Examining message-modality effects in the context of flu vaccination

Ng, Janelle Shaina Hui Yi

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**EXAMINING MESSAGE-MODALITY EFFECTS IN THE
CONTEXT OF FLU VACCINATION**

JANELLE SHAINA NG HUI YI

WEE KIM WEE SCHOOL OF COMMUNICATION AND INFORMATION

2021

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JANELLE SHAINA NG HUI YI

Wee Kim Wee School of Communication & Information

A thesis submitted to the Nanyang Technological University
in partial fulfilment of the requirement for the degree of
Master of Communication Studies

2021

Statement of Originality

I hereby certify that the work embodied in this thesis is the result of original research, is free of plagiarised materials, and has not been submitted for a higher degree to any other University or Institution.

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Janelle Shaina Ng Hui Yi

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SUMMARY

Background: Research on message effects has focused mainly on text and less attention has been given to text effects in conjunction with other modalities. Text is processed sequentially and undergoes more cognitive control compared to visuals, which are processed almost instantaneously and undergo little cognitive control (Geise, 2017). The EPPM (Witte, 1991) provides theoretical perspectives from which to assess if differing modalities would augment certain message types. It is hypothesized that threat messages would perform better in the visual modality (*H1a* and *H1b*) whereas efficacy messages would perform better in the text modality (*H2a* and *H2b*). Seasonal influenza was chosen as the context for this study as vaccination rates remain lower than desired locally (“Adults here not keen”, 2017).

Objective: This study aims to examine if these proposed effects would surface and can be used to augment presentation of EPPM message components to maximise the effects of these two message types.

Method: A two-by-two between-subjects experiment with a pre- and post-survey design was used to examine message-modality effects. One hundred and eighty-two Singaporean university students were recruited and randomly assigned to experimental conditions at post-survey. Message content and materials were developed and pretested with 62 participants to reduce the influence of confounding factors like emotion and ensure comprehension. Due to safety restrictions imposed to prevent the spread of COVID-19 at the time of study execution, the planned on-site procedures had to be converted to online surveys.

Analyses: Two-way ANCOVAs were used to test for the hypotheses pertaining to perceived severity (*H1a*), perceived susceptibility (*H1b*), and perceived response efficacy (*H2a*), and intention to vaccinate. Confounders identified from analyses of the baseline data and variables pertaining to COVID-19 were included as covariates. A set of four linear regressions were conducted to test the hypothesis for perceived self-efficacy (*H2b*) as the data failed the assumption of homogeneity of regression slopes.

Results: No statistically significant main effects of threat message modality were found for perceived severity and perceived susceptibility. Similarly, no statistically significant main effects of efficacy message modality on perceived response efficacy or perceived self-efficacy were found. However, a statistically significant two-way interaction was found for message modality on intention to vaccinate.

Conclusion: The study findings did not support *H1* or *H2*. However, the findings suggest that message-modality combinations where both visual and text is used could be more effective at improving intentions to vaccinate compared to combinations where only a single modality is used. Theoretical implications, practical implications, and future research directions are discussed.

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Abstract

Health messaging and framing research has focused extensively on text as the main medium of meaning (Geise, 2017). In health communications, much research has borrowed from behavioural theories like the Health Belief Model (Rosenstock, 1974) and the Theory of Planned Behaviour (Ajzen, 1991) to determine what content to communicate. Concepts such as gain or loss framing (O’Keefe & Jensen, 2007) and emotional appeal (e.g., Lang, & Yeghyan, 2008) are also drawn upon when posturing content. However, such carefully crafted text is rarely presented standalone on a neutral background devoid of meaning. Instead, text usually comes with a striking visual package that also embodies meaning that is implicit, heuristic, and – to some extent – open to interpretation (Geise, 2017).

Considering the impact of visual and textual stimuli together is a relatively new area of research (Powell, Boomgaarden, De Swert, & de Vreese, 2018). Those who have explored these effects have used messages of diametrically opposite objectives such as support for or against policy (Powell, Boomgaarden, De Swert, & de Vreese, 2015), or messages with unrelated content (Lochbuehler et al., 2017). To my knowledge, no study has explored the impact of modality in the context of theory-based health communications where different messages have complementary effects that promote the same behavioural outcome.

To test for message-modality effects, the Extended Parallel Process Model (EPPM) was identified as an appropriate framework to guide message design, hypotheses, and research question. Seasonal influenza vaccination uptake was used as the persuasive objective of this health communication. The same health messages were presented in different combinations of textual and 2-dimensional static visual modality (henceforth just referred to as visual modality) and compared. Attitudinal outcomes and intention to vaccinate were assessed as outcomes to explore if application of the EPPM could be enhanced with modality.

Chapter One presents the context of seasonal influenza vaccination as a messaging canvas and the practical implications for exploring modality and message effects. Chapter Two reviews the literature, and conceptualizes message and modality effects to build towards the study hypotheses and research question. Chapter Three provides a more detailed discussion of proposed message modality effects. Chapter Four outlines the method for this study, and Chapters Five and Six elaborate on the study's results, findings, and implications.

CHAPTER ONE:

SEASONAL INFLUENZA AS A MESSAGING CANVAS

Seasonal Influenza Vaccination

Seasonal influenza has been classified as a virus of significant pandemic potential and is closely watched by the World Health Organization (WHO) through the Global Influenza Surveillance and Response System (World Health Organization, 2019). Timely vaccination against the dominant strains of seasonal influenza is one method to build herd immunity within the population (Mooring & Bansal, 2016). However, vaccination uptake is still low in many countries (European Centre for Disease Prevention and Control, 2018; Palache et al., 2015).

Seasonal Influenza Vaccination in Singapore

Singapore has one of the highest population densities in the world (7,804 individuals per square kilometre; Department of Statistics Singapore, 2018), one of the best local transport systems, and the highest international airport connectivity in the Asia Pacific region (Official Aviation Guide, 2018). A high population density and an excellent transport system means that people can travel farther and to more locations. These characteristics mean that Singapore has flu year-round because both northern and southern strains will be carried by travellers (“Don’t flee the flu vaccine”, 2019), and it provides more opportunities for influenza to infect communities rapidly. Therefore, it is imperative to prevent influenza locally to reduce illness and prevent Singapore becoming a staging ground for the virus to transmit globally.

Regular vaccination against seasonal influenza coupled with good personal hygiene is the best form of prevention (Ministry of Health Singapore, 2019). However, “adult vaccination rates in Singapore are dismal” because many believe that vaccinations are only

necessary to protect children and protect oneself when travelling to risky countries (“Adults here not keen”, 2017). Use of mass media is a cost-effective method of educative outreach that can elevate awareness and spur behaviour change in a population (Wakefield, Loken, & Hornik, 2010). Yearly reminders to vaccinate are published to the Singapore public but uptake of this vaccine remains low even for at-risk groups (“Flu vaccine not effective?”, 2018). Hence, using the context of seasonal influenza vaccination to test for combined effects of multimodal framing on behavioural intentions would also contribute to understanding how best to communicate this issue broadly.

Local Undergraduates as a Key Population

This study focusses on undergraduate students as the population of interest. Undergraduate students spend a significant portion of time in academic or social spaces with high human density. This high frequency and extended durations of contact with others means increased transmission of seasonal influenza regardless of whether symptoms manifest (Bednarczyk et al., 2015). For local undergraduates in Singapore, it is common to return to a multigenerational home where grandparents, parents, and children live under one roof or close by each other (“All under one roof”, 2018). It is common for grandparents to shoulder child-sitting responsibilities on behalf of parents who remain at work for most of the day, so they are likely to be around to mind these young adults too (Thang, Mehta, Usui, & Tsuruwaka, 2011). Returning undergraduates infected with seasonal influenza then risk infecting more vulnerable others at home, like their grandparents, younger siblings, or pregnant mothers (World Health Organization, 2019; Zaman et al., 2008). Very mild or asymptomatic seasonal influenza is still contagious (“Am I contagious?”, 2018) but no clear symptoms mean that it is unlikely anyone will take precautions against infection. Household transmission studies have demonstrated that once a household member has been infected, risk of person-to-person transmission can be as high as 38% (Tsang, Lau, Cauchemez, &

Cowling, 2016). Hence, students are also a key demographic to vaccinate as they can help prevent within-household transmission of seasonal influenza and rapid peer-to-peer transmission when they are on campus.

Opportunity for targeted messaging. Undergraduates are a captive audience to the university and relatively closer to each other in age and experience. This makes them a more homogenous population that is easier to design content for targeted messaging. Seasonal influenza vaccination promotion material can be made immediately relevant by appealing to their student identity.

Opportunity for mastery. Previous research has already demonstrated that these positive mastery experiences increase the likelihood that individuals would vaccinate again (Lin et al., 2010). If undergraduates uptake seasonal influenza vaccination and avoid falling sick with seasonal influenza, they would have had a positive mastery experience. When these undergraduates join the workforce, they will be more likely to vaccinate themselves again and protect others around them.

Communication improvement using modality. No clear effective interventions have emerged in the literature for how to increase seasonal influenza vaccination in young adults – especially college students. However, several recommendations have been made to increase the clarity and accessibility of information from school-based communications as a way to notify students of the need for seasonal influenza vaccinations (Nyhan, Reifler, & Richey, 2012; Poehling, Blocker, Ip, Peters, & Wolfson, 2012) using emailed poster advertisements, for example. Hence, increasing our understanding of the nuanced impact of multimodal communications could make for more effective school-based communications that already capitalize on the relevance of students' context and increase utilisation of health resources. As modality and health communications remains relatively understudied, it represents a possible untapped potential that could be applied to health messaging in general.

Outside of the school context, still two-dimensional images and texts are also widely used as health promotion materials in various combinations. To further our understanding of whether or how modality can be used to enhance types of messages also furthers our understanding of how to create materials that more effectively impact audiences. This also increases the value of economic resources expended to set up and run such health campaigns. To that end, this study attempts to further explore how still presentations in two-dimensional images or passages of text might change message impact.

CHAPTER TWO:

LITERATURE REVIEW AND CONCEPTUALIZATION

Centrality of Communication Material and Theory-based Research

Across target groups, many interventions have focused on informing and persuading people to vaccinate against seasonal influenza. However, most of these interventions performed are not rooted in theory (Yong, Lok, & Tarrant, 2016). This means that there are likely to be inconsistencies and unknown effects on intentions that could have been caused by the communicative material used, rather than the strengths or flaws of the intervention operations. Hence, increasing knowledge of how communication materials work through theory-based research is important.

There is evidence to suggest that theory-based interventions are more effective than atheoretical interventions (Glanz & Bishop, 2010). Some of the more common theories of behaviour change used to design health interventions include the Health Belief Model, Self-Determination Theory, Social Cognitive Theory, Theory of Planned Behaviour, the transtheoretical model, and the EPPM (Davis, Campbell, Hildon, Hobbs, & Michie, 2015). These theories are suitable for designing health promotion or health behaviour messages in general because they outline a system of antecedent beliefs or factors that affect whether people adopt recommended health behaviours. However, the way in which these constructs need to be postured in a health message is not necessarily in the control of the message designer. For example, the Theory of Planned Behaviour's "subjective norm" construct (Ajzen, 1991) intends that suggesting important others' high uptake of the health behaviour would increase the intention for the viewer to uptake the behaviour as well, but this may not be the current reality of the viewer and thus creates a disconnection with the health message instead. In another example, the Health Belief Model's "cues to action" construct

(Rosenstock, 1974) intends that highlighting cues to health behaviours – like symptomology or family history – will make a message more persuasive because it increases the perception of risk of disease to the self. However, for instances where the health behaviour is pre-emptive and provides a greater benefit to the community than to the self (e.g., vaccination or handwashing), it may not be applicable to include within a health message, making for an incomplete application of the theory.

These other theories also propose more than two antecedent factors. Hence, it is more difficult to use them when looking for modal effects using only the visual and textual modalities. The EPPM states that only two types of message content – threat and efficacy – are needed in a persuasive fear appeal. This makes it suitable to use for exploring multimodal message effects by comparing the same messages semantically but presented in different combinations of modality. In the following paragraphs, the contributions of the EPPM, fear appeals, and functions of threat, efficacy, and fear in the EPPM, and utility of the EPPM for examining modality effects are discussed. Finally, possible interactions between modality and message are explored.

The Extended Parallel Process Model

The EPPM is a theory that has been used to guide the design of fear appeal messages in health communications (Tannenbaum, 2015). Its main contribution to research is providing an explanation of why using fearful messages to motivate health behaviours does not work consistently. The EPPM was developed as an advancement of the parallel process model and the protection motivation theory to explain how fear appeals work (Witte, 1992). The EPPM is commonly used to design messages for health communication interventions (Maloney, Lapinski, & Witte, 2011). It highlights that an efficacious fear appeal should contain the elements of threat, which subsequently motivates the processing of efficacy information that

recommends how the threat can be resolved. The message types of interest are therefore threat (consisting of severity and susceptibility) and efficacy (consisting of self- and response efficacy). The following sections describe how fear appeals are defined and how perceived threat and perceived efficacy work in collaboration to strengthen behavioural intentions.

Fear Appeals as Defined by the EPPM

The EPPM does not define the modalities through which fear appeals should, or best, operate. Therefore, the implicit assumption is that it should operate through any modality where meaning is interpretable. A fear appeal is a message that usually contains frightful content in the form of vivid descriptions (e.g., foul, thick and necrotizing lung tissue), language that attempts to get target audiences to identify that the message is relevant (e.g., “pregnant women like you”), or graphic images (e.g., photographs of cancerous organs) that arouse fear in the audience. It also presents viable solutions to averting depicted threats. A fear appeal thus has two message components a) a relevant threat, and b) relevant efficacy, which can be presented through different modalities.

First, a relevant threat is a harmful or costly external variable to the audience that needs to be raised to their attention. It aims to increase perceived severity, which is the audience’s beliefs about the severity of the threat, and perceived susceptibility, which is the audience’s beliefs about the likelihood that they would experience the threat. Proponents of the threat frame have demonstrated that threat-framed messages alone have produced significant improvements in intentions (Munoz, Chebat, & Suissa, 2010; Miller, Hill, Quester, & Hiller, 2011). Comparative studies have also found that threat-framed messages alone produced significantly greater improvements in intentions as compared to using efficacy-framed messages alone (Gerend & Sias, 2009).

Second, a relevant efficacy message contains information about how effective the recommended action is and/or how accessible or simple it is to perform the recommended

action. In other words, it aims to improve audience's beliefs about the efficacy of the recommended action (i.e., response efficacy) as well as improve audience's beliefs about their own ability to perform the recommended action (i.e., self-efficacy; Witte, 1992). Improving perceived efficacy thus makes it more likely that a person will undertake the recommended action by convincing them that their efforts are more likely to result in a successful outcome. Studies have demonstrated that efficacy-type messages alone are sufficient to produce improvements in behavioural intention (Keller, 2006) and that individuals who have high self-efficacy and high response efficacy have stronger intentions to perform the behaviour (Zhang et al., 2017; Hamilton, Warner, & Schwarzer, 2016; Payaprom, Bennett, Alabaster, & Tantipong, 2011).

Fear in the EPPM

Threat and fear are conceptually distinct. A successful recognition of personal threat can elicit fear, which is a negative emotion accompanied by physical arousal. It is elicited by a threat that the audience perceives as important and personally relevant (Witte, 1992). An important note here is that while fear is elicited by threat it is not necessary for creating an adaptive response to a message that increases behavioural intention. A successful perception of threat also does not necessarily result in fear. Too much fear will lead to a maladaptive response to the message whereby individuals choose to engage in controlling the negative emotional experience rather than the threat presented to them (Witte, 1994). Hence, fear was assessed to ensure that levels were evenly distributed across conditions at baseline, or so that it can be statistically controlled for during analyses.

Combining the Effects of Threat and Efficacy Message Types

Based on Witte (1992), the EPPM proposes that a person's response to a fear appeal goes through two phases. First, they evaluate whether they are susceptible to the illustrated

threat and whether that threat is severe. If they conclude that they are not susceptible and the threat is not severe, then they are unlikely to continue processing the message since it is likely irrelevant to them. If they conclude that they are susceptible to the threat, and the threat is severe, then perceived threat is high and they proceed by evaluating whether the message communicated provides useful strategies within their means to prevent the threat. If the strategies are useful and within their means (i.e., efficacy is high), then persons are likely to engage an adaptive response to the message and perform the recommended behaviour (i.e., increase behavioural intention). If the strategies are not useful or not within their means, then persons are likely to attempt to control their unresolved fear and engage a maladaptive response to the message by avoiding or ignoring performance of the behaviour (i.e., decrease or no change in behavioural intention). This illustrates how threat and efficacy messages serve to complement one another to achieve increases in behavioural intention. However, whether the characteristics of modality provide facilitative or restrictive effects on the effectiveness of message persuasion remains understudied. See Figure 1 for a summary of these processes.

Figure 1.

Illustration of fear appeal processes; adapted from Witte (1992).

Utility of the EPPM for Testing Message-Modality Effects

In summary, several characteristics make the EPPM ideal for testing multimodal effects. First, it provides threat and efficacy as distinct messages that can be housed in both visual and textual modalities. This allows for assessment of identical message-modality combinations like threat visual with threat text, as well as alternating message-modality combinations like threat visual with efficacy text. Second, it illustrates a pathway to message acceptance and behavioural intention that requires the presence of two different message types that can be delivered through different modalities. Since achieving an efficacious fear appeal will require effects from both message types, the extent to which audiences are influenced by messages from both modalities when considering their behavioural intentions can be examined by comparing alternating message-modality combinations with identical message-modality combinations.

CHAPTER THREE: MODALITY AND MESSAGE EFFECTS

Evidence for Combined Modal Effects

To examine how modal characteristics could have facilitative or inhibitory effects on threat and efficacy messages, this section explores current knowledge on multimodal, textual, and visual modalities. Text and visuals have different perceptual characteristics and so are perceived and encoded differently from each other. Dual Coding Theory (DCT) posits that textual and visual stimuli are processed via two distinct systems that interrelate – the verbal and nonverbal systems (Clark & Paivio, 1991). It also emphasizes the importance of previous experience and a spreading activation of mental constructs related to those that are primed. This means that previous experiences of the concepts that are evoked by visual or textual stimuli are activated alongside them, making their effects complex and entangled. Yet, evidence exists to support distinctions between processing these two stimuli in theoretical research of dual processing models of persuasion (Chaiken, 1980; Petty & Cacioppo, 1986). However, research in multimodal processing has found evidence supporting the integration of visual and textual stimuli into a single mental representation in a person's memory (Schüler, Arndt, & Scheiter, 2015). The proposition of spreading activation in DCT also implies that since cross-encoding of meaning in textual and visual processing (e.g., the word 'book' evokes both the encoded meaning of the composite set of characters b-o-o-k as well as the mental image of a book) is possible (Clark & Paivio, 1991). This indicates that there could be an integration of meaning from both visual and textual stimuli once the information is processed. Hence, when audiences perceive and decode multimodal stimuli, we can expect messages in both textual and visual modalities to influence them.

Recent Research on Multimodal Effects

Researchers have explored both textual and visual modality effects and found differing results when visuals and text are used together compared to either alone. For example, experiments of learning by Eitel, Scheiter, and Schüler (2013) found that exposure to conceptual illustrations had a subsequent facilitative effect on students' ability to comprehend the new concepts in text later on, demonstrating that interpretations gleaned from visual stimuli have at least a scaffolding effect when used together with textual information.

Recent studies have also found separate influences of text and visuals in different contexts. Powell and colleagues (2015) looked at how congruence of visual and textual stimuli influenced attitudes of policy support for military intervention in another country. They found that the message presented in the text influenced opinions regardless of the congruence of the visual, and that the message presented in the visual influenced behavioural intentions regardless of the congruence of the accompanying text. Thus, even though participants viewed both visual and text before responding to the survey, visual frames did not negate the textual frames. In another example, Feldman and Hart (2018) used the EPPM in their Q-sort experiment testing visual and textual frames of efficacy and threat in the context of environmental protection but also found no significant interaction effects between text and visual frames. However, the lack of findings could be due to a stimuli-specific issue as the visual stimuli used in this experiment were not pretested for representativeness of the threat and efficacy concepts for their sample.

Modality and Message Characteristics

This section reviews knowledge about the characteristics of the textual and visual modalities and attempts to explain how presenting threat and efficacy messages in each modality might influence message effectiveness.

Text

Text is a formalized set of symbols representing a language that follow a set of rules in encoding and decoding meaning. It is a syntactic, arbitrary, and structured mode of proposing a perspective that facilitates greater cognitive processing of the meaning of the narrative presented (Messaris & Abraham, 2001). Text is processed in a similar manner to verbal articulation in that it involves time-order and sequence, so readers must piece together the meaning of the text word by word as they read. Hence, readers will only be able to understand the full meaning of a sentence when they get to the end of it. Since the relations between concepts housed in a sentence are sequentially and clearly specified, reading text structures thinking more than visuals, which offer interpretative cues that may not relate to the message (Geise, 2015). As the symbols used in text are arbitrary and do not look like the concepts that they represent, audiences must have the requisite skills, interest, and knowledge to decode it, otherwise the meaning of the text will not be interpreted as intended. Relative to visuals, text is less salient and less likely to be attended to first (Clark & Paivio, 1991).

Visuals

A visual is any purposeful, two-dimensional, media-contained, illustration of meaningful content (Geise & Baden, 2015). Messaris and Abraham (2003) discuss three distinct features of visuals. First, visuals are analogical in that they use an analogy to convey meaning that is interpreted by the viewer. Second, visuals are indexical in that the symbols or images used grounds a viewer's understanding within a context. Third, meaning is implied rather than dictated since there is a lack of propositional syntax – viewers are not instructed

on what to think or how to think about it. Meanings are instead alluded to and final interpretation is completely up to the viewer. These characteristics make it suitable for visuals to organize and succinctly illustrate purposefully chosen facets of an issue, anchoring interpretations of subsequent text to a proposed frame of interpretation (Geise, 2017).

Constructing Visuals and Texts

Crafting a visual message is more complex, since due to their analogous form, visuals imply meaning more than they explicitly construct a perspective. To construct a visual message effectively, all elements of the visual need to be carefully considered. For example, content, subjects, symbols, positioning, emotional expressions, or colours. It is the composition and relative salience of these elements together which help make a visual message (Geise, 2015). Unlike text, which makes relations explicit, visuals must be constructed with the target audience in mind. This ensures that the audience will most likely have the requisite experiences to decode the visual in the intended way.

Unlike text, visuals appear in a similar manner to what they intend to portray. A visual of a woman could contain images of her curvaceous figure flattering dress and full lips, but the word ‘woman’ represents a woman with only a collection of alphabets commonly assigned to represent the idea of a woman without looking like a woman. Hence, viewers often do not require prior knowledge of a visual compared to text. However, visuals do require that the audience be able understand the imagery used such that they can decode the visual as intended.

Constructing texts is a relatively straightforward process since fewer ambiguous symbols are involved. First, the words used must be chosen such that they are commonly used enough that they exist in the vocabulary of the target audience. Otherwise, overly complex or specialised nomenclature could prevent the message from being understood.

Second, the words chosen for the text should either have no culturally ambiguous meanings, or the intended meaning needs to be properly cued in the text to avoid misinterpretation.

Threat Message and Modality

Research into emotion processing has noted that there is a consistent superiority in the salience, arousal, and processing of expressions depicting negative emotions compared to positive emotions (Fox & Damjanovic, 2006). Adaptively, this has allowed humans to better survive by paying more attention to stimuli that signal possible danger to their lives (LoBue & DeLoache, 2010). In addition to the characteristics mentioned earlier, visuals are highly salient compared to text. This means that visuals can hold audiences' attention better than text and are remembered better than text. Visuals are processed more quickly and automatically, which bypasses cognitive elaboration of the perceived message (Geise, 2017). Taken together, this implies that the threat message and visual modality could be mutually enhancing. A threat visual could arouse attention and fear that motivates further processing of the whole persuasive message before defensive cognitive elaboration can take place. Thus, a threat visual is likely to have a greater impact on perceived threat than a threat text. The following hypothesis is proposed:

H1: Exposure to a threat message visual will result in higher a) perceived severity and b) perceived susceptibility, than exposure to a threat message text.

Efficacy Message and Modality

Studies have conceptualised the experience of efficacy as a sense of confidence in accomplishing what one intends (Chen, Gully, & Eden, 2001). Since attention to positive stimuli is less crucial to survival than attention to negative stimuli (LoBue & DeLoache,

2010), this positive affective valence makes it less salient and less urgently processed compared to negatively valenced messages or emotions in the same modality (Fox & Damjanovic, 2006). Furthermore, while perceived efficacy may be evoked through an efficacy message, significantly increasing perceived efficacy in an individual could require more cognitive elaboration. This is because an individual would have to be convinced that the recommended action is effective and that they have the resources to execute the action. Such persuasion could require a more explicit and structured mode of presentation since an ‘argument’ for performing the action is required. Since visuals only analogically imply meaning, while text makes explicitly linked logical points, text could be a superior mode for presenting the efficacy message. As such, the following hypothesis is proposed:

H2: Exposure to an efficacy message text will result in higher a) perceived response efficacy and b) perceived self-efficacy, than exposure to an efficacy message visual.

Comparing Message-Modality Combinations to Answer H1 and H2

To properly assess message and modality effects, comparable combinations of threat and efficacy message modality must be constructed. To compare whether threat visual would be more effective at raising perceived severity and perceived susceptibility than threat text, the efficacy modality should be held constant, and vice versa for comparisons of efficacy modality.

Figure 2.

Illustration of comparisons needed to test H1.

H1 comparisons:

Threat Text	Vs.	Threat Visual
Efficacy Visual		Efficacy Visual

&

Threat Text	Vs.	Threat Visual
Efficacy Text		Efficacy Text

For H1, modality of efficacy message is held constant as indicated in bold text within Figure 2, while modality of threat message is varied. This results in two sets of comparisons: 1) Threat text vs Threat visual, when Efficacy is in the visual modality, and 2) Threat text vs Threat visual, when Efficacy is in the text modality. Hence, it is expected that perceived severity and perceived severity will be higher for those who received the threat visual condition compared to those who received the threat text conditions, and we expect that this difference will be similar regardless of whether the attached efficacy message is in the visual or text modality.

Figure 3.

Illustration of comparisons needed to test H2.

H2 comparisons:

Threat Text	Vs.	Threat Text
Efficacy Visual		Efficacy Text
&		
Threat Visual	Vs.	Threat Visual
Efficacy Visual		Efficacy Text

Similarly, for H2, modality of the threat message is held constant as indicated in bold text in Figure 3, while modality of the efficacy message is varied. This results in the following two comparisons: 1) Efficacy text vs. Efficacy visual, when Threat is in the visual modality, and 2) Efficacy text vs. Efficacy visual, when Threat is in the text modality. Hence, it is expected that perceived response efficacy and perceived self-efficacy will be higher for those who received the efficacy text conditions than for those who received the efficacy visual conditions, and that this should be consistent regardless of whether the accompanying threat message was in the visual or text modality.

Message-Modality Effects in Combination

Visuals can enhance text effects if they serve an organizing function. Recent research demonstrated that when audiences are presented with multimodal messages that are diametrically opposed (e.g., pro-military intervention visual paired with anti-military intervention text), visuals have a greater influence on behavioural intention regardless of the accompanying text. The authors suggest that this is due to the more emotive nature of visuals

having a stronger relation to intention. Further, when visuals accompany text that is related or explanatory, memory for content is facilitated (Lochbuehler et al., 2017).

According to the EPPM, the presence of both threat and efficacy messages are necessary to maximise increases in behavioural intention. If a threat message visual is paired with an efficacy message text, then processing the efficacy message text could be facilitated by the threat message visual. Threat message visual is likely to enhance perceived threat because of its immediate processing and high salience. While efficacy message text is likely to enhance perceived efficacy due to its logical structure and explicit presentation of meaning. If an efficacy message visual is paired with a threat message text, the lack of structure and implicit presentation of meaning of the visual modality could induce lower increases in perceived efficacy. The lower salience of threat message text and longer processing time would also induce lower increases perceived threat. Greater increases in perceived threat and perceived efficacy for the threat message visual and efficacy message text combination likely means greater increases in intention to vaccinate compared to a threat message text and an efficacy message visual. However, because both perceived threat and efficacy need to be high, and intention is a secondary process that happens only after processing perceived threat and efficacy, the following research question is proposed:

RQ: Will different combinations of threat and efficacy message modalities produce significantly different strengths of intention to vaccinate?

Variability of Thought

Examining only the resultant perspectives evoked by stimuli leaves out a richness of thought that occurs while participants are processing the stimuli and cannot capture any unintended effects. Thoughts are complex and not easily predictable, but they offer much

insight to the motivations behind individuals' perspectives, intentions, and actions. Structured questionnaires are unable to fully capture any new or unintended cognitive or affective reactions to stimuli since they are largely confirmatory in nature (Cacioppo, von Hippel, & Ernst, 1997). To have a more nuanced understanding of the impact of differing message-modality combinations on participants' message processing, the thoughts participants have in response to the stimuli in a manner will be sampled with a free-response section. Though not hypothesized, this data will be analysed alongside other variables.

Demographics and Subject Variables

Any message requires some degree of interpretation regardless of its modality and is susceptible to influences from inherent individual differences. Information presented by all stimuli are interpreted through the lens of the audience's current varied life experiences, values, skills, and predispositions. Hence, to properly identify the effects of modality, several subject variables should be assessed and checked to ensure that they are not significantly different across conditions. First, perceived involvement in the topic of influenza should be assessed because persons with different levels of involvement can be more receptive to threat or efficacy messages (Petty & Cacioppo, 1990; de Graaf, van den Putte, & de Bruijn, 2015). Second, refusal to vaccinate due to needle phobia should be assessed since this association also contributes to vaccination hesitancy and affects behavioural intentions (Taddio et al., 2012). Third, previous influenza vaccination experiences should be indicated as research has shown that those with previous vaccinations are more likely to vaccinate again (Lin et al., 2010). Fourth, processing style should be assessed to account for individual preferences for visual or textual stimuli and consequent differences in frame processing (Childers, Houston, & Heckler, 1985). Refer to Figure 2 below for a summary of the key study variables, hypotheses, and research question.

Figure 4.

Summary of key study variables, hypotheses, and research question.

CHAPTER FOUR: METHOD

Study Design

The present study consists of 1) a survey to guide stimuli development, 2) a pre-test of stimuli, 3) a baseline assessment to check for overt influences of subject variables and viability of stimuli in light of the COVID-19 situation, 4) a two-by-two between-subjects experiment post-test only survey, and 5) a post-hoc manipulation check. Due to necessary health safety restrictions imposed during COVID-19, all recruitment, participation, and debriefing which was originally planned to be in-person had to be conducted online via Qualtrics survey platform. The exploratory survey surfaced the most relevant operationalisations of threat and efficacy messages to Singaporean university students. The pre-test established the conceptual representativeness of each message in the two different modalities (text, visual) x message (threat, efficacy). See Table 1 for a summary of the stimuli developed.

Table 1.

Pre-testing materials.

	Text Modality	Visual Modality
Threat Frame	Threat Text	Threat Visual
Efficacy Frame	Efficacy Text	Efficacy Visual

Then, the baseline assessment provided data to check for any overt influences of subject variables after randomization as well as continued viability of the stimuli for the experiment in light of the closeness of the topic to the COVID-19 situation. Finally, the two-by-two experiment provided the range of comparison groups needed to test the abovementioned hypotheses. See Table 2 for a summary of the experimental conditions. A

between-subjects design was used because repeated exposure to a message could have carry-over effects (Cacioppo & Petty, 2010), and this study is only concerned with examining the effects from a single exposure. Order of message presentation was held constant as threat message before efficacy message, regardless of the modality, since processing of threat message motivates processing of efficacy message (Witte, 1992).

Table 2.

Experimental conditions.

Message Modalities	Threat Text	Threat Visual
Efficacy Text	Threat Text	Threat Visual
	Efficacy Text	Efficacy Text
	(3)	(2)
Efficacy Visual	Threat Text	Threat Visual
	Efficacy Visual	Efficacy Visual
	(1)	(4)

When narrowing down which messages to develop into stimuli, only the highest threat and highest efficacy messages were selected and matched as undergraduate populations tend to be more susceptible to high threat/high efficacy messages compared to low threat/low efficacy messages (Blondé & Girandola, 2018; Ruiter, Kessels, Peters, & Kok, 2014).

Sample Description

The total sample size for this project was 271 Singaporean undergraduate students between 18 to 28 years of age. All participants were asked to confirm that they were Singaporeans before they were allowed to participate. A convenience sample of students ($n =$

29) were first recruited to rate threat and efficacy statements gathered from searches of academic literature and news articles to guide stimuli development. A pre-test ($n = 23$) was conducted to check for conceptual representativeness of developed stimuli. Improvements were made to all images based on the data in the second pre-test. There were two surveys ($n = 182$), one to assess key variables at baseline, and one roughly a week later with exposure to the experimental stimuli. Finally, the post-hoc manipulation check ($n = 22$) comprised of randomly selected students who took part in the experiment, roughly 14% of the valid sample.

Singaporean undergraduate students were selected as the population of choice because they are easily accessible and are at high risk of exposure to influenza during the semester when campus is crowded. Targeted messaging is also more effective than non-targeted health messaging (Schmid, Rivers, Latimer, & Salovey, 2008). Experimental exploration of multimodal framing is relatively young, so establishing the existence of multimodal framing effects with high internal validity is a priority. Therefore, using a more homogenous sample is also more advantageous (Druckman & Kam, 2009). Many examples of undergraduate student samples utilised for experimental research also exist in the literature because they are less expensive, more easily acquired, and retain high internal validity (Baek & Yoon, 2017; Kim & Nan, 2016; Stroebe, Gadenne, & Nijstad, 2018; Sun, Krakow, John, Liu, & Weaver, 2016). Finally, university students are a captive audience on whom messaging interventions can be readily applied by universities. This makes the study findings more relevant for future interventions in this context.

Development and Pre-testing of Stimuli

Identifying Source Statements

To identify relevant threat and efficacy messages for Singaporean undergraduate students, a thorough search of academic literature and local news sources was conducted. These messages were extracted and presented as short statements to undergraduate students. They were asked to rate the extent to which severity, susceptibility, response efficacy, self-efficacy, and fear are perceived from these statements, as well as how persuasive each statement would be in their consideration of whether to take the seasonal influenza vaccine. Twenty-nine participants rated all statements, which were randomly presented. Two statements which were rated high in perceived threat, two statements which were rated high in perceived efficacy, and which were rated the highest in their categories for persuasiveness, were selected for stimuli development. These were determined using the interquartile ranges (IQR) of each item. Unfortunately, only five statements passed the set requirements to be developed into experimental stimuli. See Annex A for a summary of selection criteria.

Stimuli Development

Each statement was developed into a short body of text (< 40 words) and a conceptually equivalent visual. Conceptual equivalence between text and visual should be maintained, so text was kept succinct such that it did not provide information beyond the context and implications of its visual counterpart. To keep the mental processing of text from becoming too similar to the vivid qualities of visuals, the textual message was presented in a factual rather than a narrative fashion to avoid evoking vivid mental imagery. To avoid the confounding effect of any other text, no titles were provided, and only short phrases anchored the meaning of the visual without overt interpretation and without full sentence structure. The confounding effect of emotional primes was avoided by omitting faces or parts of faces clearly showing emotion (e.g., faces obstructed by objects, top or back view of head), and

text avoided the use of words or phrases that highlighted emotions. Due to a lack of online sources which completely fulfilled these stringent experimental requirements, the stimuli were developed by the experimenter by blending and modifying suitable source elements.

Second Pre-testing and Adjustments to Stimuli

These stimuli were pre-tested ($n = 23$) for conceptual representativeness. Each participant viewed all developed visual stimuli and submitted their own interpretation in a free response survey. The order of appearance of the stimuli was randomized to counter any order effects. A stimulus would get a pass point for conceptual representativeness each time a participant could articulate its core message. For the construct of severity, participants had to be able to articulate that influenza can be serious. For susceptibility, the participants had to be able to explain that others and themselves are vulnerable to spreading or being infected by influenza. For response efficacy, participants had to state that the influenza vaccine is protective for themselves and others. For self-efficacy, participants had to be able to identify that obtaining it would be convenient or opportunistic. Perceived persuasiveness was assessed for all stimuli because it was necessary to ensure that participants felt that the arguments presented within the stimuli held merit for there to be any reasonable expectation of influence on intention to vaccinate.

The set of stimuli with the highest scores for conceptual representativeness from the open-ended responses, persuasiveness score of at least 4 of 6 on the lower end of the interquartile range, and a perceived construct score of at least 4 of 6 on the lower end of the interquartile range were selected. The minimum score of 4 was selected for both persuasiveness and perceived construct levels because it was the minimum score that indicated the potential effect of the stimuli in the intended direction of the message. See Annex C for a summary of the results of statement selection by these criteria. One of the initially selected set of five visuals was dropped due to consistent confusing statements given

by participants, and the rest were modified to counter the misconceptions in the participants' responses before incorporation into the main experiment. Unfortunately, due to rapid evolution of circumstances with COVID-19 and time constraints, it was not possible to conduct an additional pre-test to verify that the re-developed stimuli would be highly effective. All participants in the pre-testing were compensated SGD5 for their time. See Annex D for the final set of stimuli that was used in the experiment.

Experiment Measures

Table 3 on the following page summarises the measures that were used in the experiment organised by the surveys in which they appeared. For the pre-survey, baseline subject variables that are unlikely to change over a week like age, sex, and race were assessed. Style of processing (Childers, Houston, & Heckler, 1985), and receipt of seasonal influenza vaccination were also assessed once here. For both pre- and post- survey, intention to vaccinate, EPPM message variables of perceived severity and susceptibility, and perceived response and self-efficacy were assessed (Witte, Cameron, McKeon, & Berkowitz, 1996). Barriers to vaccination, which include fear of needles, as well as fear of seasonal influenza were also assessed at both time points (Yang, 2014). The question on intention to obtain an influenza vaccine was asked immediately after exposure to the stimuli in the post-survey, followed by the thought-listing task, and dependent variables. This ensured as far as possible that any effects observed were due to the stimuli viewed and not the survey questions themselves. Items unique to the post-survey included an open-ended thought-listing task and two items on how the COVID-19 circumstances have impacted their thoughts and concerns about seasonal influenza. All items except previous influenza vaccination (yes/no) and fear of seasonal influenza assessment (visual analogue scale) used a Likert-type format. Finally, a post-hoc manipulation check was conducted on a subset of the participants ($n = 22$) to verify

that stimuli were interpreted as intended. Statements corresponding to each piece of stimuli in each condition were presented to participants and they answered ‘yes’ or ‘no’ depending on whether they perceived that the statement represented said piece of stimuli. See Annex 1 for scale items.

Table 3.

Summary of key measures.

Survey	Measures	Description	Source
Pre-survey only	Subject variables	Age, sex, race	-
		Style of Processing Scale (22 items)	Childers, Houston, & Heckler (1985)
		Ever/regular receipt of seasonal influenza vaccination (1 item)	-
Pre- and post-survey	Dependent variables	Intention to vaccinate this year (1 item)	-
		Perceived severity, perceived susceptibility, perceived response efficacy, perceived self-efficacy (3 items each)	Witte, Cameron, McKeon, & Berkowitz (1996)
	Subject variables	Barriers to vaccination (4 items)	Adapted from Yang (2014)
		Visual Analogue Scale for fear (1 item)	Williams, Morlock, & Feltner (2010)
		Involvement Scale	
Post-survey only	Open-ended cognitive measure	Thought-listing task after viewing stimuli	Based on Das, de Wit, & Stroebe (2003)
	COVID-19 influence assessment	Assessing frequency of COVID-19 thoughts and how COVID-19 changed importance of seasonal influenza (2 items)	-
Post-hoc manipulation check		In the above set of stimuli, there is a <passage/image> that is trying to say <key message>. (4 items per condition)	-

Procedure

Recruitment of student participants was done via email or poster advertisement on campus. After sign-up, participants were contacted and emailed the survey link to complete the pre-survey online. Upon successful completion of the pre-survey, the participants were scheduled to be contacted via email again with the link to the post-survey. Simple random assignment to one of the four conditions was automated in Qualtrics when the participant started the post-survey. Experimental stimuli were presented on a computer screen as a scrollable single page containing requisite combination of message and modality. A small financial incentive of SGD8 was provided upon completion of the post-survey to compensate participants for their time. To avoid knowledge of the study objectives from confounding responses, participants were asked to maintain confidentiality about the study procedure and stimuli until full debrief was provided over email when the data collection process was completed. Please refer to Figure 3 below for an outline of the procedure and Figure 4 for an overview of the entire method.

Figure 5.

Outline of experiment procedure.

Figure 6.

Method overview.

Approximately one month after the experiment data collection concluded, a post-hoc manipulation check was sent out to a subset of participants ($n = 20$), roughly 13% of the total sample. Five participants from each experimental condition were randomly selected using a random number generator to ensure that there was representation from each group. See Figure 5 for a simplified version of one of the conditions presented and the corresponding questions.

Figure 7.

Simplified sample of one condition from post-hoc manipulation check.

Page 1	Page 2
Severity Visual	In the set of materials above, there is an image that is trying to say that seasonal influenza is severe. Yes ☐ No ☐
Susceptibility Visual	In the set of materials above, there is an image that is trying to say that that you and others are susceptible to seasonal influenza. Yes ☐ No ☐
Response Efficacy Text	In the set of materials above, there is a passage of text that is trying to say that trying to say that being vaccinated is protective against seasonal influenza infection. Yes ☐ No ☐
Self-efficacy Text	In the set of materials above, there is a passage of text that is trying to say that getting the seasonal influenza vaccination is convenient. Yes ☐ No ☐

During the post-hoc manipulation check, participants would view the stimuli in the first section (labelled page 1 above) before scrolling down to the corresponding questions below (labelled page 2 above). Each participant viewed and answered four such sets, one set for each experimental condition. For example, a participant could have the order conditions presented randomized as 1) Threat Text + Efficacy Text, 2) Threat Visual + Efficacy Text, 3) Threat Text + Efficacy Visual, and 4) Threat Visual + Efficacy Visual. This means that the content of “page 1” of each set as illustrated in Figure 5 would follow the experimental condition, but the questions that follow on “page 2” of each set would remain the same because participants are supposed to be able to perceive the same message regardless of modality.

Ideally, all responses should have been “yes” as the statements were designed to correspond with each stimulus. For all items across conditions, at least 77.3% of responses were “yes”. Participants who indicated “no” were immediately followed up with in private and were asked to share the reasons for their responses. Only two reasons were given. First, the vast majority of “no” participants had misunderstood the question as asking for their opinion. So, because they disagreed with the message of the material, they indicated “no”. Second, a few participants cited that they had “mis-clicked” the “no” option as they recalled indicating “yes” for all of them. This was partially because a few of the participants had chosen to complete the survey on their mobile phones despite explicit instructions to use their computers. The post-hoc manipulation check thus suggests that the experimental material was successful at eliciting the desired manipulation.

CHAPTER FIVE: STUDY FINDINGS

Analyses and Results

Most of the questions are posed as Likert-type scales in this study, for analyses, they will be summed and treated as interval data. All summed items use the same Likert-type scale and the resultant data can be analysed using parametric *F* tests since it is also robust to violations of assumptions (Carifio & Perla, 2008). To test for interaction effects between modality and message on perceived efficacy and perceived threat while accounting for control variables, two-way ANCOVA and post-hoc analyses were performed.

Descriptive Analyses

Overall. The raw experiment sample comprised 182 participants. Seven participants did not attempt the post-survey and were removed. A further 20 participants failed to complete at least 80% of the survey or were duplicates and were also removed from the dataset. For duplicate entries, only the first attempt was retained. Any further attempts were removed regardless of completeness. Finally, eight more participants were removed because they had taken longer than 30 minutes to complete the post-survey, which meant that it was likely the effect of exposure to the stimuli would have been diluted. The data points were anonymized and included for analyses. See Table 4 for a summary of descriptive statistics.

Table 4.

Sample descriptive statistics.

Variable	Result
Mean age (years)	22.31
<u>Race (%)</u>	
Chinese	91.60
Malay	2.60
Indian	5.80
<u>Gender (%)</u>	
Female (%)	69.40
Male (%)	30.60
Baseline intention to vaccinate (mean/s.d.)	2.42 of 5/0.96
Proportion of “never received” seasonal influenza vaccine	69.40
Baseline involvement in issue of seasonal influenza (mean)	11.18 of 21

Reliability, Factor Analyses, and Pre-Survey Comparisons

This section describes the preparatory checks conducted to ensure that the data are suitable for final analyses to test the hypotheses and research question. Factor analyses were conducted for item scales where necessary. Reliability was then assessed using Cronbach’s alphas or Pearson correlations for scales with two items. Finally, one-way independent samples ANOVAs were conducted to check if key variables were not significantly different at baseline or should be included as covariates in final analyses. See Annex E for summary of item values of Cronbach’s alpha/Cronbach’s alpha if item deleted for all scales.

Style of processing scale. The style of processing scale consisted of 22 items and responses ranged from “1, always true” to “4, always false”. The scale was split into its

component visual and verbal subscales of 11 items each. Reliability was analysed using Cronbach's alpha and both subscales attained reasonable reliability scores of $\alpha = .742$ for the verbal scale, with $M = 25.671$ and $SD = 4.475$. For the visual scale, $\alpha = .752$, with $M = 34.045$ and $SD = 4.502$. A one-way independent samples ANOVA was also conducted to test if there were any significant differences in verbal or visual scores across experimental conditions. Both tests were statistically non-significant.

Involvement in issue of seasonal influenza. The involvement scale comprised of three items, and responses ranged from "1, strongly unconcerned" to "7, strongly concerned". Reliability was assessed for both pre- and post-survey data. Good reliability score of $\alpha = .904$, with $M = 11.180$, and $SD = 3.821$. Factor analysis was performed using principal components analysis with varimax rotation. Only one factor was extracted, so the items assessed the same underlying construct of involvement. A one-way independent samples ANOVA for the pre-survey found no significant differences in involvement scores across experimental conditions.

EPPM message components. Perceived severity, perceived susceptibility, perceived response efficacy, and perceived self-efficacy subscales comprised three items each. Responses ranged from "1, strongly disagree" to "5, strongly agree". Reliability was assessed for each subscale at pre and post survey. All subscales attained acceptable reliability scores of $\alpha > .7$. Perceived severity subscale had $\alpha = .912$, with $M = 9.272$, and $SD = 2.590$. Perceived susceptibility had $\alpha = .824$, with $M = 9.540$, and $SD = 2.402$. Perceived response efficacy had $\alpha = .751$, with $M = 11.200$, and $SD = 1.916$. Perceived self-efficacy had $\alpha = .771$, with $M = 10.960$, and $SD = 1.883$. Factor analysis was performed using principal components analysis with varimax rotation for both pre- and post-surveys. All items loaded together in the correct subscales except for one of the self-efficacy items, which loaded more onto response efficacy than self-efficacy. This item was thus dropped from analyses, leaving two items in

the self-efficacy subscale. Pearson correlations were conducted, and the items were confirmed to be strongly correlated for both pre- and post-survey, $r(153) > .800, p < .010$. The item scores for each subscale were summed to make a single score for each subscale. A one-way independent samples ANOVA found no significant differences across conditions for perceived severity, perceived response efficacy, and perceived self-efficacy at pre-survey. However, perceived susceptibility was significantly higher in the Threat Visual – Efficacy Text condition (2) at pre-survey, $F(3) = 3.787, p = .012$. Thus, linear regressions were performed for condition 2 using pre-survey susceptibility as the independent variable on each of the dependent variables. Pre-survey susceptibility significantly predicted post-survey susceptibility $R^2 = .309, F(1,40) = .539, p < .001$; and also for post-survey self-efficacy, $R^2 = .213, F(1,40) = .291, p = .002$. Pre-survey susceptibility will thus be entered into the relevant two-way ANCOVAs as a covariate.

Intention to vaccinate. One item was used to assess intention to be vaccinated against seasonal influenza, responses ranged from “1, strongly disagree” to “5, strongly agree”. A one-way independent samples ANOVA found non-significant differences between experimental conditions at pre-survey.

Descriptive comparisons across conditions. Due to the restrictions imposed to curb the spread of COVID-19, simple randomization at post-survey was used to sort participants into the experimental conditions. To check that the resultant groups were equivalent at baseline, a descriptive comparison was conducted as shown in Table 5.

Table 5.

Summary of descriptive variables across conditions.

Variable	Threat Text Efficacy Visual (One)	Threat Visual Efficacy Text (Two)	Threat Text Efficacy Text (Three)	Threat Visual Efficacy Visual (Four)
Sample size, <i>n</i>	34	39	37	37
Gender, Male, <i>n</i> (%)	6 (17.65)	20 (51.28)	8 (21.62)	11 (29.73)
Mean age, years	22.14	22.10	22.62	22.38
Race, <i>n</i> (%)				
Chinese	31 (91.18)	35 (89.74)	33 (89.19)	36 (97.30)
Malay	1 (2.94)	1 (2.56)	2 (5.41)	0 (0.00)
Indian	2 (5.88)	3 (7.69)	2 (5.41)	1 (2.70)
Never vaccinated, <i>n</i> (%)	25 (73.53)	27 (69.23)	23 (62.16)	27 (72.97)

An unusually high number of males were sorted into Condition Two. Thus, to check if gender biased responses in each condition, linear regressions were conducted for each condition at post-survey with gender as the independent variable for the dependent variables perceived severity, perceived susceptibility, perceived response efficacy, perceived self-efficacy, and intention to vaccinate. None of the regressions were statistically significant, hence gender was deemed to not be a confounding variable.

Influence of COVID-19. As the experiment was conducted during the early phases of the COVID-19 lockdown period in Singapore, there is reason to believe that there could have

been some confounding effects on the data given its similarity in symptomology to influenza. Hence, two items were used to capture this effect at post-survey. The first item assessed how often the participant thought of COVID-19 during the survey, with responses ranging from “1, not at all” to “7, all the time”. The second item assessed how the emergence of COVID-19 had changed how concerned they felt about seasonal influenza, responses ranged from “1, Much less concerned” to “7, Much more concerned”. The frequency of thoughts about COVID-19 during the survey was significantly correlated with perceived severity, $r = .291, p < .01$; perceived susceptibility, $r = .310, p < .01$; perceived response efficacy, $r = .256, p < .01$; and intention to vaccinate, $r = .298, p < .01$. Changes in concern for seasonal influenza due to COVID-19 was significantly correlated with perceived severity, $r = .456, p < .01$; perceived susceptibility, $r = .176, p < .05$; and intention to vaccinate, $r = .346, p < .01$. Hence, these two variables were entered as covariates into the respective ANCOVAs.

Hypotheses and Research Question Testing

Hypothesis One proposed that threat messages presented in the visual modality would evoke higher levels of a) perceived severity, and b) perceived susceptibility. Two-way ANCOVAs were planned for perceived severity and for perceived susceptibility as DVs to examine if a significant main effect of threat modality was present. Hypothesis Two proposed that efficacy messages presented in the textual modality would evoke higher levels of a) perceived response efficacy, and b) perceived self-efficacy. Two-way ANCOVAs were planned for perceived response efficacy and perceived self-efficacy as DVs to examine if a significant main effect of efficacy modality was present. Finally, a two-way ANCOVA was also planned to examine if different combinations of message modalities would result in significantly different strengths of intention to vaccinate. The following section details the process of assumptions testing for the two-way ANCOVA before analyses were conducted. See Table 6 for a summary of planned two-way ANCOVAs.

Table 6.

Summary of planned two-way ANCOVAs.

Analysis	Dependent Variable	Covariates
ANCOVA One	Perceived severity	COVID-19 (thoughts) COVID-19 (concern)
ANCOVA Two	Perceived susceptibility	COVID-19 (thoughts) COVID-19 (concern) Pre-survey perceived susceptibility
ANCOVA Three	Perceived response efficacy	COVID-19 (thoughts)
ANCOVA Four*	Perceived self-efficacy	Pre-survey perceived susceptibility
ANCOVA Five	Intention to vaccinate	COVID-19 (thoughts) COVID-19 (concern)

**Note: Due to failure to meet the assumption of homogeneity of regression slopes, linear regressions were conducted for this DV instead (see page 40).*

Assumptions of ANCOVA

Scatterplots were used to check for linearity of relationship between dependent variables and covariates. Homogeneity of regression slopes was violated only for perceived self-efficacy (ANCOVA Four), as determined by a comparison between the two-way ANCOVA model with and without interaction terms, $F(3, 142) = 3.581, p = .016$. Hence, for perceived self-efficacy (ANCOVA Four), a set of four regressions was conducted instead. Homogeneity of variances was achieved for all analyses. Homoscedasticity was also attained for all the analyses. Outliers were found for several items in the dataset. However, after

inspection of each participants' data, no overtly strange response patterns were detected, and all data was retained as-is.

ANCOVA Analyses

No statistically significant two-way interactions or main effects of threat or efficacy modality were found for perceived severity (ANCOVA One), perceived susceptibility (ANCOVA Two), and perceived response efficacy (ANCOVA Three).

For intention to vaccinate (ANCOVA Five), a significant two-way interaction effect was found $F(1, 142) = 4.171, p = .043$, and there were no significant main effects of threat or efficacy modality. See Figure 6 for a profile plot of the estimated marginal means of intention to vaccinate.

Figure 8.

Estimated marginal means profile plot of ANCOVA Five.

Independent samples t-tests were conducted as post-hoc analyses. However, none of the pairwise comparisons attained statistical significance.

Alternative Regression Analyses for Perceived Self-efficacy

Linear regressions were conducted for each cell of the experiment. First, to test for a main effect of efficacy modality on perceived self-efficacy linear regressions were conducted

for participants who were exposed to the visual threat modality but differed in efficacy modality while controlling for baseline perceived susceptibility. The efficacy modality that participants were exposed to did not significantly predict resultant perceived self-efficacy, $F(2, 73) = .890, p = .415$. Then, linear regressions were conducted for participants who were exposed to the text threat modality but differed in efficacy modality while controlling for baseline perceived susceptibility. Again, the efficacy modality that participants were exposed to did not significantly predict resultant perceived self-efficacy, $F(2, 68) = .341, p = .712$.

Second, to test if there was a main effect of threat modality on perceived self-efficacy, linear regressions were also conducted for participants who were exposed to the visual efficacy modality but different threat modality. Changes in threat modality did not significantly predict resultant perceived self-efficacy, $F(2, 68) = .954, p = .390$. Then, linear regressions were conducted for participants who were exposed to the text efficacy modality but different threat modality. Again, the threat modality that participants were exposed to did not significantly predict resultant perceived self-efficacy, $F(2, 73) = 2.832, p = .065$.

Free Response Data

In the post-survey, participants were asked to describe and explain as fully as possible the five most prominent thoughts and/or feelings that they experienced while viewing the stimuli. This free response data was parsed, and most participants input statements reflecting elements of perceived threat and perceived efficacy such as “Influenza, though common, can be dangerous” and “Lowering the odds of catching the disease”. Participants across conditions also cited other barriers to obtaining a seasonal influenza vaccine that were not addressed in the stimuli such as “hassle to get a vaccine for every seasonal flu” or “cost of vaccination”. Some participants also expressed their concern for COVID-19 here with statements such as “similarities between COVID-19 and seasonal influenza” or “with COVID-19 I now have a greater sense of obligation to prevent the spread of any kind of

virus”. The data was not coded in-depth as its purpose was only to provide an open-ended backdrop to better understand the results of the confirmatory analyses conducted.

CHAPTER SIX: DISCUSSION

This study attempted to examine message-modality effects using a factorial experimental design with modality of threat message and modality of efficacy message as the categorical independent variables. Key dependent variables for the hypotheses were perceived severity and perceived susceptibility, as well as perceived response efficacy and perceived self-efficacy. The hypotheses for this study were not statistically supported. However, directionally, it was found that presenting the threat and efficacy messages in a combination of modalities resulted in higher levels of persuasion than presenting them as either all visuals or all texts.

Hypothesis One proposed that when threat messages are presented in the visual modality, resulting a) perceived severity, and b) perceived susceptibility will be significantly greater than when they are presented in the text modality. However, findings from ANCOVAs One and Two showed no significant main effects. Therefore, the more automatic processing of the visual modality does not significantly increase the impact of the threat message on perceived severity and perceived susceptibility. Hypothesis One was not supported.

Hypothesis Two proposed that when efficacy messages are presented in the text modality, resulting a) perceived response efficacy, and b) self-efficacy will be significantly greater than when they are presented in the visual modality. However, findings from ANCOVA Three showed no significant main effects; and findings from the set of linear regressions for perceived self-efficacy also showed no significant effect of efficacy modality on perceived self-efficacy. Therefore, the more structured processing of the text modality does not significantly increase the impact of the efficacy message on perceived response efficacy and perceived self-efficacy. Hypothesis Two was not supported.

The research question asked whether different combinations of threat and efficacy message modalities could result in significantly different levels of intention to vaccinate. ANCOVA Five was conducted and a significant two-way interaction effect was found, but the post hoc t-tests did not yield any significant differences between groups. Examination of the group means revealed that fear appeal presented with a combination of modalities (i.e., threat text with efficacy visual, or threat visual with efficacy text) appears to be more persuasive compared to if it was presented in a single modality. In essence, any combination of one visual and one text message (Conditions One and Two) resulted in stronger intentions to vaccinate compared to the other mono-modal combinations of all text or all visual messages. Either combination of visual and text message modalities provided both an explicit narrative on which to anchor the whole message, as well as some visual ambiguity. This encourages efforts to understand the intended message of the material and could have resulted in greater meaningful reflection and thus greater influence of stimuli (Kikuno, 1995). The significant effect on intention to vaccinate could be the effect of smaller influences from each message component that interacted within the participant as they reflected on the stimuli, and is in line with what DCT suggests about interrelated processing of visual and verbal stimuli (Clark & Paivio, 1991).

Implications

Theoretical implications. Despite a lack of significant main effects for message-specific differences in modality, the findings surfaced downstream effects of modality combinations that improve intentions to vaccinate. This finding supports existing literature of interrelated processing of multimodal stimuli (Clark & Paivio, 1991), as well as increased message processing or attention by including a degree of ambiguity using visuals (Kikuno, 1995). Hence, presentation of fear appeals using the EPPM message components can be enhanced using a multimodal format. The similarity between symptomology of COVID-19

and seasonal influenza was a strong confounding factor that interfered with processing of the original message. Thus, further testing of message-modality effects needs to be conducted with other contexts to examine if the proposed hypotheses will fail to be confirmed again.

Practical implications. The study findings suggest that fear appeals can be more effective if designed in a multimodal format where the images do not correspond with the texts and vice versa. While this seems overly specific, the present study is unable to support other formats of message-modality combinations which are frequently used (e.g., all visual messages with short captions).

Since combinations of modalities could be more effective than mono-modal ones for fear appeals, health authorities designing persuasive messaging can focus on ensuring that threat and efficacy components complement each other by presenting them in these formats. This way, communications are more likely to be processed by audiences to subtly influence intentions to engage in health behaviours. Comments made by participants in the free response section suggested that other barriers not covered by the material like cost of the vaccine, laziness, perceived high immunity, and severity of its side effects also contributed to barriers against intention to vaccinate. Hence, these fear appeals could also take the form of a series of short communications that shift intentions over multiple exposures which address a wider set of barriers to health behaviours. Deeper investigations into what other barriers to vaccination exist, as well as the main drivers for those who are already vaccinating against seasonal influenza are still needed. This will allow universities or health authorities to craft more effective messaging that takes advantage of university students' easy access to the vaccine while dampening the spread of seasonal influenza through densely populated campuses and back into homes with others vulnerable to severe illness.

Limitations and Future Directions

The current study was unfortunately limited in its execution due to safety restrictions imposed around the data collection period to curb the spread of COVID-19. The planned in-person experimental setting had to be converted into an online survey completed at participants' convenience in their homes. Although explicit instructions were given to set aside an undisturbed period of time and complete the survey within that, non-compliance was expected. This likely diminished the effect of the exposure to stimuli as the experimenter had no control over the environment in which the survey took place. Some participants were likely to have switched windows mid-way through doing the post-survey as seen by some unusually long completion times (e.g., >30mins, > 60mins). Despite removing all participants who exceeded 30 minutes in duration from analyses, it is likely that stimuli effects were still diluted by ambient distractions like (e.g., alarms, messages, COVID-19 news, family). This could be one reason why no statistically significant main effects were found. Future attempts to study message-modality effects need to ensure a sterile environment to minimize the effects of these external stimuli.

The present study had a single-exposure design that could also have contributed to the generally unfavourable response to intention to vaccinate as participants were only exposed to the stimuli once, so extended contemplation was not possible. Other barriers to vaccination that were not addressed by the stimuli were also cited in the free response section. Hence, this could have limited the extent of improvements in intention to vaccinate. A multiple exposure design could be used where participants are exposed to the same sets of messages but in different combinations of modality to cover other important barriers more holistically.

Further research questions can also be asked to clarify the effect of modality combination on intention. For example, will it be better to have both the visual and textual counterparts of a threat/efficacy message in every communication (i.e., threat visual with text,

and efficacy visual with text)? Or how will the weighting of the arguments matter? For consistency, this study only utilised one argument point per message construct to create a basic fear appeal for a single exposure. However, future studies can consider creating sets of message arguments that are weighted against each other in strength (i.e., given the presented threat message, is the efficacy message convincing enough?) to achieve higher levels of perceived threat and perceived efficacy in the stimuli development stage. Future studies may also wish to incorporate comparisons of varying levels of both threat and efficacy messages (i.e., high threat – low efficacy, low threat – low efficacy, etc.). A study design incorporating multiple exposures and/or using different combinations of threat and efficacy message content is also possible to be more certain that modality effects can be generalized across specific message content.

With the rise of personal screens and leaps in technology, video has become a mainstay for message communication. Hence, investigations into other elements of media comparisons in future research are also important to examine if the effects of threat and efficacy components of EPPM are affected by these features. For example, elements like colour palette and text, or music and motion, can combine to facilitate or inhibit processing of threat and/or efficacy messages. There may also be combinations that completely distract from the intended messages and would be important to note so as not to undermine message processing by audiences.

Conclusion

To close, this study has provided an early tentative examination of how message-modality effects can play a role in affecting communication of the specific message constructs within the EPPM. Much remains to be explored in this area and different message canvases also need to be used to more thoroughly examine the role of modality in message communication effects. Growing knowledge in this area will enable communicators using the

EPPM to capitalize on the effects of modality to improve message impact and hopefully induce positive health behaviours.

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ANNEX A

Selection criteria for source statements of fear appeal.

Characteristic	Selection Criteria
Persuasiveness	Score for how convincing the statement is is the first priority. Ideal IQR will be 5 to 7, or else the statements with the closest scores will qualify. Statements with IQR below 4 will be excluded as 4 = neutral.
EPPM construct	Ideal IQR for severity/susceptibility or response/self-efficacy 5 to 7, or else statements with the closest scores will qualify. Statements with IQR below 4 will be excluded.
Fear	It is highly unlikely to generate no fear at all from reading these statements. Ideally fear IQR should be between 3 to 5. Statements with IQR above 6 will be excluded to avoid extreme levels of fear.

ANNEX B

Results of source statement selection.

Statement	Interquartile Ranges		
	Message construct	Persuasiveness	Fear
	Severity		
Falling ill with seasonal influenza could cause you to have high fever, chills, headaches, tiredness, cough, sore throat, body aches, and nasal inflammation for one to two weeks.	4 to 6	4 to 6	3 to 5
Seasonal influenza can lead to a wide range of complications e.g., pneumonia, multiple organ failure, possible death.	5 to 6	4 to 6	5 to 6
Seasonal influenza can cause you to miss out on lessons, assignments, and even examinations.	2 to 5	2 to 5	2.5 to 5
Being ill with seasonal influenza can cause you to perform worse during lessons, for assignments, and examinations.	3 to 5	2 to 5.5	2.5 to 5
Your friends, elderly family members, and young children at home are vulnerable to contracting severe seasonal influenza infections from you	5 to 6	4.5 to 6	4 to 6

even though you show mild or no symptoms.

	<i>Susceptibility</i>		
You are much more likely to fall ill with seasonal influenza in Singapore than overseas because we get influenza infections from the flu seasons of both the Northern and Southern hemispheres every June and December.	3 to 6	2 to 5	3 to 5
If you are stressed over studies, lack time to eat, sleep, or exercise properly; your immune system could be weaker, which increases your chances of becoming sick with seasonal influenza.	3 to 5.5	2 to 5	2.5 to 5
Your friends, elderly family members, and young children at home are more vulnerable to contracting seasonal influenza from you because you come in close proximity and share spaces with them.	5 to 6	4.5 to 5.5	4.5 to 5

	<i>Response Efficacy</i>		
The seasonal influenza vaccine is perfectly safe and is likely to only cause discomfort at the site of injection or a mild	3 to 5	2 to 5	-

fever for a couple of days that has very little impact on your life.			
As the seasonal influenza vaccine is concocted based on scientific data about circulating strains of influenza virus, it is guaranteed to enhance your immunity against the most common strains of influenza that year.	4 to 6	3 to 6	-
When people are vaccinated against seasonal influenza, it reduces the infection rate because vaccinated people will be less likely to catch the virus and pass it on. This protects more people and contributes to herd immunity.	4.5 to 6	4 to 6	-
Getting vaccinated primes your immune system such that even if you do fall ill with the seasonal influenza, it will be less severe than if you were not vaccinated.	3.5 to 5.5	3.5 to 5	-
Staying flu-free (or having milder symptoms) means you have more time at peak performance for your academics	2 to 5	2 to 5	-
Staying flu-free (or having milder symptoms) means you can be present for all your classes and assessments.	2 to 5.5	2 to 5	-

Self-efficacy

The seasonal influenza vaccine is conveniently available as a walk-in service at our campus clinic.	4 to 6	4 to 6	-
It is easy to make time to receive the vaccine on campus as it typically takes only 30 minutes.	3 to 6	3 to 6	-
The seasonal influenza vaccine is inexpensive, and only costs between \$20 and \$40	3 to 5.5	3 to 5	-

Notes: Bolded statements are those that passed the selection criteria. IQR highlighted in red did not pass the minimum selection criteria.

ANNEX C

Summary of judging criteria and results for responses to interpretation of visual stimuli.

Visual Message	Judging Criteria	Result
Severity 1	Participants understand that seasonal influenza can become a serious illness, pass.	20 / 23 Passes
Severity 2	Participants understand that they a) can spread influenza while asymptomatic and b) can result in severe illness in others, pass	7 / 23 Passes
Susceptibility	Participants understand that they can carry the seasonal influenza virus and spread it in the environment/ to the people they meet, or vice versa, pass	16 / 23 Passes
Response Efficacy	Participants understand that the seasonal flu vaccine helps to a) protect those who are vaccinated, and b) who in turn protect those who are unvaccinated, pass	19 / 23 Passes
Self-efficacy	Participants understand that getting the vaccine on campus is a) walk-in and b) convenient or opportunistic, pass	12 / 23 Passes

ANNEX D

Final stimuli used in the experiment.

Experiment Stimuli
<p>Severity Text:</p> <p>Seasonal influenza can lead to a wide range of complications. For example: pneumonia, multiple organ failure, and possible death.</p>
<p>Severity Visual:</p>
<p>Susceptibility Text:</p> <p>You, and vulnerable friends, elderly family members, and young children can easily contract seasonal influenza because you share spaces with each other.</p>
<p>Susceptibility Visual:</p>

Response efficacy Text:

When you are vaccinated against seasonal influenza, it reduces yours and everyone's chance of getting infected as vaccinated people will be less likely to catch the virus and pass it on. This protects people and contributes to herd immunity.

Response efficacy Visual:

Self-efficacy Text:

The seasonal influenza vaccine is conveniently available as a walk-in service at our campus clinic so that you can easily take advantage of free time to get it.

Self-efficacy Visual:

ANNEX E

Summary of items and relevant Cronbach's alpha values.

Scale/Item	Response options	Cronbach's alpha / Cronbach's alpha when item removed
Pre-survey		
What is your age?	Numerical	-
What is your sex?	Male / Female	-
What is your race?	Chinese / Malay / Indian / Others	-
<u>Style of Processing Scale (Verbal)</u> <i>Items with * are reverse coded</i>	Always true (1) – Always false (4)	.742
1. I enjoy doing work that requires the use of words		.718
*3. I can never seem to find the right word when I need it		.736
4. I do a lot of reading		.691
*6. I think I often use words in the wrong way		.741
7. I enjoy learning new words		.713
9. I often make written notes to myself		.747
15. I like to think of synonyms for words.		.732
17. I like learning new words		.706
18. I prefer to read instructions about how to do something rather than have someone show me		.759
19. I prefer activities that don't require a lot of reading		.712
21. I spend very little time attempting to increase my vocabulary		.694
<u>Style of Processing Scale (Visual)</u> <i>Items with * are reverse coded</i>	Always true (1) – Always false (4)	.752

*2. There are some special times in my life that I like to relive by mentally “picturing” just how everything looked	.746
*5. When I am trying to learn something new, I would rather watch a demonstration than read how to do it	.725
*8. I like to picture how I could fix up my apartment or room if I could buy anything I wanted	.746
*10. I like to daydream	.721
*11. I generally prefer to use a diagram rather than a written set of instructions	.716
*12. I like to “doodle”	.734
*13. I find it helps to think in terms of mental pictures when doing many things	.713
*14. After I meet someone for the first time, I can usually remember what they look like but not much about them	.752
*16. When I have forgotten something, I frequently try to form a mental “picture” to remember it	.736
*20. I seldom daydream	.739
*22. My thinking often consists of mental “pictures” or “images”	.735

Pre- and Post- Survey

I plan on getting vaccinated against seasonal influenza this year.	Strongly disagree (1) – Strongly agree (5)	-
<u>Perceived Severity</u>	Strongly disagree (1) – Strongly agree (5)	.912
<i>Cronbach’s alpha scores displayed here are for pre-survey with no manipulation</i>		
I believe that seasonal influenza is severe.		.866
I believe that seasonal influenza is serious.		.847
I believe that seasonal influenza is significant.		.907

<u>Perceived Susceptibility</u>	Strongly disagree (1) – Strongly agree (5)	.824
<i>Cronbach's alpha scores displayed here are for pre-survey with no manipulation</i>		
I am at risk of getting seasonal influenza.		.712
It is likely that I will contract seasonal influenza.		.727
It is possible that I will contract seasonal influenza.		.820
<u>Perceived Response Efficacy</u>	Strongly disagree (1) – Strongly agree (5)	.751
<i>Cronbach's alpha scores displayed here are for pre-survey with no manipulation</i>		
The seasonal influenza vaccine works in preventing severe illness from seasonal influenza.		.690
The seasonal influenza vaccine is effective in preventing seasonal influenza.		.653
If I receive the seasonal influenza vaccine, I am less likely to contract it.		.660
<u>Perceived Self-efficacy</u>	Strongly disagree (1) – Strongly agree (5)	.771
<i>Cronbach's alpha scores displayed here are for pre-survey with no manipulation</i>		
I am able to take the seasonal influenza vaccine in order to help prevent becoming ill with seasonal influenza.		.888
Obtaining the seasonal influenza vaccine is easy.		.496
Obtaining the seasonal influenza vaccine is convenient.		.585
<u>Involvement</u>		.904
<i>Cronbach's alpha scores displayed here are for pre-survey with no manipulation</i>		
How important is the issue of seasonal influenza to you personally?	Not at all important (1) – Extremely important (7)	.962
How deeply do you care about the issue of seasonal influenza	Strongly do not care (1) – Strongly care (7)	.808

How concerned are you about the issue of seasonal influenza?	Strongly unconcerned (1) – Strongly concerned (7)	.805
<u>Barriers to Vaccination</u>	Strongly disagree (1) – Strongly agree (5)	-
<i>Not a scale, items assessed individually</i>		
The seasonal influenza vaccine is affordable for me.		-
The seasonal influenza vaccine is easily accessible to me.		-
I can make time to receive the seasonal influenza vaccine.		-
A fear of needles is one of the main reasons why I would decide not to receive the seasonal influenza vaccination.		-
<hr/>		
Post-survey only		
<u>Free response section</u>		
Please describe and explain as fully as you can, at least the 5 most important thoughts and/or feelings that you had while examining the material just shown to you.	-	-
<u>COVID-19 Questions</u>		
<i>Not a scale, items assessed individually</i>		
As you were doing this survey, how much did it cause you to think of COVID-19?	Not at all (1) – All the time (7)	-
How has the COVID-19 situation changed your level of concern for seasonal influenza?	Much less concerned (1) – Much more concerned (7)	-