control scenarios was measured with the question "How well do you think that the healthcare professional in this scenario handled the discussion?", which was answered on a fully labelled Likert scale ranging from 1 – "Not at all well" to 5 – "Extremely well". Perceived performance of fictitious HCPs was only measured in Study III.

3.2.7 Perceived Vaccination Convenience

Perceived COVID-19 and influenza vaccination convenience was measured with the statement "How easy is it to get the [vaccine] in Finland?", which was answered on a visual slider ranging from "Not at all easy" to "Very easy". Answers on the visual slider were automatically coded on a scale from 0 – "Not at all easy" to 100 – "Very easy" by the survey software. Perceived vaccination convenience was measured in Studies I and II.

3.2.8 Perceived Vaccination Responsibility

The degree to which participants perceived COVID-19 and influenza vaccinations to be their responsibility was measured with the statement "It is important to take the [vaccine] as it also protects others.", which was answered on a visual slider ranging from "Strongly disagree" to "Strongly agree". Answers on the visual slider were automatically coded on a scale from 0 – "Strongly disagree" to 100 – "Strongly agree" by the survey software. Perceived vaccination responsibility was measured in Studies I and II.

3.2.9 Perceived Vaccine Efficacy

Perceived efficacy of COVID-19 and influenza vaccines was measured with the statement "How efficient do you think that the [vaccine] is/are?", which was answered on a visual slider ranging from "Not efficient at all" to "Very efficient". Answers on the visual slider were automatically coded on a scale from 0 – "Not efficient at all" to 100 – "Very efficient" by the survey software. Perceived vaccine efficacy was measured in Studies I and II.

3.2.10 Perceived Vaccine Safety

To measure the perceived safety of COVID-19 and influenza vaccines, participants were asked to rate the safety of COVID-19 and influenza vaccines on a visual slider ranging from "Not safe at all" to "Very safe". Answers on the visual slider were automatically coded on a scale from 0 – "Not safe at all" to 100 – "Very safe" by the survey software. Perceived vaccine safety was measured in Studies I and II.

3.2.11 Subjective Influence of Vaccine Messages

To assess the subjective influence of the COVID-19 and influenza vaccine messages, participants were asked "How did the texts you read influence your intention to take the [vaccine]?", which was answered on a fully-labelled Likert scale ranging from 1 – "Significantly decreased my intention to take the vaccine" to 5 – "Significantly increased my intention to take the vaccine". Subjective influence of vaccine messages was only measured in Study II.

3.2.12 Trust in Authorities

Participants' trust in health authorities was measured with four statements, such as "Health authorities would not recommend vaccines that are not safe to take.", which were answered on a Likert scale ranging from 1 – "Strongly disagree" to 7 – "Strongly agree". Two of the statements were created specifically for this thesis and two were derived from a previous study (Karlsson et al., 2019). Trust in authorities was measured in Studies I and II.

3.2.13 Use of Empathetic Refutational Interviewing Techniques

To assess participants' use of ERI techniques when responding to anti-vaccination arguments, participants were asked to explain in writing how they would respond to two anti-vaccination arguments. Participants' written responses were coded

according to a coding framework including five elements: 1) did the participant attempt to identify the root, 2) was the participant being empathetic, 3) did the participant attempt to correct misconceptions, 4) did the participant attempt to provide facts about vaccines, and 5) did the participant express uncertainty about how to address the patient's concerns. Use of ERI techniques was only measured in Study III.

3.2.14 Vaccination Intention

For COVID-19, participants' intentions to take a third and a seasonal COVID-19 vaccine were measured separately. For influenza, participants' intentions to take the next seasonal influenza vaccine were measured. To measure participants' vaccination intentions, participants were asked to rate their intentions to take the vaccines on a visual slider ranging from "Very unlikely" to "Very likely". Answers on the visual slider were automatically coded on a scale from 0 – "Very unlikely" to 100 – "Very likely" by the survey software. Vaccination intention was measured in Studies I and II.

3.2.15 Vaccine-Communication Confidence

Participants' vaccine-communication confidence was measured with four subscales of the I-Pro-VC-Be (Garrison et al., 2023; Verger et al., 2022), namely proactive efficacy, commitment to vaccination, openness to patients, and reluctant trust. The I-Pro-VC-Be measures HCPs' confidence in delivering vaccinations, with the included subscales targeting elements that are specific to communication. The scale consisted of thirteen statements, such as "I feel comfortable discussing vaccines with my patients who are highly hesitant about vaccination.", which were answered on a fully labelled Likert scale ranging from 1 – "Strongly disagree" to 5 – "Strongly agree". Vaccine-communication confidence was only measured in Study III.

3.2.16 Vaccine Confidence

Participants' general confidence in vaccines was measured with the statement "I am completely confident that vaccines are safe", which participants rated on a seven-point Likert scale ranging from 1 – "Strongly disagree" to 7 – "Strongly agree". This question was derived from the 5C scale (Betsch et al., 2018). Vaccine confidence was measured in Studies I and II.

3.2.17 Vaccine Message Reception

To assess how participants perceived the COVID-19 and influenza vaccine messages in Study II, participants were asked to indicate how frustrating, relevant, and helpful they found the vaccine messages to be. Message frustration was measured with the question "Did you get irritated while reading the texts?", which was answered on a Likert scale ranging from 1 – "Not at all" to 7 – "Very much". Message relevance was measured with the question "How relevant were the contents of the texts for you?", which was answered on a Likert scale ranging from 1 – "Completely irrelevant" to 7 – "Very relevant". Message helpfulness was measured with the question "How helpful were the contents of the texts for you?", which was answered on a Likert scale ranging from 1 – "Completely useless" to 7 – "Very helpful". Vaccine message reception was only included in Study II.

3.3 Materials

In the next two sections, the experimental materials in Studies II and III will be described briefly.

3.3.1 Format Preference-Tailored Interventions (Study II)

For Study II, the statistical and anecdotal conditions' vaccine messages were designed to give information about the safety of the vaccine, the benefits of the vaccine, the threat of the disease, as well as about the importance of protecting others through vaccination. The statistical condition's vaccine messages were derived from the Finnish Institute for Health and Welfare's webpages. The Finnish Institute for Health and Welfare is an independent expert and research institute that operates under the Ministry of Social Affairs and Health in Finland (The Finnish Institute of Health and Welfare, 2024a). The institute oversees the Finnish national vaccination program and is tasked with communicating health and safety issues to the general public (The Finnish Institute of Health and Welfare, 2024a). The vaccine messages in the anecdotal condition were crafted out of anecdotal testimonies that people have posted online (see www.voicesforvaccines.org for examples of such anecdotal testimonies). The control condition's messages consisted of fictitious anecdotal experiences that were unrelated to vaccines. See Appendices 1–3 for English translations of the COVID-19 intervention materials.

3.3.2 Empathetic Refutational Interviewing Scenarios (Study III)

For Study III, 18 ERI and 18 control text scenarios were created in which fictitious HCPs discussed vaccines with concerned patients. The patients' concerns in the scenarios corresponded to anti-vaccination arguments that have been identified in previous studies (Fasce et al., 2023). The ERI scenarios exemplified HCPs using ERI techniques to address patients' concerns, and the control scenarios exemplified HCPs providing vaccine facts to address patients' concerns. In the ERI condition, participants were presented with six of the ERI scenarios, and in the control condition, participants were presented with six of the control scenarios. In the UK sample, these scenarios were selected and presented randomly by the survey software. However, due to software limitations, a Latin square design was used in the Finnish sample to present different sets of the scenarios. See Appendix 4 for an example of the ERI intervention materials and corresponding control materials.

3.4 Statistical Analyses

In Study I, the main statistical method was hierarchical cluster analysis. Hierarchical cluster analysis is an exploratory method which groups observations together based on a (dis)similarity metric to form clusters with similar response patterns (Everitt et al., 2011). The cluster analyses were conducted separately for the COVID-19 and influenza samples. All Study I variables mentioned in section 3.2 were included in the cluster analyses.

In Study II, the main statistical method was multiple regression analysis, which was used to compare the effects of statistical and anecdotal vaccine messages to control messages. Furthermore, in Studies I and II confirmatory factor analysis was used to calculate factor scores for latent variables (Brown, 2015). These scores were then used in the cluster analyses and the multiple regression analyses.

In Study III, multiple regression analyses, independent-samples t-tests, and Pearson's chi-square tests were used to compare participants' responses in the ERI condition to participants' responses in the control condition.

4 Results

4.1 Study I

4.1.1 COVID-19 and Influenza Vaccine-Hesitancy Subgroups (RQ1)

For parallel coordinate plots of standardized survey item and factor scores for the subgroups, see Figures 1 and 2. In-text descriptions of the subgroups will refer to the unstandardized survey item and factor scores. Thus, Figures 1 and 2 highlight the subgroups' scores in relation to each other, and the in-text descriptions call attention to the actual scale of the subgroups' scores.

Six COVID-19 vaccine-hesitancy subgroups and three influenza vaccine-hesitancy subgroups with distinct hesitancy profiles were identified. The main differentiating factor between subgroups was their level of hesitancy. From least to most hesitant, the identified COVID-19 vaccine-hesitancy subgroups were named the *Vaccination Positive*^{Cov} (n = 98, 17.7%), the *Ambivalent*^{Cov} (n = 106, 19.1%), the *Fearing Skeptic*^{Cov} (n = 64, 11.6%), the *Unconvinced*^{Cov} (n = 141, 25.5%), the *Constrained Critic*^{Cov} (n = 47, 8.5%), and the *Vaccination Opponent*^{Cov} (n = 100, 18.1%). Similarly, from least to most hesitant, the identified influenza vaccine-hesitancy subgroups were named the *Vaccination Positive*^{Inf} (n = 279, 51.8%), the *Complacent*^{Inf} (n = 90, 16.7%), and the *Vaccination Opponent*^{Inf} (n = 170, 31.5%).

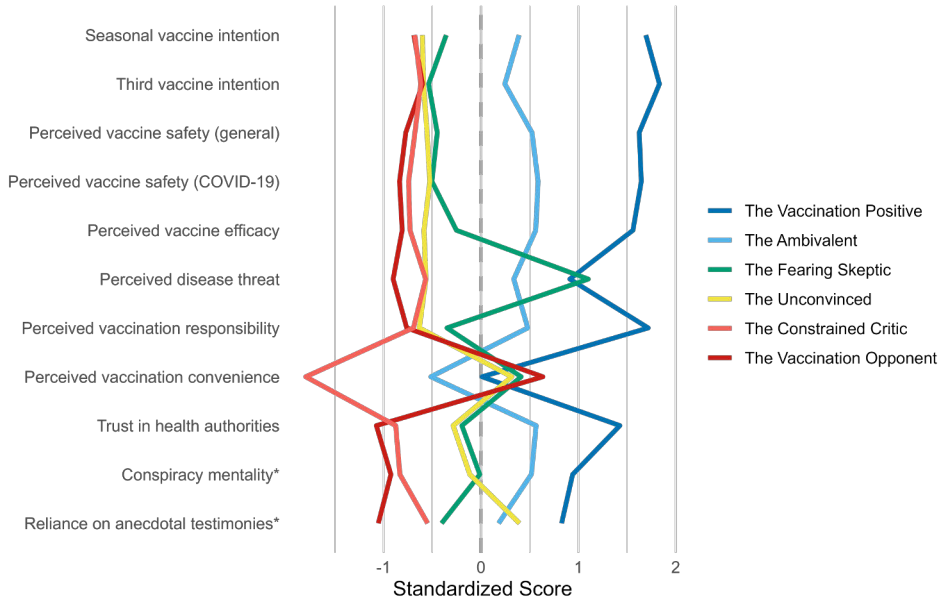

Figure 1. Standardized item and factor scores for the COVID-19 vaccine-hesitancy subgroups. * indicates that the variable has been reverse coded so that higher scores on conspiracy mentality and reliance on anecdotal testimonies indicate lower conspiracy mentality and more reliance on statistical information respectively.

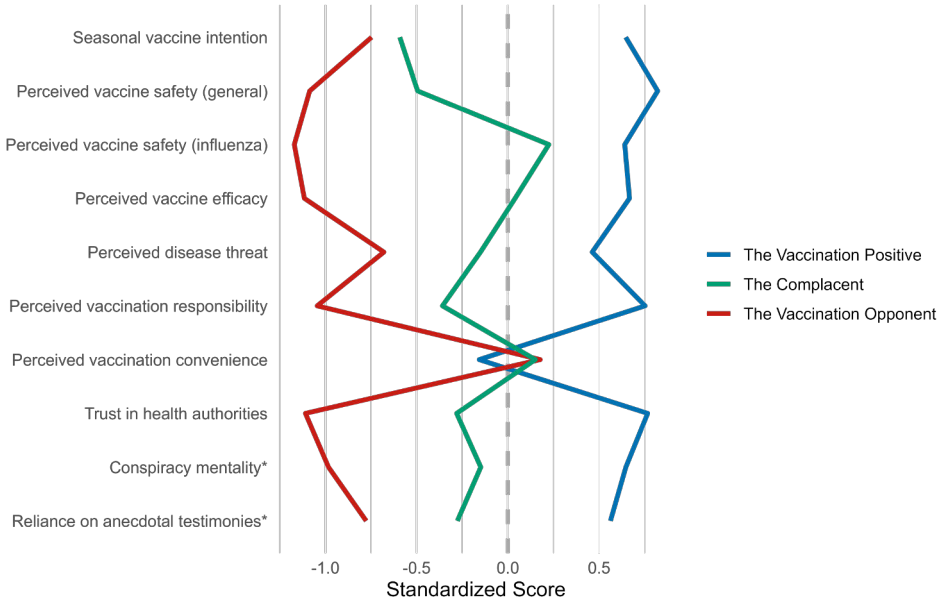

Figure 2. Standardized item and factor scores for the influenza vaccine-hesitancy subgroups. * indicates that the variable has been reverse coded so that higher scores on conspiracy mentality and reliance on anecdotal testimonies indicate lower conspiracy mentality and more reliance on statistical information respectively.

4.1.2 Similarities and Differences Between Vaccine-Hesitancy Subgroups (RQ2)

Concerning the COVID-19 vaccine-hesitancy subgroups, participants in the *Vaccination Positive*^{Cov} subgroup held the highest vaccination intentions and the most positive vaccine attitudes of all COVID-19 subgroups. Furthermore, the *Vaccination Positive*^{Cov} exhibited high trust in health authorities, low conspiracy mentality, and low reliance on anecdotal testimonies. Participants in the *Ambivalent*^{Cov} subgroup were characterized by moderate responses to all survey items except for vaccination intention, to which these participants' responses were notably lower than for participants in the *Vaccination Positive*^{Cov} subgroup.

By and large, vaccination intentions and vaccine attitudes were similarly low for participants in the remaining COVID-19 vaccine-hesitancy subgroups. Nevertheless, there were important differences between these subgroups that set them apart from each other. Participants in the *Fearing Skeptic*^{Cov} and in the *Unconvinced*^{Cov} subgroups exhibited moderate trust in health authorities, conspiracy mentality, and reliance on anecdotal testimonies. What set participants in these subgroups apart from each other was that the participants in the *Fearing Skeptic*^{Cov} subgroup reported the highest perceived COVID-19 disease threat of all subgroups and that the participants in the *Unconvinced*^{Cov} subgroup relied on anecdotal testimonies in par with participants in the *Ambivalent*^{Cov} subgroup. Participants in the *Constrained Critic*^{Cov} and the *Vaccination Opponent*^{Cov} subgroups had the lowest trust in authorities, highest conspiracy mentality, highest reliance on anecdotal testimonies, and held the most negative vaccine attitudes. However, what separated the participants in these subgroups was that the participants in the *Vaccination Opponent*^{Cov} subgroup had the highest scores on vaccination convenience and participants in the *Constrained Critic*^{Cov} subgroup had the lowest scores on vaccination convenience.

Regarding the influenza vaccine-hesitancy subgroups, participants in the *Vaccination Positive*^{Inf} subgroup held positive vaccine attitudes and had high trust in health authorities, low conspiracy mentality, and low reliance on anecdotal testimonies. Participants in the *Complacent*^{Inf} subgroup were characterized by moderate responses to most survey items, but also by low vaccination intentions. Lastly, participants in the *Vaccination Opponent*^{Inf} subgroup held the most negative vaccine attitudes and had the lowest trust in health authorities, the highest conspiracy mentality, and the highest reliance on anecdotal testimonies of the three influenza vaccine-hesitancy subgroups.

Looking at cross-vaccine comparisons, participants' vaccination intentions in the *Vaccination Positive*^{Inf} subgroup were markedly lower than for participants in the corresponding *Vaccination Positive*^{Cov} subgroup, and only slightly higher than for participants in the *Ambivalent*^{Cov} subgroup. Also, participants in the *Complacent*^{Inf}

subgroup exhibited lower vaccination intentions than participants in the *Ambivalent*^{Cov} subgroup. While participants in the *Vaccination Opponent*^{Inf} subgroup held overall negative vaccine attitudes, these attitudes were less extreme than those for participants in the *Vaccination Opponent*^{Cov} subgroup.

4.2 Study II

4.2.1 Effects of Non-Tailored Statistical and Anecdotal Vaccine Messages (RQ3)

Overall, statistical and anecdotal COVID-19 and influenza vaccine messages did not decrease vaccine hesitancy in participants, nor did the messages increase positive vaccine attitudes more than control messages when participants' format preference was held constant (i.e., non-tailored). These findings were inconsistent with hypothesis H1 (see section 2.2). There were, however, some notable exceptions. For the COVID-19 sample, there was a statistically significant difference between the anecdotal condition and the control condition in participants' responses to perceived disease threat, as the perceived disease threat decreased from pretest to posttest for the control condition but not for the anecdotal condition. For the influenza sample, there was a statistically significant difference between the statistical condition and the control condition in participants' responses to perceived vaccination responsibility, stemming from the fact that the statistical message led to a greater pretest to posttest increase in perceived collective responsibility compared to the control message.

When the participants were asked to estimate how the statistical and anecdotal vaccine messages had affected their vaccination intentions, the majority of participants in both the COVID-19 and influenza samples responded that the messages had not influenced their intentions. However, while only around 3% of participants in the COVID-19 sample responded that the statistical or anecdotal interventions had increased their vaccination intentions, approximately 25% of participants responded that the messages had decreased their vaccination intentions. In contrast, while around 10% of the influenza sample responded that the statistical and anecdotal vaccine messages had decreased their vaccination intentions, 10% responded that the anecdotal vaccine message had increased their vaccination intentions and over 20% responded that the statistical vaccine message had increased their vaccination intentions. For a visual representation of the participants' responses on subjective influence of vaccine messages, see Figure 3.

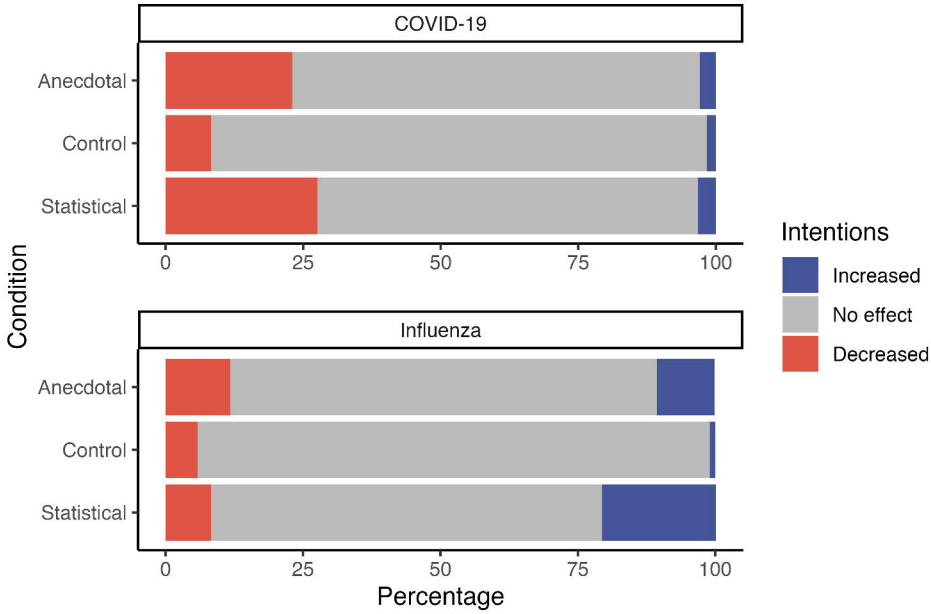

Figure 3. Subjective influence of COVID-19 and influenza vaccine messages.

Concerning message reception, participants found the statistical and anecdotal COVID-19 and influenza vaccine messages to be more relevant and helpful than the control messages. However, participants also became more frustrated from reading the statistical and anecdotal COVID-19 vaccine messages compared to the control messages. This effect was not observed for the influenza vaccine messages. For a visual representation of participants' responses on message reception, see Figure 4.

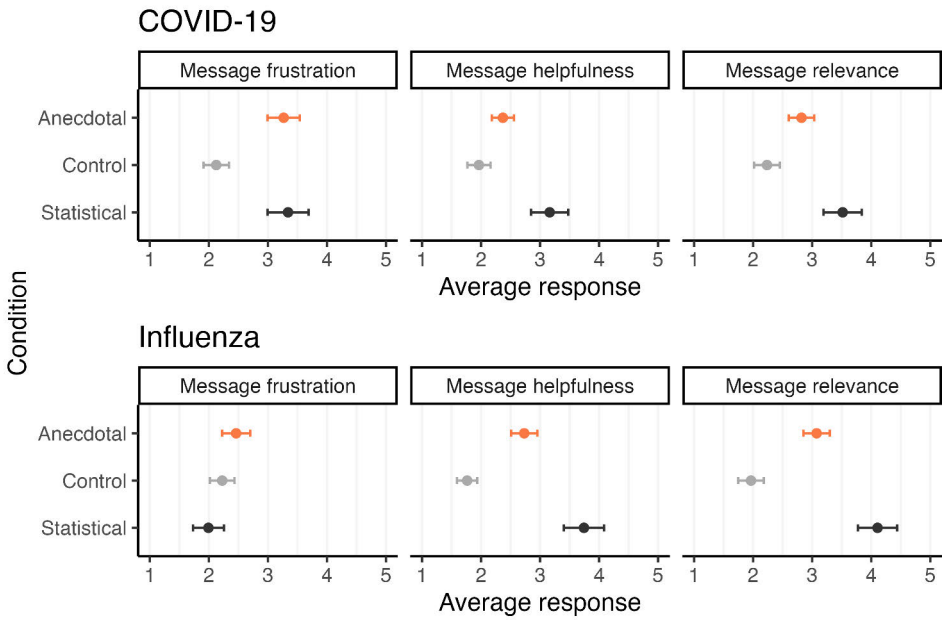

Figure 4. Average message reception scores for COVID-19 and influenza messages with 95% confidence intervals.

4.2.2 Effects of Format-Preference Tailored Vaccine Messages (RQ4)

For a visual representation of the regression models including vaccination intention, format preference, and message type, see Figure 5. The statistical and anecdotal messages did not significantly decrease vaccine hesitancy or increase positive vaccine attitudes more when the messages matched participants' self-reported format preference. This result contradicted hypotheses H2 and H3 (see section 2.2). However, there were again some notable exceptions. An unexpected interaction effect between format preference and the statistical condition was observed. This interaction effect indicated that the more a participant reported to prefer anecdotal testimonies, the more their intentions to take a third COVID-19 vaccine dose was increased by the statistical message. For the influenza sample, there was an unexpected statistically significant interaction effect between format preference and the anecdotal condition so that the more a participant relied on anecdotal testimonies, the more their influenza vaccination intentions were decreased by the anecdotal message.

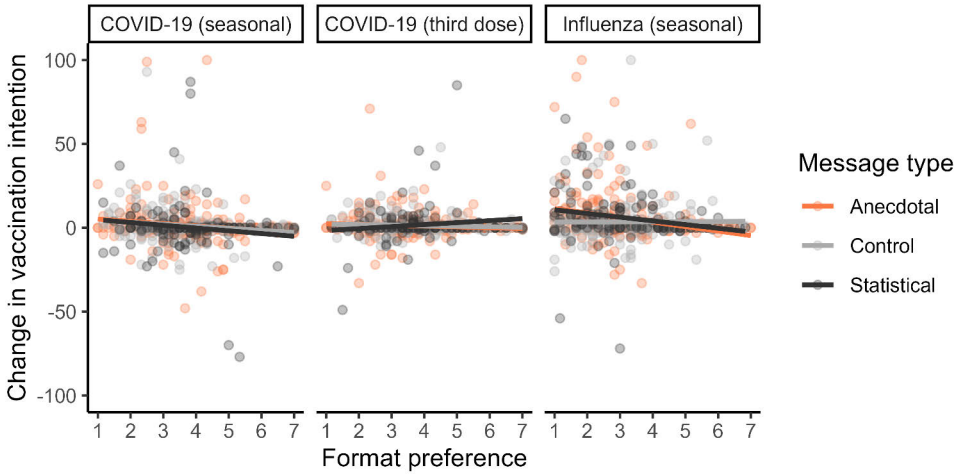

Figure 5. Change in intentions to take a seasonal COVID-19 vaccine, a third COVID-19 vaccine dose, and the next seasonal influenza vaccine by format preference and condition.

For the COVID-19 and influenza samples, participants became more frustrated by the anecdotal messages the more they reported relying on anecdotal testimonies. This effect was also visible for the statistical message in the influenza sample. Lastly, the more the participants reported relying on anecdotal testimonies, the less relevant and helpful they found both the statistical and anecdotal messages to be. These results were inconsistent with hypothesis H4 (see section 2.2).

4.3 Study III

4.3.1 Acquisition of Empathetic Refutational Interviewing Skills (RQ5)

There was no statistically significant posttest difference between participants' vaccine-communication confidence in the ERI condition and in the control condition when controlling for pretest scores. This contradicts the hypothesis that participants in the ERI condition would exhibit a higher vaccine-communication confidence at posttest compared to participants in the control condition (H5; see section 2.3).

Also, contrary to H6 (see section 2.3), participants in the ERI condition did not perceive refuting anti-vaccination arguments to be easier at posttest than did participants in the control condition. This result was not affected by whether the anti-vaccination argument had been presented in the scenarios or not.

In line with hypothesis H7 (see section 2.3), participants in the ERI condition more often reported that they would use empathetic affirmations with hypothetical patients than participants in the control condition (see Figure 6). However, and contrary to hypothesis H7, participants in the ERI condition were not significantly more likely to attempt identifying attitude roots or correcting misconceptions. Participants in the ERI condition were also less likely to report presenting facts. There was no statistically significant difference between the ERI condition and the control condition in how often the participants described the facts that they would present, how often the participants presented relevant facts, nor in how often participants reported uncertainty about what to do in the situation.

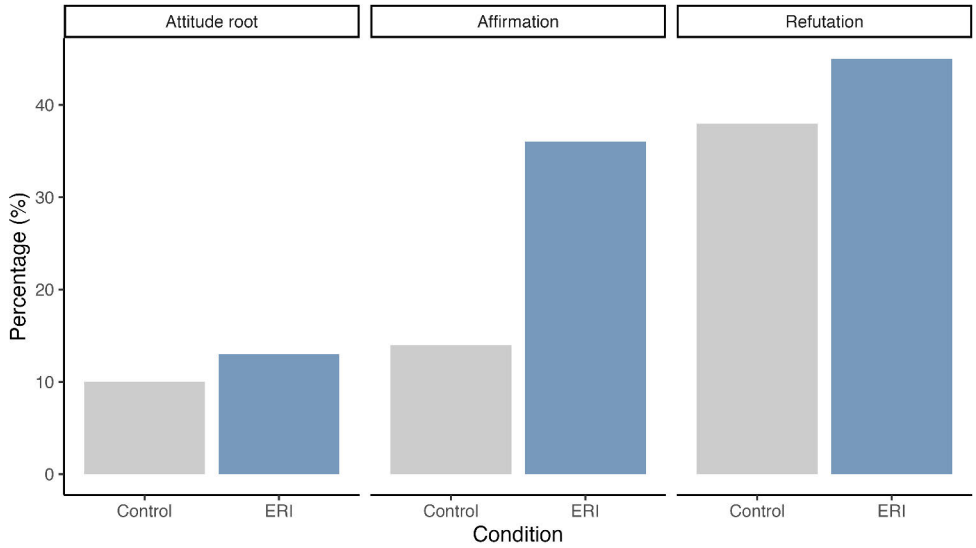

Figure 6. Percentage of participants that identified attitude roots, used affirmations, and refuted misconceptions at posttest by condition.

4.3.2 Response to Empathetic Refutational Interviewing Scenarios (RQ6)

In line with hypothesis H8 (see section 2.3), participants in the ERI condition rated the fictitious HCPs' performances to be better than participants in the control condition.

However, and contrary to hypothesis H9 (see section 2.3), participants in the ERI condition became more surprised and experienced more frustration, anger, and irritation than participants in the control condition. Furthermore, post hoc analyses revealed that participants in both conditions experienced emotions less strongly the higher they rated the fictitious HCP's performance. Nevertheless, controlling for

participants' ratings of the fictitious HCP's performance did not change the result that participants in the ERI condition became more surprised and experienced more frustration, anger, and irritation than participants in the control condition.

5 Discussion

Vaccine hesitancy poses a threat to public health, and effective communication strategies are needed to address people's vaccination concerns. Thus, the broader goal of this thesis was to provide health authorities and communicators with more information and tools to tackle vaccine hesitancy. More specifically, the present thesis aimed to 1) identify and describe COVID-19 and influenza vaccine-hesitancy subgroups in the general population, 2) develop and investigate the efficacy of format-preference tailored vaccine messages, and 3) evaluate an ERI training intervention intended for HCPs tasked with discussing vaccines with patients.

To my knowledge, Studies I and II are the first scholarly works on a personal characteristic of preferring statistical or anecdotal information, and the first to investigate how a preference for either information type relates to vaccine hesitancy and vaccine communication. Moreover, Study III is the first study to explore the effects of an ERI training intervention for HCPs. In the upcoming sections, the results and limitations of Studies I–III will be discussed.

5.1 COVID-19 and Influenza Vaccine-Hesitancy Subgroups

As health communicators need in-depth knowledge about their target audiences, Study I set out to identify and describe COVID-19 and influenza vaccine-hesitancy subgroups in the general population. Six COVID-19 and three influenza vaccine-hesitancy subgroups were identified based on variables important from a message content and receptivity to authority communication point of view. This finding is consistent with previous research, as various vaccine-hesitancy subgroups have been identified in different populations (see for example Börjesson & Enander, 2014; Cristea et al., 2022; Kwok et al., 2022). Also in line with previous studies, the vaccine-hesitancy subgroups mainly differed in their levels of hesitancy (Börjesson & Enander, 2014; Holford, Fasce, et al., 2023).

Interestingly, the number of COVID-19 and influenza vaccine-hesitancy subgroups differed despite the matching measures and methods used to identify the subgroups in both samples. This result indicates that there is more variability in why people hesitate COVID-19 vaccines than influenza vaccines. This finding is also

supported by previous research, as studies have identified differing numbers of COVID-19 and influenza vaccine-hesitancy subgroups, ranging from two to 16 for COVID-19 and only between three and five for influenza (Börjesson & Enander, 2014; Falcon et al., 2023; Lindvall & Rönnerstrand, 2022; Ward et al., 2023). While these discrepancies could previously be explained by the studies' use of different measures and methods, the fact that the number of COVID-19 and influenza vaccine-hesitancy subgroups differed even when using the same methods and comparable measures provides more robust evidence for there being greater variability in COVID-19 vaccine-hesitancy subgroups than in influenza vaccine-hesitancy subgroups. However, it is worth noting that the topic of COVID-19 vaccine-hesitancy subgroups in the general population has been studied considerably more than similar influenza vaccine-hesitancy subgroups (Mäki et al., 2024).

Direct subgroup comparisons between different studies are difficult to make due to differences in samples, measures, and methods. Nevertheless, some of the measures used in a study by Holford and colleagues (2023) were comparable to the measures used in Study I (perceived vaccination risk, general distrust, and conspiracy mentality), allowing for some comparisons to be made. For example, it is interesting to note that the profiles of COVID-19 vaccine-hesitancy subgroups identified in Study I did resemble those found in the study by Holford and colleagues (2023), despite the differences in the samples, methods, and measures. While only six subgroups were identified in Study I, in contrast to the eight identified by Holford and colleagues, this discrepancy could be explained by the fact that participants who were 80% or more likely to get a third COVID-19 vaccine were excluded from Study I, whereas this was not the case in the study by Holford and colleagues (2023). The six vaccine-hesitancy subgroups that were identified in Study I corresponded to the subgroups *Alternative Epistemology*, *Social Conservatism*, *Free-Market Ideology*, *Unspecific*[a], *Religiosity*, and *Unspecific*[b] (Holford et al., 2023), in that the participants in these subgroups exhibited perceived vaccination risks, distrust, and conspiracy mentality profiles that resembled those of Study I. These similarities may indicate that the COVID-19 vaccine-hesitancy subgroups identified in Study I and in the study by Holford and colleagues (2023) represent more general hesitancy patterns, considering that the results were similar despite the differences between these studies. However, and as mentioned above, subgroup comparisons between different studies are problematic, and since these studies were compared specifically due to their similarities, the matching results between the subgroups should be interpreted with caution.

Concerning the influenza vaccine-hesitancy subgroups, these shared some characteristics with the subgroups found in the study by Börjesson and Enander (2014). Comparable to Börjesson and Enander (2014), three influenza vaccine-hesitancy subgroups were identified. However, due to differences in the variables

Börjesson and Enander use in their study, direct comparisons are again difficult. Nevertheless, while the variables trust in health authorities and perceived disease threat in Study I were related in the influenza sample, the corresponding variables trust in authorities and perceived risk in the study by Börjesson and Enander (2014) did not follow the same gradual pattern. The reason for this discrepancy is, however, unclear. It should again be emphasized, that because these two studies were compared due to their similar results, interpretations should be made cautiously. This notion reveals a gap in the literature, namely that there is a lack of subgroup validation studies. Future studies are encouraged to attempt to validate previously identified cluster solutions, as doing so could provide evidence for the robustness of specific vaccine-hesitancy subgroups.

Considering that the variables included in the cluster analyses pertained to message content themes and receptivity to authority communication, some communication suggestions can be made based on the results and prior research. For a summary of the defining traits and the communication focus for the COVID-19 and influenza vaccine-hesitancy subgroups, see Table 2. As the *Vaccine Positive*$^{Cov/Inf}$ subgroups held positive vaccine attitudes and had high trust in health authorities, they might benefit from prosocial messaging, removal of vaccination barriers, and nudges such as reminders. This is because people are known to be less hesitant to take vaccines when they think that it helps others (Kumar et al., 2022; Schmid et al., 2017), and communicating about the benefits of herd immunity (prosocial messaging) has been found to increase vaccination intentions (Böhm & Betsch, 2022; Sprengholz & Betsch, 2020). Also, removing barriers and using reminders have shown to be effective for increasing vaccination uptake in people that already hold positive vaccine attitudes (Brewer et al., 2017; Reñosa et al., 2021). For the *Ambivalent*^{Cov} and the *Complacent*^{Inf} subgroups, it might be beneficial to also provide vaccine and disease information as well as to correct misconceptions (Olson et al., 2020; Xia & Nan, 2024), considering that they held less positive vaccine attitudes than the *Vaccination Positive*$^{Cov/Inf}$ subgroups. For the remaining subgroups, it may be necessary to focus on rapport building, considering that these subgroups exhibited moderate to high distrust in health authorities, conspiracy mentality, and reliance on anecdotal testimonies—factors that are known to be linked with science rejection (Fasce et al., 2023; Hornsey et al., 2018).

An interesting observation was made in Study I concerning the variable perceived vaccination convenience, in that it did not share the same gradual pattern as other variables. This finding stands in contrast to previous research, which has suggested that people with more positive vaccine attitudes also perceive vaccines to be more convenient (Kwok et al., 2022; Meng et al., 2023; Rountree & Prentice, 2022). It is unclear why this result differed from previous findings. However, one explanation could be the difference in how perceived vaccination convenience was

Table 2. Summary of COVID-19 and influenza vaccine-hesitancy subgroups.

SUBGROUP	DEFINING TRAITS	COMMUNICATION FOCUS
	COVID-19	
Vaccination Positive	Medium vaccination intention Positive vaccine attitudes Highly receptive to communication	Prosocial messaging Removal of barriers Reminders / nudges
Ambivalent	Medium-low vaccination intention Medium vaccine attitudes Receptive to communication	Vaccine / disease info Removal of barriers Prosocial messaging
Fearing Skeptic	Low vaccination intention Negative vaccine attitudes Resistant to communication	Rapport building
Unconvinced	Low vaccination intention Negative vaccine attitudes Resistant to communication	Rapport building
Constrained Critic	No vaccination intention Highly negative vaccine attitudes Highly resistant to communication	Rapport building
Vaccination Opponent	No vaccination intention Highly negative vaccine attitudes Highly resistant to communication	Rapport building
	INFLUENZA	
Vaccination Positive	Medium-low vaccination intention Positive vaccine attitudes Highly receptive to communication	Prosocial messaging Removal of barriers Reminders / nudges
Complacent	Low vaccination intention Medium vaccine attitudes Receptive to communication	Vaccine / disease info Removal of barriers Prosocial messaging
Vaccination Opponent	No vaccination intention Highly negative vaccine attitudes Highly resistant to communication	Rapport building

Note. Prosocial messaging – messaging that for example involves information about vulnerable groups and the benefits of herd immunity; Removal of barriers – removing barriers to vaccination; Reminders / nudges – strategies that involve sending reminders by text message or nudging toward vaccination for example with pre-booked vaccination appointments; Vaccine / disease info – information about the safety and efficacy of vaccines as well as about the threat of the diseases; Rapport building – fostering trust and positive communication experiences.

measured. In the study by Kwok et al. (2022), for example, perceived vaccination convenience was operationalized as the 5C model's constraints factor, and was measured with three distinct statements, and in the study by Meng et al. (2023), convenience was measured as how difficult it would be to get the vaccine. To explore

this matter, future studies could include different measures of perceived vaccination convenience and investigate their associations.

Study I also offers a unique contribution to the literature by suggesting that a personal tendency to rely on anecdotal testimonies might be related to vaccine hesitancy, a finding which only Studies I and II have investigated to the best of my knowledge. More research is needed to confirm this finding and to explain why a reliance on anecdotal testimonies and vaccine hesitancy might be connected.

5.2 Effects of Non-Tailored and Format-Preference Tailored Statistical and Anecdotal Vaccine Messages

To increase the understanding of when statistical and anecdotal messages result in attitudinal changes, Study II investigated the efficacy of format-preference tailored vaccine messages. The statistical and anecdotal vaccine messages did not notably affect participants' vaccine attitudes nor their vaccination intentions. This stands in opposition to previous research which has suggested that statistical and anecdotal vaccine messages can increase positive vaccine attitudes and vaccination intentions in individuals that are hesitant to take COVID-19 and influenza vaccines (Olson et al., 2020). However, some research also suggests that individuals who are very hesitant toward vaccines can be resistant to vaccine messages (Betsch, Korn, et al., 2015; Leask, 2011; Nyhan et al., 2014; Nyhan & Reifler, 2015). This could explain why the messages used in Study II had little to no effects on participants vaccine hesitancy, considering that over 60% of participants reported that they were highly hesitant toward COVID-19 or influenza vaccines (vaccination intention under 20%). On the other hand, other scholarly work on COVID-19 vaccine messages specifically has found opposing results, indicating that more hesitant individuals are in fact more affected by vaccine messages (Freeman et al., 2021). Another possible explanation for the results of Study II could be that it did not account for anti-vaccination attitude roots, considering that the attitude root framework suggests that change is unlikely to happen unless the root of the anti-vaccination attitude is addressed specifically (Hornsey et al., 2018). Future studies could thus investigate the efficacy of statistical and anecdotal vaccine messages when these are designed using the anti-vaccination attitude roots framework. For example, considering that reliance on anecdotal testimonies was found to be related to conspiracy mentality (Mäki et al., 2023), it is possible that negative vaccine attitudes rooted in conspiratorial beliefs could be more susceptible to anecdotal vaccine messaging compared to statistical messaging.

The result, that participants who reported a stronger preference for anecdotal testimonies were more likely to react more negatively to statistical and anecdotal messages, indicates that a reliance on anecdotal testimonies might be tied to

distrust in science and the sources providing scientific information. In other words, it is possible that participants with a stronger preference for anecdotes reacted negatively even to the anecdotal messages because these anecdotal testimonies were presented by scientists. This notion is supported by findings during the validation phase of the Format Preference Scale (see Mäki et al., 2023). When validating the Format Preference Scale, a stronger reliance on anecdotal testimonies was found to be strongly associated with distrust in health authorities and conspiracy mentality (Mäki et al., 2023). Furthermore, the identified vaccine-hesitancy subgroups in Study I also support this idea, as participants in subgroups that relied more on anecdotal testimonies were also more distrustful of health authorities and more hesitant toward COVID-19 and influenza vaccines. An additional or alternative explanation for why participants with a stronger reliance on anecdotal testimonies reacted negatively to both types of messages could be psychological reactance—i.e., unpleasant motivational arousal in response to a threat of individual freedom (Dillard & Shen, 2005). Persuasive messaging can be seen as a threat to individual freedom (Reynolds-Tylus, 2019), and considering that the participants responded negatively to attempts to influence their vaccine attitudes and vaccination intentions (statistical and anecdotal vaccine messages), but not to non-persuasive messaging (control messages) suggests that a stronger reliance on anecdotal testimonies might be related to reactance. Future studies could investigate this result further by adding reactance inducing and reducing conditions to the Study II design. Doing so could yield valuable insights into the nature of the novel format preference construct.

Despite the research evidence supporting the use of anecdotal vaccine messaging (Olson et al., 2020), in this study, statistical messages were received more positively. Thus, contrary to previous research, the results from Study II suggest that statistical messaging might be less likely to backfire and that it might be the preferable communication option when choosing between the two message styles. However, it is important to highlight that combinations of statistical and anecdotal vaccine messages were not investigated in Study II. Research is needed on the effectiveness of statistical and anecdotal vaccine-message combinations. It is also worth noting that during the time of Study II, most people were likely to be familiar with statistics about COVID-19 and that many had likely encountered anecdotal testimonies from people who had either received COVID-19 vaccines or had contracted COVID-19. Such knowledge could have influenced the effectiveness of the materials used in Study II. The fact that more people in the COVID-19 sample, compared to the influenza sample, reported that their vaccination intention had at least somewhat decreased supports this idea and possibly indicates message exhaustion.

5.3 Effects of Empathetic Refutational Interviewing Scenarios

While ERI has shown promise as a technique for reducing vaccine hesitancy in individuals, little was known about how to effectively acquire ERI skills. Therefore, Study III explored the effects of an ERI training intervention. Participants in the ERI condition used more empathetic affirmations in their free-text responses compared to participants in the control condition. However, the participants in the ERI condition were not more likely to attempt to identify possible attitude roots, to refute misconceptions, nor to provide vaccine facts. In fact, the participants in the ERI condition were less likely to provide vaccine facts than participants in the control group. These results suggest that the ERI scenarios were able to convey the importance of affirmations when discussing vaccines with patients and further suggest that the participants were able to acquire said skill and even apply it to new anti-vaccination arguments that had not been previously presented in the ERI scenarios. However, these results also suggest that the ERI scenarios were not clear about or did not stress the importance of the identification of attitude roots, refutations, nor about fact provision. That the participants in the ERI condition were less likely to provide vaccine facts could also be an indication of participants incorrectly interpreting the ERI scenarios' lesser focus on fact provision to mean that no facts should be presented. Future studies are encouraged to investigate ways to more clearly convey the importance of all ERI techniques.

The ERI scenarios did not decrease the participants' perceived difficulty of refuting anti-vaccination arguments nor did the scenarios increase participants' vaccine-communication confidence. A possible explanation for this result could be the short length of and the lack of practical training in the ERI intervention. In fact, medical students have rated practical training to be significantly more effective than lectures in increasing their vaccine-communication confidence (Kernéis et al., 2017). Furthermore, a previous vaccine-communication training intervention that was successful in increasing participants' communication confidence took over seven times longer to complete than the ERI training intervention and it included practical training sessions which the ERI training intervention did not have (World Health Organization, 2023a, 2023b). With these findings in mind, extending the ERI training intervention and including practice sessions could prove beneficial.

As expected, the participants in the ERI condition rated the HCP's performance higher than participants in the control condition. This result suggests that the participants value some aspects of the ERI approach that were not present in the facts-only training materials.

Contrary to expectations, participants in the ERI condition experienced more emotions in general, compared to participants in the control condition. It is possible

that the participants in the ERI felt more surprised due to the novelty of the ERI techniques presented in the scenarios. That the participants in the ERI condition felt more frustrated, angry, and irritated could be an indication of psychological reactance. Previous research has found that learners may experience reactance when they feel that they are being persuaded or when they are unsure of what is being expected of them (Mirick, 2016). Thus, the negative emotional responses to the ERI scenarios and the low adoption rate of ERI techniques suggest that the ERI scenarios may need to be clearer, and that the learning expectations might need to be explicitly stated. In sum, the ERI training intervention using short text scenarios showed promising results for teaching ERI techniques to HCPs, however, longer training sessions and the inclusion of practice rounds could potentially improve learning outcomes.

5.4 Limitations

The presented studies include some limitations that should be considered. Studies I and II utilized convenience sampling, which entails that the samples might not be fully representative of the general population. While the social media platforms used for data collection have a wide userbase in Finland (Statista, 2024), women and individuals with higher education were slightly overrepresented in these samples. Another sample-related limitation for Studies I and II is that these studies did not include participants who were 80% or more likely to take COVID-19 or influenza vaccines. Due to this exclusion, it remains unclear how such participants would have been categorized in Study I and how the statistical and anecdotal vaccine messages in Study II would have influenced such individuals' vaccine attitudes and vaccination intentions. Studies I and II were also fully based on self-reports, which are susceptible to biases like desirability bias. In Study I, another limitation was that only a fraction of all known vaccine-hesitancy related variables was used. However, the choice of these variables was based on theoretical models (TPB, HBM, and 5C) and empirical research results that have stressed the importance of the chosen variables (Cascini et al., 2021; Fasce et al., 2023; Kumar et al., 2022; Schmid et al., 2017). In Study II, one limitation was the use of fictional vaccine anecdotes. While these anecdotal testimonies were created based on real vaccine anecdotes found on websites such as www.voicesforvaccines.org, it is possible that the messages were not believable enough. Other limitations of Study II were that combinations of statistical and anecdotal vaccine messages were not tested, and that vaccine uptake was not measured.

In Study III, the assessment of whether participants attempted to identify attitude roots or not might have been suboptimal. Considering that the participants were asked to describe how they would discuss vaccines with fictitious patients, and that

the attitude roots are not to be discussed with patients, it is possible that more participants would have mentioned attitude roots, had the question been formulated differently.

6 Conclusions and Suggestions

The primary objective of this thesis was to provide health authorities and communicators with more information and tools to tackle vaccine hesitancy.

COVID-19 and influenza vaccine-hesitancy subgroups were found to share similar vaccine-hesitancy patterns, ranging from people that are a more positive toward these vaccines to people that are strongly against vaccines. Nevertheless, COVID-19 vaccine hesitancy exhibited greater variability. In summary, these results add to the body literature highlighting the complexity of vaccine hesitancy, and further suggest that vaccine communication for COVID-19 vaccine-hesitancy subgroups may need to be tailored in more detail than for influenza vaccine-hesitancy subgroups.

Both statistical and anecdotal vaccine messages were found to have small to no effects on participants' vaccine attitudes and vaccination intentions. This finding, together with the fact that participants responded less negatively to the statistical vaccine messages, challenges the idea that vaccine-promoting messages should utilize more anecdotal storytelling than statistical evidence. However, while the current study does not support format-preference tailoring nor the pure usage of anecdotal vaccine messages for addressing vaccine hesitancy, more research is needed on how combinations of statistical and anecdotal messages could be implemented in multi-approach interventions. Furthermore, even though the format-preference tailored vaccine messages did not yield the desired outcomes, format preference was found to be an interesting construct and worth further investigation, considering that it was strongly associated with both distrust in health authorities and conspiracy mentality. It could be meaningful to develop a more comprehensive and general measure of format preference, as doing so would enable exploring format preference in more detail and to study it in other contexts than in the health-communication setting.

The short ERI training intervention showed modest yet encouraging results, suggesting that HCPs may be able to quickly learn and implement empathetic affirmations into their own communication approach. While other ERI techniques were not as easily acquired, future studies with longer ERI training sessions including practice rounds are strongly encouraged.

All in all, more research is needed on the combined effects of different vaccine-communication approaches, as any single vaccine-communication approach is unlikely to be sufficient to address vaccine hesitancy.

Abbreviations

AHCA	Agglomerative hierarchical cluster analysis
Cov	COVID-19
CS	Pearson's chi-squared test
HBM	Health Belief Model
HCP	Healthcare professional
Inf	Influenza
LR	Linear regression
TPB	Theory of Planned Behavior
TT	Independent-samples t-test
WHO	World Health Organization

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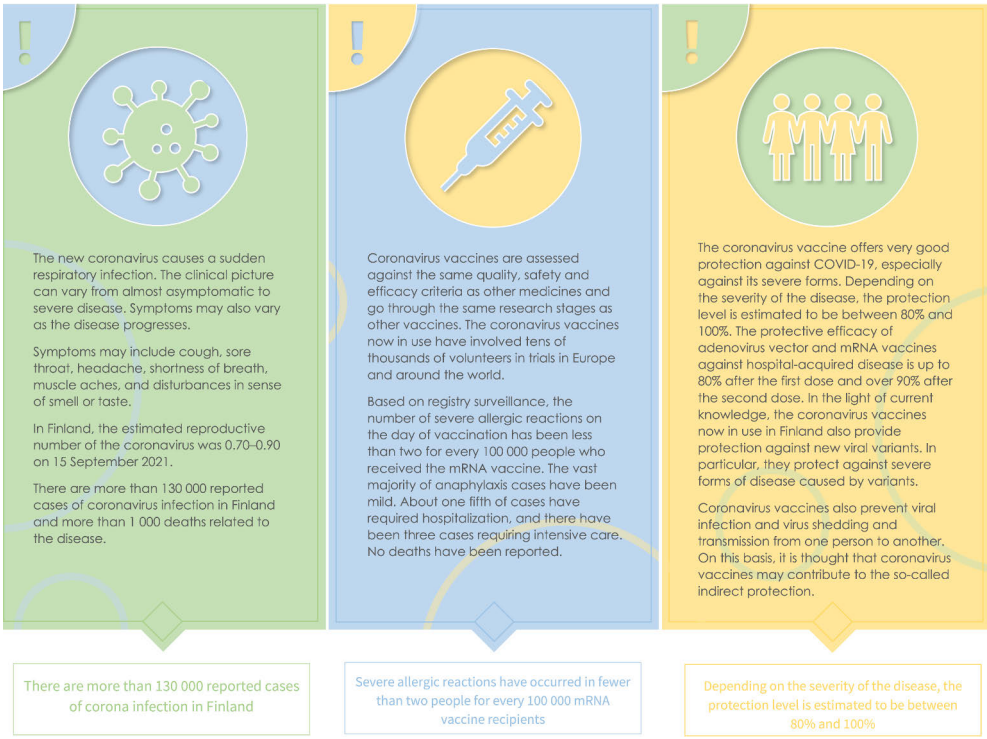
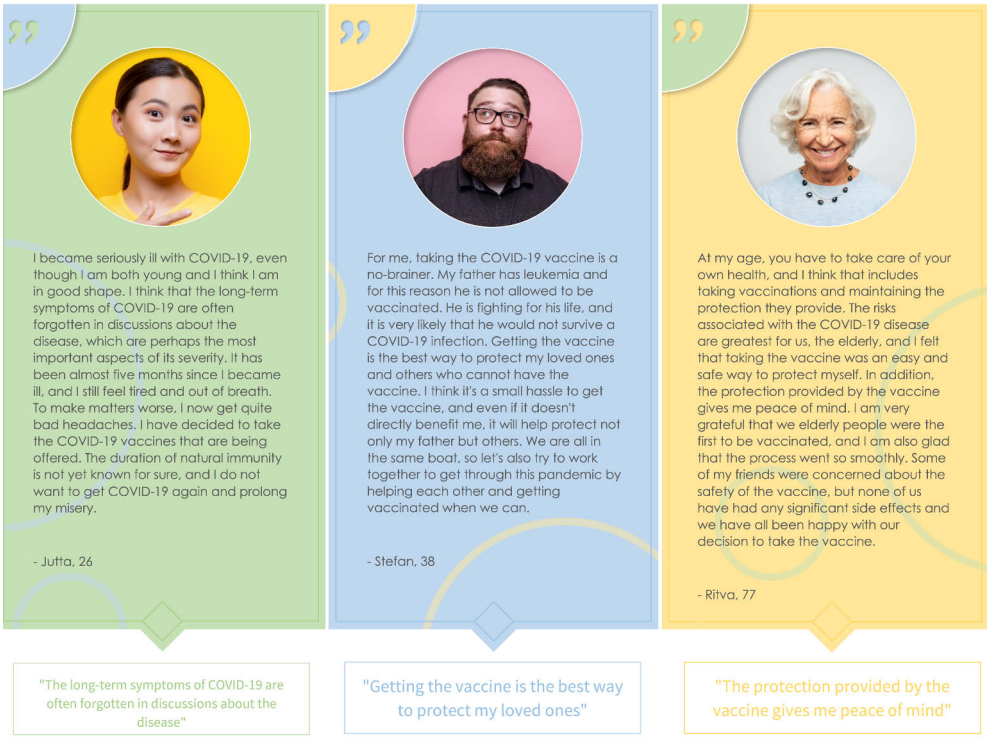
Appendices

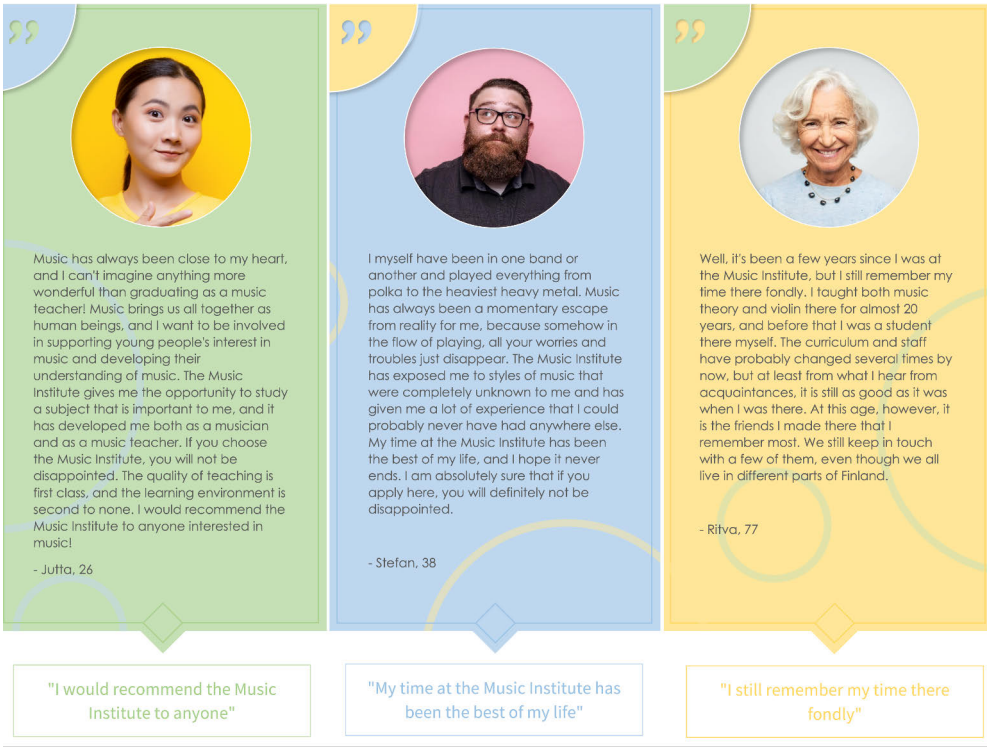
Appendix 1. Statistical COVID-19 vaccine message.



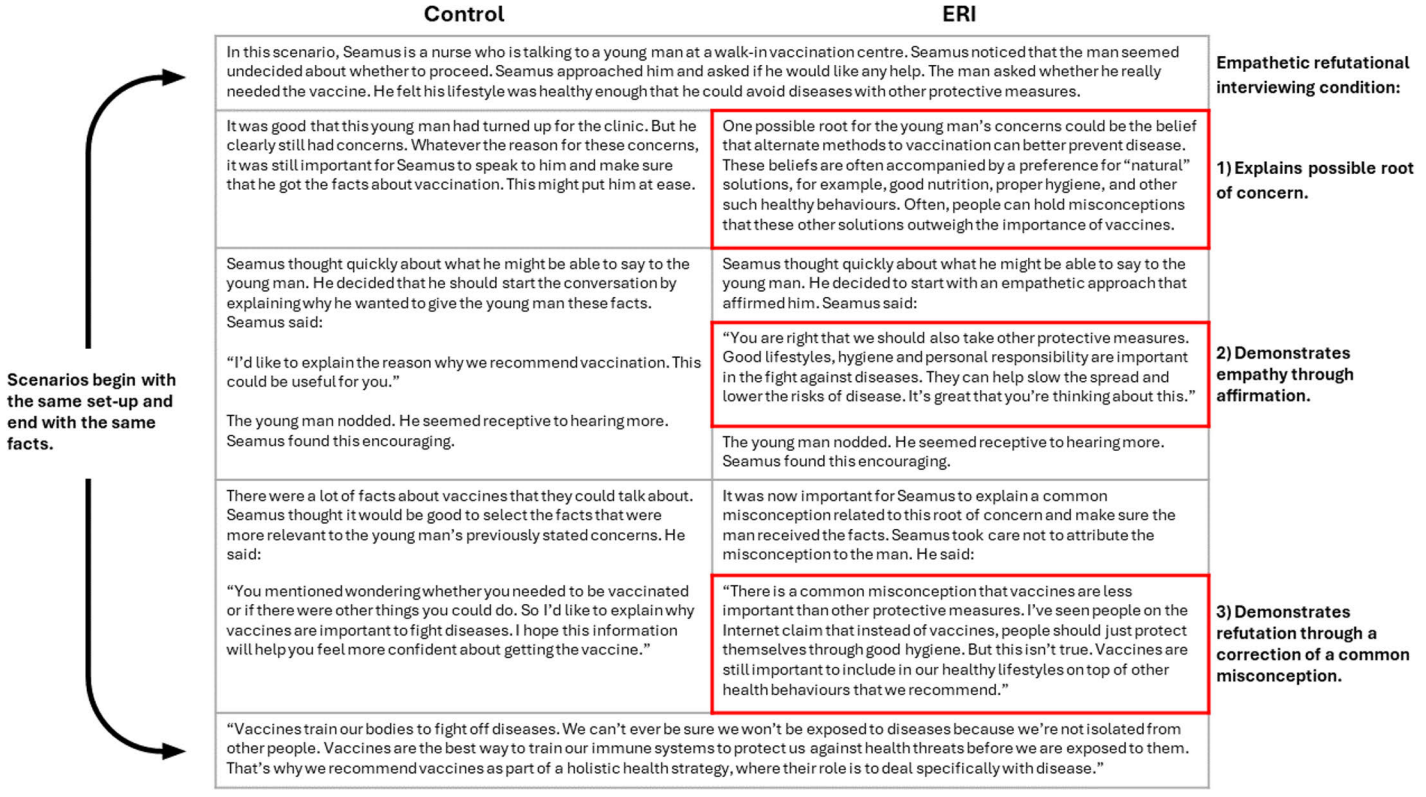
Appendix 2. Anecdotal COVID-19 vaccine message.



Appendix 3. Control message.



Appendix 4. Example of the ERI and control intervention materials in Study III. The areas highlighted in red signify the sections in the exemplifications that differ from the fact-based control exemplifications.



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