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REDEFINING RISK IN PROSPECT THEORY:

HOW GOAL FRAMING AND EFFICACY DIFFERENCE INTERACT

TO PROMOTE ELDERLY SINGAPOREANS' INFLUENZA VACCINATION

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Master of Communication Studies

2019

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.

25 Feb 2019
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Name

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25/02/2019

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Date Name

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SUMMARY

Suboptimal influenza vaccination may increase pandemic risks and add burdens to public healthcare systems. Applications of goal framing to the vaccine advocacy have captured mixed findings and brought challenges to its rationale – prospect theory. Given debates on the concept explications of risk in the framing literature, the notion of vaccine risk has been further refined from a novel perspective. This research examined how goal framing and efficacy salience interacted to yield optimal persuasiveness in influenza vaccine messages. A 2 (goal framing) × 3 (salience of efficacy difference) between-factorial experiment was conducted in Singapore. Results showed that weak persuasiveness of goal framing could be optimized when introducing the efficacy difference. Theoretically, this research improves the applicability of prospect theory in the health persuasion by redefining vaccine risks as the salience of efficacy difference between action and inaction. Practically, for Singapore government and public healthcare industry, present findings shed light on the alternative message designs to promote influenza vaccine engagement in the elderly population.

Keywords: goal framing, prospect theory, risk, salience, influenza vaccination

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CHAPTER ONE: INTRODUCTION

The way people consider and maintain their health has changed in modern times. In the past, individuals have usually valued personal health only when illness arrives. Nowadays, people tend to plan ahead to avoid diseases by caring for themselves in their daily routine. Though staying healthy has become more popular, some medical preventative practices still receive little attention, such as influenza vaccination (Bish, Yardley, Nicoll, & Michie, 2011).

Seasonal influenza, also called the flu, is an acute respiratory infection caused by viruses. It spreads through the air with pandemic potential and can affect people of any age (Thompson et al., 2004). Between 2007 and 2017, about 290,000 to 650,000 people died of flu each year. These fatalities constitute about one-fifth of deaths from lower respiratory infections, the third highest cause of global death (World Health Organization, 2017). As its virus spreads easily through infected saliva and droplets in humid and warm environments, tropical regions such as Singapore have a greater chance to spur the transmission (Ang, Cutter, James, & Goh, 2017). To curb the epidemic risks from seasonal flu, vaccines have been developed as a first-line precaution and saved millions of lives in the last decade (Hannoun, 2013). However, in recent years, as more vaccines become available and adverse events are publicized, safety concerns and misbeliefs around flu vaccines' side effects and efficacy also increased, causing public distrust and hesitancy (Palache, 2011; Wolfe & Sharp, 2002). Immunization coverage against the flu is suboptimal, with less than fifty percent of targeted recipients receiving vaccinations worldwide (Bish et al., 2011) and only about 15 percent of coverage in the elderly in Singapore (Ang et al., 2017).

Given the public's hesitancy about the flu vaccine, communication scholars have tried multiple approaches to promoting vaccination. Framing is one such

approach. Goal framing (Kahneman & Tversky, 1979) refers to ways of communicating logically equivalent information with either action gains or inaction losses to yield attitude and behavioral change. For example, a gain-framed message advocating sunscreen use may depict the benefits provided by sunscreen, such as lower skin cancer rates, fewer brown spots, and slower signs of aging. Conversely, a loss-framed message advocating sunscreen use may depict the consequences of failure to use sunscreen, such as higher skin cancer rates, more brown skin spots, and faster signs of aging.

Goal framing has been extensively studied in the context of vaccines, but findings are mixed. Some scholars have found gain-framed messages more effective (e.g., Frew, Zhang, Saint-Victor, Schade, Benedict, & Banan, 2013), while others have found a loss-frame advantage (e.g., Van't Riet et al., 2014), and still others found no main effects (e.g., Wen & Shen, 2016). As the scholarly discussion over the persuasiveness of mixed framing widens, its theoretical underpinning – prospect theory – is being challenged. The central debate rests on inconsistent conceptualizations of risk in the goal framing postulate.

Prospect theory initially defined risk as an option's probability of leading to certain outcomes. When an option is more likely to produce the outcome, it is described as certain or not risky; when less likely to cause the outcome, an option is defined as uncertain or risky (Tversky & Kahneman, 1981). However, in vaccine studies, risk is defined differently. For instance, some scholars measured vaccine risks as the downsides of taking vaccines, including procedural pains (Ferguson & Gallagher, 2007) and response costs (Russell, 2009). Conversely, others measured the positive outcomes of vaccines to determine how non-risky a vaccine can be perceived as being – that is, the response efficacy (Abhyankar, O'Connor, & Lawton, 2008; Nan,

Xie, & Madden, 2012). These vaccine risks, it is worth noting, center on favorable outcomes that a behavior produces, which deviates from prospect theory's earliest tenet – that risk is the probability or uncertainty linking options and outcomes (Van't Riet et al., 2016).

Some scholars critically claim that the absence of a shared definition may cause incomparable findings, for which prospect theory cannot be blamed (O'Keefe & Jensen, 2007; Van't Riet et al., 2016). For instance, according to the theory's notion of risk, taking an HPV vaccine is not risky because it has a very high chance of producing the desired outcome – namely, preventing the human papilloma virus. However, if risk is defined as potential drawbacks of a behavior, such as taking an HPV vaccine, a person who fears injections may perceive this behavior as having very adverse outcomes (e.g., pains). Thus, it is hard to determine the prediction power of prospect theory by using data with different measures of risk. Thus, the non-significant framing effects found herein may not truly challenge prospect theory.

A few vaccine studies define the perceived risk of vaccines as an individual's uncertainty that taking a vaccine can prevent the targeted disease, also known as response efficacy (e.g., Bartels, Kelly, & Rothman, 2010; Van't Riet et al., 2014). Similar to the concept of probability in prospect theory, this definition captures assumed framing effects but with statistical non-significance (e.g., Bartels et al., 2010).

Besides the inconsistency of risk definitions, some scholars pose a translation problem in prospect theory in the health persuasion (O'Keefe & Jensen, 2007; Van't Riet et al., 2016). Levin et al. (1998) posit that the single-option adherence setting in health promotion has deviated from the original alternative-option design in prospect theory. O'Keefe and Jensen (2006; 2007) suggest offering recipients the relative

certainty of outcomes between action and inaction. Though views on this translation problem highlighted the relativeness of outcome certainty in alternative options, they did not justify its role in a particular health behavior. They noted the absence of reference outcomes in gain and loss frames but offered no operational solutions to account for this absence.

Such loss in the goal-framing literature can be crucial, especially for influenza vaccination. As it is often mixed with a cold, the severity of the flu has been largely underrated as compared with other infectious diseases such as HPV (Green, 2000). In other words, a person may form the view that there is no risk or difference in uncertainty between getting and not getting flu shots. In that case, even if individuals are informed of flu vaccines' very high efficacy rate, they may still ignore that information. In this event, people may perceive no risk regarding flu vaccines, and goal framing effects would consequently vanish.

People's indifference toward the flu vaccine's efficacy may explain the non-significant framing effects previously observed (e.g., McCaul, Johnson, & Rothman, 2002; Natter & Berry, 2005; Yu & Shen, 2013). Moreover, it indicates the potential of research to optimize goal framing effects in this behavior. Which frame works better does not depend on the perceived risk associated with the promoted action; rather, it may depend on the perceived risk of the promoted action relative to that of inaction.

Thus, this study examined how goal framing works when people are primed with various levels (salient/moderate) of efficacy differences between taking and not taking flu vaccines.

CHAPTER TWO: LITERATURE REVIEW

This research aims to understand the joint effects of goal framing and efficacy difference in influenza vaccine persuasion. To achieve these aims, I reviewed three groups of literature. First, I introduced the seasonal flu, its vaccination challenges, and the public health culture in Singapore. Second, I focused on vaccine persuasion strategy – goal framing. In this group, I introduced the theoretical rationale for prospect theory, reviewed relevant applications, and specified the problem of inconsistency in the persuasiveness of the framing. To ascertain the mechanism behind this problem, I reviewed the third group of literature. In this group, I reviewed previous definitions of risk in goal framing, suggested an alternative view on this construct, and concluded with research hypotheses.

Challenges of Preventing Seasonal Flu in Singapore

Seasonal influenza is an acute respiratory infection that can cause severe complications and mortality (Thompson et al., 2004). As its virus spreads easily through infected saliva and droplets in humid and warm environments, tropical regions such as Singapore have a greater chance to spur the transmission (Ang, Cutter, James, & Goh, 2017). Every year, influenza occurs irregularly and brings about 1,500 hospitalizations and 600 deaths to Singapore (Ministry of Health, 2015b). Symptoms can be mild (e.g., cough and fever) to severe (e.g., pneumonia and heart attack) across population groups. Specifically, individuals aged 65 years and above are at higher risk of developing complications and account for about 90% of flu-relevant deaths every year (Thompson et al., 2003; World Health Organization, 2017). Studies conducted in Singapore also suggest the elderly over 65 years have a much higher death rate of influenza (i.e., 11.3 times) compared to the general population (Chow, Ma, Ling, & Chew, 2006).

To avert the risk of flu epidemics among the elderly, annual flu vaccines have been developed as the key strategy and recommended by the Ministry of Health in Singapore (Ministry of Health, 2015b; World Health Organization, 2017). In particular, the Singapore government have offered extensive vaccine accesses covering hospitals, polyclinics, and GP clinics to make the flu jab more convenient (Ministry of Health, 2015a). MediSave, the national medical saving scheme also allows residents at higher risk to pay for influenza vaccines at a lower price (Ministry of Health, 2015a).

However, the acceptance of flu vaccines among the elderly is low in Singapore. According to the Health Behavior Surveillance of Singapore (2012), only 8.7% of adults aged between 50 and 69 years have taken flu vaccines. Also, the 2013 National Health Surveillance Survey in Singapore (Ang et al., 2017) found 15.2% of participants over 50 years with flu shots experiences within a year. These uptake rates are much lower than the World Health Organization's recommendations for older adults that attain 50% coverage by 2006 and 70% by 2010 (World Health Organization, 2003).

Studies on influenza vaccination are considerable and mainly focus on the impacts of attitudes, knowledge, and beliefs on the vaccine uptake across populations. For example, Nichol, Lofgren, and Gapinski (1992) examined risk attitudes and knowledge of flu vaccines among outpatients and compared influences of these factors on the vaccine performance. Ru-Chien and Neuzil (2004) conducted a mail survey and found physicians' advice exerted a strong impact on elderly patients' flu vaccine engagement. Existing research in Singapore is primarily conducted with a cross-sectional survey in healthcare workers (e.g., Hwang & Lim, 2014; Yang, Fong, Koh, & Lim, 2010). And only a few studies tested patients and high-risk populations such as diabetics (e.g., Tan, Lim, Teoh, Ong, & Bock, 2010) and HIV-infected patients (e.g.,

Lim, Tan, Yusoff, Win, & Chow, 2013). However, studies on the vulnerable group – the elderly adults are scarce in tropical Singapore and thus require further investigations.

Goal Framing and Vaccine Persuasion

Theories of behavioral change have examined the factors that account for the low acceptance of influenza vaccines in order to promote engagement. One such strategy is framing, which refers to the method of conveying information in such a way as to yield attitude and behavioral change (Levin, Schneider, & Gaeth, 1998). Specifically, goal framing aims to produce favorable responses to a behavior by depicting either the benefits of an action or the drawbacks of inaction. Its theoretical mechanism originates from prospect theory.

The Rationale: Prospect Theory

Prospect theory (Kahneman & Tversky, 1979) identifies how people make choices in uncertainty. It states that a person's preference for risk is influenced by the manner in which an option is framed. For example, when choosing between gain-framed options, individuals tend to avoid risks and prefer the option with the surest gains. When facing loss-framed options, however, individuals become risk-acceptant and prefer the option with uncertain loss. Tversky and Kahneman (1981; 1992) explained this preference shift with a two-stage choice model. First, people define and edit an option's value as gains or losses based on its positive or negative deviations from a psychological reference point. Second, they evaluate each option by multiplying its value and weighting functions together.

For the value function in prospect theory, its asymmetric S-curve explains why people avoid risks in gains and seek risks in losses (see Figure 1, Kahneman & Tversky, 1979). Specifically, the S-shape indicates that values are concave for gains

and convex for losses. For example, people value a pay raise from $500 to $1000 more than one from $5000 to $5500. The non-symmetry indicates that the value drops much faster with losses than it rises with gains. For instance, people with the same wealth are more resistant to losing $500 than to gaining $500.

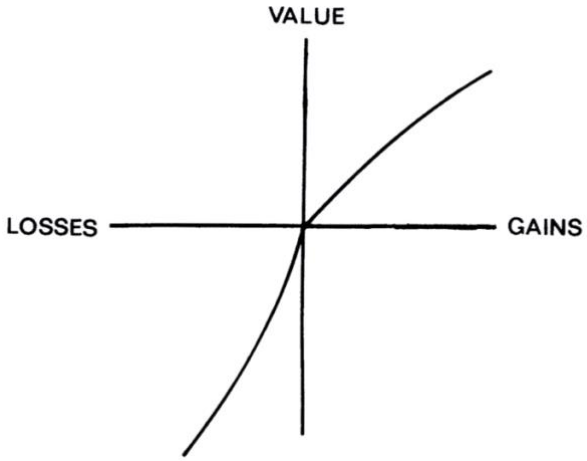

Figure 1. A hypothetical value function in prospect theory.

For the weighting function, the decision weight is not a probability but a rising function of probabilities. Its nonlinear convex curve presents several properties regarding risky choice preferences – overweighting, subadditivity, subcertainty, and subproportionality (see Figure 2, Kahneman & Tversky, 1979). According to subadditivity, individuals assign more decision weight to a choice with low probability but assign fewer decision weights to a choice with moderate and high probability. That is why people prefer certainty in gains and moderate uncertainty in losses.

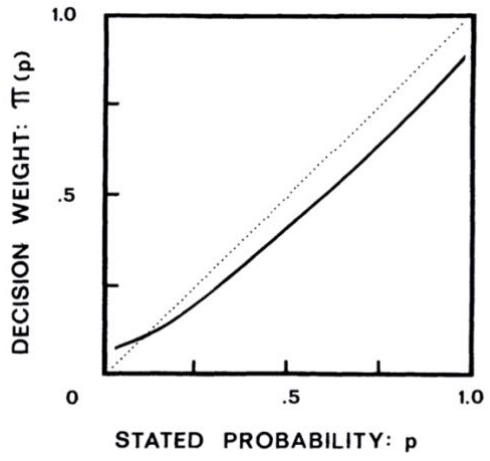

Figure 2. A hypothetical weighting function in prospect theory.

Although Kahneman and Tversky (1979) justified the interplay between the outcome value function and the decision weighting function based on the theory of expected utility (Keeney & Raiffa, 1976), the theory's mathematical nature has been implicitly simplified to explain health choices that are not quantifiable. Prior empirical research has primarily tested whether people preferred certainty in gains and moderate uncertainty in losses over testing the mathematical reasoning.

The Applications: From Monetary Choices to Health Persuasion

Prospect theory has generated extensive research ranging from economic decisions to health actions. Initially, this theory served as a manipulation guide that nudges humans into proposed monetary choices. For example, Levin et al. (1985) found that a person was more likely to play gamble when they were framed with the chance of losing. Puto (1987) examined gain and loss messages in a sales letter and found a preference shift among industrial buyers.

As evidence accumulated in the economic field, health psychology scholars began to inquire if similar results could be captured in the hypothetical medical context. Eraker and Sox (1981) conducted the first study to capture patients' drug preferences upon gain and loss frames. In the scenario stressing the benefits of drugs, more patients chose to receive the drug with a certain outcome; however, in the scenario stressing the drug's side effects, patients chose the drug with an uncertain outcome. However, these designs may not apply to the non-imaginary scenarios that healthy people encounter in the real world. It suggests alternative designs to persuade the healthy public into real protective behaviors.

Meyerowitz and Chaiken (1987) took the first step in expanding prospect theory's scope to actual health behaviors. In their experiment promoting breast self-

examination, 79 college women were exposed to brochures that were framed with either action gains or inaction losses. As a result, recipients gave more favorable responses to loss-framed brochures. This is consistent with prospect theory because checking for potential breast illness seems riskier than not checking. Inspired by their work, extensive replications have been done in alternative health settings, such as breast screening (e.g., Siminoff & Fetting, 1989), testicle check-up (e.g., Steffen, Sternberg, Teegarden, & Shepherd, 1994), exercise (e.g., Kroll, 2004), and vaccination (e.g., O'Connor, Pennie, & Dales, 1996).

Mixed Findings in Promoting Vaccine Uses

Applications of goal framing to the vaccination focus on how various outcome frames affect uptake adherence. Extant literature, however, has revealed inconsistent results. Since 1996, there have been forty-seven vaccine persuasion studies on various infectious diseases. Only five (11%) found the gain frame more persuasive (e.g., influenza, Frew et al., 2013); nine (19%) found a loss-frame advantage (e.g., West Nile virus, Van't Riet et al., 2014); and thirty-three (70%) found no framing effects (e.g., HPV, Wen & Shen, 2016). A meta-analytic review of thirty-two empirical studies (O'Keefe & Nan, 2012) also cast doubt on framing persuasiveness in promoting vaccine engagement because effect sizes did not differ significantly. Different reasons have been proposed in the last decade. In the next section, I evaluated conflicting views and proposed an alternative view of risk.

The Notion of Risk in Goal Framing

There are conflicting explanations for the inconsistency of vaccine framing effects. Some have attributed this failure to the potential moderation of individual factors. By stepping out of the tenets of prospect theory, they examined alternative psychological mechanisms, such as regulatory focus theory (Higgins, 1997) and the

elaboration likelihood model (Petty & Cacioppo, 1986) for moderators such as regulatory goals (e.g., Gerend & Shepherd, 2007) and issue involvement (e.g., Jung & Villegas, 2011). To be noted, this research would focus on the risk logic within prospect theory. Thus, factors from other theories were not addressed as the main effects in this study.

Previous Definitions of Risk

Concerning prospect theory, the persuasiveness of framed appeals depends on the risk of advised behaviors. Thus, different conceptualizations of risk may account for the mixed findings of vaccine framing studies (see Table 1).

Risk as a behavioral attribute. Rothman and Salovey (1997) originally defined risk as *the negative potential that a behavior produce*s. In their risk-framing hypothesis, risk is an attribute inherent in and differing across behaviors. If a behavior protects against future illness, it is risk-averse; if it indicates pre-existent illness and involves danger, a behavior is risk-seeking (Rothman, Kelly, Hertel, Salovey, 2003). Following this logic, messages using action gains should be adopted to persuade vaccination because this behavior reduces infection risks.

As opposing findings have been observed (e.g., McCaul et al., 2002), Orbell, Perugini and Rakow (2004) posited an alternative view that vaccination is risk-seeking rather than risk-averse because it entails safety concerns. Despite making general advances to health (Frew et al., 2013), the efficacy and safety of vaccines have been greatly misinterpreted by the public (e.g., exaggerated side effects, Sawaya & Smith-McCune, 2007). Thus, people may be more motivated to take a vaccine when they read loss-framed messages, as observed by some studies (e.g., Abhyankar et al., 2008; Van't Riet et al., 2014). Treating vaccines as risk-seeking tentatively supported Rothman and Salovey (1997)'s definition that risk is a behavioral attribute. However,

it cannot explain the inconclusive findings with non-significant persuasiveness difference between gain and loss frames (see review in Gallagher & Updegraff, 2012; O'Keefe & Jensen, 2007; Penţa & Băban, 2018).

Risk as an individual perception. Regarding the public's concerns about the security of vaccines, evaluations of their risks vary across people. In line with this phenomenon, some scholars argue that behavioral risks depend on how risky people perceive the behavior to be rather than which risk category it belongs to (Rothman, Bartels, Wlaschin, & Salovey, 2006; Latimer, Salovey, & Rothman, 2007). In other words, risk is a subjective perception that differs across individuals. Based on this conceptual view, researchers further operationalized vaccine risks into three dimensions.

Defining perceived risk as severity. Ferguson and Gallagher (2007) defined vaccine risks as perceived severity, which refers to the perceived negative outcome of a vaccine. These negative outcomes, in particular, were measured by asking participants how much they agreed with statements on the vaccine's downsides, such as costs (Nan, Madden, Richards, Holt, Wang, & Tracy, 2016), response costs (Gainforth & Latimer, 2011; Russell, 2009), procedural pains (Ferguson & Gallagher, 2007), and long- or short-term side effects (Van' Riet et al., 2014).

Defining perceived risk as efficacy. Abhyankar et al. (2008) defined vaccine risks as perceived efficacy, which refers to the perceived positive outcome of a vaccine. They measured perceived efficacy by asking the extent to which participants agreed that a vaccine can bring benefits (Abhyankar et al., 2008; Nan et al., 2012).

These explications, however, received critiques for deviating from the initial theoretical accounts of prospect theory. Specifically, this theory's original concept of risk refers to the probability of an option leading to outcomes rather than the

unfavorability of an option's outcome (Kahneman & Tversky, 1979). When an option is more likely to produce the outcome, the option is not risky; when an option is less likely to produce the outcome, it is risky. Cox, Cox, and Zimet (2006) also placed doubt on equating risk (i.e., variance of desirable and undesirable outcomes) with downside risks (i.e., increased likelihood of undesirable outcomes). O'Keefe and Jensen (2007) criticized the ambiguity of existing risk definitions and suggested that future studies distinguish unpleasant behavioral outcomes (i.e., unfavorability) from uncertain behavioral outcomes (i.e., probability).

Table 1

Prior Risk Definitions in Goal Framing for Vaccine Promotion

Dimensions	Source	Definitions
Behavior-based attribute	Rothman & Salovey, 1997	If a behavior protects against future illness, it is risk-averse; and if the behavior informs pre-existent illness and involves danger, it is risk-seeking.
Individual-based perception	Rothman et al., 2006	Risk is a subjective perception that differs across individuals.
• Perceived severity	Ferguson & Gallagher, 2007; Nan et al., 2016; Gainforth & Latimer, 2011; Russell, 2009	It refers to the perceived negative outcome a vaccine produces.
• Perceived efficacy or favorability	Abhyankar et al., 2008; Nan et al, 2012.	It refers to the perceived positive outcome a vaccine produces.

• Perceived probability (prospect theory)	Kahneman & Tversky, 1979	It refers to the probability or uncertainty an option leads to outcome occurrences.
• Perceived efficacy rate	Bartels et al., 2010; Van't Riet et al., 2014	It refers to the probability associated with vaccine upsides – avoiding infectious diseases.

In my opinion, these conceptual deviations may result in incomparable vaccine framing findings for which prospect theory is not responsible. For instance, taking an HPV vaccine can be perceived as both risky (e.g., procedural pains) and not risky (i.e., high probability of preventing illness). Specifically, this behavior is not risky in prospect theory because it has a high chance of leading to proposed outcomes – preventing human papillomavirus. Yet, according to the concept of risk in the persuasion literature, taking an HPV vaccine can be very risky because individuals who fear injection may perceive this behavior as having adverse outcomes (e.g., pains). Thus, it is difficult to determine the predictive power of prospect theory with data that uses a different concept of risk. Accordingly, non-significant results found in these studies may not truly challenge prospect theory.

Defining perceived risk as efficacy rate. Recent studies offered an alternative operational view that was close to the core concepts of prospect theory. That is, perceived vaccine risk refers to *the probability of the vaccine's benefits, such as avoiding infectious diseases*. Bartels et al. (2010) manipulated the efficacy of West Nile virus vaccines by priming participants with numerical data. They found that when primed to think that the vaccine was 90% effective, gain frames worked better; but when primed to think that the vaccine was only 60% effective, loss frames worked

better. Replicating this design on a hypothetical new flu vaccine, Van't Riet et al. (2014) found similar results. Though findings revealed the assumed pattern, the data was not statistically significant (e.g., study 1, Bartels et al., 2010; study 5, Van't Riet et al., 2014).

The Translation Problem in Health Persuasion

Some scholars recently proposed a translation problem in prospect theory within the context of health persuasion (O'Keefe & Jensen, 2007; Van't Riet et al., 2016). Specifically, Levin et al. (1998) posited that the one-choice adherence setting in health promotion had deviated from the original multiple-choice design of prospect theory. This deviation created added difficulty for recipients to understand the perceived risk of health behaviors, thus influencing the performance of gain and loss frames. O'Keefe and Jensen (2006; 2007) commented on this discrepancy on information presentation as problematic and stressed the relative certainty of outcomes between action and inaction. Moreover, Van't Riet et al. (2016) raised new points about whether recipients spontaneously compared the outcomes of alternative options and how absent reference outcomes weakened the direct prediction of prospect theory.

Though views on prospect theory's translation problem highlighted the relative certainty of alternative behavioral options, they did not justify its role in a particular health behavior. They noted the absence of reference outcomes in gain and loss frames but offered no operational solutions to account for this absence. In the next section, I review how prospect theory presented its option certainty and identified the uniqueness of vaccine behaviors. Moreover, I suggest a novel operational definition of option certainty within vaccine framing.

Vaccine Risk Redefined

In prospect theory's classic experiment, participants are asked to decide between two options (Tversky & Kahneman, 1981). As both options clearly present the outcome likelihood (e.g., saving 200 people with a 90% chance vs. saving 600 people with 30%), participants can comprehend the respective uncertainty level as expected. That is, the option of saving 600 people is perceived as being riskier than the option of saving 200 people because 30% is much smaller than 90%. Once participants understand the perceived risk of options, prospect theory can predict the performance of gain frames. It is worth noting that the perceived risk or uncertainty of an option is *relative*. In Wilson, Purdon, and Wallston's (1988) review on health message framing, the authors also stressed the research value of manipulating different outcome likelihoods to affect risks:

> ...impact that varying the probability of an outcome's occurrence may have on perceived threat awaits more detailed investigation....subjects may be more risk-seeking…when given loss frame information with lower probabilities of an outcome occurring but, when confronted with a loss frame outcome that has a high probability of occurring, they may become more risk-averse. (p. 168)

However, when translating to the health persuasion context, the *relativity* component in prospect theory has been left out. This creates difficulties for participants in terms of perceiving a health behavior's level of risk and may lead to poor predictions of prospect theory.

In my opinion, the relativeness of action risks is crucial for vaccine behaviors. When reading persuasive messages on vaccination, recipients sometimes think about the positive outcomes of inaction. As most receipts are healthy, they may prefer the status quo (i.e., inaction) to intentional changes. Besides, as most people are not confident with vaccination, they may treat it (i.e., action) as an added uncertainty.

Since vaccine use brings some uncertainties, such as needle pain and side effects, more persuasion is required than with other preventive health behaviors. As a result, it is essential to emphasize the uncertainty of the benefits of vaccination compared with inaction. In other words, the perceived uncertainty of vaccine benefits should be highlighted by comparing it with the perceived uncertainty of the status quo.

For example, some studies primed the perception of vaccine risks by delivering different efficacy percentages (e.g., study 1, Bartels et al., 2010; study 5, Van't Riet et al., 2014). However, their priming may fail to induce the intended level of perceived risk, because there is no comparison between taking and not taking vaccines. Even though taking vaccines produces a high probability of not catching illness (e.g., fighting viruses for 90% of people, Bartels et al., 2010), this behavior can be construed as risky because recipients may consider not taking vaccines as 100% safe. Consequently, the persuasiveness of a gain frame may be weakened (i.e., not approach statistical significance, Bartels et al., 2010).

To Take Flu Vaccines or Not: Action or Inaction

Seasonal influenza can be ambiguous in terms of its perceived threat and vaccine efficacy. As the public normally lacks sufficient knowledge about this precaution, they tend to depend on personal experience for vaccine decisions (Sundaram et al., 2018; Yap, Lee, Yau, Ng, & Tor, 2010). For example, sometimes individuals taking flu shots suffer from other viral infections with "flu-like" symptoms and produce misbeliefs in its vaccine failure (Green, 2000). Such individuals may become disappointed and confused about the prevention efficacy of influenza vaccination.

O'Keefe and Jensen (2007, p. 637) describe influenza vaccination as not changing a person's chances of catching the flu. When a person has such indifference

about the vaccination, perceived uncertainty of the vaccine may vanish because it does not differ from the perceived uncertainty of not taking a flu vaccine. Such individuals can be persuaded neither by gain nor by loss frames. This may explain why most framing studies on flu shot promotion found no effects (e.g., McCaul et al., 2002; Natter & Berry, 2005; Yu & Shen, 2013).

Can the probability difference between getting and not getting flu shots be primed to strengthen the goal framing effects? No studies have answered this question.

To conclude, findings on the interaction between *perceived risk* and goal framing have detected some promising results in the vaccine literature. However, few results reached statistical significance. This may be due to the problematic definitions and manipulations of perceived risk in vaccine behaviors. The *relativity salience* of *perceived risk*, I suggest, is a key component of prospect theory that has largely been ignored. Thus, this study examines how goal framing works when people are primed with different levels (salient/moderate) of efficacy between taking and not taking flu vaccines.

$H1_{a,b}$: When people perceive *a salient efficacy difference* between taking and not taking flu vaccines, a *gain*-framed message will elicit (a) more favorable attitudes toward flu vaccines and (b) higher flu vaccination intentions than a loss-framed message.

$H2_{a,b}$: When people perceive a *moderate efficacy difference* between taking and not taking flu vaccines, a *loss*-framed message will elicit (a) more favorable attitudes toward flu vaccines and (b) higher intentions to take flu vaccines than a gain-framed message.

On the other hand, this study also set a control condition that gave no information on outcome efficacy. The control group aims to assess whether any faming effects exist:

RQ1$_{a,b}$: When *reading messages only with goal-framed appeals*, which frame will elicit (a) more favorable attitudes toward flu vaccines and (b) higher flu vaccination intentions?

CHAPTER THREE: METHOD

Study Context

This study was conducted in Singapore, a context that presents several unique challenges. First, Singapore is a tropical country with warm temperatures and humidity through the year. The moist air often spurs infectious viruses like influenza. Second, Singapore has two peak outbreaks of influenza each year (Chow et al., 2006). Though its government has taken significant efforts to encourage flu vaccine use in the last decade, overall acceptance is not satisfactory (Lee et al., 2007). According to the latest survey on nation-wide representative samples in Singapore, about four-fifths of participants reported a reluctance toward future uptake of flu shot, replying with "definitely won't," "probably won't" or "undecided"; about three-fifths of participants had never received influenza vaccination (Lwin, 2017, manuscript in preparation). Thus, it is of great importance to conduct this promotion research in the context of Singapore.

The target population in this study was adults aged 55 or older. They were chosen because this age group is targeted for influenza vaccines. Compared with other adult groups, this group has the highest risk of catching seasonal flu and developing severe complications (World Health Organization, 2017). In addition, this study also included adults 55-64 years old, members of the "pre-old" group whose immunization abilities have been found decrease but with relatively strong reading and listening abilities (Hong, 2007). The elderly in this group often pay more attention to and are better able to comprehend persuasive messages (Gazibara et al., 2019). As a result, their exposure to influenza vaccine messages may yield more effective responses, which merits further investigation.

Persuasion Outcome Variables

This study defined the persuasiveness of framed messages based on the theory of planned behavior (Ajzen, 1991; 2002). It posits a causal chain (i.e., attitude–intention–behavior) that explains why humans take actions. In general, people's attitudes toward a behavior will yield their intentions to perform that behavior; in turn, intentions determine actual performance. This framework has been studied for years and received extensive support in various human behaviors (Hale, Householder, & Greene, 2002).

On the interplay between goal framing and probability difference, existing studies usually examine one outcome variable – intentions (e.g., Kim, Pjesivac, & Jin, 2017; Natter & Berry, 2005) – and a few examine both attitudes and intentions (e.g., Bartels et al., 2010). Drawing on the theory of planned behavior, this study chose as persuasion measures two outcome variables – attitudes toward flu vaccines and intentions to take flu vaccines. Since project timeline was limited, the actual performance of flu vaccinations was not addressed.

Design

A 2 (goal framing) × 3 (efficacy difference) between-factorial experiment was conducted at six senior activity centers in Singapore. This design aimed to understand how goal framing and efficacy difference between taking and not taking flu vaccines interact to yield the optimal persuasiveness of flu vaccine messages among the elderly.

Goal framing (gain and loss) was manipulated with two conditions – gains or losses. Efficacy difference was manipulated with three conditions – salient, moderate, and none. In the salient condition of efficacy difference, 80% of people who had taken flu vaccines did not catch the flu, while 20% of people who had not taken flu vaccines did not catch the flu. In the moderate condition of efficacy difference, 60% of people

who had taken vaccines did not catch flu, while 20% of people who had not taken flu vaccines did not catch flu. In the control condition, no efficacy information was provided. Participants were randomly assigned to six conditions to read different persuasive messages on flu shots. Next, they completed a questionnaire with induction measures, confounding measures, and outcome measures.

Participants

Invitation letters endorsed by IRB were sent to eight senior activity centers (SilverACE) in Singapore. SilverACE centers are non-profit organizations under NTUC Health that provide voluntary home services, entertainment and health training campaigns for local seniors with low income. The inclusion requirements were Singaporean citizens aged 55 years and above, having no mental disorders and who are able to hear and speak.

Six centers replied to the invitation email and participated. They are mainly located in the western and southeastern regions of Singapore, including Taman Jurong, Lengkok Bahru, Whampoa, Henderson, Redhill, and Telok Blangah. Initially, 215 senior adults joined the study, but as seven participants dropped out midway, the final participation number was 208 (70% female). Each participant was randomly assigned to one of the six message conditions pre-set in the center (see Table 2).

Table 2

Six Message Conditions Across Gender

		Male	Female	Total
Condition	Gain frame + Salient efficacy difference	10	22	32
	Gain frame + Moderate efficacy difference	5	31	36
	Gain frame only	14	18	32
	Loss frame + Salient efficacy difference	4	26	30
	Loss frame + Moderate efficacy difference	21	22	43

Loss frame only	9	26	35
Total			208

Procedure

After signing the consent form, participants were instructed to read a brief introduction on seasonal flu in the first section. This briefing was introduced by Assistant A in a seven-page Chinese-English PowerPoint presentation (see Appendix A, World Health Organization, 2017). To reduce processing difficulty, slides were simplified and supplemented with vivid illustrations. In the second section, participants were randomly assigned to one of the six message conditions and given a printed message promoting flu vaccination. Information in the message was also shown onscreen and orally introduced by Assistant B. After reading the stimuli message, in the third section, participants were given a questionnaire with manipulation checks and variable measurements stated below. The questionnaire was also shown on screen and orally introduced by Assistant C to assist comprehension. To avoid confounding effects, three assistants were randomly assigned to a section, and their methods of presentation were made to be consistent through training. The entire process took about 45 to 60 minutes.

Stimuli

Goal framing. Framing contents were designed based on Bartels et al.'s (2010) manipulation of West Nile virus vaccines. Framing statements were given in both English and Chinese as (see Figure 3):

> By [not] taking influenza vaccines, you will [fail to] protect yourself from developing serious complications from flu infection (e.g., sinus and ear infections, pneumonia). People who are [not] vaccinated will be more confident [hesitant], feel less [more] regret, and [not] have more peaceful mind to maintain their lifestyle than those who are not [are] vaccinated.

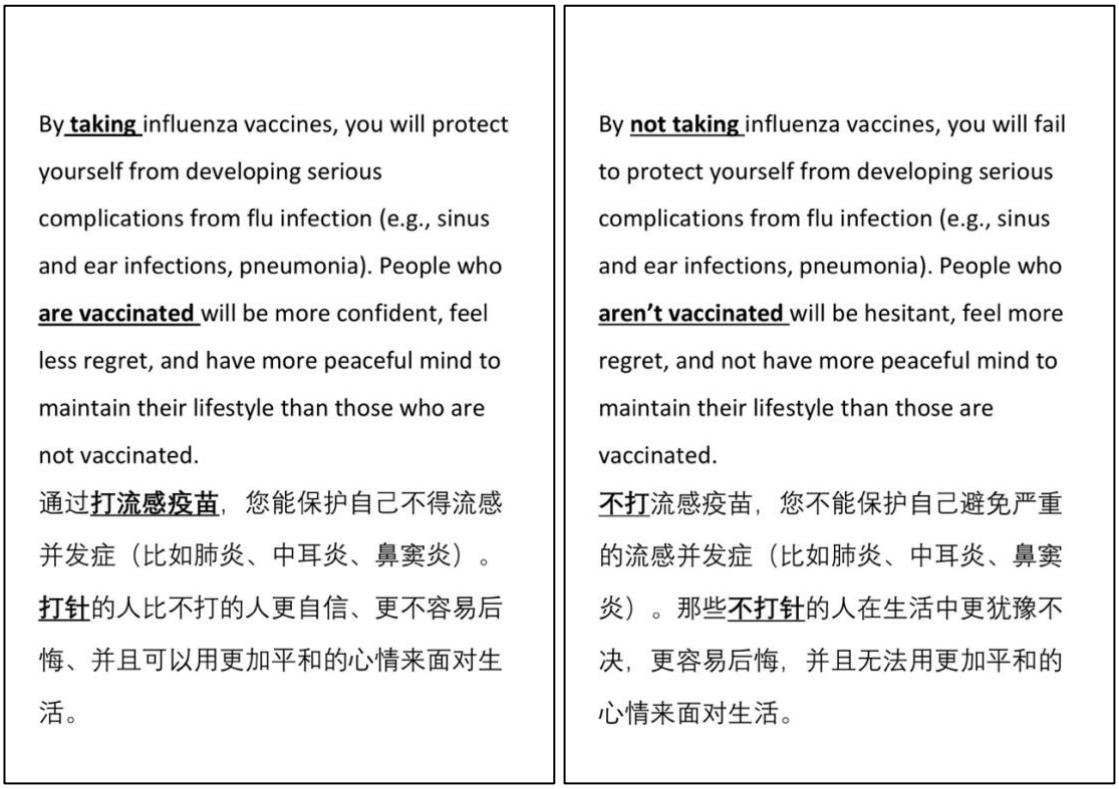

Figure 3. The gain- versus loss-framed stimuli

In the statements, identical information was delivered with a simple shift of outcomes. Gain-framed messages emphasized the benefits of taking flu vaccines, whereas loss-framed messages emphasized the harms of not taking flu vaccines.

The salience of efficacy difference between action and inaction. Unlike prior manipulations presenting the likelihood one option leads to (e.g., efficacy rate of taking vaccines, Bartels et al., 2010), this study posed an original manipulation (see Figure 4). By using a phrase of local statistic report (i.e., "Latest statistics in Singapore suggests that –"), I presented not only the likelihood an action-option (i.e., taking vaccines) leads to but also the likelihood an inaction-option (i.e., not taking vaccines) leads to. The efficacy difference between taking and not taking flu vaccines was manipulated in two levels (salient and moderate). In addition, a blank condition mentioning nothing on efficacy was also included as the control group. I designed the phrasing based on Bartels et al., (2010). And moreover, I added illustrations to ease the

processing burden for senior recipients because the graphic illustrations have been proved more effective in framing information (Chang, 2006; Tait, Voepel-Lewis, Zikmund-Fisher, & Fagerlin, 2010).

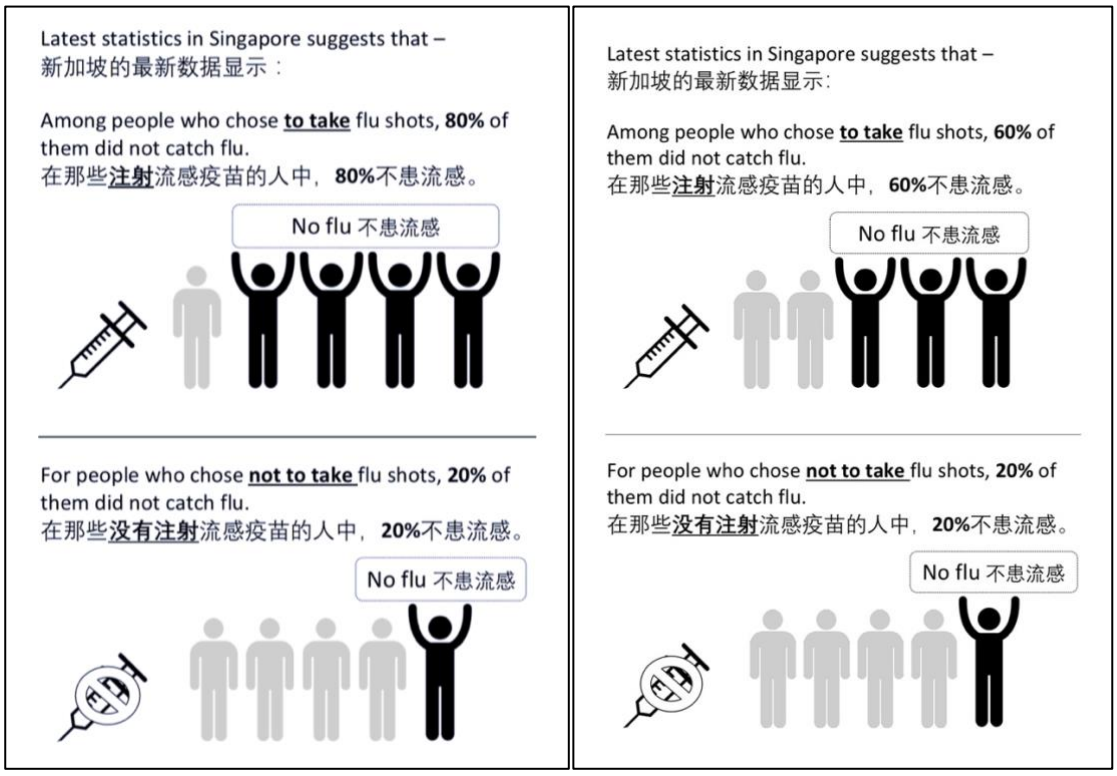

Figure 4. The salient versus moderate efficacy-difference stimuli

In the salient efficacy-difference condition, the option efficacy in action and inaction was manipulated as "Among people who chose to take flu shots, 80% of them did not catch flu. For people who chose not to take flu shots, 20% of them did not catch flu." In contrast, in the moderate efficacy-difference condition, the option efficacy in action and inaction was manipulated as: "Among people who chose to take flu shots, 60% of them did not catch flu. For people who chose not to take flu shots, 20% of them did not catch flu." In the control group, no information was provided on the efficacy difference.

To be noted, the statement on the efficacy of not taking flu vaccines were identical (i.e., 20%) in the salient and moderate groups. But the statements on the efficacy of taking flu vaccines were different. In this study, efficacy was defined as the

chance a behavior would lead to positive outcomes. By assigning different chance numbers (i.e., 80% and 60%), the efficacy difference was manipulated as salient (i.e., 80% versus 20%) and moderate (i.e., 60% versus 20%). Since O'Keefe and Jensen (2007) indicated that the outcome probability of action and inaction may not be asymmetry. We used 60% and 20% at the same time in the moderate condition.

Measures

The measurement scales in this study were largely adopted from Bartels et al.'s (2010) and Russell's (2009) measurement scales. Unlike their studies using college students, the targeted population in this study is the elderly adults who have higher risk of developing flu complications (Gazibara et al., 2019). Thus, when using their measures, I made two revisions. First, I simplified their seven-point or ten-point Likert scales to a five-point scale with illustrated emoji faces to ease recipients' comprehension. Second, I removed some of the semantic scales that were considered long, similar or complicated by the participants. To ensure the measurement validity, I ran the reliability test in the later analysis.

Induction Check Measures

To make sure that the stimuli messages have stimulated the intended outputs in goal framing and efficacy difference, participants answered a series of questions after exposing to the stimuli messages.

Goal framing. To check if framing conditions have been understood as the intended gains or losses, participants were asked to rate the number that accords with three pairs of semantic scales to best depict how they thought about the message. A five-point Liker scale concerning "negative/positive, bad/good, and loss/gain" from "1" to "5" were used with emoji faces to assist the elderly's comprehension (see Figure B1).

Efficacy comprehension and efficacy difference. To check that if the efficacy difference stimuli have induced the intended comprehension, I measured the comprehension of efficacy rate by asking participants to fill in the number of people who did not catch flu among every five Singaporeans (see Figure B2).

To understand whether the efficacy difference stimuli have induced the intended level of perceived risk, I measured the perceived efficacy and severity of flu vaccines. It is because that as mentioned earlier in chapter two, efficacy and severity are the two dimensions of perceived risk defined in the vaccine framing literature (O'Keefe & Jensen, 2007). I measured the perceived efficacy of flu vaccines with a five-point scale using one item (see Figure B3) and measured the perceived severity of flu vaccines with a five-point scale using three items (see Figure B4).

Confound Check Measures

Three covariates – message clarity, message processing effort, and perceived susceptibility to flu, were identified in this study in case that the stimuli messages have induced unintended results.

Effects of goal framing on two message variables have been captured and explained in the framing literature using the elaboration likelihood model (Petty & Cacioppo, 1986). It indicates that sometimes recipients do not read the argument carefully and as a result, they respond to the message based on heuristics such as negative appeals or fear arousals but not on the real logic in the argument. In that case, people may perceive a message's clarity and processing effort in varying levels. These variations may affect message persuasiveness and as a result, conceal the impact of goal framing. It is because that even a person is persuaded by the message, we cannot tell which factor leads to this result. Thus, this study measured these two message covariates in order to control them in the main effect analysis. Perceived susceptibility

was derived as a crucial factor in the health belief model (Janz & Becker, 1984) and protection motivation theory (Rogers, 1975). In their arguments, individuals' risk beliefs about themselves affect their health behaviors. For the perceived susceptibility, if a person feels highly vulnerable to a disease, then he may be more willing to take protections or to accept health protection arguments (Chaffee & Roser, 1986). Since perceived susceptibility can be a factor that affects message framing outcomes, this variable was also measured as the control to exclude its confounding effects.

Message clarity. I adopted the covariates measures from Russell's (2009). For the message clarity, it was measured with a 5-point scale using two items concerning "unclear/clear" and "not understandable/understandable" (see Figure C1). I removed three items concerning "confusing/not confusing, incomprehensible/comprehensible, not apparent/apparent" in Russell's original scales because the elderly had difficulties understanding these adjectives and treated them as identical.

Message processing effort. For the message processing effort, it was measured with a 5-point scale using two items concerning "difficult to process/not difficult to process" and "tough to understand/not tough to understand" (see Figure C2). I also removed three items (i.e., hard to read/not hard to read, challenging to read/not challenging to read, complex to process/not complex to process) in the original scale posed by Russell in order to ease the elderly's processing.

Perceived susceptibility to the flu. The perceived susceptibility to flu was measured with a 5-point scale using three items, from 1 = "very unlikely" to 5 = "very likely". By asking "how likely do you think the following things will happen", participants rated the number that accords with three statements that best depict their thoughts about "I think I am at high risk of getting influenza" and so on (see Figure C3).

Outcome Measures

Attitudes toward flu vaccines. The attitude toward flu vaccine use was measured with a 5-point scale using five items, from 1 = "strongly disagree" to 5 = "strongly agree". By asking "how much do you agree with the following statements", participants rated the number that accords with five statements that best depict their opinions on "Getting a flu shot to prevent influenza is good/beneficial" and so on (see Figure D1).

Intentions to take flu vaccines. Behavioral intention to engage in flu vaccination was measured with a 5-point scale using a single item, from 1 = "definitely won't" to 5 = "definitely will". By asking "how likely are you to get vaccinated against flu in the next year", participants rated the number that accords that best depict their future plan (see Figure D2).

Demographics. Participants' gender, age, and prior flu vaccine history were also recorded (see Appendix E).

CHAPTER FOUR: RESULTS

First, I tested the measurement model regarding both scale validity and manipulation check. For the validity check, I used the reliability and internal consistency tests. To check whether stimuli messages have induced the intended effects, I used the independent *t*-test to compare the variable performance across conditions. Second, I tested the hypotheses by using ANCOVA.

Analysis of Measurement Reliability

To check if all relevant scales have measured the single proposed concept, the measurement reliability was tested by the Cronbach's alpha. For the goal framing induction scale, the reliability of three items was quite high ($\alpha = 0.95$) and thus can be summed to create a composite score for framing effects ($M = 3.20$, $SD = 1.39$). Moreover, as expected, the framing score in the gain condition ($M = 4.48$, $SD = 0.57$) should be higher (i.e., positive-oriented) than the score in the loss condition ($M = 2.01$, $SD = 0.69$). The difference between gain and loss scores were significant in the assumed direction, $t\,(206) = 28.38$, $p < 0.001$.

For the manipulation of efficacy difference, both perceived efficacy and severity of influenza vaccination were measured. Specifically, for the perceived efficacy scale, I used a single item ($M = 4.39$, $SD = 0.69$). Participants in the salient condition (80% and 20%) reported a higher number ($M = 4.58$, $SD = 0.53$) than participants in the moderate efficacy-difference condition (60% and 20%, $M = 4.30$, $SD = 0.76$). But the difference was not significant, $t\,(139) = 2.55$, $p < 0.05$, which indicated that the manipulation of efficacy-difference induced participants to perceive flu vaccines with different benefit levels. On the other hand, for the perceived severity scale, the reliability of three items was high ($\alpha = 0.67$) and can be summed to create a composite score for perceived severity of influenza vaccination ($M = 1.91$, $SD = 0.66$). Moreover, as expected, the

perceived severity score in the moderate condition (60% and 20%, $M = 1.99$, $SD = 0.51$) was higher than the score in the salient condition (80% and 20%, $M = 1.58$, $SD = 0.62$). And the difference between two scores was significant, $t\ (139) = 4.24$, $p < 0.001$. It indicated that the manipulation of efficacy difference did induce a variation in participants' perceived severity of flu vaccines. That is, in the salient efficacy-difference condition, they considered flu vaccines as less severe than participants in the moderate efficacy-difference condition.

For the message clarity scale, the reliability of two items was high ($\alpha = 0.87$) and thus they were summed to create a composite score ($M = 4.35$, $SD = 0.83$). For the message processing effort scale, the reliability of two items was high ($\alpha = 0.76$) and thus were summed to create a composite score ($M = 4.32$, $SD = 0.73$).

For the perceived susceptibility to flu scale, the reliability of two items was high ($\alpha = 0.83$) and can be summed to create a composite score ($M = 3.05$, $SD = 1.06$).

For the attitudes toward flu vaccines scale, the reliability of two items was moderate ($\alpha = 0.59$) and thus they were summed to create a composite score ($M = 4.06$, $SD = 0.61$). For the intentions of taking flu vaccines scale, as only one item ($M = 3.89$, $SD = 1.12$) was used thus no measurement check was performed.

Independence Test of Treatments and Covariates

As mentioned earlier, three covariates are expected to be independent of the stimuli treatments. To check whether the means of three covariates are roughly equal across framing and efficacy difference, I fit a linear model with three covariates as outcomes, goal framing and efficacy difference as predictors.

For message clarity, different goal framing groups have non-significant impacts on the average level of message clarity, $F\ (1, 139) = 2.98$, $p = 0.09 > 0.05$, which indicates that the scores of message clarity is generally equal across framing

groups. Also, the main effect of efficacy difference on the message clarity is not significant, F (1, 139) = 1.23, p = 0.27. Therefore, message clarity is workable as a covariate.

For message processing effort, different goal framing groups have non-significant impacts on the average level of message processing effort, F (1, 139) = 3.51, p = 0.16, which means that the means for message processing effort are not significantly different across framing groups. Also, the main effect of efficacy difference on the message processing effort is not significant, F (1, 139) = 3.21, p = 0.08. Thus, message processing effort can be workable as a covariate.

For perceived susceptibility to influenza, different goal framing groups have non-significant impacts on the average level of perceived susceptibility, F (1, 139) = 1.32, p = 0.25, which means that the means for perceived susceptibility are not significantly different across framing groups. Same conclusion is also obtained in efficacy difference, F (2, 138) = 0.44, p = 0.51. Thus, it is accepted to test perceived susceptibility to flu as the covariate in this study.

Sample Characteristics

Table 3 summarized characteristics of individual variables including age, gender, influenza vaccine history and confounds. In particular, mean age of participants was 75 (SD = 7.43) and the majority are females (69.7%). More than half of the participants have no flu vaccine experience (53.4%). And 10.1% of participants perceived that they were less likely to or would not get flu shots. Perceived susceptibility to influenza was moderately high (M = 3.05, SD = 1.05). In addition, they perceived the delivered messages as clear (M = 4.35, SD = 0.83) and easy to understand (M = 4.32, SD = 0.73).

Table 3
Variable Characteristics

Demographics		*n*	%
Gender			
	Male	63	30.3
	Female	145	69.7
Age			
	< 65	15	7.2
	≥ 65	193	92.8

Characteristics		*n*	%
Have you taken flu vaccines before?			
	Yes	97	46.6
	No	111	53.4
How likely are you to get vaccinated against flu in the next year?			
	Definitely won't	11	5.3
	Probably won't	10	4.8
	Undecided	47	22.6
	Probably will	63	30.3
	Definitely will	77	37.0

Others	Mean	*SD*
Message clarity	4.35	0.83
Message processing effort	4.32	0.73
Perceived susceptibility to influenza	3.05	1.05

Note. $N = 208$

Analysis of Hypotheses

A 2 (goal framing: gain and loss) × 3 (efficacy difference: salient, moderate, and control) two-way ANCOVA was performed to test whether the interaction of goal framing and efficacy difference would yield hypothesized results in two outcome variables – attitudes toward the flu vaccine use and intentions to take flu vaccines. In the analysis, message clarity, message processing effort, and perceived susceptibility were controlled as covariates.

Attitudes toward the flu vaccine use. Figure 5 illustrates senior participants' general attitudes toward the uptake of influenza vaccines as a function of goal framing and efficacy difference. Overall, the interaction effect on attitudes toward the flu vaccine engagement is significant after controlling covariate effects, F (2, 199) = 3.53, $p < 0.05$, partial $\eta^2 = 0.03$.

Specifically, when informed that the action efficacy rate (i.e., 80% people not catch flu after taking flu vaccines) is much higher relative to the inaction efficacy rate (i.e., 20% people not catch flu after not taking flu vaccines), participants in the gain-framed message condition ($M = 4.30$, $SD = 0.61$) have more favorable attitudes toward flu vaccines than those in the loss-framed condition ($M = 4.28$, $SD = 0.46$), t (60) = 0.18, $p = 0.18 > 0.05$, but the difference does not reach significance. Thus, H1a is not supported.

Conversely, when the action efficacy rate (i.e., among people who take flu vaccines, 60% of them do not catch flu) is moderately higher compared to the inaction efficacy rate (i.e., among people who do not take flu vaccines, 60% of them do not catch flu 20%), participants in the loss-frame condition ($M = 4.13$, $SD = 0.41$) have more favorable attitudes than those in gains ($M = 3.83$, $SD = 0.90$), t (60) = 1.81, $p <$ 0.001, this difference is significant. Thus, H2a is supported.

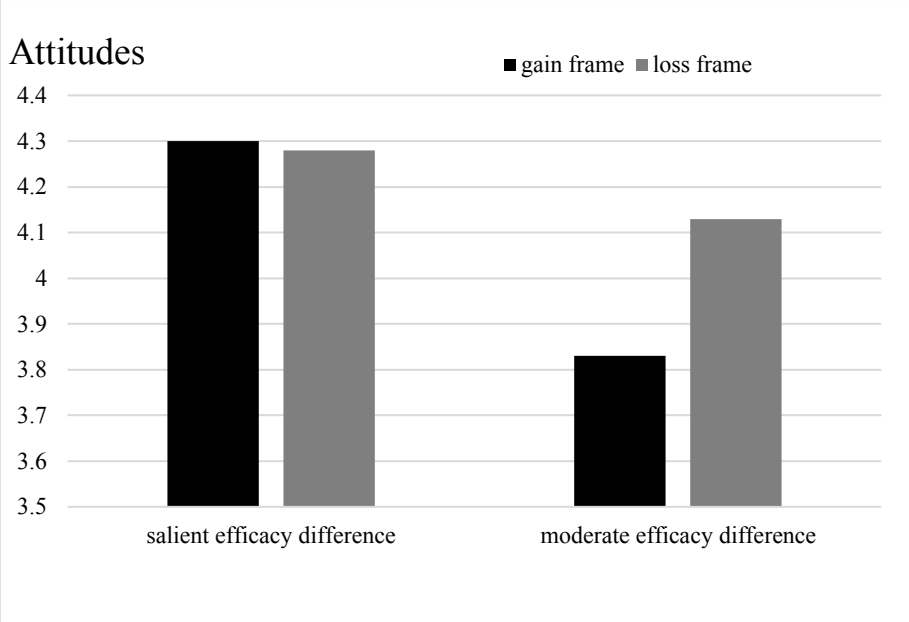

Figure 5. Attitudes toward flu vaccines across goal framing × efficacy difference

In the control group without efficacy information, participants are more willing to get flu shots when they read the gain-framed message ($M = 4.11$, $SD = 0.60$) than those who read loss-framed messages ($M = 3.62$, $SD = 0.54$). But the difference almost approaches marginal significance. $t\ (82) = –3.89$, $p = 0.51$, Thus, the answer to RQa is that when reading messages only with goal framed appeals, gain frames elicit more favorable attitudes toward flu vaccines than loss frames, but without significance.

Intentions to take flu vaccines. Figure 6 illustrates participants' overall intentions to take flu vaccines as a function of goal framing and efficacy difference. In general, the interaction effect on intentions is marginally significant after controlling message clarity, message processing effort and perceived susceptibility, $F\ (2, 199) = 4.28$, $p < 0.05$, partial $\eta^2 = 0.04$.

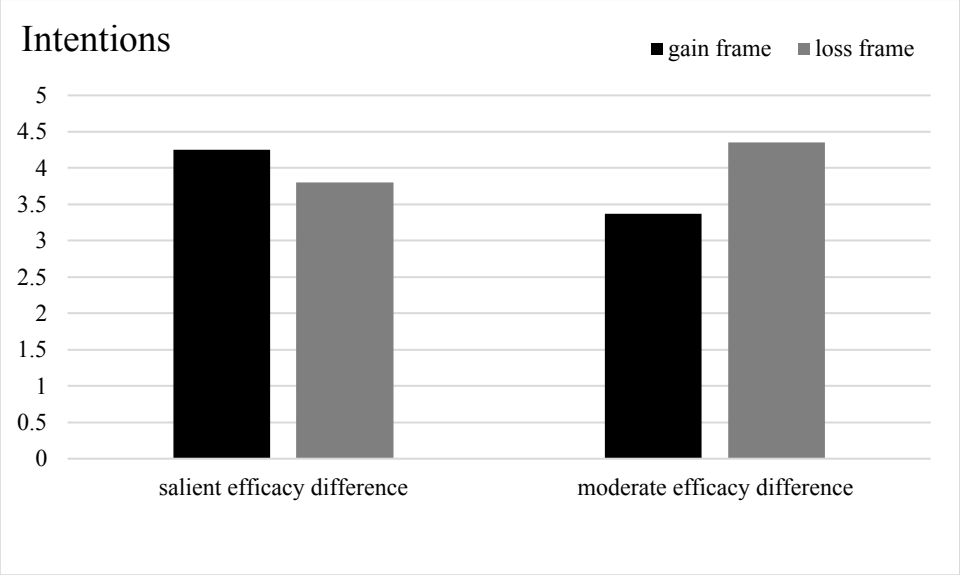

Figure 6. Intentions to take flu vaccines across goal framing × efficacy difference

Specifically, when informed with a salient efficacy-difference between action and inaction (i.e., action efficacy of 80% with inaction efficacy of 20%), participants in the gain condition ($M = 4.25$, $SD = 0.84$) are more willing to take flu vaccines than those in the loss-framed condition ($M = 3.8$, $SD = 1.13$), $t\ (60) = –1.79$, $p = 1.92$, this difference is not significant. Thus, H2a is not supported though in the expected direction.

Conversely, when informed with a moderate efficacy-difference between action and inaction (i.e., action efficacy of 60% with inaction efficacy of 20%), participants in the loss condition ($M = 4.35$, $SD = 0.81$) are more willing to take flu vaccines than those in the gain-framed condition ($M = 3.37$, $SD = 1.30$), this difference is significant because $t\ (60) = 3.61$, $p = 0.03 < 0.05$, Thus, H2b is supported.

In the control group without efficacy information, participants are more willing to get flu shots when they read the gain-framed message ($M = 3.94$, $SD = 1.25$) than those who read loss-framed messages ($M = 3.29$, $SD = 1.05$). But the difference is not significant. $t\ (82) = –2.53$, $p = 0.69$. Thus, the answer to RQb is that the gain-framed

message will produce higher intentions to take flu vaccines than the loss-framed message, but this result is not statistically significant.

CHAPTER FIVE: DISCUSSION

Findings in this study imply that efficacy difference can strengthen the persuasion performance of goal framing. As expected in Hypotheses 1a and 1b, when people perceive a salient efficacy difference between taking and not taking flu vaccines, gain-framed messages will elicit more favorable attitudes toward flu vaccines and higher flu vaccination intentions than loss-framed messages, however at a non-significant level. By contrast, when people perceive a moderate efficacy difference between taking and not taking flu vaccines, loss-framed messages will elicit more favorable attitudes and higher intentions than gain-framed messages, as partially expected in Hypothesis 2a. Also, intention outcomes significantly vary across frames, so Hypothesis 2b is supported. Moreover, this study also set a control condition without efficacy information. This aimed to check whether any main effects exist before introducing the factor of efficacy difference. The results shown a gain-framed advantage for both attitudes and intentions but with no statistical significance.

The study also captured some findings consistent with prior vaccine framing literature. Regarding the interaction effect of goal framing and efficacy, Bartels et al.'s (2010) also found a significant interplay. In loss-framed messages with high vaccine efficacy (i.e., 90%), the authors found a marginal significance. Nan and her associates (2012) found a similar pattern – namely, that the gain frame works better on vaccines when recipients perceive vaccine use as safe, less risky, or having a high response rate. However, the researchers only measured vaccine safety and examined the moderation effect without manipulation controls. Van't Riet et al. (2014) conducted an experiment but found no significant interaction between vaccine efficacy rate and framing. As a result, what my study detected is worth noting because it not only uses manipulations but also approaches significance with an assumed direction. The reason why this study

achieved inspiring results is due to the novel design on vaccine efficacy that informs the *relative* efficacy advantage by showing the efficacy rate of inaction. Such a design is based on a reconsideration of prospect theory's concept of risk.

Rethinking Risk in Prospect Theory

Prospect theory's theoretical tenets have been applied in alternative decision contexts. In translating prospect theory to the field of health persuasion, the initial notion of risk shifts from relative probability to a behavior's perceived negative/positive outcomes. These different definitions have been criticized as being used interchangeably for risk measures and thus generating mixed empirical results in the health context (O'Keefe & Jensen, 2007; Van't Riet et al., 2016). Safety concerns about vaccine behaviors, such as vaccines inject viruses and cause infection (Sundaram et al., 2018), often produce ambiguous risk perceptions among the public. This is because a person who hesitates to take vaccines can face a risk paradox – that he/she perceives vaccine uptake as both risky (i.e., side effects, needle pain) and not risky (i.e., high chance of feeling fortified) at the same time. This paradox offers potential directions for research because existing definitions of vaccine risk are mixed, which may explain why framing research has received little empirical support in the vaccine domain (Penţa & Băban, 2018).

Theoretically, this study helps advance prospect theory by rethinking its notion of risk in health persuasion, especially for vaccine behaviors. The original definition of risk is the probability that an option will lead to the desired outcome (Kahneman & Tversky, 1979). The concept of risk is crucial to prospect theory because whether an option is risky or not determines the framing direction – prefer less risky options with gains but risky options with losses. Yet, in the vaccine framing literature, the probability aspect in the initial concept of risk has been replaced by the magnitude of

negativity (perceived severity) or positivity (perceived efficacy). This replacement weakens the predictive power of prospect theory. Some have noticed this problem and manipulated the efficacy rate of vaccines (e.g., Bartels et al., 2010); however, they ignored another problem that is unique to the persuasion setting – people are persuaded to a single choice instead of two.

The original choice setting in prospect theory is to pick one solution for a hypothetical problem (Tversky & Kahneman, 1981; 1992). Alternative solutions provide all the necessary information for prospect theory – i.e., probability and results. Thus, people are well informed as to which solution is riskier because they can perform the comparison. In other words, the risk level of options is relative in prospect theory; however, in the persuasion setting, the message designer cares about which frame will persuade more people to action and which will persuade fewer. They do not assume that people can also choose inaction. As a result, most framing studies assume that the information they provide has been comprehended as expected. For example, recipients can be well informed of the vaccine efficacy or risk once the message presents a high efficacy rate (i.e., 90%, Bartels et al., 2010). These designs ignore the relativity component originally highlighted in prospect theory. In the persuasion setting, people choose between action and inaction. When considering whether a behavior is risky or not, people often base their decisions on the risk of the status quo being changed. For example, when reading persuasive messages for vaccine use, people often ask why they are supposed to take additional efforts to change their life when it is already fine. In that case, the way to inform the high vaccine efficacy should change from simply offering numerical data (e.g., 90%) to offering qualitative accounts on the efficacy of both action (e.g., 90%) and inaction (e.g., 20%). As a result, recipients can decide which option is more certain. Only when they understand

which option is riskier or more uncertain can their framing preferences be predicted by prospect theory.

To conclude, in this explorative study, I manipulated the efficacy difference between action and inaction and found that goal framing and efficacy difference had a significant interaction effect on Singaporean elderly's attitudes toward and intentions to influenza vaccination. These results are inspiring because they shed light on a novel message design that not only redefines the notion of risk in prospect theory but also strengthens the effects of goal framing.

The Role of Goal Framing in Vaccine Persuasion

This study established a control group wherein recipients read goal framing messages only, with either gains or losses. Both attitudes and intentions indicate that gain frames are more persuasive, though only marginally. This result is inconsistent with prior meta-reviews on preventive health and vaccination. O'Keefe and Nan's (2012) meta-review suggests no main effects of goal framing for vaccination. O'Keefe and Jensen (2007) found a weak loss-framed advantage in preventive health practices. This inconsistency, I suggest, may be due to individual characteristics. Senior adults may be alerted to potential gains instead of losses as their life is much more limited. They may pay greater attention to gain-framed messages with higher elaboration. Subsequently, gain-framed messages let them feel more favorable and give more favorable feedback. Previous studies have mainly drawn participants from colleges, students who have been found to be more optimistic and alert to losses (Ruthig, Haynes, Perry, & Chipperfield, 2007). The discrepancy in samples also indicates practical values in this study.

Practically, this study contributes to influenza vaccine promotion by targeting the high-risk group with illustrated and simplified message design. Since senior adults

are less likely to learn new knowledge (Gazibara et al., 2019), message design in previous studies can be complicated as most stimuli messages and questionnaires are long texts without illustrations. This study simplified some of the measurement scales and added emoji illustrations to guide the elderly. Reliability and CFA test confirm these modifications with acceptable results. In addition, improved goal framing effects found in this study confirm the application potential in daily life.

CHAPTER SIX: LIMITATIONS AND FUTURE STUDY

This study has limitations regarding stimuli validity, confounding effects, and samples. This chapter discuss them and suggest future directions for vaccine framing.

Some results showed the framing difference in a hypothesized direction but with little or no significance. For example, to test Hypothesis 1a, I compared attitude scores of the gain and loss groups. Data showed that when participants were informed with a salient efficacy difference between taking (80%) and not taking flu vaccines (20%), those in the gain group were more willing to get vaccinated than those in the loss group; but the "more willing" group only achieves partial significance ($p < 0.1$). A similar problem arises in testing Hypothesis 2b; I compared the intention score between gain and loss groups. Data showed that when informed with a moderate efficacy difference between taking (60%) and not taking flu vaccines (20%), participants in the loss group were more willing to get vaccinated than those in the gain group; however, "more willing" does not reach statistical significance ($p > 0.05$).

These results may be due to limitations of the message design. Since risk is defined as uncertainty, this study operationalized uncertainty based on the likelihood of positive outcomes. As a percentage of people who are free of influenza infections, information on the efficacy of action and inaction are provided to inform people about the efficacy difference level (moderate or salient). However, sometimes uncertainty is determined by the likelihood of negative outcomes. Some people are less interested in how effective a flu vaccine is and more interested in how ineffective it is or how likely it may be to have side effects. Thus, the original design may weaken the message power and reduce its outcome significance. I did not use this manipulation because the sample targeted in this study was over 55 years – a vulnerable population who may have less chance to learn new knowledge and thereby make decisions based on

personal experiences (Gazibara et al., 2019). Thus, it may harm them to inform them of the negativity of action (i.e., flu shots), such as 20% of people who take flu vaccines will suffer side effects. Also, this wording creates difficulty in designing the negativity text on inaction with symmetric outcomes such as 80% of people will suffer from side effects when they decide not to take flu vaccines. Thus, future research should look into the probability of various negative outcomes in vaccine behaviors.

Some confounding factors may have been overlooked in this study, thus weakening the framing effects. When doing the independence test of treatment and covariates, the message clarity and message processing effort change across framing conditions but with marginal significance. This indicates that treatment messages sometimes have unintended effects on the stimuli variables, thereby influencing the persuasion outcomes. Vaccine framing research has examined different moderators such as persuasion environment (e.g., Gerend, Shepherd, & Monday, 2008), targeted recipient (e.g., Shen & Dillard, 2007) and message format (e.g., Tait et al., 2010). In my view, whether a moderator deserves investigation depends on how much it influences the stimuli variable. As risk is the key concept in prospect theory and health prevention, future research needs to identify what factors alter people's perception of risk or uncertainty, such as time pressure. Preventive health is the act of preparing for – and protecting oneself from – future harm. Thus, time-related variables such as the consideration of future consequences, anticipated regret, and long-/short-term efficacy are moderators worth exploring.

The elderly's relatively low comprehension level of background knowledge (Gazibara et al., 2019) may also limit message validity in this study. During the experiment, the principal investigator and assistants made every effort to control external factors introduced in communicating with elderly participants. Thus, future

research targeting the elderly should focus on younger senior groups to maintain the validity of stimuli and questionnaires.

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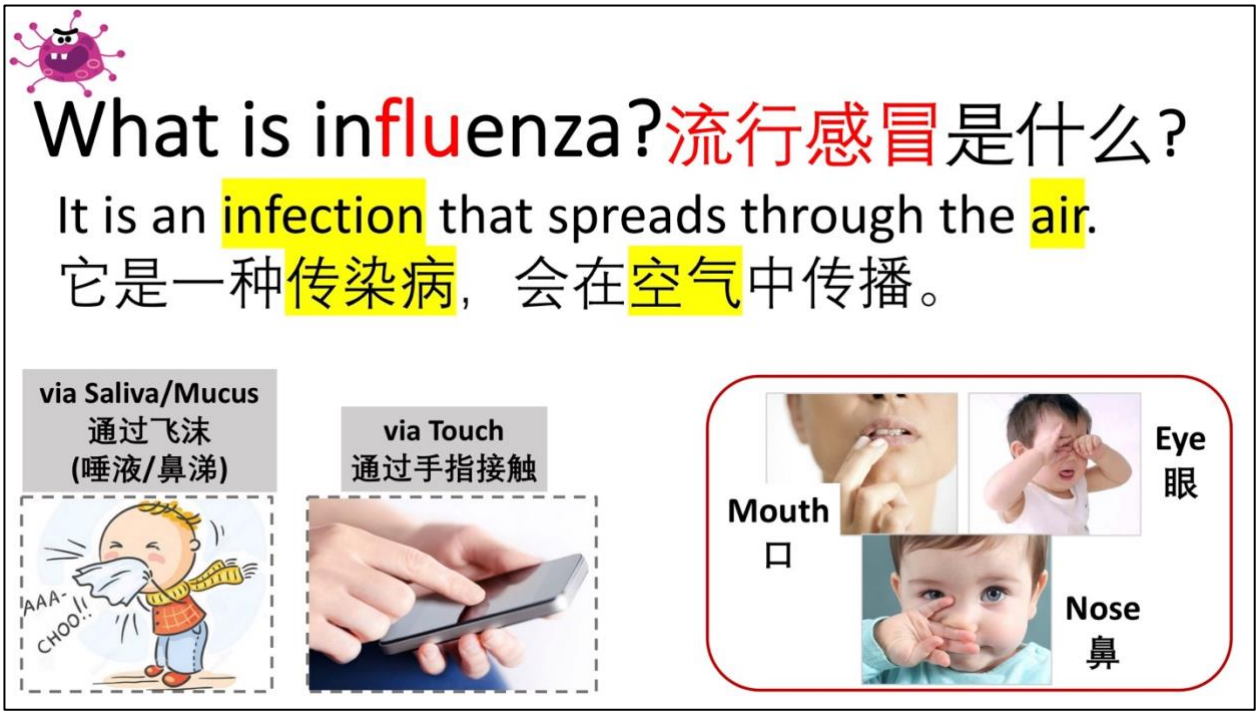
APPENDIX A

Facts of Seasonal Influenza and Its Vaccines

(World Health Organization, 2017)



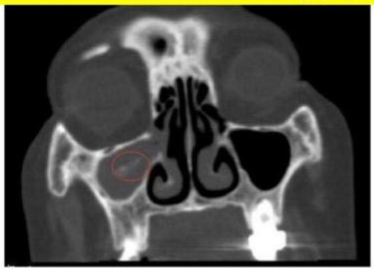
If catch the influenza, you will…

得了流行感冒，你会…

Flu may develop to more serious complications:

流感可能发展为更严重的疾病…

Sinus infections 鼻窦炎



Ear infections 中耳炎

Pneumonia 肺炎

Flu epidemics are more likely to occur in conditions of high humidity and crowding.
流感更容易在潮湿、拥挤的环境下传播。

Two big
FLU SEASONS in Singapore:
新加坡每年两次流感爆发：
June & December
六月和十二月

The influenza and vaccination
流行感冒和流感疫苗 (打针)

The best way to prevent the flu is to get the yearly vaccination.
预防流感的最佳方法是：每年接种疫苗 (打针)。

EVERY YEAR
每年打一次

The influenza & the elderly protection

流行感冒和老人保护

WHO, Ministry of Health, and Health Promotion Board recommend:

the elderly (especially 65+ years) to get yearly flu vaccines.

联合国世界卫生组织，新加坡卫生部，新加坡健康促进局建议：

“老人(特别是65岁以上) 每年接种流感疫苗 (打针)。”

APPENDIX B

Induction Check Measures

Figure B1. Goal framing measures.

① Fill in the number 填数字

According to the poster message we shown, please answer the number in the following two questions:
想一想海报上的信息，请用数字回答下面两个问题：

Among FIVE Singaporeans who **chose to take** flu shots, how many of them did not catch the flu? 在 5 个**打流感疫苗**的人中，有几个人不会得流感？

_____ persons（人）

Among FIVE Singaporeans who **chose not to take** flu shots, how many of them did not catch the flu? 在 5 个**没有打流感疫苗**的人中，有几个人不会得流感？

_____ persons（人）

Figure B2. Efficacy comprehension measures.

② Pick a number 选数字

HOW EFFECTIVE do you think the INFLUENZA VACCINE would be in protecting you from developing the flu? Please pick a number from 1 to 5.
您觉得流感疫苗可以有效预防流行感冒吗？请在 1 到 5 中选一个数字。

Not effective at all 完全无效	Not effective 无效	Average 一般	Effective 有效	**Very effective 非常有效**
1	2	3	4	5

Figure B3. Perceived efficacy of influenza vaccines

Figure B4. Perceived severity of influenza vaccines.

APPENDIX C

Confounding Check Measures

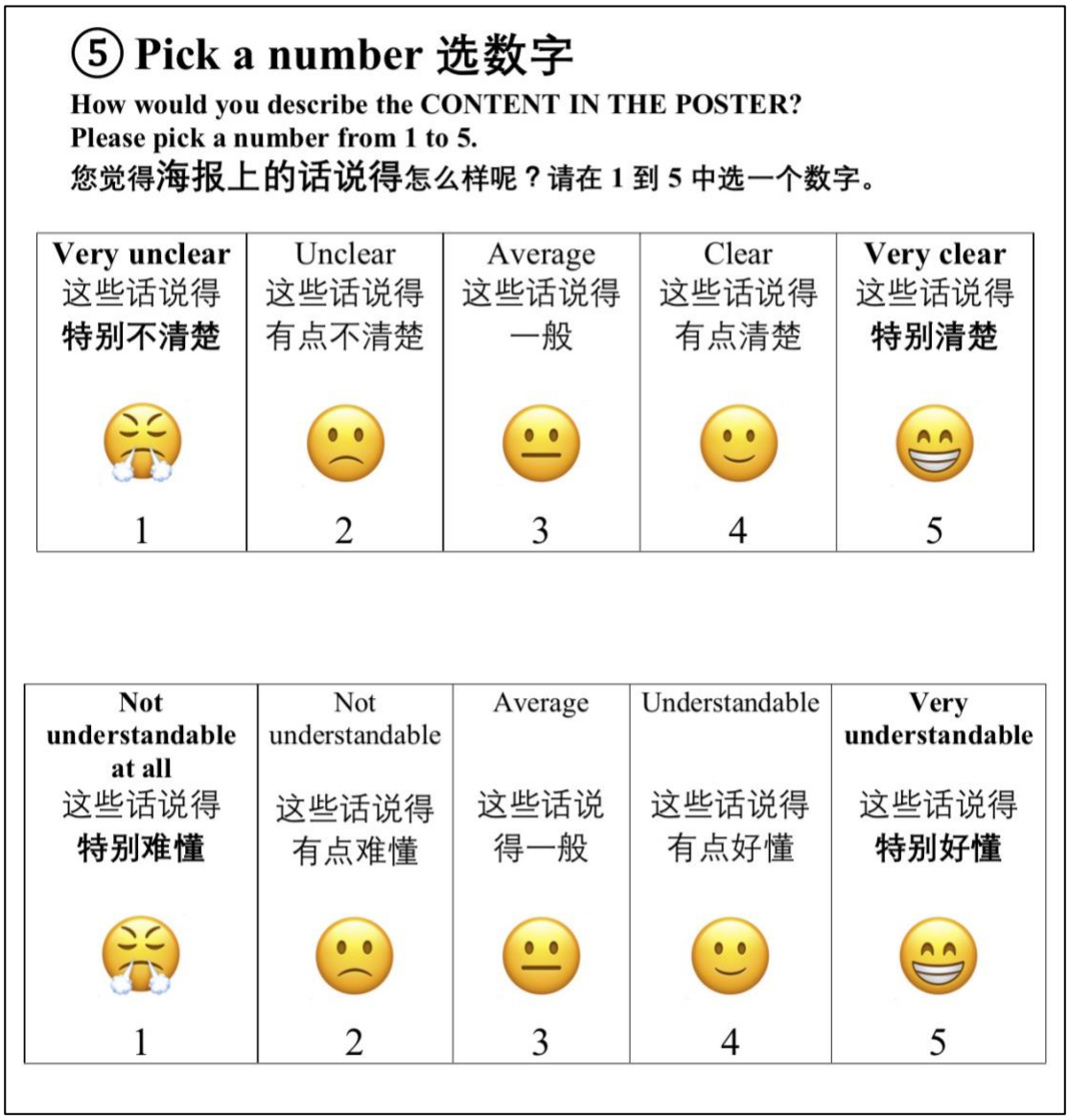


Figure C1. Message clarity measures.

⑥ Pick a number 选数字

How would you describe the CONTENT IN THE POSTER?
Please pick a number from 1 to 5.
您觉得海报上的话听起来怎么样呢？请在 1 到 5 中选一个数字。

Very difficult to process 这些话听起来**特别吃力**	Difficult to process 这些话听起来有点吃力	Average 这些话听起来一般般	Not difficult to process 这些话听起来不算吃力	**Not difficult at all** to process 这些话听起来**完全不吃力**
				
1	2	3	4	5

Very tough to understand 这些话**非常难理解**	Tough to understand 这些话有点难理解	Average 这些话听起来一般般	Not tough to understand 这些话不难理解	**Not tough at all** to understand **这些话完全不难理解**
				
1	2	3	4	5

Figure C2. Message processing effort measures.

Figure C3. Perceived susceptibility to flu measures.

APPENDIX D

Outcome Measures

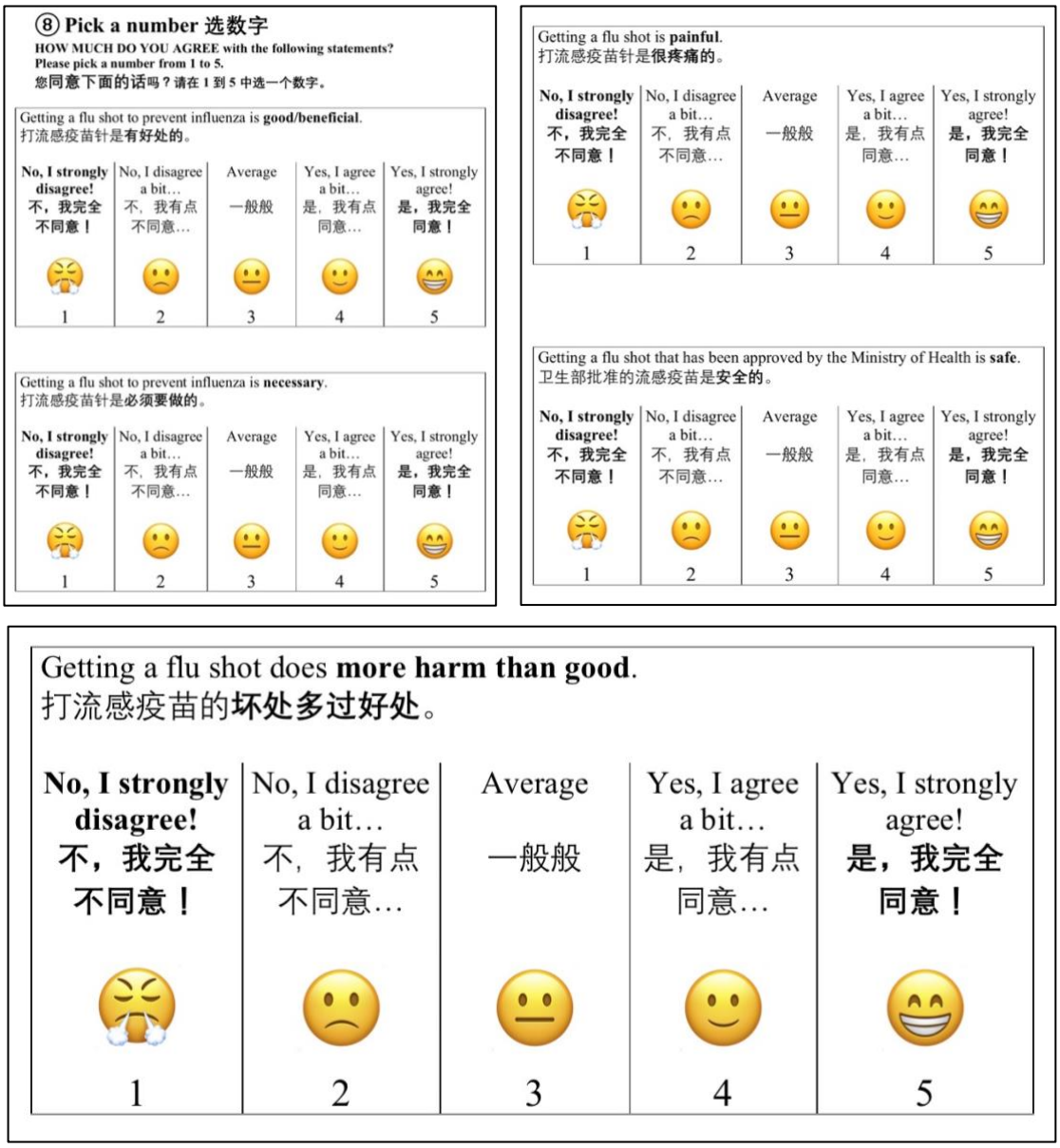


Figure D1. Attitudes toward flu vaccine uses.

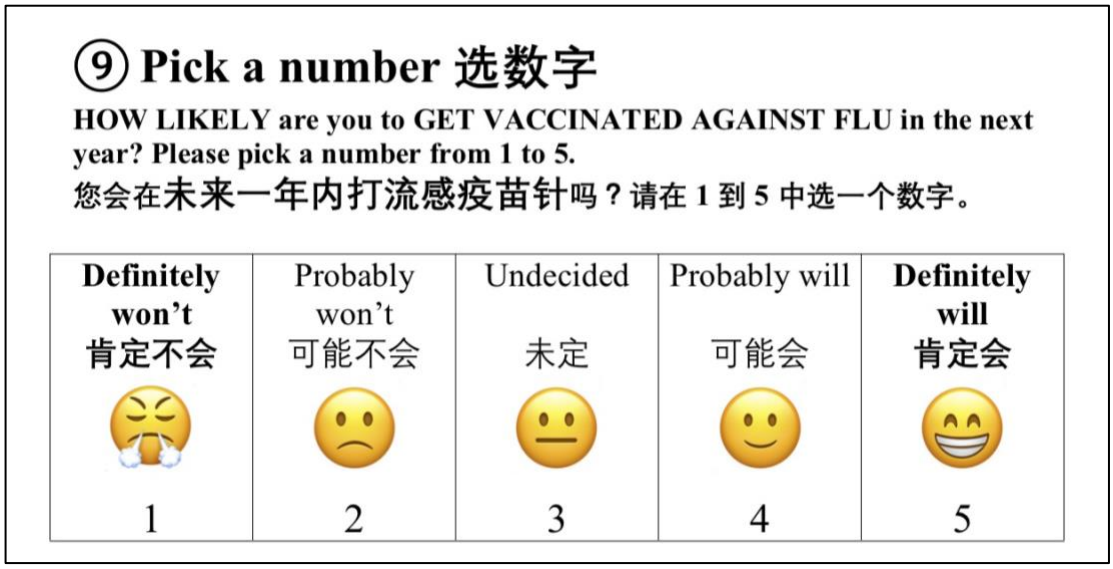


Figure D2. Intentions to take flu vaccines.

APPENDIX E

Demographics

What is your gender? 您的性别？

☐ Male 男

☐ Female 女

How old are you? 您今年几岁？ _____ years old 岁

Have you taken influenza vaccines before? 您打过流感疫苗吗？

☐ Yes, I have received flu shots before. 是的，我曾打过。

☐ No, I never take flu shots. 不，我从来没有打过这个针。