Could evaluation mode nudge people's health-related decisions? Extending the general evaluability theory to risk communication

Xu, Yihan

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**COULD EVALUATION MODE NUDGE PEOPLE’S HEALTH-
RELATED DECISIONS? — EXTENDING THE GENERAL
EVALUABILITY THEORY TO RISK COMMUNICATION**

YIHAN XU

**WEE KIM WEE SCHOOL OF COMMUNICATION AND
INFORMATION**

2020

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HEALTH-RELATED DECISIONS? — EXTENDING
THE GENERAL EVALUABILITY THEORY TO RISK
COMMUNICATION**

YIHAN XU

Wee Kim Wee School of Communication & Information

A thesis submitted to the Nanyang Technological University in partial
fulfillment for the requirements for the degree of the Doctor of Philosophy

2020

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Courage is not simply one of the virtues, but the form of every
virtue at the testing point. — C.S. LEWIS

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ABSTRACT

Many important decisions people make are related to health. However, people often show inconsistent preferences, even for life-or-death matters. Preference inconsistency happens because people's preferences are often constructed on the spot — not as stable as normative decision theories assume. Preference reversals can be induced by many factors, and notably, by evaluation mode — the focus of this dissertation.

Evaluation mode refers to the condition under which options are presented and evaluated. People engage in single evaluation (SE) mode if they evaluate one single option in isolation, and they engage in joint evaluation (JE) mode if they evaluate two (or more) options simultaneously, and their preferences may reverse between SE and JE. As the evaluability hypothesis and general evaluability theory (GET) predict, when people evaluate two options that involve trading off between an easy-to-evaluate attribute (e.g. condition) and a hard-to-evaluate attribute (e.g. number of entries), their preferences for the two options may reverse between SE and JE. In JE, the hard-to-evaluate attribute becomes easier to evaluate and thus has more impact. For example, students prefer the music dictionary with a neat cover and 10,000 entries in SE, but they prefer the one with a torn cover and 20,000 entries in JE, presumably it is easier to evaluate the condition (new vs. old) than the usefulness of the dictionaries.

Whereas previous research on preference reversals between SE and JE has accumulated mostly in the domain of consumer behavior and managerial decision-making, this dissertation demonstrates SE/JE preference reversals in health-related decisions that involve risks. The extent to which laypeople can make good health-related decisions is often dependent on how reasonably they perceive the riskiness of the available options. Risk is a multifaceted concept with several important dimensions that tap into both emotion and cognition — while emotion-laden attributes such as severity and pain intensity may be easy to evaluate, numerical attributes such as likelihood and prevalence are often hard to evaluate. Therefore, it is often challenging for laypeople to evaluate the risks holistically and retain their evaluations under different evaluation modes.

It is thus hypothesized that when laypeople face two options that involve a trade-off between an easy-to-evaluate risk attribute and a hard-to-evaluate risk attribute, their risk preferences will shift (even reverse) between SE and JE. More specifically, in SE, laypeople will prefer the option superior in the easy-to-evaluate attribute; in JE, they will prefer the option superior in the hard-to-evaluate attribute. This dissertation tests this main hypothesis and its derivative hypotheses with three progressively designed experiments.

Study 1a examines laypeople's willingness to accept a potentially risky business travel assignment to a foreign country, where they trade off severity of loss (easy-to-evaluate) and likelihood of loss (hard-to-evaluate). The results show moderate preference shifts between SE and JE, though the direction of JE/SE prediction contradicts the prediction. Study 1b examines laypeople's perceived price fairness of a costly magic pill that offers a lifetime exemption of two potentially severe health hazards (stroke vs. stomach cancer), where they trade off intensity of loss (easy-to-evaluate) and magnitude of loss (hard-to-evaluate). The results conceptually replicate the findings from study 1a.

Contrary to what the GET-derived hypothesis predicts, the results of study 1 show that the easy-to-evaluate risk attribute, rather than being crowded out by the hard-to-evaluate one, becomes even more impactful in JE. A risky option's relative inferiority in the easy-to-evaluate risk attribute heightens, rather than abates, in JE.

Study 2 aims to clarify the unexpected findings from study 1, expanding the scope of study 1 by investigating the boundary conditions of GET-derived hypothesis. It examines how laypeople trade off a *risk* attribute and a *non-risk* attribute when attributes' justifiability (how relevant an attribute is for the decision-making task) vary. Study 2 investigates how the relative justifiability of costs affects laypeople's evaluations of two flu vaccines, where they trade off costs (easy-to-evaluate) and chance of side effects (hard-to-evaluate). The results show that consistent with the hypothesis, preferences reverse between SE and JE, but to a greater extent when the costs is relatively more justifiable than when it is less so. The results also suggest that the pattern of hypothesized preference reversals is contingent upon an attribute's relative justifiability.

The findings from the two studies show that evaluation mode could nudge people's health-related decisions. When laypeople have to deal with two options

that are risky in a more or less intuitive sense, they generally prefer to avoid the more intuitively risky one in SE, but prefer to avoid the less intuitively risky one in JE. However, when the options are too risky overall, they may dread both options more when comparing them together than examining them one by one. How their preferences change from SE to JE is also somewhat contingent on the relative justifiability of the attributes in questions. In general, laypeople's preferences are more malleable in SE, but more stable in JE, indicating that JE could serve as a buffer for contextual cues.

Overall, this dissertation extends the GET framework to the context of health-related decision-making that involves risks and identifies one boundary condition for it. It also offers valuable insights for designing effective risk communication for risk communicators.

CHAPTER ONE: INTRODUCTION

1.1 Background

Many important decisions people make are related to health. At some point in life, most people will need to decide whether to take a screening test or not, whether to choose radical or conservative therapies to treat cancer, or whether to visit the hospital that is closer but has lower quality versus the one that is further but has higher quality. Despite the high stakes and long-term consequences, laypeople (and sometimes even professionals) often rely on intuition or heuristics (mental shortcuts) in health-related decision-making, and their preferences are often inconsistent (Peters, Klein, Kaufman, Meilleur, & Dixon, 2013; Reyna, Nelson, Han, & Pignone, 2015; Stiggelbout, Vries, & Scherer, 2015). For example, cancer patients prefer surgery when they read medical statistics presented in a survival frame, but they prefer radiation therapy when the same information is presented in a mortality frame (McNeil, Pauker, Sox, & Tversky, 1982). Similarly, laypeople prefer the surgery with a lower complications rate but a higher mortality rate to the one with a higher complications rate but a lower mortality rate, even though they prefer living with any complications to dying from colon cancer (Amsterlaw, Zikmund-Fisher, Fagerlin, & Ubel, 2006). One may wonder, how can we help laypeople make better health-related decisions – preferably more informed, value-based, and consistent?

It is futile to seek answers from normative theories of decision-making, as preference inconsistency is contradictory to what they tacitly assume. Normative theories, notably the expected utility theory proposed by von Neumann and Morgenstern's (1947), take a rational choice approach and model

how people *should* make decisions to maximize expected utility. They assume that people have stable and consistent preferences, which are immune to variations of the way options are described (*descriptive invariance*), the methods with which preferences are elicited (*procedure invariance*), and the contexts in which the options are presented (*context independence*) (Fox, Erner, & Daniel J. Walters, 2015, p. 60).

To explain why and how preference inconsistency arises, scholars in behavioral decision-making have proposed a few descriptive theories that model how people *naturally* form preferences and make judgment and decisions. Simon (1955, 1956, 1957) introduces the idea of *bounded rationality* to accommodate humans' limited cognitive power. Under the information processing constraints, Tversky and Kahneman (1974) exemplify how people adopt heuristics in judgment and decision-making, such as elimination-by-aspect, representativeness, anchoring and adjustment, and availability. They further propose prospect theory to illustrate how preferences are influenced by the frame (gains vs. losses) of potential outcomes as well as the reference points (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992), all of which make preferences prone to inconsistency under different situations. The theoretical development in descriptive models and growing empirical evidence on preference inconsistency (Bazerman, Loewenstein, & White, 1992; Slovic, Fischhoff, & Lichtenstein, 1977; Tversky & Kahneman, 1981; Tversky & Thaler, 1990, 2004) led Slovic (1995) to propagate people's preferences as an *ad hoc* construction process.

As Lichtenstein and Slovic (2006) argue, preferences are often constructed on the spot rather than being well-defined and stable. People's

preferences tend to differ (sometimes even reverse) systematically under normatively equivalent descriptions, elicitation methods, and contexts – a phenomenon termed *preference inconsistency* or *preference reversal* (p. 2). One of the earliest demonstration of preference reversals is between choice and pricing: when making trade-off between chance and pay-offs, gamblers prefer to choose the high-probability-low-payoff bet, but they are more willing to pay for the low-probability-high-payoff bet (Lichtenstein & Slovic, 1971; Slovic & Lichtenstein, 1968). Later research has demonstrated the ubiquity of preference reversals in consumer buying and managerial decision-making (Ariely, 2008; Bazerman et al., 1992; Bettman, Luce, & Payne, 1998; Gideon & Wu, 2015; Reyna et al., 2015; Thaler, 1980; Tversky & Thaler, 1990).

Preference reversals may be more likely to happen, and to a greater extent, in health-related decision-making, where laypeople are often new to the decision-making situations and unfamiliar with the potential risky outcomes (Reyna et al., 2015; Saposnik, Redelmeier, Ruff, & Tobler, 2016; Stiggelbout et al., 2015). Few would disagree that choosing a medical treatment is often more complex than choosing a cutlery set. Preference reversals in health-related decisions, therefore, can be problematic for laypeople if their preferences accidentally sway toward the direction that is against their best interests. However, preference reversals may also be a blessing in disguise if laypeople's preferences can be predictably reversed to the better direction (Thaler & Sunstein, 2003).

The extent to which laypeople can make good health-related decisions is often contingent on how reasonably and reliably they perceive the riskiness of the available options (Garcia-Retamero & Cokely, 2013; Lipkus, 2007; Paling, 2003; Reyna & Adam, 2003; Reyna, Nelson, Han, & Dieckmann, 2009; Sandman,

1993; Slovic, 1987; Turner, Skubisz, & Rimal, 2011). However, risk preferences are often elusive (Fox & Tannenbaum, 2011). They are elusive because risk is a multifaceted concept with several important dimensions that tap into both emotion and cognition (Roeser, Hillerbrand, Sandin, & Peterson, 2012; Yates & Stone, 1992), which laypeople are not equally sensitive to. Moreover, to have stable and informed risk preference assumes that laypeople could holistically evaluate the risks involved and retain their evaluations under different situations. However, laypeople are constrained by certain individual characteristics, such as numeracy, literacy (Reyna & Brainerd, 2008; Reyna et al., 2009), personality (Nicholson, Soane, Fenton-O'Creevy, & Willman, 2005; Saposnik et al., 2016), and risk attitude (Blais & Weber, 2006; Pedersen, Olesen, Hansen, Zachariae, & Vedsted, 2011). Their risk preferences are also susceptible to many situational factors, such as formats of information displays (Johnson, Payne, & Bettman, 1988), ambiguity of option attributes (Nowlis & Simonson, 1997), extreme triviality or difficulty of decisions (Beattie & Barlas, 2001), and diversity of evaluation scales (e.g. choices, acceptability, willingness to pay) on which responses are elicited (Lichtenstein & Slovic, 2006).

Notably, preference reversals can be induced by evaluation mode, which is the focus of this dissertation. Evaluation mode refers to the condition under which options are presented and evaluated. People engage in single evaluation (SE) mode if they evaluate one single option in isolation, and they engage in joint evaluation (JE) mode if they evaluate two (or more) options simultaneously (Hsee, 1996b). Among the many explanations of preference reversals between SE and JE (Bazerman, Tenbrunsel, & Wade-Benzoni, 1998; Kahneman & Miller, 1986), insofar the most parsimonious one is the evaluability hypothesis

(Bazerman, Moore, E., Wade-Benzoni, & Blount, 1999), which is later theorized in the general evaluability theory (GET) (Hsee & Zhang, 2010).

The evaluability hypothesis can be illustrated with a few examples. Hsee (1996) found that in SE, participants preferred the music dictionary that has 10,000 entries with its cover like new to the one that has 20,000 entries with its cover torn, but their preferences reversed in JE. Presumably, the desirability of the condition is easy-to-evaluate, whereas that of the number of entries is hard-to-evaluate. Another example is that when evaluating two political candidates, in SE, voters preferred the candidate who would create 5,000 new jobs and had no rumor to the one who would create 10,000 new jobs but had tax evasion rumor, but their preferences reversed in JE (Lowenthal, 1996). The evaluability hypothesis posits that an option has multiple attributes: some are easy to evaluate, and some are hard to evaluate in isolation. When people evaluate two options that involve trading off between an easy-to-evaluate attribute and a hard-to-evaluate attribute, their preferences for the two options may reverse between SE and JE. In JE, it is easier to compare and evaluate those hard-to-evaluate attributes that would have been dismissed or discounted in SE, making hard-to-evaluate attributes more influential in JE.

1.2 Research Motivation

Evaluation mode is worth investigating for several reasons.

First, evaluation mode is an important yet under-explored factor in decision-making research (J. Zhang, 2015), and currently there is a paucity of evidence on JE/SE preference reversals in the domain of health-related decisions. The GET and previous research on JE/SE preference reversals imply that in the context of health-related decision-making, laypeople's risk preferences may also

reverse between SE and JE. As mentioned earlier, the concept of risk is complex and multi-dimensional. While emotion-laden attributes such as severity and pain intensity may be relatively easy to evaluate, numerical attributes such as likelihood and prevalence can be hard to evaluate (Fetherstonhaugh, Slovic, Johnson, & Friedrich, 1997; Sandman, 1993; Slovic, Finucane, Peters, & MacGregor, 2004). Therefore, JE/SE preference reversals are likely to occur when laypeople face two options that involve a trade-off between an easy-to-evaluate risk attribute and a hard-to-evaluate risk attribute. However, insofar, the body of evidence demonstrating JE/SE preference reversals has accumulated mostly in the domain of consumer behavior and managerial decision-making, where the options rarely evoke threats or sense of non-monetary loss (Kahneman & Ritov, 1994; Bazerman, Moore, E., Wade-Benzoni, & Blount, 1999; Hsee & Leclerc, 1998; Sevdalis & Harvey, 2006; Paharia, Kassam, Greene, & Bazerman, 2009; Christopoulos, Kokkinaki, Harvey, & Sevdalis, 2011; Zhang, 2015). Even if one study observed JE/SE preference reversal in patients' health care decision (Zikmund-Fisher, Fagerlin, & Ubel, 2004), such evidence was highly contextualized and far from conclusive. Therefore, it is uncertain whether the JE/SE preference reversals are generalizable to health-related decisions that involve risks.

Second, if JE/SE preference reversals turned out to be generalizable, they could have important implications for risk communication. Risk information is notoriously hard to grasp for laypeople and challenging to communicate for risk communicators (Steel & Guest, 2013). While much research has focused on making knowledge more accessible and understandable to the public (Garcia-Retamero & Cokely, 2013; Peters, 2017; Trevena et al., 2013), such efforts often

prove time-consuming and even unsuccessful. For example, the public's vaccine hesitancy has not abated with increasing availability of knowledge on this issue (Larson, Cooper, Eskola, Katz, & Ratzan, 2011; Nyhan, Reifler, Richey, & Freed, 2014). Two recent meta-analysis reviews also conclude that evidence for the effectiveness of knowledge-based anti-stigma interventions is at best modest (Mehta et al., 2015; Thornicroft et al., 2016). As Rosenbaum (2014) remarks, "the problem is that once impressions have formed, whatever their source, educational efforts to address misperceptions often fail...in fact, sound scientific information that challenges beliefs can simply intensify those beliefs" (p. 1550-1551). Sometimes, unintended effects, such as obfuscation and social reproduction (cementing knowledge gap among social classes) may also arise from conflicting, confusing, or overly technological risk communication (Cho & Salmon, 2007).

Even if educational efforts work, they could not fully address the challenges of risk communication. Neither could emotional appeals (e.g. fear appeals, sadness appeals). Although emotional appeals are generally effective (Lu, 2016; Tannenbaum et al., 2015), such effectiveness is often accompanied with undesired effects. An emotional appeal that is too strong may cause excessive public concerns or emotional burnout (Cho & Salmon, 2007), it may also render subsequent emotional appeals less feasible as people quickly adapt to emotional stimuli with repeated exposure and need an even stronger emotional appeal to maintain the same effect (Frederick & Loewenstein, 1999). Moreover, the duration of effectiveness is often short, as attitude is never easy to change, nor does attitude translate easily to intended behaviors (Sheeran, 2002; Webb & Sheeran, 2006).

Fortunately, a third option is available – “nudge”, which is orthogonal to educational efforts and emotional appeals. A nudge refers to a small and seemingly insignificant detail of the choice architecture (decision environment) that may alter people’s behavior in a predictable way (Thaler & Sunstein, 2008, p. 6). Previous research has demonstrated how nudges have been successfully applied in health-related decisions (Hallsworth, 2016; Sunstein, 2014; Vlaev, King, Dolan, & Darzi, 2016). For example, people are highly affected by default options. Their food intake changes with the size of the default containers – they consume much more (>33%) snacks when serving from bigger containers even if the taste is stale (Wansink & Cheney, 2005; Wansink & Kim, 2005), and they stick to the default even for high-stake choice such as organ donation (Matjasko, Cawley, Baker-Goering, & Yokum, 2016). Designing a desired behavior as a default option, therefore, can work as a nudge.

In fact, evaluation mode can potentially work as a nudge. Similar to many other situational factors, a nudge is “supposedly irrelevant” to the target of evaluation or is imbedded in the decision environments (choice architecture), but has the potential to predictably change people’s preferences (Thaler, 2016, p. 9). Redesigns of choice architecture have recently been recognized as one of the most promising ways to help people wade through choices and make decisions that improve their well-being (Johnson et al., 2012; Weber & Johnson, 2009). By engineering option presentations that prompt laypeople to evaluate options in a certain evaluation mode, it is possible to nudge them to make health-related decisions in a more informed, value-based, and confident way.

To conclude, the scarcity of evidence on JE/SE preference reversals in the domain of health-related decisions and the potential application of evaluation

mode as a nudge in risk communication posit a research gap that is worthwhile to investigate—how evaluation mode affects laypeople’s health-related decisions, and what its boundary conditions could be.

1.3 Thesis Overview

This dissertation comprises a series of progressively designed experiments to investigate the effects of evaluation mode on laypeople’s health-related decisions, i.e., whether and how their preferences shift between SE and JE. I only consider health-related decision-making situations that involve risks, where neither dominant nor dominated option exists (there is no single option that is superior or inferior to the rest in all attributes). In other words, I only examine situations where at least some tensions, i.e. some necessities of making trade-offs exist, and make sure that such trade-offs are non-trivial and not straightforward to make, which reflects the reality that lay decision-makers often face. In real life, laypeople often cannot identify an optimal option, and need to resolve conflicts among incompatible goals (Coombs, 1987).

My dissertation aims to make theoretical contributions by 1) extending the GET framework from the domain of consumer behavior and managerial decision-making to the domain of health-related decision-making that involves risks, and 2) identifying possible boundary conditions for it. It aims to make practical contributions by discussing how the findings can offer insights for engineering health-related decision-making choice architecture that nudges people to make health-related decisions in a more informed, value-based, and confident manner.

The rest of the dissertation flows as follows. In chapter two, I first summarize a few characteristics peculiar to health-related decisions and argue

why preference reversals are more likely to occur in this context. Then I introduce the general evaluability theory and explicate evaluability of key risk attributes. Finally, based on the literature review and risk explication, I propose to test this general hypothesis: when laypeople face two options that involve a trade-off between an easy-to-evaluate risk attribute and a hard-to-evaluate risk attribute, their risk preferences will shift (even reverse) between SE and JE. More specifically, in SE, laypeople will prefer the option superior in the easy-to-evaluate attribute; in JE, they will prefer the option superior in the hard-to-evaluate attribute.

In chapter three, I present study 1a where I tested this hypothesis using one set of operational definitions of risk attribute evaluability. Study 1a examines laypeople's willingness to accept a potentially risky business travel assignment to a foreign country, where they trade off severity of loss (easy-to-evaluate) and likelihood of loss (hard-to-evaluate). The results show moderate preference shifts between SE and JE, though the direction of JE/SE shifts contradicts the prediction: participants were indifferent between the more-severe-but-less-likely hazard and the less-severe-but-more-likely one in SE, but they preferred to avoid the more-severe-but-less-likely hazard in JE.

In chapter four, I present study 1b where I conceptually replicated the findings of study 1a using another set of operational definitions of risk attribute evaluability: when the trade-off is between pain intensity (easy-to-evaluate) and prevalence (hard-to-evaluate) of health hazards. The results also show moderate preference shifts between SE and JE, and again the direction of JE/SE shifts contradicts the prediction: participants preferred to prevent the less-painful-but-

more-prevalent health hazard than the more-painful-but-less-prevalent one in SE, but they were indifferent between the two in JE.

In chapter three and four, I also review evidence for and against the hypothesized JE/SE preference reversals, discuss possible theoretical explanations and practical suggestions for experimental design.

Subsequently in chapter five, I introduce a moderator – attribute justifiability – to explain why the findings from study 1a and study 1b are not entirely consistent with the GET-derived hypothesis. I also introduce a few relevant co-variates and a new dependent variable – confidence during decision-making. Then I present study 2, which expands the scope of study 1 by investigating the boundary conditions of hypothesized JE/SE preference reversals. Study 2 examines how laypeople trade off an easy-to-evaluate *non-risk* attribute and a hard-to-evaluate *risk* attribute when attributes' relative justifiability (how relevant an attribute is for the decision-making task) vary. Study 2 investigates how the relative justifiability of costs affects laypeople's evaluations of two flu vaccines, where they trade off costs (easy-to-evaluate) and chance of side effects (hard-to-evaluate). The results show JE/SE preference reversals as predicted by the GET-derived hypothesis: participants slightly preferred the cheaper-but-less-safe vaccine in SE, but they strongly preferred the pricier-but-safer vaccine in JE. In addition, the degree of JE/SE preference shifts is contingent upon an attribute's relative justifiability: preferences reversed between SE and JE when the justifiability of costs was relatively high, but merely shifted when the justifiability of costs was relatively low.

In chapter six, I recapitulate the major findings, discuss how they relate to previous literature on JE/SE preference reversals, decision-making, and

particularly on its implications for risk communication. Then I make some practical advice for laypeople and risk communicators on how to consider evaluation mode in health-related decision-making. Further, I discuss how evaluation mode may work as a nudge and its ethical concerns. I also address some alternative explanations, limitations, and open questions about this research. I conclude this work with future directions and closing remarks.

CHAPTER TWO: LITERATURE REVIEW

In this chapter, I first introduce a few characteristics peculiar to health-related decisions and argue why preference reversals are likely to happen in the context of health-related decision-making. Then I introduce the general evaluability theory (GET) and explicate evaluability of key risk attributes. Lastly, I propose research questions and hypotheses based on GET and risk explication.

2.1 Characteristics of health-related decisions

Health-related decisions share many properties with general decision-making (Stiggelbout et al., 2015). They refer to decisions where certain aspects of one's health are at stake, either directly or indirectly. They typically involve outcomes with risks and uncertainties, where there is limited or controversial evidence as the basis of the decision and there is often no single option that is optimal for everyone (Balcetis & Granot, 2015).

One defining property of health-related decisions is that they are often difficult to make. The difficulty lies in their complexity (Balcetis & Granot, 2015; van Weert et al., 2016), which is inherited from the complexity of general decision-making process. Another defining property is that health-related decisions often involve risks that laypeople cannot fully grasp and understand (Sandman, 1993; Slovic, 1987; Turner et al., 2011). Those two properties make laypeople's health-related decisions prone to the influence of situational factors (Reyna, 2008; van Weert et al., 2016), such as to the one that this dissertation focuses on – evaluation mode.

Before elaborating what makes general decision-making complex, it is necessary to define what decisions are. Decisions are typically manifested by people's preference. In everyday use, the term preference assumes many

meanings, such as being favored, a priority of payment, or the right or chance to make a choice (see American Heritage Dictionary). In psychology and decision-making literature, preference has a more specific meaning, it refers to subjective comparative evaluations (Hansson & Grüne-Yanoff, 2018).

Preference is subjective in the sense that the evaluations are based on people's understanding, experience, and feelings, and are not necessarily anchored to objective facts. It is comparative in the sense that the evaluation of one option is often made in comparison with another option. Preference can take three major forms: choices, evaluations, or constructions (Yates, 1990). Choices refer to situations where the decision-maker encounters a set of alternatives and selects the best one among them. Evaluations refer to situations where the decision-maker indicates the value of alternatives, either one at a time or simultaneously. Constructions refer to situations where the decision-maker has to use the limited sources to create the most satisfactory option. Most previous literature on preference focuses on choices and evaluations (Koehler & Harvey, 2004).

It is worth noting that the term prefer does not strictly imply that more than one option are being evaluated. Although this is the case in early studies on preference reversals, where participants typically evaluate two options in seemingly equivalent manners — see review in Saposnik et al. (2016) and Soll, Milkman, & Payne (2015). But in later studies, scholars start to use the term “preference” more loosely. In particular, when Hsee (1996) introduced evaluation mode as a potential inducer of preference reversal, he used the phrase “participants prefer A to B in single evaluation mode, but prefer B to A in joint evaluation mode”, even though participants in single evaluation mode had no other option to compare with when evaluating the target option. This

use, though potentially problematic, has nevertheless been widely adopted. To be consistent with previous literature, I will use the term preference in the same tradition.

A decision can be seen as a response to a situation (Hastie & Dawes, 2010). In the context of health-related decision-making, such response may correspond to several distinctive courses of action. A decision-maker may decide to not to decide, e.g. postponing deciding when to do a physical examination, and tacitly choose inaction (error of omission) as a decision. A decision-maker can take proactive actions (e.g. take a screening test) when circumstances have not changed or take reactive actions (e.g. choose a treatment option) when circumstances have. Thus, the multiple courses of action manifest the complexity of health-related decisions.

Even if a course of action had been identified, the complexity remains. Because a decision-maker may need to consider multiple alternatives within each course of action, to evaluate key attributes of each alternative, then to decide which one to choose. In this sense, a decision can also be viewed as an allocation of resources (e.g. money, time, efforts) that is irrevocable, or requires additional resources (could be prohibitive in amount) to undo (Howard & Matheson, 1968, p. 23). The irrevocability creates significant tension in the deliberate decision-making process, compelling the decision-maker to balance four conflicting goals: maximise accuracy, minimize efforts, maximise transparency, and minimize emotional strain (Payne, Bettman, & Johnson, 1993).

Balancing those goals is challenging because the decision-maker has to make trade-offs – to achieve one goal usually means to forgo the other (Mankiw, 2015). Many types of bias and heuristics ensue during the process of making

trade-offs, which have been demonstrated by previous literature in judgment and decision-making. The most common ones include outcome bias, representative bias, availability bias, confirmation bias, hindsight bias, and the framing effects (Baron & Hershey, 1988; Koehler & Harvey, 2004; Tversky & Kahneman, 1974). Those biases and heuristics are largely applicable to health-related decisions, where decision-makers tend to exert less efforts in making careful trade-offs that result in poorer quality decisions (Balcetis & Granot, 2015; Elstein, 2009; Reyna & Brainerd, 2008; Saposnik et al., 2016).

Apart from complexity, health-related decisions also often involve risks, regardless of one-off (or rarely-made) decisions such as choosing cancer treatment (Reyna et al., 2015) and registering for advance care (Winter & Parker, 2007), or slightly more frequent decisions such as whether to take a vaccine (Reyna, 2012) or a screening test (Gigerenzer, 2016). Moreover, those decisions also involve making trade-offs. For example, Smokers have to trade off the risk of getting lung cancer if they continue to smoke against the risk of gaining weight if they quit (Filozof, Fernández Pinilla, & Fernández-Cruz, 2004). Middle-aged women have to trade off the risk of late diagnosis of breast cancer if they do not go for routine screenings against the risk of over-diagnosis if they do (Rosenbaum, 2014).

Ironically, the way that people make those complex and risky decisions do not vary greatly from the way they make trivial ones (Bazerman & Moore, 2013; Keeney, 2002). This implies that preference reversals that are prevalent in consumer-buying decisions (Lichtenstein & Slovic, 2006) are likely to occur in health-related decisions. In fact, they are more likely to happen, as the descriptions of available options are more diverse, the elicitation methods more

random, and the situational and contextual cues more unpredictable than that of typical consumer-purchasing decisions (Redelmeier, 1995).

2.2 Defining risk in the context of health-related decisions

Risk is also one of the most richly researched topics across the social and behavioral sciences (Fox et al., 2015). Economists, lawyers, environmentalists, psychologists, doctors, public health practitioners, health communicators – all talk about risks. However, scholars from different disciplines usually focus on only one or two dimensions of risk. It is thus not surprising to find risks being defined and described in a dozen of ways (Fischhoff, Hope, Watson, & Hope, 1990). As a result, consensus on risks is hard to reach. People disagree on how large a risk is – the risks that evoke public fear (e.g. nuclear power) are often considered minimal by the experts (Sjöberg, 1999). People also disagree about what constitutes a risk. As Fischhoff (1985, p. 89) posits, “people disagree more about what a risk is than about how large it is”. In fact, as Sandman remarks (1993, p. 2), the risks that kill people have little to do with risks that upset them.

In spite of the disagreements on the construct of risk, there appear to be some implicit underlying elements of risk that are common across disciplines and contexts (Yates & Stone, 1992). In fact, a closer examination indicates that *possibility* and *losses* are two common elements that echo throughout the literature on risk (Roeser et al., 2012). For example, in epidemiology and public health, risk is defined the probability that some particular adverse outcomes occur within certain period of time caused by factors such as environmental pollution, recreational drug use, malnutrition, physical inactivity, and unprotected sex (World Health Organization, 2009, p. v; Steel & Guest, 2013, p. 466). In economics, the risk can be seen as the chance of missing or failing to choose the

option with the optimal prospect (Kahneman & Tversky, 1979). In finance and business management, the risk refers to the possibility that an investment will yield financial loss or fail to achieve an expected return (Horcher, 2011). And when assessing safety of new technologies, the risk is defined as conditional probabilities of experiencing “threats to humans and what they value” (Hohenemser, Kates, & Slovic, 1985, p. 67-68).

Altogether, the elements of possibility and potential losses seem to have captured the essence of risk. In the context of health-related decisions, risk is defined as a possibility of experiencing potential losses (Yates & Stone, 1992). Both elements involve multiple dimensions, i.e. attributes, which I will explicate in a later section. In this dissertation, risk preference is simply used to describe patterns of observed behaviors of how people make trade-offs among risks (Hsee & Weber, 1999, p. 166). In this sense, risk preference is inferred through people’s choices or evaluations rather than from their attitude. Risk sensitivity refers to the degree to which people are responsive to variations of risk attributes.

As mentioned earlier, risk preferences are often elusive (Fox & Tannenbaum, 2011) because the risk is a multifaceted concept with several important dimensions that tap into both emotion and cognition (Roeser et al., 2012; Yates & Stone, 1992), which laypeople are not equally sensitive to. The reason that laypeople are not equally sensitive to various risk attributes is that those attributes are not equally evaluable – some are easier to evaluate, whereas others are harder to evaluate. Before explicating how evaluable general risk attributes are, it is necessary to introduce the general evaluability theory, which illuminates what factors may determine people’s risk sensitivity by distilling the key determinants of people’s general value sensitivity.

2.3 General evaluability theory

2.3.1 Historical background

The antecedent of the general evaluability theory (GET) is the evaluability hypothesis (Hsee, 1996b). The evaluability hypothesis was originally proposed as a mechanism to explain how evaluation mode can cause preference reversals. Before it was proposed, scholars had documented various occasions of JE/SE preference reversals and offered multiple theoretical accounts to explain why they occurred.

Hsee (1996b) reviewed those studies and suggested that most of seemingly independent observations of preference reversals could be explained using a single concept – evaluability. For example, one study found that when trying to resolve a confliction with neighbors, people seemed to prefer different resolution options in SE and JE (Bazerman et al., 1992). In SE, when they were presented with the following two options (p. 221), most participants considered option B more acceptable, but in JE, most considered option A more acceptable.

Option A: \$600 for self and \$800 for neighbor

Option B: \$500 for self and \$500 for neighbor

The authors attributed this JE/SE preference reversal to individuals' different concerns: they were more concerned with interpersonal comparison in SE, but were more concerned with payoffs in JE. Hsee (1996b) argues that this result could be re-interpreted in terms of attribute evaluability. The two resolutions options can be seen as varying on two attributes: 1) the absolute amount of payoff, 2) the fairness of the pay-off. Accordingly, the superiority of each option in the two attributes is illustrated in Table 2.1. While fairness is easy-to-evaluate in SE,

the pay-off is relatively hard-to-evaluate in SE, but it becomes easier to evaluate in JE.

Table 2.1

Evaluability and Relative Superiority of Two Resolution Options

	Option A	Option B	Superiority
Fairness (equality of pay-off) (easy-to-evaluate in SE)	Unequal	Equal	Option A < Option B
Pay-off (hard-to-evaluate in SE)	\$600	\$500	Option A > Option B

Similarly, many other JE/SE preference reversals could be re-interpreted from the account of evaluability. Apart from re-interpreting earlier findings, Hsee also empirically tested this hypothesis in various occasions. For example, Hsee (1996b) found that when evaluating two job candidates, student participants favored the candidate with higher GPA in SE, but they favored the candidate with more experience in JE. This preference reversal can be explained by students' relatively familiarity with GPA, which they must have found it very easy to evaluate. When interpreting this finding, Hsee (1996b) succinctly summarizes the core idea of the evaluability hypothesis – how attributes' evaluability affects their relative impacts in SE and JE:

Some attributes (such as one's GPA) are easy to evaluate independently, whereas other attributes (such as how many programs a candidate has written) are more difficult to evaluate independently. In SE, difficult-to-evaluate attributes have little impact in differentiating the evaluations of the target options, so that easy-to-evaluate attributes are the primary determinants of the evaluations of the target options. In JE, people can compare one option to the other. Through this comparison, difficult-to-evaluate attributes become easier to evaluate and hence exert a greater influence. Easy-to-evaluate attributes do not benefit as much from JE because they are easy to evaluate even in SE. This shift in the relative impact of the two attributes, if sufficiently large, will result in a JE/SE reversal. (p. 578)

Over the years, it has received growing empirical support and arguably offers the most parsimonious explanation for JE/SE preference reversals

(Bazerman et al., 1999; Hsee, 2000; J. Zhang, 2015). In the earliest demonstration of JE/SE preference reversals, however, the evaluability of an attribute is largely dependent on the evaluator's knowledge. Yet there are some other important determinants of evaluability, which are later explicated in GET (Hsee & Zhang, 2010).

2.3.2 Three determinants of evaluability

The general evaluability theory (GET) is an integrative theory that specifies value sensitivity, i.e. when one's evaluation is responsive to variations in value and when it is not. In GET, value is a general term that may refer to "a level of an objective attribute one cares about", whereas sensitivity refers to the degree to which "one's evaluation is responsive to variations in value" (p. 343). Price, probability, and risk, all of them are instances of values.

GET posits that value sensitivity is dependent on evaluability. Evaluability is defined as "the extent to which a person has relevant reference information to gauge the desirability of target values and map them onto evaluation" (Hsee & Zhang, 2010, p. 344). GET proposes three basic constructs as the key determinants of evaluability, corresponding to three sources of reference information: nature, knowledge, and evaluation mode. Each of them can be categorized as having high or low levels of evaluability (see Table 2.2). Accordingly, high evaluability leads to high value sensitivity, and vice versa.

Table 2.2
Three Determinants of Evaluability by Levels of Evaluability

Determinant of evaluability	Low evaluability level	High evaluability level
Evaluation mode	SE	JE
Knowledge	Poor	Rich
Nature	Inherently unevaluable	Inherently evaluable

Note. Adapted from Hsee (2010), p. 345

Nature refers to the innate source of evaluability, where human beings are endowed with a stable physiological or psychological scale to evaluate values of an attribute (p. 345). For example, most people can instinctively tell whether the room temperature is pleasant to them or not. They can also instantly feel whether they are deprived of sleep, whether they are under stress (S. Cohen & Wills, 1985), and whether they are well connected with their social network (Berkman & Syme, 1979). In general, attributes will have high evaluability if they are inherently evaluable.

Knowledge refers to the acquired source of evaluability. It is mostly gained through learning and familiarization and is manifested by the quantity and quality of distributional information (e.g., mean, range, and variation) that one possesses about the attribute (p. 345). It usually takes much time and effort to acquire knowledge. For example, a well-trained physician can interpret medical graphs and statistics that seem alien to laypeople, because they have spent years in accumulating knowledge on how to make a diagnosis. In general, attributes will have high evaluability if the evaluator has rich knowledge on them.

Evaluation mode is orthogonal to both nature and knowledge. It refers to the condition under which values are presented and evaluated. People engage in single evaluation (SE) mode if they evaluate one single option in isolation, and they engage in joint evaluation (JE) mode if they evaluate two (or more) options simultaneously (Hsee, 1996b). In general, attributes will have higher evaluability when it is evaluated in JE than in SE.

2.3.3 JE/SE preference reversals

JE/SE preference reversal may happen when laypeople evaluate two options that involve a trade-off between two attributes that differ in evaluability. Apart from the dictionary example elaborated in Section 1.1, JE/SE preference reversal can be illustrated by another example. One study (Bazerman, Schroth, Shah, Diekmann, & Tenbrunsel, 1994) found that when evaluating two jobs, MBA students preferred the one with a lower salary (\$60,000) and a better work culture (democratic) to the other with a higher salary (\$75,000) and a worse work culture (hierarchical) in SE, but their preferences reversed in JE.

The originally evaluability hypothesis does not specify the source of attribute evaluability, and simply predicts, “when two stimulus options involve a trade-off between a hard-to-evaluate attribute and an easy-to-evaluate attribute, the hard-to evaluate attribute has a lesser impact in SE than in JE, and the easy-to-evaluate attribute has a greater impact in JE than in SE.” (Hsee, 1996b, p. 250). According to GET, an attribute could be easy-to-evaluate either because of nature (one can evaluate it intuitively) or because of knowledge (one is very knowledgeable to judge the value of that attribute).

More specifically, when evaluating options that involve a trade-off along an easy-to-evaluate attribute versus a hard-to-evaluate attribute, GET predicts that laypeople will favor the option that is superior on the easy-to-evaluate attribute in SE but favor the option that is superior on the hard-to-evaluate attribute in JE. However, preference may not reverse between SE and JE when the superiority of either attribute is too small. For instance, MBA students may favor a lower-paid (\$60,000/year)-better-work-culture job in SE and favor a better-paid (\$75,000/year)-worse-work-culture job in JE. But if the salary of the better paid job is only \$68,000, they might favor the lower-paid job in JE as well.

In other words, preference reversals would only occur when the difference between the two attributes' relative impacts is sufficiently large. Otherwise, preferences may merely shift, instead of reverse, between JE and SE.

To predict the patterns of JE/SE preference reversals in the context of health-related decisions that involve risks, it is necessary to explicate the evaluability of risk attributes under the GET framework.

2.4 Explicating the evaluability of risk attributes

In this dissertation, since the health-related decisions I focus on involve risks, the value that I am focusing on is the risk. Correspondingly, the sensitivity of concern is risk sensitivity. To understand how risk sensitivity is determined by the evaluability of risk attributes, it is necessary to explicate risk attributes using the key concept from GET – evaluability.

In the following section, I will review the relevant literature and explicate risk attributes in terms of evaluability, i.e. whether they are easy-to-evaluate or hard-to-evaluate.

As reviewed in Section 2.2, *possibility* and *potential losses* are two common elements that echo throughout the literature on risk (Yates & Stone, 1992), and thus are seen as two key attributes of risk.

2.4.1 Possibility

Possibility can be interpreted from two perspectives: qualitative or quantitative. From the qualitative perspective, the possibility of losses merely suggests a binary outcome – the losses may or may not occur. For example, people may ask, is it possible for the bird flu virus to transmit from person to person? Is it possible to eradicate the whole human race with a nuclear explosion? In those questions, what people are chiefly concerned with is to know whether it

is viable for some unwanted outcome to occur or not. From the quantitative perspective, the possibility of losses can be seen as the statistical probabilities that potential losses may happen, and its value may fall upon any value on the continuum from zero to one. Alternatively, it can be inferred from the magnitude (width) of losses, such as instances or prevalence of such losses (Steel & Guest, 2013). Although the quantitative possibility is more informative than the qualitative one, it usually comes with higher variance and uncertainty, which make it harder to evaluate for the laypeople.

Quantitative possibility, when it is manifested in terms of probability, is usually harder to evaluate independently than qualitative one for laypeople, and it is also harder to communicate for risk communicators (Steel & Guest, 2013; Trevena et al., 2013). It has been proposed in prospect theory and fuzzy trace theory (Reyna, 2008; Tversky & Kahneman, 1992) and demonstrated in experiments (Hsee, Zhang, Wang, & sZhang, 2013) that as long as probabilities do not involve extreme values, e.g. certainty (100%) or impossibility (0%), people's sensitivity toward probabilities are generally low. For example, people may view 0% and 1% radically different, but they may view 1% and 5% only marginally different (Hsee, Zhang, Wang, et al., 2013).

Quantitative possibility, when it is manifested in terms of magnitude, also tend to be hard to evaluate independently because scope insensitivity (psychological numbing) is a well-established psychological effect (Fetherstonhaugh et al., 1997). As reviewed by Hsee and colleagues (2013), people generally do not make much sense about the scope (e.g. size, duration, and magnitude) of an outcome that they are concerned with, particularly when information on scope is evaluated separately. For example, when asked to donate

to a project that aims to protect birds from drowning, participants' willingness to donate only increased marginally when the number of affected birds rose from 2,000 to 200,000 (Devousges et al., 1993).

2.4.2 Loss

The significance of loss is highly dependent on the nature and the severity of loss (Yates & Stone, 1992). The nature of loss can be understood from two perspectives. The first is concerned with the domain, and the second is concerned with the cause. Loss may occur in multiple domains, such as financial loss and health loss. The same loss may also be caused by different causes. One could contract communicable diseases by voluntary (unsafe sex) or involuntary behaviors.

The nature of loss is generally easy to evaluate for two reasons. First, domain is categorically different. Laypeople generally can distinguish a health loss from a financial loss intuitively. Just like people are born with a hierarchy of needs (Maslow, 1943), they may also have an innate hierarchy of loss, thus they are highly sensitive to the domain of loss. Second, laypeople also tend to be sensitive to the causes of loss, especially when moral issues are involved (Sjöberg, 2000). As demonstrated by a study on the social dilemma of self-driving cars, laypeople regarded car accidents caused by self-driving cars much more unacceptable than those caused by human drivers (Bonnefon, Shariff, & Rahwan, 2016).

The severity of loss is also generally easy to evaluate because human beings usually possess an innate scale to evaluate it. As human beings are endowed with a comprehensive internal regulation system to respond to and interact with the external environment (Bear, Connors, & Paradiso, 2014), they

can evaluate the intensity and desirability of many stimuli effortlessly. For example, they can easily tell whether the room temperature is pleasant, whether the steak is juicy, or whether the proportion is pleasing to the eye. Such acuity is not constrained to physiological stimuli only, it also applies to psychological domain (Hsee, Yang, Li, & Shen, 2009). For example, the French sociologist Durkheim found that people are acutely aware of the presence or absence of social integration, the lack of which can be detrimental to a person's well-being (Durkheim, 1951).

2.4.3 Operationalizing possibility and loss by evaluability

In the context of health-related decisions that involve risks, the quantitative possibility (such as likelihood and prevalence) is usually hard-to-evaluate, because laypeople generally do not possess sufficient health literacy to decipher such information (Davis et al., 2009; Lipkus, 2007; Reyna & Brainerd, 2008). In contrast, the nature and severity of loss are generally easy-to-evaluate as they possess innate scales, both physical and psychological, to evaluate them.

2.5 Research questions and hypotheses

Based on the literature review on JE/SE preference reversals and the explication of the evaluability of risk attributes, I propose the following research question: will JE/SE preference shifts/reversals occur in the context of health-related decisions that involve risks?

First, I review the general GET hypothesis on JE/SE preference reversals:

Hypothesis 1 (option x evaluation mode): When a decision-maker evaluates two options that involve a trade-off between two attributes: one is superior in the hard-to-evaluate attribute (option A), whereas the other is superior

in the easy-to-evaluate attribute (option B), preferences for the two options will shift (even reverse) between SE and JE.

More specifically, as illustrated in Figure 2.1, the decision-maker will favor option B more in SE than in JE, and favor option A more in JE than in SE.

Figure 2.1. Conceptual illustration of H1, derived from Hsee and Zhang (2010, Fig.2)

Note. The figure is only illustrative, it emphasizes the how the relative preference of each option changes from SE to JE, and it does not assume that there is no main effects of option or evaluation mode.

Second, based on the explication of the evaluability of risk attributes, I derive a hypothesis from the above hypothesis when the trade-off is between two risk attributes.

H 1: When a decision-maker evaluates two options that involve a trade-off between two *risk* attributes: quantitative possibility (hard-to-evaluate) and loss (nature / severity) (easy-to-evaluate), preferences for the two options will shift (or even reverse) between SE and JE.

More specifically, the option that is superior in the easy-to-evaluate risk attribute (option B) will be favored in SE, whereas the option that is superior in the hard-to-evaluate risk attribute (option A) will be favored in JE.

In the context of travelling hazards evaluation, **H1** predicts that when faced with two travelling destinations: one is associated with a more-severe-but-less-likely hazard (country A) and the other is associated with a less-severe-but-more-likely one (country B), participants' travelling willingness to the two countries will shift (even reverse) between SE and JE. They will favor country B more in SE than in JE, and they will favor country A more in JE than in SE (**H1.1**).

In the context of health hazards evaluation, **H1** predicts that when faced with two health hazards: one is more-painful-but-less-prevalent (stomach cancer) and the other is less-painful-but-more-prevalent (stroke), participants' preferences of hazard prevention will shift (even reverse) between SE and JE. They will prefer to prevent stomach cancer more in SE than in JE, and they will prefer to prevent stroke in JE than in SE (**H1.2**).

CHAPTER THREE: STUDY 1A

3.1 Overview

This study seeks to test H1.1 by examining participants' willingness to accept a potentially risky business travel assignment to a foreign country. In this study, the risk attributes of concern are severity of loss and likelihood of loss. Accordingly, the trade-off that participants face is between a more-severe-but-less-likely travelling hazard (Ebola infection / Diarrhoea infection) and a less-severe-but-more-likely one (mobile phone theft / music-player theft).

Recall H1.1: When a decision-maker evaluates two options that involve a trade-off between two risk attributes: one incurs more-severe-but-less-likely losses (option A), whereas the other incurs less-severe-but-more-likely losses (option B), preferences for the two options will shift (even reverse) between SE and JE. More specifically, the decision-maker will favor option B more (i.e., prefer to avoid option A) in SE than in JE, and they will favor option A more (i.e., prefer to avoid option B) in JE than in SE.

In the context of travelling hazards evaluation, H1.1 predicts that when faced with two travelling destinations: one is associated with a more-severe-but-less-likely hazard (country A) and the other is associated with a less-severe-but-more-likely one (country B), participants' travelling willingness to the two countries will shift (even reverse) between SE and JE. They will favor country B more in SE than in JE, but they will favor country A more in JE than in SE.

3.2 Methods

3.2.1 Design.

A randomized between-subject experiment was designed to test the proposed hypothesis. This experimental design aimed to elicit participants' risk

preferences by gauging participants' willingness to accept a promising but risky business assignment to a foreign country with certain travelling hazards. Three versions (as illustrated in Table 3.1) of questionnaires were designed to examine whether participants' travel willingness differed between single and joint evaluation mode. Participants assigned to SE reported their travel willingness to either country, while those assigned to JE reported both.

Table 3.1
Illustration of Between-Subject Design

Target of Evaluation	Between-subject factor: Evaluation mode		
	Single Evaluation		Joint Evaluation
	Version 1	Version 2	Version 3
	Country A only	Country B only	Country A and B (counter-balanced)

The pair of travelling hazards was designed to create a meaningful trade-off between two risk attributes: severity of loss and likelihood of loss. One country was associated with a more severe but less likely hazard, whereas the other was associated with a less severe but more likely hazard. While the severity was deemed easy-to-evaluate, the likelihood was deemed hard-to-evaluate in SE (see Table 3.2).

The design and procedure of this study were examined and approved by the institutional review board (IRB) at Nanyang Technological University (see Appendix A for the IRB approval letter).

Table 3.2
Illustration of the Relative Superiority of Each Travelling Hazard

	Country A	Country B	Superiority
Severity (easy-to-evaluate in SE)	Severity-A	Severity-B	Country A < Country B
Likelihood (hard-to-evaluate in SE)	Likelihood-A	Likelihood-B	Country A > Country B

3.2.2 Participants.

For the pilot study (for manipulation pretesting), a total of 81 participants were recruited from M-turk (see Appendix C for full questionnaire). There were more females (58.0%) than males (40.7%), and 1.2% preferred not to reveal their sex, around half of them (53.1%) aged between 18 to 34 years old, and 43.2% of them had college degree.

For the main study, a total of 180 participants were recruited from Amazon Mechanical Turk (M-turk), an online crowdsourcing platform that provides a variety of human intelligence service, including data validation, content moderation, and survey participation. They were adults residing in the United States and had a HIT (Human Intelligence Task) approval rate ¹ above 88%. Their age ranged from 20 to 68 years old ($M = 36.4$, $SD = 10.5$). The gender ratio was well-balanced, with 46.7% females and 52.8% males (0.6% preferred not to reveal their sex), and most participants (60.0%) had college degree.

The number of participants for each evaluation mode condition was balanced, $\chi^2(2) = .133$, $p = .936$. Fifty-eight and 60 participants were randomly assigned to SE, where they evaluated the travelling assignment to *either* country A *or* country B in isolation. Another 62 were randomly assigned to JE, where they evaluated the travelling assignment to both country A and country B simultaneously.

Among the 180 participants, 7 answered at least one of the two attention check questions wrongly. The percentage (3.9%) of those that failed the attention

¹ HIT approval rate proxies M-Turk workers' reputation as a reliable worker. It is measured as the percentage of completed tasks that are approved by the requesters. The higher the rate is, the more reliable and attentive the workers are considered to be.

check was acceptable. However, to be consistent with study 1b where 14.0% of participants failed the attention check, a more conservative approach (Hoaglin & Iglewicz, 1987; Hoaglin, Iglewicz, & Tukey, 1986) was used to remove outliers – only those answers of dependent variables that deviated at least 3 *SDs* from the mean were removed and replaced with the mean. This approach was considered conservative because by definition, if the outcome variables had perfect normal distribution, 99.7% of the data will fall within 3 *SDs*. In my sample, less than 2% data were replaced with the mean as the outcome measures were mostly normal. This outlier handling process would have only a minor effect on the analysis results. Although alternative methods exist to impute data for the outliers, such as item mean substitution, person mean substitution, and regression imputation (Fichman & Cummings, 2003; Rosenthal, 2017; Schafer & Graham, 2002), those imputation methods are probably more applicable to survey data with larger sample size and more predictors. See Appendix H for a sensitivity analysis of using different outlier handling procedure.

3.2.3 Procedure.

The whole experiment was administered on online platforms – M-turk and Qualtrics, and participants spent an average of 5.9 (*SD* = 4.8) minutes in finishing the questionnaire. Eligible participants signed up for this paid study on M-turk, then were instructed to click a Qualtrics survey link to start the questionnaire. The experimental procedures can be conceptually organized into four stages: consent-giving, random assignment, scenario presentation, and travelling hazard(s) evaluation.

Participants were asked to carefully read the study information sheet <IRB-2017-08-039> (see Appendix B). After indicating consent, they were

randomly assigned to three evaluation mode conditions (see Section 3.2.5 for details). Participants then read the travel assignment scenario and indicated how willing they were to travel to the described country with certain travelling hazards. After finishing the evaluation, they proceeded to answer a questionnaire regarding their risk attitude and demographics. During the scenario presentation and evaluation, they were asked a few questions to check whether they paid sufficient attention to the experimental scenario.

3.2.4 **Pilot study.**

The objective of this pilot study was to validate two pairs of manipulation stimuli that would be used in the main study. This study aimed to validate that severity of loss is easy to evaluate while likelihood of loss is hard to evaluate. Two between-subjects factorial survey experiments were conducted to validate the manipulation stimuli (see Appendix C for the full questionnaire). To avoid scale re-norming (flexible interpretation of scales in different contexts), the manipulation stimuli were designed based on a common modulus-based measurement of loss (Hsee & Tang, 2007). Scale re-norming is a type of measures bias. It often arises in studies that adopt a between-subject design where participants report judgment that are context dependent. Scale re-norming is a type of measures bias. It often arises in studies that adopt a between-subject design where participants report judgments that are context dependent. For example, when asked to rate the size of two numbers – 9 and 221, participants rated the former larger than the latter using the semantic differential scale anchored on “small” and “large”. Presumably, participants who evaluated the size of 9 compared the former with other single-digit numbers, whereas those who evaluated the size of 221 compared it with other three-digit numbers.

Therefore, the counter-intuitive result that 9 was judged to be bigger than 221 seemed to be an arbitrary finding induced by scale re-norming.

A common-module-based measurement is designed to mitigate scale re-norming (Hsee & Tang, 2007). It works by introducing a common referent that participants are familiar with and ask participants to report judgment in comparison to the common-module-based measurement.

The common-module-based measurement is relevant to my study because one key concept of my study -- loss -- is a relative concept. Losing \$100 might seem painful compared to losing \$1, but might not seem painful compared to being infected with a rare disease. Because participants might judge the same loss differently under different contexts, which might obscure result interpretation, I decided to use a common-module-based measurement when designing experimental stimuli and doing manipulation checks. I will also further discuss re-norming in Section 5.4.1, point two. See Appendix C for the complete questionnaire used for pre-testing.

The results of pre-tests are presented in Table 3.3. For the high-stake travelling hazards, participants perceived Ebola infection as more severe than mobile theft, $t(80) = 4.64$, $p < .001$, $d = 0.95$. They also considered Ebola infection' severity significantly easier to evaluate than its likelihood, $t(80) = 1.72$, $p = .045$, $d = 0.41$, and similarly for mobile theft, $t(80) = 3.41$, $p < .001$, $d = 0.86$. For the low-stake pair, participants perceived diarrhoea infection as more severe than music-player theft, $t(80) = 1.96$, $p = .027$, $d = 0.44$. They also considered diarrhoea infection' severity significantly easier to evaluate than its likelihood, $t(80) = 2.21$, $p = .015$, $d = 0.46$, and similarly for music-player theft, $t(80) = 1.65$, $p = .051$, $d = 0.34$. Therefore, both high-stake and low-stake travelling hazards

were evaluated as intended and were subsequently used as experimental stimuli in the main experiment.

Table 3.3

Pre-test Results of the Relative Superiority and Relative Evaluability of Travelling Hazards

		<i>Ms and SDs</i>			
		Relative Superiority		Relative Evaluability	
		Severity	Likelihood	Evaluability	Likelihood
High-stake	Country A				
	(Ebola infection)	74.9 (21.4)	6 cases /year	6.31 (2.94)	5.27 (2.56)
	Country B	51.8	12,000 cases	7.19	5.44
	(Mobile theft)	(24.2)	/year	(2.16)	(2.03)
Low-stake	Country A				
	(Diarrhoea)	63.1 (27.9)	600 cases /year	6.39 (2.46)	4.50 (2.85)
	Country B	50.9	6,000 cases	6.40	5.40
	(Music-player theft)	(27.6)	/year	(1.96)	(2.92)

Note. The relative severity ranges from 0 (not severe at all) to 100 (extreme severe). The relative evaluability ranges from 0 (hard to evaluate) to 10 (easy to evaluate). The relatively likelihood ranges from 0 (not likely) to 10 (highly likely).

3.2.5 Experimental Manipulations.

Evaluation mode. Evaluation mode was manipulated between-subject.

Participants assigned to the two SE conditions would report their travel willingness to either country A or country B, whereas those assigned to the JE condition did so for both countries.

Trade-off of travelling hazards. In this study, the two travelling hazards involved a trade-off between severity of loss and likelihood of loss. The levels of those two risk attributes were designed to be well-balanced such that the relative superiority of each was noticeable yet not dominating so as to make meaningful trade-offs possible. The two pairs of pre-tested travelling hazards were used to create the trade-offs, as shown in Table 3.4.

Table 3.4
Severity and Likelihood of Travelling Hazards by Country and Stake

	Travelling Hazards	
	Country A	Country B
High-stake	Ebola infection; 6 cases/year	Mobile theft; 12,000 cases/year
Low-stake	Diarrhoea infection; 600 cases/year	Music-player theft; 6,000 cases/year

Scenario presentation. A hypothetical scenario on taking a promising but risky business trip to a foreign country was developed to solicit participants' risk preferences. They were instructed to read the following passage carefully before reporting their travel willingness:

Imagine your employer has assigned you an important field project, requesting you to travel to a foreign country for a few months. If you take the assignment, you will get a promotion. After some background checking, however, you realize that this assignment involves some risks. You found out that this country

Country A has a higher incidence of infectious diseases than where you live. Within the past year, [high-stake: 6 cases of Ebola infection / low-stake: 600 cases of diarrhoea infection] were reported in this country.

Country B has a higher rate of theft than where you live. Within the past year, [high-stake: 12,000 cases of mobile phone theft / low-stake: 6,000 cases of music player theft] were reported in this country.

Faced with this situation, how much are you willing to take this business assignment?

3.2.6 Measures

The online questionnaire comprised questions and scales measuring (a) attention check, (b) travel willingness, (c) travel preference (for JE only), (d) risk attitude, and (e) demographics.

Attention check. One question was used to check whether participants paid sufficient attention to the experimental stimuli. It read: "Please tick the hazard(s) that you have just read about (select all relevant choice(s))." and had

six choices: Ebola infection [correct], Mobile phone theft [correct], diarrhoea [correct], music player theft [correct], Zika infection [wrong], digital camera theft [wrong]. Most participants (96.1%) passed the attention check. In addition, a pair of confirmation questions were used to help participants make sense of the trade-off they faced, and participants were required to answer them after reading the scenario. The first question read: “Before indicating your answer, are you aware that certain risks?” It had two choices: “Yes, it has some safety concerns,” “No, it is risk free this business assignment entails.” The second question read: “Before indicating your answer, are you also aware that promises certain rewards?” Again, it had two choices: “Yes, it has some career opportunities,” “No, it does not promise any rewards.”

Travel willingness. The main dependent variable, operationalized as participants’ willingness to take the travel assignment, was designed to capture their risk preference. Participants were asked: “How willing are you to take this business travel assignment?” Then they reported their willingness on a 11-point Likert scale, from 0 (*not willing at all*) to 10 (*very willing*). Comparison of participants’ travel willingness to country A (B) was made between participants that were assigned to SE that evaluated country A (B) and those that were assigned to JE that evaluated country A (B).

Travel preference (for JE only). Participants assigned to the JE condition were asked to choose which country they preferred to go before indicating their travel willingness. They were asked: “Faced with this situation, and if you had to take this assignment, which country do you prefer to travel?” Then they chose either country A or country B.

Risk attitude. Including risk attitude as a covariate in the ANCOVA analysis had two general purposes. First, including covariates would reduce within-group error variance, which helped isolate the effects of experimental manipulation. Second, it might eliminate confounding effects (variables other than the experimental manipulation that affect the outcome measures). In my study, risk attitude in the health domain was also particularly relevant as people's willingness to take health risks were not only affected by the presentation of experimental scenarios, but also by their domain-specific inclinations of risk-taking (Figner & Weber, 2011; Nicholson et al., 2005). That's why I included risk attitude as a covariate, and only selected the risk-taking scale in the domain of health and safety. Blais and Weber's (2006) risk-taking scale in the health/safety domain was used to measure participants' health-related risk attitude. This subscale comprised of six items: "Drinking heavily at a social function," "Engaging in unprotected sex," "Driving a car without wearing a seat belt," "Riding a motorcycle without a helmet," "Sunbathing without sunscreen," and "Walking home alone at night in an unsafe area of town". For each item, participants rated on a 11-point Likert scale (a) the gut feeling of how risky each situation or behaviour was, from 0 (*not at all risky*) to 10 (*extremely risky*) and (b) the likelihood of engaging in the described activity or behavior, from 0 (*extremely unlikely*) to 10 (*extremely likely*). The scale had reasonable reliability in both dimensions, $\alpha_a = .84$, $\alpha_b = .90$.

Demographics. Participants were asked for their age, sex, education level, and annual household income (see Appendix E for the full questionnaire).

3.3 Results

3.3.1 Manipulation checks.

The stimuli used in the main study have been pre-tested with a similar sample, and the pre-test results are presented in Section 3.2.4, thus they were not further checked in the main study.

3.3.2 Descriptive and bivariate analysis.

To identify co-variables to be included in the ANCOVA analysis, a correlation analysis was conducted to explore the relationships among the dependent variable – travel willingness – and potential co-variables. Since all of them are non-normally distributed according to the Kolmogorov-Smirnov normality tests (all p s < .001), Spearman's correlation coefficients are reported.

As shown in

Table 3.5, for high-stake hazards, travel willingness had a weak, positive, and significant relationship with risk attitude (perceived riskiness of common health-related risky activities), and a moderate, positive, and significant relationship with risk attitude (likelihood of engaging in those activities). For low-stake hazards, the relationship between travel willingness and risk attitude (perceived riskiness) was negligible and non-significant, meanwhile the relationship between travel willingness and risk attitude (likelihood of engaging) remained moderately and significantly positive. For simplicity and consistency, only risk attitude (likelihood of engaging) was included as a covariate in the ANCOVA model. See Table 3.6 for descriptive statistics of travel willingness.

Table 3.5

Correlations among Dependent Variables and Potential Covariates by Hazards Stake

	High-stake Hazards			Low-stake Hazards		
	1	2	3	1	2	3
1. Travel willingness	1			1		
2. Risk attitude - perceived riskiness	.196*	1		.059	1	
3. Risk attitude - likelihood of engaging	.334**	0.098	1	.380**	.020	1

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3.6

Unadjusted Mean and SDs of Travel Willingness by Evaluation Mode and Health Hazards

	High-stake Hazards				Low-stake Hazards			
	Ebola infection		Mobile theft		Diarrhoea		Music- player theft	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Single Evaluation	7.55	1.45	7.76	1.38	7.03	2.50	7.67	1.49
Joint Evaluation	4.94	3.66	7.29	1.68	6.06	3.12	7.26	2.48

Note. The willingness of travel ranges from 0 (not willing at all) to 10 (very willing).

3.3.3 Hypothesis tests.

Hypothesis 1.1 predicts that when a decision-maker faces two options that involve a trade-off between two risk attributes: severity of loss (inherently easy-to-evaluate) versus likelihood of loss (inherently hard-to-evaluate), preferences for the two options will shift (even reverse) between SE and JE. More specifically, if a employee were given a risky travelling assignment associated with two travelling hazards that differ in severity and likelihood, s/he would be less willing to travel to the country with more-significant-but-less-likely hazard in SE, but

more willing to travel there in JE. The patterns of preference shifts shall apply to both high-stake and low-stake hazards, though may be to a different extent.

High-stake hazards. A two-way ANCOVA with risk attitude (likelihood of engaging in common health-related risky activities) as a covariate was carried out to find out if participants' travelling preferences for countries with high-stake hazards – country A (Ebola infection) and country B (mobile theft) – shifted (or reversed) between SE and JE. This analysis revealed significant main effects of evaluation mode [$F(1, 117) = 9.36, p = .003, \eta_p^2 = .074$] and travelling hazard [$F(1, 117) = 12.50, p = .001, \eta_p^2 = .097$]. It also revealed significant main effects of the covariate risk attitude [$F(1, 117) = 12.66, p = .001, \eta_p^2 = .098$]. In general, regardless of which travelling hazard participants evaluated, they were more willing to accept the risky travelling assignment in SE ($M_{\text{adjusted}} = 7.49, SE = 0.28$) than in JE ($M_{\text{adjusted}} = 6.27, SE = 0.28$). And regardless of which evaluation mode participants evaluated in, they were more willing to travel to country B with the risk of mobile theft ($M_{\text{adjusted}} = 7.57, SE = 0.27$) than to country A with the risk of Ebola infection ($M_{\text{adjusted}} = 6.19, SE = 0.28$).

The interaction between travelling hazard and evaluation mode was also significant (see Figure 3.1), $F(1, 117) = 6.18, p = .014, \eta_p^2 = .050$. This effect indicated that participants' relative willingness to accept the risky travelling assignment to country A and country B was moderated by evaluation mode. Across evaluation mode, participants' travel willingness to country A dropped considerably from SE to JE, $F(1, 117) = 14.92, p < .001, \eta_p^2 = .113$, meanwhile their travel willingness to country B was barely affected from SE to JE, $F(1, 117) = 0.21, p = .648, \eta_p^2 = .002$. Specifically, as shown by the planned comparisons, in SE, participants had a slight and non-significant preference for country B (M

adjusted = 7.70, $SE = 0.39$) compared to country A ($M_{\text{adjusted}} = 7.29$, $SE = 0.41$), $F(1, 117) = 0.54$, $p = .464$, $\eta^2_p = .005$. Whereas in JE, participants had a strong and significant preference for country B ($M_{\text{adjusted}} = 7.45$, $SE = 0.39$) compared to country A ($M_{\text{adjusted}} = 5.09$, $SE = 0.39$), $F(1, 117) = 18.54$, $p < .001$, $\eta^2_p = .137$. Participants' ratings of travel willingness were consistent with their direct choices. Among the 31 participants that were assigned to the JE condition, when asked to choose directly which country they preferred to travel, most of them ($n = 23$, 74.2%, $p = .01$, 95% CI [55.4%, 88.1%]) chose country B).

Figure 3.1. Travel willingness for the high-stake health hazards (adjusted for covariates) by evaluation mode

Note. Covariates appearing in the model are evaluated at the following values: Risk attitude (likelihood of engaging) = 5.11

Low-stake hazards. Another two-way ANCOVA with the same covariate was conducted to find out whether the above findings were also applicable to travelling assignments associated with low-stake hazards – country A (diarrhoea infection) and country B (music-player theft). This analysis revealed only

marginally significant main effects of evaluation mode [$F(1, 115) = 3.54, p = .062, \eta_p^2 = .030$] and travelling hazard [$F(1, 115) = 2.97, p = .088, \eta_p^2 = .025$]. The main effects of the covariate risk attitude became even stronger compared to high-stake hazards [$F(1, 115) = 20.54, p = .001, \eta_p^2 = .152$]. Participants were generally more willing to accept the risky travelling assignment in SE ($M_{\text{adjusted}} = 7.40, SE = 0.30$) than in JE ($M_{\text{adjusted}} = 6.61, SE = 0.29$), though the effect size was not as big as that of the high-stake hazards. Participants were also generally more willing to travel to country B with the risk of music-player theft ($M_{\text{adjusted}} = 7.37, SE = 0.30$) than to country A with the risk of diarrhoea infection ($M_{\text{adjusted}} = 6.65, SE = 0.30$), and again, the effect size was not as big as that of the high-stake hazards.

Interestingly, for low-stake hazards, the interaction between travelling hazard and evaluation mode was not significant (see Figure 3.2), $F(1, 115) = 1.24, p = .268, \eta_p^2 = .011$. The non-significant interaction suggested that participant's relative travel willingness – the degree of preferring to travel to country B than to country A did not differ much between SE and JE. Nevertheless, the planned comparisons revealed some differences regarding participants' travel willingness across travelling destinations and evaluation mode. On one hand, the degree of decrease in travel willingness differed slightly for the two countries. Participants were much less willing to travel to country A in JE ($M_{\text{adjusted}} = 6.02, SE = 0.41$) than in SE ($M_{\text{adjusted}} = 7.28, SE = 0.43$), $F(1, 115) = 4.45, p = .037, \eta_p^2 = .037$. However, they were only slightly less willing to do so for country B in JE ($M_{\text{adjusted}} = 7.21, SE = 0.41$) than in SE ($M_{\text{adjusted}} = 7.53, SE = 0.43$), $F(1, 115) = 0.293, p = .589, \eta_p^2 = .003$. On the other hand, the degree of preference for country B also differed between SE and JE. In SE, participants had a slight and

non-significant preference for country B ($M_{\text{adjusted}} = 7.53$, $SE = 0.43$) compared to country A ($M_{\text{adjusted}} = 7.28$, $SE = 0.43$), $F(1, 115) = 0.178$, $p = .674$, $\eta^2 = .002$. Whereas in JE, participants had a significant preference for country B ($M_{\text{adjusted}} = 7.21$, $SE = 0.41$) compared to country A ($M_{\text{adjusted}} = 6.01$, $SE = 0.41$), $F(1, 115) = 4.20$, $p = .043$, $\eta^2 = .035$. Participants' ratings of travel willingness were quite consistent with their direct choices. Among the 30 participants that were assigned to the JE condition, when asked to choose directly which country they preferred to travel, more participants chose country B ($n = 19$, 63.3%, $p = .20$, 95% CI [43.9%, 80.1%]) over country A, although the strength of preference was non-significant yet for the given sample.

Figure 3.2. Travel willingness for the low-stake health hazards (adjusted for covariates) by evaluation mode

Note. Covariates appearing in the model are evaluated at the following values: Risk attitude (likelihood of engaging) = 4.83

3.3.4 Summary.

Evaluation mode and travelling hazard had significant main effects regardless of the stake. Although the interaction effect was only significant for the high-stake hazards, not for the low-stake hazards, the interaction patterns

were very similar as shown in Figure 3.1 and Figure 3.2. The results from ANCOVA show that preferences for the travelling hazards shifted moderately, though did not reverse, between SE and JE. Participants were less willing to accept the risky travelling assignment in JE than in SE, for both high-stake and low-stake travelling hazards. In SE, participants were indifferent between country A (with the more-severe-but-less-likely) and country B (with the less-severe-but-more-likely hazard) in SE, but in JE, they had a strong preference for country B. The JE/SE preference shifts occurred regardless of the stake of travelling hazards, though the degree of preference shifts was higher for the high-stake ones. However, the the direction of the preference shifts is contradictory to what hypothesis 1.1 predicts. Instead of finding the less-severe-but-more-likely hazard more acceptable in SE, participants were indifferent between the two; instead of finding the more-severe-but-less-likely more acceptable in JE, participants actually found it much less acceptable. In sum, the SE/JE preference shifts did occur, but the direction of shifts was opposite to the prediction. Overall, the main results did not support hypothesis 1.1.

3.4 Discussion

3.4.1 Preliminary interpretations

The purpose of study 1a was to test whether the hypothesized JE/SE preference shifts/reversals occur in the context of health-related decision-making by examining participants' willingness to accept a risky business assignment that involves a trade-off between severity of loss (easy-to-evaluate) and likelihood of loss (hard-to-evaluate).

The observed patterns of JE/SE preference shifts suggest that the dynamics of how participants' preferences shifted between SE and JE may be

more nuanced than hypothesized. On one hand, as severity of loss is easy to evaluate independently, the less-severe-but-more-likely hazard's superiority in severity should be salient in SE, yet participants were indifferent between the two hazards. On the other hand, as likelihood of loss becomes easier to evaluate in JE, it should have rendered the less-severe-but-more-likely hazard's superiority in likelihood, which is somewhat masked in SE, more salient in JE. Ironically, participants found it less acceptable in JE.

There are several possible explanations to account for the contradictory findings. One possibility is that participants could have inferred the type of destination countries from the type of travelling hazards, and subsequently revealed their preferences based on the inferred, rather than the presented information. Although the scenario presentation emphasizes the comparability of the two countries except in traveling hazards, Ebola infection is typically associated with least developed countries in Africa while mobile phone theft is common in most countries. Since Ebola infection connotes more negative imagery, participants might find country A less appealing if they tried to infer which country it corresponded to in reality. The temptation to infer might be stronger in JE than in SE, when participants were trying to compare two countries and to decide which the overall better option was.

Another possibility is that the trade-off participants faced was between two categories of loss: possession loss (mobile phone theft/ music player theft) versus health loss (Ebola infection/ diarrhoea infection), and participants may prioritize reconciling these category differences over trading off the attribute differences in JE. Ritov and Kahneman (1997) suggest that JE/SE preference reversals could be explained by *norm theory* (Kahneman & Miller, 1986) when

the two options belong to different categories. According to this account, when people evaluate a single option, they evoke a set of internal referents to make better sense of the option, but when they evaluate multiple options, they could use other options as the referents, and if the options are from different categories, they will focus on reconciling those category differences first. For example (Kahneman, Ritov, & Schkade, 1999), when asked about their of two issues and their willingness to contribute, participants were more willing to contribute to the ecological issue “coral reefs degradation caused by cyanide fishing” in SE, but their preference reversed to the human welfare issue “multiple myeloma among the elderly” in JE (p. 219). The categorical difference between the two issues – humans vs. coral reefs – became salient once they were compared directly. Similarly, when participants compared the two travelling hazards in JE, they might become aware of the different categories of loss and considered health loss more unacceptable compared with possession loss, therefore preferring country B to country A in JE.

3.4.2 Limitations.

This study has one limitation that need to be addressed. The travel assignment scenario that I used for hypothesis-testing might not be particularly relevant to the participants – M-turk workers that reside in the United States. U.S. residents generally do not travel often. When they do, they prefer domestic than international travelling destinations, as indicated by the percentage of citizens that hold a passport. According to the U.S. Deaprtment of State (2018), this figure was 42% in 2017, and it was as low as 3% in 1989. Therefore, it might be difficult for them to imagine the travelling assignment task.

To rule out those explanations, I designed and conducted study 1b, where participants would make more relevant health-related decisions, face trade-off hazard options that were designed to be of the same category and less likely to draw inference information from.

CHAPTER FOUR: STUDY 1B

4.1 Overview

The primary goal of this study is to conceptually replicate findings from study 1a by using a different operational definition of evaluability of risk attributes under a different trade-off situation. The secondary goal is to rule out the alternative explanations discussed in study 1a by refining the design of experimental stimuli. In so doing, I could gauge the reliability and generalizability of findings from study 1a as well as investigating why H1.1 was not fully supported in study 1a.

This study seeks to test H1.2 by examining participants' perceived price fairness of a magic pill that can protect them from a potential health hazard but comes at a considerable cost. In this study, the risk attributes of concern are intensity of loss (pain intensity of health hazards) and magnitude of loss (prevalence of health hazards). Accordingly, the trade-off that participants face was between a more-painful-but-less-prevalent health hazard (stomach cancer) and a less-painful-but-more-prevalent one (stroke).

Recall H1.2: When a decision-maker evaluates two options that involve a trade-off between two risk attributes: one incurs more-painful-but-less-prevalent losses (option A), whereas the other incurs less-painful-but-more-prevalent losses (option B), preferences for the two options will shift (even reverse) between SE and JE. More specifically, the decision-maker will favor option B more (i.e., prefer to avoid option A) in SE than in JE, and they will favour option A more (i.e., prefer to avoid option B) in JE than in SE.

In the context of health hazards evaluation, H1.2 predicts that when faced with two health hazards: one is more-painful-but-less-prevalent (stomach cancer)

and the other is less-painful-but-more-prevalent (stroke), participants' preferences of hazard prevention will shift (even reverse) between SE and JE. They will prefer to prevent stomach cancer more in SE than in JE, and they will prefer to prevent stroke more in JE than in SE.

Unlike study 1a, where participants might draw difference inference from the traveling hazards, in study 1b, both hazards are among the leading causes of death among developed countries (World Health Organization, 2018a). Unlike study 1a, where the travelling hazards belonged to two categories, in study 1b, the hazards were set in the same category – non-communicable disease. Therefore, even if participants were still tempted to draw inference from the health hazards, the inference should be more or less comparable. In addition, they would not need to consider category differences, either.

4.2 Methods

4.2.1 Design.

A randomized between-subject experiment was designed to test H1.2. This experimental design aimed to elicit participants' risk preferences by asking them to evaluate a costly magic pill that offered a life-time exemption of two potentially severe health hazards. Three versions (as illustrated in

Table 4.1) of questionnaires were designed to gauge whether participants evaluated the magic pill deal differently between SE and JE. Participants assigned to SE evaluated either hazard, while those assigned to JE evaluated both.

Table 4.1
Illustration of Between-Subject Design

	Between-subject Factor: Evaluation Mode		
	Single Evaluation		Joint Evaluation
	Version 1	Version 2	Version 3
Target of Evaluation	Hazard A only	Hazard B only	Hazard A and B (counter-balanced)

The pair of health hazards were designed to create a meaningful trade-off between two risk attributes: Pain intensity and prevalence. One health hazard was more painful but less prevalent, whereas the other was less painful but more prevalent. While the pain intensity was deemed easy-to-evaluate, the prevalence was deemed hard-to-evaluate in SE (see Table 4.2).

The design and procedure of this study were examined and approved by the institutional review board (IRB) at Nanyang Technological University (see Appendix A for the IRB approval letter).

Table 4.2
Illustration of the Relative Superiority of Each Health Hazard

	Hazard A	Hazard B	Superiority
Pain intensity (easy-to-evaluate in SE)	Pain-A	Pain-B	Hazard A < Hazard B
Prevalence (hard-to-evaluate in SE)	Prevalence-A	Prevalence-B	Hazard A > Hazard B

4.2.2 Participants.

For the pilot study (for manipulation pretesting), a total of 97 participants were recruited from M-turk (see Appendix D for full questionnaire). There were more females (58.8%) than males (40.2%), and 1.03% preferred not to reveal their sex, most of them (58.7%) aged between 18 to 34 years old, and about half of them (46.4%) had college degree.

For the main study, a total of 215 participants were recruited from Amazon Mechanical Turk (M-turk), an online crowdsourcing platform that provides a variety of human intelligence service, including data validation, content moderation, and survey participation. They were adults residing in the United States and had a HIT approval rate above 90%. There were slightly more male (55.3%) than female (43.7%) participants (0.9% preferred not to reveal their sex), most of them (64.7%) aged between 18 to 34 years old, and about half of them (48.8%) had college degree.

The number of participants for each evaluation mode condition was balanced, $\chi^2(2) = .484, p = .785$. Seventy-three and 75 participants were assigned to evaluate stroke-prevention-deal and stomach-prevention deal in SE, and 67 were assigned to evaluate both deals in JE.

Among the 215 participants, 30 answered at least one of the two attention check questions wrongly. Since the percentage (14.0%) of those that failed the attention check was relatively high, removing them might introduce some unintended demographic bias (Anduiza & Galais, 2017; Berinsky, Margolis, & Sances, 2016). The outliers were handled in the same way as explained in Section 3.2.2. See Appendix H for a sensitivity analysis of using different outlier handling procedure.

4.2.3 Procedure.

The whole experiment was administered on the online platforms – M-turk and Qualtrics, and participants spent an average of 5.3 ($SD = 2.7$) minutes in finishing the questionnaire. Eligible participants signed up for this paid study on M-turk, then were instructed to click a Qualtrics survey link to start the questionnaire. The experimental procedures can be conceptually organized into

five stages: consent-giving, random assignment, pre-evaluation, scenario presentation, and final evaluation.

Participants were asked to read carefully the study information sheet <IRB-2017-08-039> (see Appendix B). After indicating consent, they were randomly assigned to three evaluation mode conditions (see Section 4.2.5 for details). All participants were asked to evaluate the pain intensity and prevalence of the two health hazards, which served two aims. The first was for manipulation check, and the second was to prime participants to evaluate the magic pill deal based on the hazards' pain intensity and prevalence as asking them about those would increase the accessibility (Tversky & Kahneman, 1974) and eases the representation (Levav & Fitzsimons, 2006) of the two criteria. Afterwards, participants read the magic pill scenario, evaluated how fair the corresponding hazard prevention deal was. After finishing the evaluation, they proceeded to answer a questionnaire regarding their risk attitude and demographics. In addition, they answered a few questions to check whether they paid sufficient attention during the experiment.

4.2.4 Pilot study

The objective of this pilot study was to validate two pairs of manipulation stimuli that would be used in the main study. This study aimed to validate that pain intensity is easy to evaluate while prevalence is hard to evaluate. Two between-subjects factorial survey experiments were conducted to validate the manipulation stimuli (see Appendix D for the full questionnaire). In addition, the relative superiority of pain intensity and prevalence effects should be designed such that it is noticeable yet not dominating so as to make meaningful trade-offs possible.

Two pairs of health hazards (stroke versus stomach cancer; snake bite versus severe flu) were pre-tested to see whether they met the requirements of relative evaluability and relative superiority specified in Table 4.2. The two pairs were chosen based on their actual and perceived pain intensity and prevalence. Both stroke and stomach cancer are among the leading causes of death, with stroke and stomach cancer caused 5.78 million and 0.76 million of deaths globally in 2016, according to World Health Organization (2016a, 2018a). Stroke is mostly painless, and only certain types of stroke (e.g. haemorrhagic stroke) cause moderate pain, which affect less than one third of patients (Jönsson, Lindgren, Hallström, Norrving, & Lindgren, 2006). In contrast, stomach cancer is often considered one of the most painful cancer types (Sykes, Bennet, & Yuan, 2008). Therefore, stroke is more prevalent but less painful than stomach cancer. Similarly, severe influenza is also more prevalent (World Health Organization, 2016b) but less painful than deaths caused by snake bite.

The results of pre-tests are presented in Table 4.3. For the first pair of health hazard, participants perceived snake bite as more painful than severe flu, $t(96) = 2.00, p = .048, d = 0.21$, and they perceived severe flu as more prevalent than snake bite, $t(96) = 6.92, p < .001, d = 0.65$. However, they did not consider snake bite' pain intensity significantly easier to evaluate than its prevalence, $t(96) = 1.06, p = .289, d = 0.12$, nor was the case for severe flu, $t(96) = 1.27, p = .207, d = 0.12$. For the second pair, participants perceived stomach cancer as more painful than stroke, $t(96) = 6.24, p < .001, d = 0.72$, and they perceived stroke as more prevalent than stomach cancer, $t(96) = 6.66, p < .001, d = 0.59$. Moreover, they also considered stomach cancer' prevalence significantly harder

to evaluate than its pain intensity, $t(96) = 8.28, p < .001, d = 0.82$, and the case was similar though weaker for stroke, $t(96) = 1.82, p = .072, d = 0.16$.

Therefore, the second pair generally met the requirements and was selected for use in the subsequent experimental manipulations.

Table 4.3
Pre-test Results of the Relative Superiority and Relative Evaluability of Health Hazards

		<i>Ms and SDs</i>			
		Relative Superiority		Relative Evaluability	
		Pain Intensity	Prevalence	Pain Intensity	Prevalence
Pair 1	Stomach Cancer	7.85 (1.79)	4.87 (2.32)	6.93 (2.39)	4.96 (2.78)
	Stroke	6.15 (2.37)	6.23 (2.10)	6.18 (2.46)	5.78 (2.56)
Pair 2	Snake Bite	6.97 (1.86)	3.03 (2.55)	5.93 (2.60)	5.59 (2.77)
	Severe Flu	6.58 (1.84)	4.68 (2.44)	6.08 (2.32)	5.79 (2.43)

Note. The pain intensity ranges from 0 (not painful at all) to 10 (very painful). The prevalence ranges from 0 (very low) to 10 (very high). The relative evaluability of pain intensity and prevalence ranges from 0 (hard to evaluate) to 10 (easy to evaluate).

4.2.5 Experimental Manipulations.

Evaluation mode. Evaluation mode was manipulated between-subject. Participants assigned to the two single evaluation conditions would evaluate either the stroke prevention deal or the stomach cancer prevention deal. Participants assigned to the joint evaluation condition would evaluate both deals.

Trade-off of health hazards. The validated pair of health hazards (stroke vs. stomach cancer) was used to create a trade-off between pain intensity and prevalence. To further strengthen the manipulation, in the main study, explicit information on pain intensity and prevalence were provided before scenario

presentation. The prevalence information was based on World Health Organization (2016a). The intensity of pain for the two health hazards are illustrated using Wong-Baker FACES pain rating scale (2016), as shown in Figure 4.1:

Figure 4.1. Illustration of pain intensity for two health hazards.

Scenario presentation. A hypothetical scenario on a hazard-prevention magic pill was developed to solicit participants' risk preferences. They were instructed to read the following passage carefully before proceeding to evaluating the deal:

Imagine there is a magic pill, which can protect you from [one and only one health hazard: stroke or stomach cancer]. If you buy it now, you will never suffer from it in your lifetime, but it would cost you \$5,000² (about 1.5 months' median personal income in the U.S.). Do you think the deal is worth it?

² Three price tags (\$1,000, \$5,000, \$10,000) of the magic pill were pre-tested. When the price tag of the magic pill was set at \$1,000, the deal was seen as overwhelmingly superb regardless which hazard it promises to prevent. Whereas when the price tag was set at \$10,000, it was seen as overwhelmingly poor. In the end, the \$5,000 price tag was selected as it enabled most participants to make a meaningful evaluation of the magic pill.

4.2.6 Measures

The online questionnaire comprised questions and scales measuring (a) attention check, (b) manipulation checks, (c) perceived price fairness, (d) deal preference (for JE only), (e) qualitative feedback, (f) risk attitude, and (g) demographics.

Attention check. Two questions were used to check whether participants paid sufficient attention to the experimental stimuli. The first question read: “Please tick the health hazards that you have just read about (select all relevant choice(s)).” and had six choices: stomach cancer [correct], stroke [correct], heart disease [wrong], diabetes [wrong], kidney disease [wrong], liver cancer [wrong]. The second question read: “How much does the magic pill cost?” It had four choices: \$500 [wrong], \$1,000 [wrong], \$5,000 [correct], \$10,000 [wrong]. Only 86.0% of participants answered both questions correctly. And since 14% of participants failed the attention check, which was relatively high, it might introduce demographic bias to remove all of those as outliers. Therefore, those that failed attention check were retained for analysis.

Manipulation checks. A pair of questions was used to check the relative superiority of each health hazard in terms of pain intensity and prevalence. The questions on pain intensity read: “How painful do you think a person dying of stroke/stomach cancer (depending on the experimental condition) would experience relative to other general causes of death?” Participants answered them on an 11-point Likert scale, from 0 (*not painful at all*) to 10 (*extremely painful*). The question on prevalence read: “How many people do you think are dying of stroke annually? Are the death tolls high or low relative to other general causes of death?” Participants answered them on an 11-point Likert scale, from 0 (*very low*) to 10 (*very high*).

A follow-up question was used to check the relative evaluability of pain intensity and prevalence. It appeared right after the question on pain intensity and prevalence, and it read: “How sure are you of your estimation?” Participants answered them on an 11-point Likert scale, from 0 (*not sure at all*) to 10 (*very sure*).

Perceived price fairness. The main dependent variable, operationalized as participants’ judgment of price fairness of health hazard prevention deals, was designed to capture their risk preferences³ across evaluation mode. Participants were asked: “If you could buy the magic pill to prevent [stroke / stomach cancer], how fair would you consider the deal to be in terms of price?” Then they rated the deal on an 11-point Likert scale, from 0 (*poor deal*) to 10 (*superb bargain*). Comparison of participants’ perceived price fairness of stroke (stomach cancer) prevention deal was made between participants that were assigned to SE that evaluated stroke (stomach cancer) prevention deal and those that were assigned to JE that evaluated stroke (stomach cancer) prevention deal.

Deal preference (for JE only). Participants assigned to the JE condition were asked to choose their preferred deal before indicating the perceived price fairness. They were asked: “Which deal of the magic pill do you think is more worth it: to prevent stomach cancer, or to prevent stroke?” Then they chose from two options: “to prevent stroke,” “to prevent stomach cancer”.

³ Willingness to buy seems to be the first choice for dependent variable, but as the magic pill is a hypothetical product, I reckon participants’ willingness to buy may be confounded with their perception of the implausibility of the scenario. Therefore, judgment of price fairness was chosen instead, which was also used in previous study (Christopoulos et al., 2011).

Qualitative feedback. Participants were asked to explain what factors they considered when judging the price fairness of the magic pill deal. This question helped prompt participants to elaborate and justify their preferences based on the pain intensity and prevalence criteria that they were exposed to earlier.

Risk attitude. Blais and Weber's (2006) risk-taking scale in the health/safety domain was used to measure participants' health-related risk attitude (see Section 3.2.6 for details). The scale had reasonable reliability in both dimensions, $\alpha_a = .81$, $\alpha_b = .87$.

Demographics. Participants were asked for their age, sex, education level, and annual household income (see Appendix F for the full questionnaire).

4.3 Results

4.3.1 Manipulation checks.

Two experimental manipulations were checked to examine whether they worked as intended. The first manipulation was the relative evaluability of two risk attributes (intensity versus magnitude of loss) associated with health hazards. The second manipulation was the relative superiority of two health hazards in terms of intensity and magnitude of loss.

A paired-samples t-test was performed to verify whether the intensity of loss (pain intensity associated with stroke and stomach cancer) was easier to evaluate than the magnitude of loss (their corresponding global death tolls). On average, participants felt much surer when evaluating pain intensity ($M = 6.31$, $SD = 2.65$) compared to global death tolls ($M = 5.38$, $SD = 2.70$). This difference, 0.93, 95% CI [0.61, 1.27], was significant, $t(276) = 5.53$, $p < .001$, and

represented a medium-sized effect (P. Cohen, 2014), $d = 0.34$, indicating that pain intensity was indeed easier to evaluate.

Two independent t-tests were used to verify whether stomach cancer was perceived more painful, whereas stroke was perceived more prevalent. Indeed, participants considered stomach cancer ($M = 7.89$, $SD = 1.73$) substantially more painful than stroke ($M = 6.13$, $SD = 2.58$), $t(242.9)_4 = 6.69$, $p < .001$, $d = 0.68$. In contrast, they considered stroke ($M = 6.21$, $SD = 2.26$) considerably more prevalent than stomach cancer ($M = 4.80$, $SD = 2.50$), $t(271.1)_5 = 4.96$, $p < .001$, $d = 0.57$.

In conclusion, both manipulations worked well.

4.3.2 Descriptive and bivariate analysis.

To identify co-variables to be included in the ANCOVA, a correlation analysis was conducted to explore the relationships among the dependent variable – perceived price fairness – and potential co-variables. Since all of them are non-normally distributed according to the Kolmogorov-Smirnov normality tests (all $ps < .01$), Spearman's correlation coefficients are reported. As shown in Table 4.4, perceived price had a moderate, positive, and significant relationship with perceived susceptibility to health hazards, and the relationship strength was moderate. Perceived price also had a weak, positive, and significant relationship with risk attitude (perceived riskiness of common health-related risky activities), but its relationship with risk attitude (likelihood of engaging in those activities) was negligible and non-significant. Therefore, perceived susceptibility and risk

^{4,5} The degree of freedom of t-statistics was adjusted using the Welch-Satterthwaite method since the Levene's test indicated that the equal variances assumption was violated, $p < .05$.

attitude (perceived riskiness) were included as covariates in the ANCOVA model.

See

Table 4.5 for descriptive statistics of the above-mentioned key variables.

Table 4.4

Correlations among Dependent Variables and Potential Co-variables

	1	2	3	4
1. Perceived price fairness	1			
2. Perceived susceptibility	.412**	1		
3. Risk attitude - perceived riskiness	.159**	.219**	1	
4. Risk attitude - likelihood of engaging	.081	.220**	-.182**	1

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4.5

Unadjusted Mean and SDs of Key Variables by Health Hazards

	Average		by Health hazards			
			Stroke		Stomach Cancer	
	Mean	SD	Mean	SD	Mean	SD
Perceived price fairness	7.03	2.70	7.65	2.52	6.32	2.71
Perceived price fairness (SE)	6.34	2.89	7.22	2.71	5.49	2.81
Perceived price fairness (JE)	7.69	2.27	8.12	2.23	7.25	2.24
Perceived susceptibility	4.33	2.66	5.25	2.45	3.24	2.5
Risk attitude - perceived riskiness	7.23	1.66	N/A			

Note. The perceived price fairness ranges from 0 (not fair at all) to 10 (very fair). The perceived susceptibility ranges from 0 (very low) to 10 (very high).

4.3.3 Hypothesis tests.

Hypothesis 1.2 predicts that when a decision-maker faces two options that involve a trade-off between two risk attributes: Intensity of loss (easy-to-evaluate) versus magnitude of loss (hard-to-evaluate), preferences for the two options will shift (even reverse) between SE and JE. More specifically, if a consumer were given a magic pill deal that offers life-long exemption of two health hazards that involves a trade-off between pain intensity and prevalence, s/he would prefer to prevent the more-painful-but-less-prevalent hazard (stomach cancer) in SE, but the less-painful-but-more-prevalent hazard (stroke) in JE.

A two-way ANCOVA with perceived susceptibility and risk attitude as covariates was carried out to find out if participants' preferences for the stroke-prevention deal and the stomach-cancer-prevention deal shifted (or reversed) between SE and JE. This analysis revealed significant main effects of evaluation mode [$F(1, 274) = 15.8, p < .001, \eta^2_p = .055$] and marginally significant main effects of health hazard [$F(1, 274) = 3.64, p = .057, \eta^2_p = .013$]. The main effects were also significant for the covariate perceived susceptibility [$F(1, 274) = 36.7, p < .001, \eta^2_p = .118$], indicating that the more susceptible participants considered themselves to those health hazards, the fairer they perceived the deals to be. However, the main effects were non-significant for the covariate risk attitude (perceived riskiness), $F(1, 274) = 1.02, p = .314, \eta^2_p = .004$. In general, regardless of the hazards, participants considered the deals fairer in JE ($M_{\text{adjusted}} = 7.58, SE = 0.21$) than in SE ($M_{\text{adjusted}} = 6.45, SE = 0.19$). In addition, regardless of the evaluation mode, they considered the stroke-prevention deal ($M_{\text{adjusted}} = 7.31, SE = 0.21$) fairer than the stomach-cancer-prevention deal ($M_{\text{adjusted}} = 6.72, SE = 0.21$).

The interaction effect between health hazard and evaluation mode was non-significant (see FigureTable 4.2), $F(1, 274) = 1.59, p = .208, \eta_p^2 = .006$. However, two planned comparisons clearly revealed that participants judged the price fairness of the two deals differently between SE and JE. In SE, participants preferred the deal that prevents stroke ($M_{\text{adjusted}} = 6.92, SE = 0.28$) to the one that prevents stomach cancer ($M_{\text{adjusted}} = 5.98, SE = 0.28$), $F(1, 274) = 5.30, p = .022, \eta_p^2 = .019$. Whereas in JE, participants judged the perceived price fairness slightly higher, though non-significantly, for the stroke-prevention deal ($M_{\text{adjusted}} = 7.69, SE = 0.30$) than the stomach-cancer-prevention deal ($M_{\text{adjusted}} = 7.47, SE = 0.30$), $F(1, 274) = 0.285, p = .594, \eta_p^2 = .001$. When judging the price fairness for stroke prevention deal, participants rated it significantly fairer in JE than in SE, $F(1, 274) = 3.75, p = .054, \eta_p^2 = .013$. The same pattern also emerged for the stomach-cancer-prevention deal, and to an even greater extent, $F(1, 274) = 13.68, p < .001, \eta_p^2 = .048$.

Figure 4.2. Perceived price fairness of two health-hazard-prevention deals (adjusted for covariates) by evaluation mode

Note. Covariates appearing in the model are evaluated at the following values: Perceived susceptibility = 4.23, risk attitude (perceived riskiness) = 7.26.

However, it is worth noting that unlike in study 1a, where participants' ratings of travel willingness were largely consistent with their direct choices, in the current study, their ratings of perceived deal fairness were inconsistent with their direct choices. Among those 67 participants that were assigned to the JE condition, when asked to choose directly which deal they preferred, most of them ($n = 52$, 77.5%, $p < .001$, 95% CI [65.8%, 86.9%]) chose to prevent stroke. In other words, although their preference for the stroke-prevention was weak and non-significant based on the ratings of the perceived price fairness, such preference was strong and significant based on direct choice. This issue will be elaborated in Section 4.4.1. Meanwhile, for sake of consistency with study 1a and relevant previous literature, the discussion will focus on results generated from the ANCOVA.

In sum, despite the non-significant interaction effect between health hazard and evaluation mode, the simple effects analysis suggested that hypothesis 1.2 was supported in the sense that preferences for the two deals did shift to a certain extent between SE and JE. Surprisingly, the direction of the shift was opposite to what was hypothesized. Participants are predicted to consider it fairer to prevent stomach cancer in SE and consider it fairer to prevent stroke in JE. The results suggested that participants preferred the stroke-prevention deal rather than the stomach-cancer-prevention deal in SE. In addition, although they slightly preferred the stroke-prevention deal in JE, the strength of preference was non-significant. In this sense, hypothesis 1.2 was not supported.

4.3.4 Summary.

The results of study 1b were similar to that of study 1a. Hypothesis 1.2 was supported in the sense that preferences for the two health hazards did shift

to a certain extent between SE and JE: they shifted, though did not reverse, between SE and JE. In general, participants perceived the price of the health-hazard-prevention deals fairer in JE than in SE. In SE, participants preferred the stroke-prevention deal to the stomach-cancer-prevention deal, but in JE, they were indifferent between the two. The JE/SE preference shifts were similar for both deals, though to a greater extent for the stomach-cancer prevention deal. Hypothesis 1.2 was not supported in the sense that the direction of the preference was opposite to what was hypothesized. Instead of preferring to avoid the more-painful-but-less-prevalent health hazard in SE, participants actually preferred to avoid the less-painful-but-more-prevalent one; instead of preferring to avoid the less-painful-but-more-prevalent health hazard in JE, participants were indifferent between the two. In sum, findings of study 1b conceptually replicated that of study 1a.

4.4 Discussion

4.4.1 Preliminary interpretations.

The main goal of this study was to gauge the reliability and generalizability of findings from study 1a. It tested whether the hypothesized JE/SE preference shifts/reversals would occur (H1.2) by examining participants' perceived price fairness of a costly magic pill that offered a lifetime exemption of two potentially severe health hazards that involved a trade-off between pain intensity and prevalence. The main results did not support hypothesis 1.2, which conceptually replicated findings from study 1a.

The observed patterns of JE/SE preference shifts are not consistent with the GET-derived hypothesis. On one hand, as pain intensity is easy to evaluate independently, the superiority of preventing the more-painful-but-less-prevalent

hazard should be salient in SE, yet participants preferred to prevent the less-painful-but-more-prevalent one. On the other hand, as prevalence becomes easier to evaluate in JE, it should have made the superiority of the deal that prevents the less-painful-but-more-prevalent hazard more salient in JE; however, participants were indifferent between the two.

Since this study addressed the issues of hazards' confounding inference and category differences that appeared in study 1a, the contradictory findings of the current study could not be attributed to these two factors. However, the contradictory findings might be explained by a few alternative mechanisms.

First, some particular characteristics of stroke might partially explain why the stroke-prevention deal was preferred over the stomach-cancer-prevention deal in SE. Most participants probably have family members or relatives who have suffered from stroke since it is the second leading cause of death (World Health Organization, 2018a). Although stroke itself is relatively painless, participants might be aware of its potential complications, such as loss of consciousness, limited mobility, and sensory impairment (U.S. Centers for Disease Control and Prevention, 2019), all of which might evoke similar negative affective responses that pain intensity does. Therefore, although participants were primed with questions only on pain intensity and prevalence, the complications of stroke might be more available, accessible (Tversky & Kahneman, 1974), and with more vivid negative imagery (Slovic, Finucane, Peters, & MacGregor, 2002) to them than that of stomach cancer, leading them to consider stroke-prevention deal fairer in SE.

Second, the between-subject experimental design might also partially explain why participants were indifferent between the two deals in JE. The price

tag of the magic pill – \$5,000 – was designed so that participants would find it neither too intimidating nor too affordable. Yet participants assigned to the JE condition might be less price-sensitive than those assigned to the SE conditions. In SE, since participants only evaluated one deal, they might pay much attention to the salient attribute – price tag. In contrast, in JE, since participants evaluated two deals that had the same price, they might adopt the elimination-by-aspect heuristic (Tversky, 1972) and consider other attributes instead, thus became less price-sensitive and felt indifferent between the two deals. This explained why participants’ ratings of perceived deal fairness were inconsistent with their direct choices in JE — although their ratings showed an indifference between the two deals, their choices revealed a strong preference for the stroke-prevention deal in JE as hypothesis 1.2 predicts.

One may argue that the rating-choice inconsistency could be a manifestation of response biases. As Birnbaum (1999) reviews, rating-choice inconsistency often arise from judgment-related studies that adopt a between-subject design. However, this study was unlikely to be susceptible to the bias of scale re-norming (flexible interpretation of scales in different contexts, see Section 4.2.4 for more details), as the price tag of the magic pill – an absolute rather than a relative anchor – was held constant across all experimental conditions. Therefore, participants’ preferences were elicited based on a common modulus-based measurement (Hsee & Tang, 2007), which made comparison across conditions meaningful and legitimate. It should be further noted that more researchers used the between-subject design than the within-subject design in demonstrating the JE/SE preference reversals (J. Zhang, 2015), and the robust

effects of evaluation mode could not be entirely attributed to the choice of experimental design even if it proved crucial.

Third, the idea of *loss multiplicity* might explain why both stroke-prevention and stomach-cancer-prevention deals had higher perceived price fairness in JE than in SE. It might also explain why participants in study 1a were less willing to travel to both countries in JE (see Section 0). Loss multiplicity is a term coined by Yates and Stone (1992), it suggests that a single event may incur losses from multiple domains, and the significance of losses increases with the number and the importance of those domains. For example, the massive BP oil spill that swept the Gulf of Mexico in 2010 has resulted in injuries and casualties of BP personnel, underwater facilities explosion, and massive destruction of the water ecosystem, which altogether amplified the risk of deep-water oil drilling (Office of the Maritime Administrator, 2011). In JE, as participants evaluated two health hazards, they were likely to ruminate more domains of losses than participants that evaluated only one hazard in SE. Accordingly, the heightened risk perception was reflected by participants' higher perceived price fairness for both hazard-prevention deals.

Last but not least, the prominence principle (Tversky, Sattath, & Slovic, 1988) might also partially explain why the extent of preference JE/SE shift was greater for the deal that prevents the more-painful-but-less-prevalent stomach cancer than the deal that prevents the less-painful-but-more-prevalent stroke. Although the hard-to-evaluate attribute – prevalence – had the potential to exert more impact in JE due to its boost in evaluability, such potential might not come to fruition if prevalence were deemed less justifiable than pain intensity in JE.

The prominence principle was originally proposed to explain preference reversals between choice (in which respondents make a direct choice between two options) and matching (in which respondents see the same options with information on one attribute missing, and they are required to fill in the missing information to match the two options' desirability). The choice-matching preference reversal refers to people's tendency to choose the option that is superior on the more important attribute despite that the options are matched as equally desirable. The prominence principle suggests that the reason is that the more important attribute looms larger in choice than in matching, and it has been widely supported in both lab and field experiments (Lichtenstein & Slovic, 2006). In a broader sense, Hsee (1996b) considers it a competing hypothesis to explain the JE/SE preference reversal, that the more important/justifiable attribute will loom larger in JE than in SE. Although Hsee (1996b) tried to rule out this alternative explanation by conducting two experiments where he demonstrated that JE/SE preference reversals could be turned on and off by manipulating the attribute evaluability alone, he assumed that the relative justifiability of attributes was always obvious and decisive, and would remain stable across evaluation mode. In fact, to my best knowledge, in all of previous studies on JE/SE preference reversals, whether an attribute was relatively more or less justifiable was largely inferred or presumed as a definite characteristic of the attribute, and it was never manipulated empirically.

In the case of study 1a and 1b, all risk attributes (severity vs. likelihood; pain intensity vs. prevalence) are justifiable for decision-making. Some participants might even find it hard to decide the absolute justifiability of each attribute in SE, but they may find it easier to tell the relative justifiability of

attributes in JE as they gained better perspectives. If the easy-to-evaluate attribute were considered more important, then the hard-to-evaluate might not become as influential despite its increased evaluability in JE. It is possible that the reason that JE/SE preference did not occur as predicted in study 1a and 1b was due to the confounding effect of attributes' relative justifiability.

4.4.2 Limitations.

This study also has one limitation to be address. This study has only included risk attitude as a co-variate, and it might have left out other important co-variates. For example, participants' decision style might also affect the degree of preference shifts. Previous research (Schwartz et al., 2002) has revealed some important individual differences regarding the efforts that people spare in evaluating options. To control for variance associated with decision style, it is worth including it as a co-variate in the next study.

To address the alternative explanations and limitations that mentioned above, I would need to conduct study 2 to refine the experimental design and stimuli design to achieve higher conceptual clarity and operational unambiguity.

To better isolate the effects of evaluation mode, study 2 would use a within-subject design, where participants evaluated two trade-off options first in SE, then in JE, with an irrelevant filler task between each round of evaluation. To reduce confounding characteristics associated with health hazards and increase ecological validity, study 2 would design experimental stimuli using health hazards that are less severe, more realistic, having fewer complications and connotations. To avoid loss multiplicity, study 2 would require participants to make trade-offs between a risk attribute and a non-risk attribute instead of between two risk attributes. To minimize potential response bias, if any,

associated with a single subjective scale used for risk preference measurement, study 2 would include a few more dependent variables. To reduce within-group error variance and eliminate potential confounders, study 2 would consider a few more co-variates (e.g. decision style and regret tendency) that have been demonstrated to be influential during laypeople's decision-making process. Most importantly, to investigate the boundary condition of the effects of evaluation mode in the context of health-related decision-making, study 2 would incorporate one moderator – attributes' relative justifiability – into the experimental design and manipulate it empirically.

The details and justification for the refined design for study 2 will be elaborated in the following chapter.

CHAPTER FIVE: STUDY 2

5.1 Overview

The purpose of study 2 is threefold. The chief goal is to expand the scope of study 1 by investigating the boundary conditions of GET in the context of health-related decisions. It seeks to examine whether the relative justifiability of the easy-to-evaluate attribute moderates the JE/SE preference shifts specified in H1. The second goal is to corroborate and complement findings from study 1 by extending the type of health-related decision-making scenarios: from evaluating two options that involve a trade-off between two *risk* attributes to that between a *risk* attribute and a *non-risk* attribute instead of between two risk attributes. The third goal is to refine the experimental design by adopting a within-subject design, designing more realistic health-decision making scenario, adding some additional dependent variables, and considering a few more potentially important co-variables.

To achieve those goals, I first introduce the concept of attribute justifiability, distinguishes it from similar concepts such as importance, then propose how it could be operationalised, and finally explain how it relates to the JE/SE preference shifts hypothesized in H1. Then I review a few relevant dependent variables and co-variables, and finally propose new hypotheses accordingly.

5.2 Introduction

5.2.1 Justifiability

Contextualizing justifiability. It is important to introduce the concept of justifiability for at least two reasons. First, it is particularly relevant in the context

of health-related decision-making. Second, it might help explain why the hypothesized JE/SE preference shifts did not occur in study 1.

When people make decisions in a professional setting such as evaluating candidate competence or choosing prospective careers, they often need to decide whether they should count certain factors into their overall evaluation. Justifiability refers to the degree to which an attribute is judged as relevant for a decision-making or judgement task (Hsee, 1993). To have a more concrete understanding of justifiability, let us consider a scenario proposed by Hsee (1996, p. 122): suppose a judge is to score two finalists in a first-tier piano competition, and he realises one is his compatriot while the other is not. In the competition, one player chooses a more difficult piece, but the other commits fewer errors. Faced with this situation, the judge is likely to be aware that music difficulty and note accuracy are justifiable factors in evaluating player competency, whereas players' nationality is unjustifiable even if he wishes his compatriot to win. Justifiable factors, therefore, refer to attributes which the judge thinks *should* be taken into consideration; in contrast, unjustifiable factors refer to those which the judge is tempted to take into consideration but knows that it *should not* be (Hsee, 1996a). The unjustifiable factor may still affect the judge's final evaluation to a certain extent, which is often parallel to the situations in health-related decisions.

One challenge of health-related decisions is that laypeople often need to make trade-offs between clinical and non-clinical factors, such as clinics' location versus success rate (Zikmund-Fisher et al., 2004). The clinical factors, though being more critical to achieve the desired health outcomes and should be deemed more justifiable as the basis of decision-making, are often hard-to-evaluate (Soll et al., 2015), under-weighted, or even ignored (Bond, Carlson, &

Keeney, 2008, 2010). For example, when choosing hospitals based on multiple categories of quality indicators, laypeople' preferences tend to be more sensitive to non-clinical factors such as location of the hospital, cleanliness, and dignity of the care provided than to clinical factors such as quality and safety of care (e.g. re-admission risk, hospital-acquired infection rate) (Fasolo, Reutskaja, Dixon, & Boyce, 2010).

In the context of health-related decision-making, it is unfair to say that non-clinical factors are entirely unjustifiable, and some people may consider contingency and dignity highly justifiable. In the current context, the borderline lies in whether the attribute is directly related to health outcomes, i.e. whether it is clinical or non-clinical. In other words, clinical factors are instrumentally justifiable, whereas non-clinical factors are instrumentally unjustifiable (Hsee, 1993). For sake of brevity, instrumental justifiability will be hitherto simply referred to as justifiability.

Conceptualizing justifiability. The concept of justifiability is related to, yet distinct from a few concepts in decision-making, such as importance. Justifiability refers to the degree to which an attribute is considered relevant (i.e. should be taken into account) for a judgement or decision-making task (Hsee, 1993). The relevancy of an attribute depends on the extent to which one could find "effective" reasons to support the necessity of considering this attribute (Simonson, 1987, p. 35). In this sense, the justifiability of an attribute seems synonymous to its importance, because one often justifies the relevancy of an attribute on the ground of importance.

However, the importance of an attribute has a broad spectrum of meanings, and most of which don't overlap with justifiability. There are at least

three notable ways to conceptualize the importance of an attribute (Goldstein, 1990; Goldstein & Beattie, 1991; Goldstein & Mitzel, 1992).

First, the importance of an attribute may reflect one's general attitudes toward abstract concepts which the attribute represents. For example, when evaluating two issues (coral reefs degradation vs. multiple myeloma among the elderly) (Kahneman et al., 1999), they may reflect the underlying concepts — ecological vs. human health issues — and judged the latter to be more important regardless of the severity or magnitude of each issue.

Second, the importance of an attribute may refer to how responsive one's decisions or judgement are to changes in attribute values. If an attribute is deemed important in this sense, it would often prove pivotal on the overall desirability of an option — “a ‘small’ increment in an important attribute produces as much change in overall desirability as a ‘large’ increment in a less important attribute” (Goldstein & Beattie, 1991, p. 114). In other words, the importance of an attribute is determined by the impact it could potentially have on decisions, and decision-makers will be most sensitive to changes in important attributes.

Third, the importance of an attribute may refer to the psychological representation of how stimuli are processed, which is independent from the innate property of the attribute. In this sense, important attributes would be those that are perceptually salient, having high priority in being received and processed, or prompt strong affective responses. For example, an attribute could be made more important if it is placed at the first or the last of the list, as the serial-position effect (Murdock, 1962) suggests, or if it is simply presented in a bigger size (Detenber & Reeves, 1996).

Among the above three conceptualisation of the importance of an attribute, the first one (importance as general attitude) is most related to justifiability. When people consider an attribute justifiable, they often intuitive feel that this attribute is important. In addition, justifiability generally denotes a sense of deliberation and accountability, it implies that the decision-maker may need to weight reasons carefully and may be held accountable to oneself and others for the decisions made (Lerner & Tetlock, 1999).

Operationalizing justifiability. Justifiability can be operationalised in three possible ways. The first way is to directly solicit people's perceived justifiability of attributes. This method is particularly useful when the justifiability of the attributes is intuitive to tell. For those attributes, their perceived justifiability can be measured by a five-point Likert scale (1 = should not consider, 5 = should consider). For example, most human resource managers would agree that job candidates' education and work experience are highly justifiable when making hiring decisions, whereas their ethnicity and gender are not justifiable. Accordingly, they will rate education and work experience high in the justifiability Likert scale, though they might nevertheless show bias in their actual decisions (Bertrand & Mullainathan, 2004). The relative justifiability of attributes can be further operationally verified by pre-tests.

The second way is to explicitly explain that an attribute should or should not be considered in decision-making. This method becomes more useful when there is some ambiguity around how justifiable an attribute is in a given context. For example, although education and work experience are justifiable in most hiring decisions, their relative justifiability may depend on the specific roles. Education may be more justifiable than work experience when recruiting a

management trainee, and vice versa when recruiting a senior manager. In this case, the relative justifiability can be specified upfront before the decisions are made. The decision-makers can read a brief note that explains which attribute to consider and which to ignore.

The third way is to change the situations of the decision-makers so as to render the same attribute to be more or less justifiable. This method is most useful when the justifiability of an attribute is context-dependent. For example, costs might not be highly justifiable when a diabetes patient is considering buying a blood glucose monitor because of the high value such portable medical equipment provides. However, costs might be highly justifiable when the same patient (with perfect teeth) is choosing a dental care plan. In this case, the relative justifiability of the same attribute can be manipulated by changing the specific situations in which the decisions are made.

Finally, each of the three ways should be accompanied by manipulation checks to ensure that the relative justifiability of attributes is manipulated effectively.

How justifiability relates to the JE/SE preference. Previous research on JE/SE preference reversals has almost always designed the hard-to-evaluate attribute as the more justifiable attribute (Hsee, 2000, p. 556), since this design is more likely to induce JE/SE preference reversals. For example, for the music dictionary example (see Section 1.1), the implicit assumption is that students would consider the number of entries more justifiable than physical condition. However, for health-related decisions, sometimes it is not easy to tell which attribute is more justifiable, and sometimes laypeople may consider several

attributes as equally important. Therefore, it will be interesting to investigate how attribute justifiability moderates the JE/SE preference reversals. In this study, I use the third way to operationalize justifiability because attributes such as costs are relevant in many health-related decisions, yet its relative justifiability might differ depending on the situations.

5.2.2 Confidence during decision-making

Although the quality of decisions is often evaluated by how good the outcomes of the decisions are, this approach may overemphasize the importance of outcomes while discounting the process of decision-making, a phenomenon called *outcome bias* (Baron & Hershey, 1988). Outcome bias is particularly likely to happen in health-related decisions, where unwanted outcomes are unavoidable even for the best physicians (Saposnik et al., 2016).

Therefore, it may be necessary to consider subjective indicators, such as confidence during decision-making. Confidence is an important indicator of decision quality, because it is closely associated with one's self-efficacy, i.e., believing one is capable of doing necessary things to attain certain valued goals (Bandura, 1976). Self-efficacy can influence people's decisions to attempt or not attempt certain behaviors, to persist or not when facing obstacles (Glanz, Rimer, & Viswanath, 2008; Maddux, Brawley, & Boykin, 1995). In this sense, the more confident (as long as it is not over-confidence) that laypeople feel about their decisions, the more likely they may act on their decisions and the less likely that they will feel regretful after the decisions are made (Bell, 1982; Schwartz et al., 2002).

In study 1a and study 1b, I have tested the effects of evaluation mode on health-related decisions, but I have not taken into consideration laypeople's

confidence during decision-making: will they feel equally confident in SE and JE?

The positive relationship between information (when not exceeding cognitive load) and confidence is often tacitly assumed in the tradition of information studies (Heath & Gonzalez, 1995). My conjecture is that they will feel more confident in JE, since they have better access to reference information which may enable them to evaluate options in a more informed matter.

5.2.3 Other co-variates

Decision style. As discussed in Section 4.4.2, laypeople's decision style may also affect the degree of JE/SE preference reversals. In any decision-making task, a general assumption is that people would maximise utilities, welfare, or any values they care. In study 1a and 1b, participants need to make trade-offs when evaluating options in joint evaluation mode. However, the amount of efforts they are willing to spare in making trade-offs may vary by their decision style. Decision style can be categorized into two types: maximizers versus satisfisers (Schwartz et al., 2002). Maximizers want to achieve the optimal outcomes and minimize regrets, thus typically exert lots of efforts in evaluating options. In contrast, satisfisers only look for something that is good enough and seldom feel regretful once decisions are made, thus they exert fewer efforts in evaluating options. As maximisers spend more time and cognitive efforts in evaluating options, they might invoke internal or whatever available reference information when evaluating options in single evaluation mode, it implies that maximizers might show weaker JE/SE preference shifts than satisfisers do.

Therefore, decision style might serve as a useful covariate when investigating JE/SE preference reversals in health-related decision-making.

Regret inclination. Similarly, laypeople's tendency to feel regretful after the decisions are made (Schwartz et al., 2002) may also affect the JE/SE preference reversals. Those who tend to regret more are likely to spare more efforts when making trade-offs.

Control preference. Control preference refers to one's preference in taking control during decision-making (Degner, Sloan, & Venkatesh, 1997). Active decision-makers prefer to make decisions all by themselves, whereas passive decision-makers prefer to have someone else to make decisions on their behalf (Degner & Sloan, 1992). It is likely that active decision-makers will exert more efforts during decision-making.

Numeracy. Since most risk information is presented with numerical values, which requires numerical skills to interpret, numeracy also seems like a good candidate as a co-variate.

5.3 Research questions and hypotheses

Like earlier studies, this study will also test hypothesis 1 that I derived from the GET framework (see Section 2.5). More specifically, I will examine decision situations where the trade-off is between a risk attribute and a non-risk attribute. Accordingly, I propose the following hypothesis:

H 1.3: When a decision-maker evaluates two options that involve a trade-off between two attributes: one is superior in the hard-to-evaluate risk attribute (option A), whereas the other is superior in the easy-to-evaluate non-risk attribute (option B), preferences for the two options will shift (even reverse) between SE

and JE. More specifically, the decision-maker will favor option B more in SE than in JE, and favor option A more in JE than in SE.

In the context of vaccines evaluation, H1.3 predicts that when faced with two vaccine options, one is pricier-but-safer (vaccine A) and the other is cheaper-but-less-safe (vaccine B), participants' preferences will shift (even reverse) between SE and JE. They will prefer vaccine B more in SE than in JE, and they will prefer vaccine A more in JE than in SE.

Based on the above introduction on justification, I propose to test whether preference shifts between single and joint evaluation mode are moderated by attributes' relative justifiability:

Hypothesis 2 (option x evaluation mode x attribute justifiability) The degree of JE/SE preference shifts specified in H1 will be moderated by the relative justifiability of the easy-to-evaluate attribute. Greater extent of JE/SE preference shifts will happen when the easy-to-evaluate attribute is relatively less justifiable (see Figure 5.1 for conceptual illustration).

In the same context, H2 predicts that participants will exhibit greater JE/SE preference shifts when the justifiability of vaccine costs is lower than when it is higher.

Figure 5.1. Conceptual illustration of H2

Similar to Figure 2.1, Figure 5.1 is also for illustrative purpose only. It only emphasizes the relative degree of JE/SE preference reversals by the relative justifiability of the easy-to-evaluate attribute, and it does not assume that there is no main effects of option or evaluation mode.

In terms of confidence during decision-making, I propose the following hypothesis:

Hypothesis 3: (main effect of evaluation mode) Participants will feel more confident of their decisions in JE than in SE.

5.4 Methods

5.4.1 Design.

A randomized experiment involving a decision-making task on vaccination was designed to test the proposed hypotheses. As shown in Table 5.1, the experiment adopted a mixed design, with the relative justifiability of the easy-to-evaluate attribute (high vs. low) as a between-subject factor, vaccine option (costs vs. chance of side effects trade-off) and evaluation mode (single vs. joint) as within-subject factors.

Table 5.1
Illustration of the Mixed Design

Within-subject factors: Evaluation mode (single then joint) × Options (counter-balanced)	Between-subject factor: Relative justifiability of the non-clinical attribute			
	High		Low	
	Single Evaluation Option A,B/B,A	Joint Evaluation Option A,B/B,A	Single Evaluation Option A,B/B,A	Joint Evaluation Option A,B/B,A

The two vaccine options were designed to create a meaningful trade-off between two attributes: price (non-clinical) and chance of side effects (clinical). Each vaccine option was superior in one and only one attribute. While the clinical attribute (chance of side effects) was deemed hard-to-evaluate, the non-clinical attribute (price) was deemed easy-to-evaluate in the single evaluation mode (see Table 5.2).

Table 5.2
Illustration of the Relative Superiority of Each Option

	Option A	Option B	Superiority
Costs (easy-to-evaluate in SE)	Price-A	Price-B	Option A < Option B
Chance of side effects (hard-to-evaluate in SE)	Chance-A	Chance-B	Option A > Option B

The main dependent variables were the acceptability of vaccine options and confidence of decision-making. Other dependent variables included perceived vaccine affordability, perceived vaccine safety, and perceived relative importance of vaccine costs versus chance of side effects. Potential co-variables included demographics, numeracy, health care profile, and a few decision-making related individual traits (decision style, control preference, and proneness to regret).

The design and procedure of this study were examined and approved by the institutional review board (IRB) at Nanyang Technological University (see Appendix A for the IRB approval letter).

5.4.2 **Participants.**

Participants for the main study were recruited online from Nanyang Technological University, Singapore. An invitation email was sent to current students from a mixture of art, science, business, and engineering schools. A total of 109 participants took part in the second wave of the study, and they received SGD \$5 as a token of appreciation for their time. Participants that failed attention checks ($n = 2$), provided constant or contradictory answers ($n = 4$) were excluded from further analysis, and 103 participants remained.

Participants' age ranged from 18 to 35 years old ($M = 22.9$, $SD = 2.6$), and 56.3% of them were females. Participants were mostly undergraduate (80.6%)

and graduate (13.6%) students, and roughly half of them reported their household income as above SGD \$50,000 per year. In general, participants enjoyed good health care service, but they were not familiar with flu vaccine yet. Over 84.5% of participants reported they received good to excellent health care service, and 95.1% of them visited a health professional less than four times in the past 12 months. Only 14.6% of participants had taken a flu vaccine by the time they took part in the study.

For the pre-test, participants were recruited from Amazon Mechanical Turk (M-turk), an online crowdsourcing platform that provides a variety of human intelligence service, including data validation, content moderation, and survey participation. The pre-test was administered to validate the experimental stimuli, using the same within-subject design as the main study. The costs and the chance of side effects of Vaccine A and B were designed in a way that the relative superiority of each option should be noticeable yet not dominating. A total of 115 participants took part in the pre-test. Their ages ranged from 19 to 68 years old ($M = 32.0$, $Mdn = 29.0$, $SD = 8.6$), and most of them were males (67.0%).

5.4.3 Procedure.

The whole experiment was administered online, and participants spent an average of 23.3 ($SD = 18.5$) minutes in finishing the whole experiment. Participants received an invitation email on a paid study and signed up via a web link provided by Qualtrics, a company specialized in survey research. They were instructed to find a quiet place to avoid interruption for 20 mins; use a big screen device (e.g. laptop/desktop/tablets); use full screen mode, preferably with Chrome or Firefox for maximum compatibility. The experimental procedures can be conceptually

organized into five stages: consent-giving, random assignment, vaccine scenario presentation & vaccine evaluation, answering questions on covariates, debriefing.

Participants were asked to read carefully the study information sheet <IRB-2019-03-029> (see Appendix B). After indicating consent, they were randomly assigned to two experimental conditions (see Experimental Manipulations for details). Then they read the vaccine scenario, evaluated two vaccine options in single evaluation mode first, followed by evaluating them again in joint evaluation mode. To minimize carry-over effects between each round of evaluation, participants were asked to do a word counting task that was completely irrelevant to vaccine evaluation (see Appendix G: distraction task 1, 2). After finishing the vaccine evaluation, they proceeded to answer a questionnaire regarding their risk attitude, decision styles and preferences, numeracy, health care profile, and demographics. In addition, they answered a few questions to check whether the experimental manipulations worked and whether they paid sufficient attention during the experiment. Then they were debriefed, thanked, and directed to an external web link to collect payment.

5.4.4 **Experimental manipulations.**

Scenario presentation. To simulate an experimentally-controlled yet realistic health-related decision-making setting, a vaccine scenario was developed based on Kuhn and Budescu's (1996, p. 313) previous study. Participants were instructed to read the following passage carefully before proceeding to make three rounds of evaluations on both vaccines:

Imagine that in your residence city, there's recently an outbreak of influenza (flu), which is a new strain of flu virus that is particularly serious. Although generally not fatal, this new strain of the flu is associated with longer periods (two to three weeks) of severe illness. Various pharmaceutical companies have developed different vaccines to combat the spread of this disease.

Because this virus is highly contagious, however, it is likely that anyone not vaccinated will contract the disease and become seriously ill. Although all vaccines are relatively new, they have all gone through similar clinical trials and have been researched to the same degree.

Evaluation mode. Evaluation mode was manipulated within-subject.

Participants first evaluated vaccine A and vaccine B separately (counter-balanced), then evaluated them again jointly. They read brief instructions before each round of evaluation.

Single evaluation for vaccine A: *Suppose you're considering taking a flu shot because this flu virus has spread around your neighborhood. Below is the detailed information of one vaccine.*

Single evaluation for vaccine B: *Now besides the vaccine that you just evaluated; another option is also available. Below is the detailed information of the other vaccine.*

Joint evaluation for vaccine A and B: *Previously, you evaluated two vaccine options one by one. Now you could read their detailed information side by side. They differ in price and chance of side-effects.*

Trade-off of vaccine options. As illustrated in Table 5.3, the trade-off was between costs and chance of side effects. While vaccine B is superior to vaccine A in the easy-to-evaluate attribute – costs, vaccine A is superior to vaccine B in the hard-to-evaluate attribute – chance of side effects. The price figures were designed based on the prices of general vaccines (U.S. Centers for Disease Control and Prevention, 2018). The figures of chance of side effects were designed to be around 1% ~ 5%, which were small enough to reflect the general safety of flu vaccines, yet not too small to be dismissed altogether. The relative

superiority of costs and chance of side effects was pre-tested such that it is noticeable yet not dominating so as to make meaningful trade-offs possible⁶.

Table 5.3

Relative Superiority of Vaccine Options in Costs and Chance of Side Effects

	Vaccine A	Vaccine B	Superiority
Costs (easy-to-evaluate in SE)	\$ 75	\$25	Vaccine A < Vaccine B
Chance of side effects (hard-to-evaluate in SE)	0.9%	4.5%	Vaccine A > Vaccine B

Relative justifiability of the easy-to-evaluate attribute – costs. To empirically manipulating attributes' relative justifiability, I had three options: manipulate the justifiability of the easy-to-evaluate attribute, manipulate that of the hard-to-evaluate attribute, or manipulate that of both.

In the context of evaluating vaccines, I chose to only manipulate the easy-to-evaluate attribute (costs) for two reasons. First, the justifiability of the price is more manipulatable than that of the side-effects as lay people typically have a strong prior belief on the latter. Second, if I were to manipulate the justifiability of vaccines' side-effects, I would need to have participants read additional texts on vaccines, which might affect their overall preference of the vaccines.

The relative justifiability of costs was manipulated by having participants experience high/low subjective socio-economic status (SSES). The stimuli were adapted from Cheon and Hong (2017). Those who experienced high SSES would feel more socially privileged and consider costs to be less justifiable in vaccine

⁶ The symptoms of vaccine side effects were included in the pretests, but were removed in the main study for fear of confounding the effects of the chance of side effects.

evaluation, whereas those who experienced low SSES would feel more socially deprived and consider the opposite.

Participants were randomly assigned to the high or low condition, where they were shown a picture of a ladder with nine rungs. They were asked to compare themselves either with the lower class (high SSES condition) or the upper class (low SSES condition) and imagine possible social interaction with them according to the following instructions (Cheon & Hong, 2017, p. 73):

Think of this ladder as representing where people stand in Singapore. Now, please compare yourself to the people at the very bottom (top) of the ladder. These are the people who are the worst (best) off—those who have the least (most) money, least (most) education, and least (most) respected jobs. In particular, we'd like you to think about how YOU ARE DIFFERENT FROM THESE PEOPLE in terms of your own income, educational history, and job status. Where would you place yourself on this ladder relative to these people at the very bottom (top)? Please select the number that corresponds to the ladder where you think you stand in relation to these people. (9 = upper class, 1 = lower class).

Now imagine yourself in a getting acquainted interaction with one of the people you just thought about from the very bottom (top) of the ladder. Think about how the DIFFERENCES BETWEEN YOU might impact what you would talk about, how the interaction is likely to go, and what you and the other person might say to each other. Please write a brief description about how you think this interaction would go (at least 25 words).

The administration of this SSES manipulation took place before participants read the instructions of vaccine evaluation. Although it seemed subtle and implicit as it did not actually change participants' relative social class, Cheon and Hong's (2017) study has demonstrated that it could considerably affect people's mind sets and behaviors.

5.4.5 Measures

The online questionnaire comprised questions and scales measuring (a) attention check, (b) manipulation checks, (c) acceptability of vaccine, (d) preferred vaccine choice, (e) confidence of decision-making, (f) risk attitude, (g)

decision style, (h) regret inclination, (i) control preference, (j) numeracy, (k) health care profile, and (l) demographics.

Attention check. Two questions were used to check whether participants paid sufficient attention to the experimental stimuli. The first question read: “Do you recall what this vaccine is for?” and had three choices: to prevent influenza (flu) [correct], to prevent Zika [wrong], and to prevent measles [wrong]. The second question read: “Do you recall the price of the two vaccines? Please select TWO OPTIONS that apply.” It had five choices: \$25 [correct], \$75 [correct], \$80 [wrong], \$100 [wrong], and \$150 [wrong]. Participants needed to answer both questions correctly to pass the attention check, and only two failed.

Manipulation checks. Three questions were used to check the relative evaluability of vaccine’s two attributes. The first question read: “Do you have any idea what price is considered fair vaccine?” The second read: “Do you have any idea what chance of side-effects (%) for a typical flu vaccine is considered safe by the clinical standards?” Participants answered those two questions on a 10-point Likert scale (1 = No idea at all, 10 = Very clear idea). The third read: “Which did you find it easier to evaluate?” Participants then selected one from the two choices: Chance of side effects is easier to evaluate; price fairness is easier to evaluate.

A pair of questions was used to check the relative superiority of the two vaccine options in terms affordability and safety. The question on affordability read: “How (i.e. reasonably-priced for the public) do you think [SE: this vaccine / JE: each vaccine] is?” The question on safety read: “How safe (considering the chance of side-effects) do you think [SE: this vaccine / JE: each vaccine] vaccine is?” This pair of questions was repeatedly asked in both SE and JE, and

participants answered them on a 10-point Likert scale, from 1 (*not affordable at all / not safe at all*) to 10 (*very affordable / very safe*).

Another pair of questions were used to check the relative justifiability of costs and chance of side effects. The first was a forced choice question that read: “When you evaluated the vaccine's overall acceptability, which factor were you more concerned with?” Participants had two options to choose from: Costs or chance of side-effect. The second was an extension of the first question, which read: “Please rate the relative importance between costs and chance of side-effects.” Participants rated the relative importance on a 9-point semantic differential scale, from 1 (*cost is much more important*) to 9 (*chance of side-effects is much more important*). This pair of questions was also asked repeatedly in each round of vaccine evaluation.

Acceptability of vaccine. Participants were asked to rate how acceptable [SE: this vaccine / JE: each vaccine] seem to them overall on a 10-point Likert scale, from 1 (*not acceptable at all*) to 10 (*very acceptable*).

Preferred vaccine choice. Participants’ preferred vaccine choice were inferred in SE, and directly solicited in JE. The methods of inferring choice was adopted from previous research (Hsee, Dubé, & Zhang, 2008). In SE, each participant’s acceptability ratings for vaccine A and vaccine B were compared. Those who gave a higher/lower rating to vaccine A were inferred that they would choose vaccine A/ vaccine B in SE, and those who gave the same ratings were inferred to be indifferent between the two options. In JE, participants were directly asked: “If you were to choose one of them, which do you prefer?” Then they chose from two options: “I prefer vaccine A,” “I prefer vaccine B”.

Confidence of decision-making. The scale comprised three items adapted from the decisional conflict scale developed by O'Connor (1995). The items read: "The acceptability of the vaccine is easy for me to evaluate," "I'm sure whether I've made a good evaluation of the vaccine," and "It's clear how acceptable the vaccine is to me". All items were rated from 1 (strongly disagree) to 7 (strongly agree). It was measured in both SE and JE, and achieved high reliability in both modes, Cronbach's $\alpha_{SE} = .90$, $\alpha_{JE} = .92$.

Decision style. Schwartz and colleagues' (2002) decision style scale was used to categorize whether a decision-maker acted more like a maximizer or a satisfier during decision-making. The scale comprised 13 items that covered a wide range of common decision-making scenarios (see Appendix G for a complete list of scale items). Sample items included: "No matter how satisfied I am with my job, it's only right for me to be on the lookout for better opportunities," "I never settle for second best," and "Whenever I'm faced with a choice, I try to imagine what all the other possibilities are, even ones that aren't present at the moment." Participants rated how much they agree or disagree with each item from 1 (*strongly disagree*) to 7 (*strongly agree*). The more strongly that a decision-maker agreed with these items, the more s/he was inclined to be a maximizer. This scale had modest reliability, $\alpha = .60$. On average, participants scored 4.51 ($SD = 0.65$).

Regret scale. The regret scale developed by Schwartz and colleagues (2002) was used to qualify the tendency of a decision-maker to feel regretful after a decision was made. It comprised 5 items (see Appendix G for a complete list of scale items), and sample items included: "Whenever I make a choice, I'm curious about what would have happened if I had chosen differently," and "Once

I make a decision, I don't look back (reverse coded).” Participants were asked: “How do you typically feel about the decisions you make?” Then they rated how much they agree or disagree with each item from 1 (*strongly disagree*) to 7 (*strongly agree*). The more strongly that a decision-maker agreed with these items, the more s/he was likely to regret about decisions being made. The scale achieved good reliability, $\alpha = 0.70$. Participants scored 4.97 on average ($SD = 0.97$).

Control preference scale. The control preference scale was developed under the specific context of medical decision-making (Degner et al., 1997). In this study, two out of the original five items were selected. Participants were asked: “When you consult with your physicians, what's your preferred degree of control in treatment decision-making?” Then they rated how much they agree or disagree with the two statements from 1 (*strongly disagree*) to 7 (*strongly agree*): “I prefer to make the decision about which treatment I will receive,” “I prefer to make the final decision about my treatment after seriously considering my doctor's opinion.” The scale achieved good reliability, $\alpha = .79$. Participants scored 5.26 on average ($SD = 1.18$).

Risk attitude. Blais and Weber's (2006) risk-taking scale in the health/safety domain was used to measure participants' health-related risk attitude. (see Section 3.2.6 for details). The scale had reasonable reliability in both dimensions, $\alpha_a = .73$, $\alpha_b = .66$.

Numeracy. The numeracy test was adapted from Boyce, Dixon, Fasolo, and Reutskaja (2010). It comprised three math questions (see Appendix G for the full version). One of them read: “Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up

even (2, 4, or 6)?” Participants were asked to choose the correct answer from three choices: 333 [wrong], 500 [correct] and 167 [wrong]. On average, participants correctly answered 2.68 out of 3 questions ($SD = 0.66$), thus they had high numeracy in general.

Health care profile. Health care profile included five questions on participants’ general health care quality and specific experience on flu vaccine. Participants answered the quality of health care they received and the frequency of visiting health professionals in the past 12 months. They also answered whether they had taken a flu vaccine, how often they took it, and how successful the vaccine was (see Appendix G for the full version).

Demographics. Participants were asked for their age, sex, education level, and annual household income (see Appendix G for the full version).

5.5 Results

5.5.1 Manipulation checks.

Three experimental manipulations were checked to verify if they worked as intended. The first manipulation was the relative evaluability of vaccine’s costs versus its chance of side effects. The second manipulation was the relative superiority of two vaccine options in terms of affordability and safety. The third manipulation was the relative justifiability of the easy-to-evaluate attribute – vaccine’s costs. All of them worked reasonably well.

Relative evaluability of vaccine’s attributes. A paired-samples t-test and a binomial test were conducted to verify if the price-fairness was indeed easier to evaluate than the chance of side effects. On average, participants rated the evaluability of vaccine’s costs ($M = 3.74$, $SE = 0.24$) to be marginally higher than its chance of side effects ($M = 3.50$, $SE = 0.22$), $t(102) = 1.12$, $p = .1$, $d = 0.1$.

The difference of their relative evaluability became more apparent when participants were asked to choose directly which attribute was easier to evaluate. Among the 103 participants, 71 chose costs and 32 chose chance of side effects. Thus, most participants (68.9%, $p < .001$, 95% CI [59.1%, 77.7%]) considered vaccine's costs to be easier to evaluate. Overall, the manipulation of relative evaluability worked, though not as strong as intended.

Relative superiority of vaccine options. Two mixed-design ANOVA were conducted to verify whether participants considered vaccine A safer than vaccine B, and whether they considered vaccine B more affordable than vaccine A. Participants rated vaccine A ($M = 8.24$, $SE = 0.16$) to be safer than vaccine B ($M = 5.60$, $SE = 0.21$), $F(1, 101) = 243$, $p < .001$, $\eta_p^2 = 0.71$. The relative superiority of vaccine A's safety was consistent across compare-to-the-rich and compare to-the-poor conditions, $F(1, 101) = 0.728$, $p = .396$, $\eta_p^2 = .007$, but it was more pronounced in JE than in SE, $F(1, 101) = 8.30$, $p = .005$, $\eta_p^2 = .076$. Participants also rated vaccine B ($M = 7.81$, $SE = 0.21$) to be more affordable than vaccine A ($M = 4.63$, $SE = 0.16$), $F(1, 101) = 344$, $p < .001$, $\eta_p^2 = 0.77$. The relative superiority of vaccine B's affordability was consistent across evaluation mode, $F(1, 101) = 0.043$, $p = .836$, $\eta_p^2 < .001$, and also across compare-to-the-rich and compare to-the-poor conditions, $F(1, 101) = 0.001$, $p = .973$, $\eta_p^2 < .001$. Therefore, the manipulation of relative superiority of vaccine options worked very well.

Relative justifiability of the easy-to-evaluate attribute – costs. Two Mann-Whitney U tests, a Chi-square test, and an independent t-test were conducted to verify whether participants felt less socially privileged (having lower socio-economic status), became more concerned with costs, and weighed

costs more heavily during decision-making when they were assigned to the compare-to-the-rich condition rather than the compare-to-the-poor condition.

Participants' actual annual household income did not differ significantly between the compare-to-the-rich condition ($Mdn = 3.00$) and the compare-to-the-poor condition ($Mdn = 2.50$), $U = 1262$, $z = 0.407$, $p = .684$, $r = .04$. However, participants assigned to the compare-to-the-rich condition ($Mdn = 4.00$) reported lower socio-economic status than those assigned to the compare-to-the-poor condition ($Mdn = 5.00$), $U = 1870$, $z = 3.68$, $p < .001$, $r = .36$.

As a result of the social comparison manipulation, there was a significant association between the attribute they considered more important and the condition participants were assigned to, $\chi^2(1) = 10.7$, $p = .001$. For participants assigned to the compare-to-the-rich condition, they selected costs as more important 41.5% of the times (including both single and joint evaluations), and selected chance of side effects as more important 58.5% of the times. For participants assigned to the compare-to-the-poor condition, they selected costs as more important 24.1% of the times, and chance of side effects, 75.9% of the times. Based on odds ratio, the odds that participants considered costs more important than chance of side effects were 2.38 times higher if they were assigned to the compare-to-the-rich than to the compare-to-the-poor condition. In addition, participants rated the relative importance of vaccine costs versus chance of side effects similarly between SE and JE, for both compare-to-the-rich ($\chi^2(1) = 0.35$, $p = .554$) and compare-to-the-poor ($\chi^2(1) = 0.152$, $p = .697$) conditions. For participants assigned to the compare-to-the-rich condition, they selected costs as more important 39.8% of the times in SE versus 44.9% in JE. For those assigned

to the compare-to-the-poor condition, they selected costs as more important 25.0% of the times in SE versus 22.2% in JE.

The difference of participants' concerns on costs versus chance of side effects across experimental conditions was also reflected by their relative decision weights of the two attributes. Participants weighed costs (reverse-coded) marginally more heavily if they were assigned to the compare-to-the-rich condition ($M = 6.07$, $SD = 1.98$) than to the compare-to-the-poor condition ($M = 6.52$, $SD = 1.89$), $t(101) = 1.18$, $p = .1$, $d = 0.24$. It should be noted that ideally, participants assigned to the compare-to-the-rich condition should consider costs significantly more important (which happened), and also assign significantly higher decision weight (which did not happen as the difference was only marginally significant). However, I would argue that although the social comparison manipulation did not work perfectly, it had largely achieved its purpose and was adequate for the purpose of this study.

In addition, participants' relative decision weights of vaccine costs versus chance of side effects were also consistent between SE and JE, for both the compare-to-the-rich condition ($M_{SE} = 6.18$, $SD_{SE} = 2.00$; $M_{JE} = 5.96$, $SD_{JE} = 2.18$), $t(49) = 1.15$, $p = .256$, $d = .11$, and the compare-to-the-poor condition ($M_{SE} = 6.51$, $SD_{SE} = 1.82$; $M_{JE} = 6.54$, $SD_{JE} = 2.14$), $t(53) = .169$, $p = .867$, $d = .02$. The similar ratings and decision weights of relative importance of vaccine costs between SE and JE indicated that the social comparison manipulation was stable and reliable.

Altogether, the manipulation of relative justifiability of the easy-to-evaluate attribute – vaccine costs – worked well. Since the manipulation of SSES was successful, to enhance conceptual clarity, the compare-to-the-rich and

compare-to-the poor conditions will be hereafter referred to as justifiability-of-costs-relatively-high and justifiability-of-costs-relatively-low conditions, respectively.

5.5.2 Descriptive and bivariate analysis.

Among the participants that passed the attention checks, 54 were assigned to the justifiability-of-costs-relatively-high condition, and 49 were assigned to the alternative condition. The randomization process was successful as the demographics, health care profiles, and co-variates were mostly equivalent across the two conditions as shown by the t-tests and Chi-square tests (see

Table 5.4).

Table 5.4

Demographics, Health Care Profiles, and Covariates of Participants across Two Conditions

	Relative Justifiability of Costs		Difference across conditions
	High (N = 49)	Low (N = 54)	
Demographics			
Age*	22.9 (2.9)	23.0 (2.3)	$t(101) = -0.249, p = .804$
Gender (Female)	59.2%	53.7%	$\chi^2(1) = 0.314, p = .575$
Household income ($\geq$ \$50k/year)	49.0%	48.1%	$\chi^2(1) = 0.007, p = .933$
Education ($\geq$ Bachelor degree)	91.80%	96.30%	$\chi^2(1) = 0.931, p = .335$
Health care profiles			
Vaccine efficacy*	7.44 (1.50)	7.55 (1.84)	$t(101) = -0.327, p = .745$
Flu shot ever (No)	87.8%	83.3%	$\chi^2(1) = 0.404, p = .525$
Doctor visits frequency (≤ 4 times/year)	100.0%	90.7%	$\chi^2(1) = 4.77, p = .029$
Healthcare quality*	3.69 (1.04)	3.45 (0.89)	$t(101) = 1.23, p = .222$
Covariates			
Risk attitude - perceived riskiness*	5.38 (1.00)	5.16 (0.96)	$t(101) = 1.15, p = .255$
Risk attitude - likelihood of engaging*	2.74 (1.13)	2.76 (1.05)	$t(101) = -0.105, p = .917$
Decision style (Maximizer)	53.1%	44.4%	$\chi^2(1) = 0.764, p = .382$
Regret scale (Regretful)	53.1%	55.6%	$\chi^2(1) = 0.064, p = .800$
Control preference (Active)	42.9%	51.9%	$\chi^2(1) = 0.833, p = .361$
Numeracy*	2.67 (0.7)	2.69 (0.62)	$t(101) = -0.208, p = .836$

Note. *Data presented as Mean (Standard Deviation).

To identify co-variables to be included in the ANOVA analysis, a correlation analysis was conducted to explore the relationships among the dependent variable – vaccine acceptability – and potential co-variables. Spearman's correlation coefficients are reported since most variables are not

normally distributed (except for decision style and regret scale) according to the Kolmogorov-Smirnov normality tests (all $ps < .05$). As shown by Table 5.5, overall, the correlation between dependent variables and potential covariates were weak and mostly non-significant. Although health care quality, control preference, and numeracy had a positive relationship with vaccine acceptability, such relationship was weak and only applied to one of the four dependent variables. Therefore, *none* of them were selected as co-variables in the mixed-design ANOVA analysis. See

Table 5.6 for descriptive statistics of vaccine acceptability by evaluation mode and instrumental justifiability.

Table 5.5
Correlations among Dependent Variables and Potential Covariates

	Vaccine Acceptability			
	Vaccine A in SE	Vaccine B in SE	Vaccine A in JE	Vaccine B in JE
Vaccine efficacy	.075	.122	.093	.067
Flu shot ever	.013	.035	.061	.157
Doctor visits frequency	.049	.057	.087	.018
Healthcare quality	.179	.162	.241*	.123
Risk attitude - perceived riskiness	.007	-.104	-.085	-.166
Risk attitude - likelihood of engaging	-.049	.113	.079	.155
Decision style	-.036	.026	-.061	.114
Regret scale	-.132	.044	-.151	.117
Control preference	.206*	.191	.187	.056

Numeracy	.028	.061	.126	.202*
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Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.6

Mean and SDs of Acceptability of Vaccine Options by Relative Justifiability of Costs and Evaluation Mode

	Justifiability of Costs: High				Justifiability of Costs: Low			
	Vaccine A		Vaccine B		Vaccine A		Vaccine B	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Single Evaluation	5.96	2.19	6.59	1.89	6.39	2.01	6.09	2.43
Joint Evaluation	6.65	2.20	6.39	2.00	7.20	2.13	6.20	2.35

Note. The perceived vaccine acceptability ranges from 1 (not acceptable at all) to 10 (very acceptable).

5.5.3 Hypothesis tests.

Evaluation of vaccine options. Hypothesis 1.3 predicts that when a decision-maker evaluates two options that involve a trade-off between two attributes: one is superior in the hard-to-evaluate risk attribute (option A), whereas the other is superior in the easy-to-evaluate non-risk attribute (option B), preferences for the two options will shift (even reverse) between SE and JE.

In the context of vaccines evaluation, H1.3 predicts that when faced with a trade-off between vaccine costs (easy-to-evaluate) and chance of side effects (hard-to-evaluate): one is pricier-with-lower-side-effects (vaccine A) and the other is cheaper-with-higher-side-effects (vaccine B), participants' preferences will shift (even reverse) between SE and JE. They will prefer vaccine B more in SE than in JE, and they will prefer vaccine A more in JE than in SE.

Hypothesis 2 predicts that the SE-JE preference shifts specified in H1.3 is moderated by the relative justifiability of the easy-to-evaluate attribute. More specifically, the degree of a vaccine consumer's JE/SE preference shifts will be depend on the relative justifiability of vaccine's costs versus its chance of side effects. The JE/SE preference shifts will be greater if the justifiability of costs is relatively low rather than relatively high.

A three-way mixed-design ANOVA (between-subject factor: relative-justifiability-of-costs; within-subject factors: evaluation mode, vaccine option) was conducted to find out if participants' preferences for vaccine A and vaccine B shifted between SE and JE (H1.3) and whether the preference shifts were moderated by the relative justifiability of vaccine costs (H2). The sphericity assumption of ANOVA was fully met, as shown by the Mauchly's test, for the repeated-measures variable – acceptability – only had two conditions.

There was a significant interaction effect between vaccine option and evaluation mode (see Figure 5.2), $F(1, 101) = 14.7, p < .001, \eta_p^2 = .127$. Two planned comparisons revealed that participants rated the vaccine B ($M = 6.34, SE = 0.22$) slightly, though non-significantly, more acceptable than vaccine A ($M = 6.17, SE = 0.21$) in SE, $F(1,101) = 0.453, p = .503, \eta_p^2 = .004$. However, they rated vaccine A ($M = 6.93, SE = 0.21$) significantly more acceptable than vaccine B ($M = 6.30, SE = 0.22$) in JE, $F(1,101) = 5.73, p = .019, \eta_p^2 = .054$. Participants rated vaccine A significantly more acceptable in JE than in SE, $F(1,101) = 18.78, p < .001, \eta_p^2 = .157$, but they rated vaccine B similarly in SE and in JE, $F(1,101) = 0.076, p = .783, \eta_p^2 = .001$.

Although participants' preference for vaccine B was non-significant, and their acceptability ratings of vaccine B did not decline significantly from SE to JE, the patterns of preference shifts fitted well with H1.3. Overall, H1.3 was mostly supported.

Figure 5.2. Acceptability of two vaccine options by evaluation mode

The option $\times$ evaluation mode $\times$ relative-justifiability-of-costs interaction was not significant, $F(1, 101) = 0.216$, $p = .643$, $\eta_p^2 = .002$. The non-significant results suggested that there existed some similarities of how preferences shifted between SE and JE for the two relative-justifiability-of-costs conditions. Indeed, regardless of the justifiability of costs, the acceptability of vaccine A increased from SE to JE, whereas the acceptability of vaccine B did not change much from SE to JE (the degree and significant of change will be discussed below).

However, planned comparisons revealed that despite the overall non-significant three-way interaction, there were some nuances between the two relative justifiability conditions (see Figure 5.3 and Figure 5.4). The interaction between option and evaluation mode was significant for both the justifiability-of-costs-relatively-high condition, $F(1, 48) = 7.01$, $p = .011$, $\eta_p^2 = .127$, and the

justifiability-of-costs-relatively-low condition, $F(1, 53) = 7.73$, $p = .007$, $\eta_p^2 = .127$. However, preference reversal of vaccine options only occurred in the justifiability-of-costs-relatively-high condition, whereas preference shifts for vaccine options occurred in the justifiability-of-costs-relatively-low condition.

When the relative justifiability of costs is high, in SE, participants rated vaccine B ($M = 6.59$, $SE = 0.27$) – the more affordable option – more acceptable than vaccine A ($M = 5.96$, $SE = 0.31$), $F(1, 48) = 3.14$, $p = .08$, $\eta_p^2 = .061$. In JE, participants' rated vaccine A slightly more acceptable, though non-significantly, than vaccine B ($M_A = 6.65$, $SE_A = 0.32$; $M_B = 6.38$, $SE_B = 0.29$), $F(1, 48) = 0.790$, $p = .378$, $\eta_p^2 = .016$.

In contrast, when the relative justifiability of costs is low, participants rated vaccine A – the less affordable option – consistently more acceptable than vaccine B in both SE and JE, though to a greater extent in JE. In SE, participants had modest but not statistically significant preference of vaccine A ($M = 6.39$, $SE = 0.29$) to vaccine B ($M = 6.09$, $SE = 0.30$), $F(1, 53) = 0.719$, $p = .400$, $\eta_p^2 = .013$. In JE, participants had strong and significant preference for vaccine A to vaccine B ($M_A = 7.20$, $SE_A = 0.29$; $M_B = 6.20$, $SE_B = 0.32$), $F(1, 53) = 7.01$, $p = .011$, $\eta_p^2 = .117$.

Figure 5.3. Acceptability by evaluation mode when relative justifiability of costs is high

Figure 5.4. Acceptability by evaluation mode when relative justifiability of costs is low

Notably, participants' vaccine acceptability ratings were consistent with their choices. As shown in

Table 5.7, in SE, they were more likely to choose vaccine B when the justifiability of costs was relatively high, $\chi^2 (2) = 5.46, p = .065$. In JE, they

were more likely to choose vaccine A regardless of the justifiability of costs, $\chi^2(1) = 1.41, p = .295$.

To sum up, despite that the three-way interaction was non-significant, the patterns of JE/SE preference shifts of vaccine options were different depending on the relative justifiability of costs. In this sense, hypothesis 2 was partially supported.

Table 5.7
Inferred and Direct Choice of Vaccine Options by Relative Justifiability of Costs

			Relative Justifiability of Costs	
			High	Low
Inferred Choice in SE	Vaccine A	Count	16 _a	30 _b
		Percentage (%)	32.7%	55.6%
	Vaccine B	Count	25 _a	18 _a
		Percentage (%)	51.0%	33.3%
	Indifferent	Count	8 _a	6 _a
		Percentage (%)	16.3%	11.1%
Direct Choice in JE	Vaccine A	Count	30 _a	39 _a
		Percentage (%)	61.2%	72.2%
	Vaccine B	Count	19 _a	15 _a
		Percentage (%)	38.8%	27.8%

Note. Each subscript letter denotes a subset of relative-justifiability-of-costs categories whose column proportions do not differ significantly from each other at the .05 level.

In addition, the mixed ANOVA analysis revealed significant main effects of evaluation mode, $F(1, 101) = 6.79, p = .011, \eta_p^2 = .063$. In general, vaccine

options were deemed more acceptable in JE ($M = 6.61$, $SE = 0.17$) than in SE ($M = 6.17$, $SE = 0.17$). The mixed ANOVA also revealed non-significant main effects of vaccine option [$F(1, 101) = 0.976$, $p = .326$, $\eta^2_p = .010$], as well as non-significant main effects of relative justifiability of costs [$F(1, 101) = 0.057$, $p = .812$, $\eta^2_p = .001$]. Notably, the overall acceptability vaccine A and vaccine B were comparable despite that each option was designed to be superior in either costs or chance of side effects ($M_A = 6.55$, $SE_A = 0.19$; $M_B = 6.32$, $SE_B = 0.20$; see

Table 5.6 for the acceptability of each vaccine option by experimental conditions). The equivalent overall acceptability of vaccine A and vaccine B was a highly desirable design feature of experimental stimuli, which helped participants to make more meaningful trade-offs during evaluation, as there was no dominant option available. Likewise, vaccine options' overall acceptability were similar between the justifiability-of-costs-relatively-high ($M = 6.40$, $SE = 0.23$) and justifiability-of-costs-relatively-low ($M = 6.48$, $SE = 0.22$) conditions. The equivalent overall acceptability of vaccine options between the two justifiability conditions was also a desirable feature of experimental stimuli design. It showed that the justifiability of costs was neither overwhelmingly high nor overwhelmingly low, both of which might encourage participants to adopt heuristics such as the lexicographic rule (choosing the option that is superior in

the more justifiable attribute) (Schoemaker & Russo, 1993) instead of making careful trade-offs between the two options.

Overall, the patterns of JE/SE preference shifts of vaccine options were different depending on the relative justifiability of costs. However, such differences were not equally distributed between SE and JE. Participants' preferences of vaccine options were sensitive to the justifiability of costs, to which they became more resistant in JE.

In this sense, hypothesis 2 was partially supported.

Confidence of decision-making. H3 predicts that participants will feel more confident about their evaluation in JE than in SE. A two-way mixed-design ANOVA (between-subject factor: relative-justifiability-of-costs; within-subject factor: evaluation mode) was conducted to find out if participants' confidence level of decision-making differed between SE and JE, and whether this difference, if any, differed between the two relative-justifiability-of-costs conditions.

The results showed that participants felt equally confident about their decision-making across evaluation mode. Their confidence level did not differ between SE ($M = 4.95$, $SD = 1.16$) and JE ($M = 4.96$, $SD = 1.33$), $F(1,101) < 0.001$, $p = .982$, $\eta_p^2 < 0.001$, nor did it differ between the justifiability-of-costs-relatively-high ($M = 4.78$, $SD = 1.31$) and the justifiability-of-costs-relatively-low ($M = 5.12$, $SD = 1.04$) conditions, $F(1,101) = 2.25$, $p = .137$, $\eta_p^2 = 0.022$.

Therefore, H3 was not supported.

5.5.4 Summary

The first section of results illustrated the JE/SE preference shifts postulated in H1.3. Irrespective of the relative justifiability of costs, preferences for the two vaccine options reversed between SE and JE: participants slightly

preferred the cheaper-but-less-safe vaccine (B) in SE, but they strongly preferred the pricier-but-safer vaccine (A) in JE. H1.3 would have found more support if participants showed stronger preference for vaccine B; nevertheless, the current results already provided good support for H1.3.

The second section of results showed that the patterns of JE/SE preference shifts were contingent, to a certain degree, on the relative justifiability of costs. When the relative justifiability of costs was high, participants slightly preferred vaccine B in SE, but they strongly preferred vaccine A in JE. When the relative justifiability of costs was low, participants preferred vaccine A in both SE and JE, though to a stronger degree in JE.

Despite the different patterns of JE/SE preference shifts, the direction of preference shifts was similar regardless of the justifiability of costs: vaccine A was more acceptable from SE to JE, whereas the vaccine B was equally acceptable in SE and JE. As revealed by further analysis, participants' preferences were sensitive to the relative-justifiability-of-costs manipulation in SE, but seemed more resistant to it in JE. Notably, the patterns and direction of JE/SE preference shifts by justifiability of costs were consistent across two evaluation scales: acceptability ratings and choice. Overall, the results lent partial support for H2.

The final section of results showed that participants did not feel more confident in their decisions in JE than in SE as hypothesized, instead, they felt equally confident. Therefore, H3 was not supported.

5.6 Discussion

The main purpose of study 2 was to investigate one boundary condition of GET in the context of health-related decisions using a more refined and

controlled experimental design. It sought to test whether JE/SE preference shifts/reversals occur when laypeople evaluate two options that involve a trade-off between a *risk* attribute and a *non-risk* attribute (H1.3). It also sought to test whether the hypothesized JE/SE preference shifts/reversals are moderated by attribute's relative justifiability (H2) by examining participants' acceptability of two flu vaccines that involves a trade-off between costs (easy-to-evaluate) and chance of side effects (hard-to-evaluate) under two conditions: when the relative justifiability of costs was high versus low. In addition, it tested whether participants felt more confident in their decisions in JE than in SE. The results mostly support H1.3, partially support H2, and contradict H3.

5.6.1 Preliminary interpretations

Consistent with previous JE/SE preference reversals research in the domain of consumer buying and managerial decisions (Bazerman et al., 1999; Hsee, 1996b; Hsee, Blount, Loewenstein, & Bazerman, 1999; Hsee & Zhang, 2010; J. Zhang, 2015), results related to H1.3 demonstrate the critical role that evaluation mode plays in laypeople's health-related decision-making.

Specifically, I observe that in SE, laypeople's evaluations of vaccines are more susceptible to the easy-to-evaluate attribute (costs), which makes the superiority of the cheaper vaccine B more salient, and therefore, they slightly prefer vaccine B. In JE, however, as they could compare two options side by side, they find vaccines' chance of side effects (safety) easier to evaluate, which makes the superiority of the safer vaccine A more salient, and subsequently, they strongly prefer vaccine A.

Indeed, laypeople generally prefer the option that is superior in the easy-to-evaluate attribute in SE, however, as the hard-to-evaluate attribute becomes

more influential in JE, they will instead prefer the option that is superior in the hard-to-evaluate attribute.

In addition, results related to H2 suggest that the relative justifiability between the easy-to-evaluate attribute and the hard-to-evaluate attribute could be a boundary condition of JE/SE preference shifts. Specifically, I observe that laypeople's preferences for the vaccine options either reverse or shift between SE and JE depending on whether the justifiability of the easy-to-evaluate attribute – costs – is relatively high or low.

However, there are some underlying similarities behind the seemingly different patterns. I observe that in SE, laypeople's vaccine preferences are particularly susceptible to the relative justifiability of costs: they prefer the cheaper vaccine B when costs are more justifiable, and they prefer the safer vaccine A when costs are less justifiable. Interestingly, in JE, laypeople's preferences seem immune to costs' justifiability: they consistently prefer vaccine A, though to a greater extent when costs are less justifiable. Moreover, regardless of the justifiability of costs, laypeople's evaluations for the two vaccines change in the same direction from SE to JE: the acceptability of vaccine A improves, but the acceptability of vaccine B does not change much.

These results suggest that whether the hypothesized preference reversals occur or not is somewhat contingent upon an attribute's relative justifiability. Before justifiability is introduced as a moderator, the evaluability hypothesis predicts that SE/JE preference reversal will occur because the hard-to-evaluate attribute becomes more impactful in JE, making the option superior in the hard-to-evaluate more favorable in JE compared to in SE. However, such SE/JE preference reversal usually presumes that the hard-to-evaluate attribute is also

more justifiable than the easy-to-evaluate attribute. When the hard-to-evaluate attribute is less justifiable, however, it might exert relatively less impact (i.e. the easy-to-evaluate attribute could exert substantial impact in JE as well). This is supported by the results that laypeople's preference of vaccine A (pricier-but-safer) in JE is much greater when the justifiability of costs (easy-to-evaluate attribute) are low than when it is high. In other words, the degree of JE/SE preference reversals are contingent on the relative justifiability of the easy-to-evaluate vs. the hard-to-evaluate attribute.

Finally, H3 not being supported suggests that although JE offers laypeople more reference information, which presumably help them evaluate each option more objectively and thoroughly, laypeople do not necessarily feel more confident in their decisions.

One way to explain this counterintuitive finding is to attribute it to people's general overconfidence tendency. As reviewed by Camerer and Lovo (1999), overconfidence has been documented in many aspects of human lives, including driving abilities, life expectancy, and future prospects. Previous research on financial decision-making has also provided robust evidence that demonstrates individual investors' overconfidence in their investment skills (Barber & Odean, 2013; Bazerman & Moore, 2013). They may attribute casual success to their stock-picking skills rather than luck (Taleb, 2004). Sweetened by quick gains, their overconfidence may prompt them to hold under-diversified portfolios, trade excessively (Barber & Odean, 2000, 2001; Odean, 1999), sell winners too early and cling to losers for too long (Odean, 1998). It is likely that such overconfidence may manifest itself in people's health-related decision-

making. Even if they have limited information and evidence in SE, they may still feel confident about their decisions.

Alternatively, according to the rationale construction hypothesis (Heath & Gonzalez, 1995), confidence is likely to increase when people undergo the elaboration process, constructing rationale to justify why they favor one option over another. In contrast, confidence does not necessarily increase when they merely collect more information, it may even decrease when they experience information overload (Sheena S. Iyengar & Lepper, 2000).

The fact that laypeople's confidence level does not increase from SE to JE suggests that they may not consciously engage in rationale construction in JE even if they are better equipped to do so. In this sense, the JE/SE preference reversals seem to be an automatic rather than conscious process (Marteau, Hollands, & Fletcher, 2012), making a case for using evaluation mode to nudge laypeople's health-related decisions.

5.6.2 Alternative explanations and limitations.

Overall, study 2 has refined the experimental design and addressed a number of alternative explanations and limitations discussed in study 1a and study 1b.

The findings of the current study are unlikely to result from response bias associated with the evaluation scales. Although the acceptability of vaccine is a subjective scale, it should not be prone to scale re-norming (interpret scales differently under various contexts) as each vaccine is anchored to a fixed price (King & Wand, 2007). Moreover, the issue of scale re-norming mostly arises from studies that adopt a between-subject design (Hsee & Tang, 2007), whereas the current study adopts a within-subject design. Besides, participants' ratings of

vaccine acceptability are consistent with their choices in both SE and JE, which further palliates the measurement bias issue, if any.

It is also unlikely that the findings are highly contingent on the decision-making scenario that I designed. Unlike study 1a and 1b, where the travelling hazards and health hazards may carry some inferences or complications, study 2 uses a cleaner low-stake hazard –influenza – that most participants are familiar with, meanwhile the majority of them had never taken a flu vaccine before and held no prejudice against vaccines in general. Therefore, it is safe to assume that participants' vaccine preferences result from the exposure to the vaccine information presented in the scenario, rather than based on *a priori* belief or knowledge. Moreover, the issue of loss multiplicity is also unlikely to occur since the most prominent risk associated with vaccine is its side effects. In addition, none of the vaccine option has dominant advantage, neither is the manipulation of justifiability-of-costs overwhelming. Therefore, just like Kahneman and Tversky's (1981) Asian disease scenario has been widely adopted in decision-making research, the current decision-making scenario can also serve as an exemplar for studying general health-related decision-making.

The current study has also found a new way to address the confounding effects of attributes' relative importance. In earlier JE/SE preference reversals research, the hard-to-evaluate attribute is always designed to be decisively more important than the easy-to-evaluate attribute, and the relative importance between the two attributes is always fixed. Hsee (2000) argues that this is a necessary design feature for JE/SE preference reversals to occur (p. 556). However, the current study shows that JE/SE preference reversals can occur even if the relative importance between the two attributes is not in sharp contrast.

Although study 2 has addressed several limitations of earlier studies, it still has several limitations. First, the within-subject design is a double-edged sword. Although it helps eliminate response bias associated with subjective evaluation scale, it is not immune to carryover effects. To minimize them, I counterbalanced the presentation of vaccine options in SE and engaged participants to do an irrelevant filler task between each round of vaccine evaluations.

Second, the evaluations were based on self-reports. Previous research (Brown, 2005) suggests that sometimes people's stated preferences (what they say) may differ from their revealed preferences (what they actually choose), and that was what happened in study 1b (see Section 0). However, unlike consumer buying decisions which almost everyone routinely makes, many health-related decisions are made less frequently, and some of them are even one-off events (e.g. whether to use surgery or radiation therapy; whether to choose caesarian or natural delivery). To investigate how laypeople make those less frequent and less familiar decisions (which they may seldom or never need to in real life), it is necessary to simulate the situations and elicit self-reports.

Third, since people naturally want to appear consistent (Festinger, 1957), participants might feel reluctant to alter their evaluations when repeatedly asked to evaluate the same vaccine option with short time intervals. However, this tendency would strengthen the findings – the extent of the observed JE/SE preference shifts would have been greater if participants were less reluctant to change their mind.

In sum, despite the above limitations, findings from the current study provide a stronger demonstration of the JE/SE preference reversals, providing

good empirical support for the GET framework and extending the evaluability hypothesis from the domain of consumer buying and managerial decisions to the domain of health-related decision-making. It also identified the relative justifiability of attributes as one boundary condition in the context of health-related decision-making that involves risks and trade-offs.

CHAPTER SIX: GENERAL DISCUSSION AND CONCLUSION

In this chapter, I recapitulate the major findings of this work, discuss how it relates to prior research, and provide practical advice for laypeople and risk communicators. I also address some concerns, alternative explanations, limitations, and open questions about this research. I conclude this work with future directions and closing remarks.

6.1 Overview

Arguably, any evaluation is formed either in single evaluation, joint evaluation, or some combination of the two, i.e., sequential SEs (Hsee et al., 1999, p. 576). The important role that evaluation mode plays in inducing preference reversals has been theorized in the general evaluability theory (GET) (Hsee & Zhang, 2010), and evidence of JE/SE preference reversals has accumulated mostly in the domain of consumer behavior and managerial decision-making, where the options rarely evoke threats or sense of non-monetary loss (J. Zhang, 2015). As GET posits, when laypeople evaluate two options that involve trading off between an easy-to-evaluate attribute and a hard-to-evaluate attribute, their preferences for the two options may reverse between SE and JE. The JE/SE preference reversals occur because in JE, the hard-to-evaluate attribute becomes easier to evaluate and thus has more impact.

Evaluation mode is under-explored in the domain of health-related decision-making, where the options typically involve trade-offs that straddle several important dimensions of risk that tap into both emotion and cognition. This dissertation explicates key attributes of risk, elucidates their relative evaluability, and proposes to test whether the critical role of evaluation mode is

applicable to the domain of health-related decision-making (chapter two: literature review).

I set out to demonstrate that the JE/SE preference reversals will also occur in health-related decisions. In other words, laypeople's preferences will not be consistent between SE and JE. More specifically, they will generally prefer the option that is superior in the easy-to-evaluate attribute in SE; however, as the hard-to-evaluate attribute becomes easier to evaluate thus more influential in JE, they will instead prefer the option that is superior in the hard-to-evaluate attribute. After collecting initial evidence for and against the GET-derived hypothesis, I continue to explore possible mechanisms that govern the degree and direction of JE/SE preference shifts in health-related decisions.

6.2 Major Findings

I first show (chapter three: study 1a) that consistent with the GET-derived hypothesis, laypeople exhibit moderate preference shifts between SE and JE when they evaluate two options that involve a trade-off between an easy-to-evaluate risk attribute and a hard-to-evaluate risk attribute. I find that when the trade-off is between severity of loss (easy-to-evaluate) and likelihood of loss (hard-to-evaluate), laypeople are indifferent between the more-severe-but-less-likely hazard and the less-severe-but-more-likely one in SE, but they prefer to avoid the more-severe-but-less-likely hazard in JE.

I then conceptually replicate the findings of study 1a (chapter four: study 1b) when the trade-off is between pain intensity (easy-to-evaluate) and prevalence (hard-to-evaluate) of health hazards. I find laypeople prefer to prevent the less-painful-but-more-prevalent health hazard than the more-painful-but-less-prevalent one in SE, but they are indifferent between the two in JE.

However, contrary to the GET-derived hypothesis, in both studies, laypeople's preferences in JE are more sensitive to the easy-to-evaluate risk attribute compared to the hard-to-evaluate one. The easy-to-evaluate risk attribute, rather than being crowded out by the hard-to-evaluate one, becomes even more impactful in JE. Consequently, an option's relative inferiority in the easy-to-evaluate risk attribute heightens, rather than abates, in JE.

I conjecture that loss multiplicity (the significance of loss increases with the number of domains where losses incur) might partially explain the heightened risk perception in JE. I also conjecture that risk attributes' relative justifiability may partially explain the contradictory impact of the easy-to-evaluate risk attribute in JE: when the easy-to-evaluate risk attribute is also deemed more justifiable, its influence relative to the hard-to-evaluate risk attribute will amplify in JE, hindering the predicted JE/SE preference reversal from happening.

Indeed, I confirm my first conjecture by showing that when the trade-off is between a *risk* attribute and a *non-risk* attribute instead of between two *risk* attributes, preferences do reverse between SE and JE as the GET-derived hypothesis predicts (chapter five: study 2). I further confirm my second conjecture by showing that the degree of JE/SE preference shifts is contingent upon an attribute's relative justifiability. I find that preferences reverse between SE and JE when the justifiability of the easy-to-evaluate attribute is relatively high, but it does not when the justifiability of the easy-to-evaluate attribute is relatively low (chapter five: study 2). This is because SE/JE preference reversal usually presumes that the hard-to-evaluate attribute is also more justifiable than the easy-to-evaluate attribute. When the hard-to-evaluate attribute is less justifiable, however, it might exert relatively less impact. In sum, I identify

attributes' relative justifiability as a boundary condition of the previously hypothesized JE/SE preference reversals in health-related decisions.

I further observe some nuanced dynamics of the JE/SE preference reversals. I find that although laypeople's preferences are not consistent between SE and JE, though their confidence level is—they are equally confident with or without additional reference information.

In addition, I observe that when the trade-off is between two *risk* attributes, regardless of laypeople's relative preferences of the two options, their risk perceptions amplify from SE to JE (chapter three and four). However, when the trade-off is between a *risk* attribute and a *non-risk* attribute, regardless of laypeople's relative preferences of the two options, their risk perceptions lessen from SE to JE (chapter five). I will speculate possible reasons in the open question (Section 6.4.2).

In all, I introduce evaluation mode to the domain of health-related decision-making.

Through a series of progressively designed experiments, I document how laypeople's preferences shift between SE and JE when trading off risk or non-risk attributes that differ in evaluability. I further identify attribute justifiability as a boundary condition for the JE/SE preference reversals in health-related decisions.

6.3 Potential Concerns and Alternative Explanations

Before discussing theoretical and practical implications from the research findings, I would like to address several questions.

The first question is concerned with whether the findings are generalizable to other hazards. In this research, I explicate risk attributes in terms of their

evaluability, and I categorize them into two groups: easy-to-evaluate versus hard-to-evaluate. Presumably, there are thousands of possible hazards, each of which is associated with a particular set of risk attributes. One may wonder, is the dichotomous classification over-simplified – a form of reductionism?

The answer is yes and no. The findings will be more applicable to general hazards than to those that evoke overwhelming affective responses, such as rage or stigma. For general hazards, such simple classification seems adequate to quickly decide whether laypeople's perceptions toward them can be influenced by situational factors like evaluation mode. If, however, a hazard evokes rage or stigma, it implies that it has some extremely easy-to-evaluate risk attributes that are perceived as highly justifiable. In that case, those attributes would dominate laypeople's decision-making, curbing the decision weights that other hard-to-evaluate attributes might potentially have, either in SE or in JE. Indeed, the power of those extremely easy-to-evaluate attributes seems persistent and resistant to external interventions, which explains why anti-stigma education programs are not effective enough (Mann & Himelein, 2008), or why its effectiveness fades quickly (Friedrich et al., 2013). It also explains why anti-stigma interventions may even further reinforce the public's existing unfavorable opinions by exposing the intervention population to more stigma-related information (Stuart & Arboleda-Flórez, 2012), which is supposedly super easy-to-evaluate. Therefore, it seems that when risk communicators present both easy-to-evaluate and hard-to-evaluate information, laypeople tend to remember the former much better.

The second question is concerned with whether the findings are generalizable to other populations. For all studies, I recruited participants either

from online panel, i.e., Amazon Mechanical Turk or from the student pool of Nanyang Technological University. One may wonder, will the findings be contingent on the chosen samples?

The answer is a tentative yes. Each sample choice has its own advantages and disadvantages. M-Turk sample's superiority lies in its sample heterogeneity, efficiency, and fair cost. It has also been widely adopted by social scientists (Berinsky, Huber, & Lenz, 2012). On the other hand, NTU students sample's superiority lies in participants' higher level of literacy and attentiveness.

However, both samples have some peculiar traits that might limit the generalizability of the findings. Participants' certain traits might affect the degree and direction of preference shifts. Take the vaccine study for example, I assume M-turk workers will be more sensitive to the costs, as their chief motivation to join M-turk is to earn money, whereas students will be less sensitive to them, as they generally have limited working experience and cannot fully appreciate the difficulty of earning money. Therefore, the exact patterns of JE/SE preference shifts might not be replicated in an independent population if it differs from my samples in certain traits that are highly influential on the preferences of concern. Nevertheless, the JE/SE preference shifts are expected to occur, though perhaps with different patterns.

The third question is how the mechanism of JE/SE preference reversals differs from availability heuristics and framing effects. Availability heuristic refers to people's tendency to infer the frequency of certain events based on the ease of retrieving such instances (Tversky & Kahneman, 1974). It seems that JE is a special case of availability heuristics where certain reference information becomes more cognitively available to the evaluators. However, while difficulty

of retrieval often implies difficulty of evaluation, ease of retrieval does not necessarily imply ease of evaluation. For example, most people could easily recall that the typical treatments for cancer is surgery and radiation therapy, but they are not necessarily able to evaluate the overall desirability of those two treatments. Moreover, high cognitive availability also does not automatically imply ease of evaluation. One can make an attribute more cognitively available without making it more evaluable (meaningful). For example, suppose a public health initiative saves 2,000 life-years, campaigners can highlight the number in the billboards so that everyone may notice, yet the public may not make sense of the number (SE). In contrast, if campaigners present and highlight another initiative that saves 1,000 life-years (JE), the public will not only see, but also understand the meaning behind these numbers, and thus do not need to rely on heuristics to draw comparison.

Framing is essentially a process of selective presentation. According to Entman (1993), “to frame is to select some aspects of a perceived reality and make them more salient” (p. 52). For example, 90% of survival and 10% of mortality are quantitatively equivalent presentation of treatment efficacy. Similarly, one may argue that the essence of JE is to make certain attributes more salient thus more cognitively available. However, JE does not engage in selective presentation, or at least to a lesser degree. The options presented in JE are the same as those in SE, although one might argue that JE might evoke certain reference information that is not cognitively available in SE (Hsee & Leclerc, 1998). In sum, framing effects might take place in both SE and JE, but the JE/SE preference reversals can occur independent of framing effects.

6.4 Theoretical Implications

6.4.1 Relationship with prior research.

Relationship with previous research on preference reversals. The findings from this research corroborate Slovic's (1995) general claim that people's preferences are often constructed on the spot rather than being well-defined and stable, and methods of elicitation that are seemingly equivalent often yield systematically different preferences (Lichtenstein & Slovic, 2006). It also strengthens the claim that "true" preferences seldom exist as they often change with available contextual cues (Peters et al., 2013). In particular, it joins a growing body of literature on SE/JE preference reversals (Kahneman & Ritov, 1994; Bazerman, Moore, E., Wade-Benzoni, & Blount, 1999; Hsee & Leclerc, 1998; Hsee et al., 1999; Sevdalis & Harvey, 2006; Paharia, Kassam, Greene, & Bazerman, 2009; Christopoulos, Kokkinaki, Harvey, & Sevdalis, 2011; Zhang, 2015) and expands the domain from consumer buying and managerial decisions to health-related decisions. This research shows that evaluation mode might play an even more important role in health-related decisions, where the decision situations often involve deciphering hard-to-grasp concepts and unfamiliar technical information (Reyna et al., 2015; Saposnik et al., 2016; Stiggelbout et al., 2015), and the options often involve trading off risk or non-risk attributes that differ in evaluability. This research also enriches the general evaluability theory by identifying attribute justifiability as a boundary condition.

Relationship with previous research on decision-making. This research relates to several schools of thoughts on general decision-making. First, the JE/SE preference reversals caused by evaluability difference are reminiscent to what psychologists articulate as the dual-process model of thinking (Weber & Johnson, 2009). This model distinguishes two parallel yet interactive modes of

thought: “System 1” is intuitive, emotional, and fast, whereas “system 2” is logical, deliberate, and slow (Epstein, 1994; Kahneman, 2011; Sloman, 1996; Västfjäll & Slovic, 2013). Those two systems may yield inconsistent appraisals of the same objects, particularly those that are likely to invoke both systems, resulting in contradictory evaluations (Bechera, Damasio, Tranel, & Damasio, 1997; Damasio, 1994; Finucane, Alhakami, Slovic, & Johnson, 2000; Pessoa, 2008; Peters, Lipkus, & Diefenbach, 2006; Slovic et al., 2004). However, while the dual-process model emphasizes the inconsistent appraisals caused by cross-category difference between affective and cognitive thinking, the JE/SE preference reversals can be induced by both cross-category and within-category evaluability differences. For example, when evaluating job candidates, laypeople prefer the higher-GPA-less-work-experience candidate in SE, but they prefer the lower-GPA-more-work-experience candidate in JE (Hsee, 1996b), and the evaluations of GPA and work experience are both cognitive.

This research also relates to research on processing fluency, which has found that people tend to evaluate items based on the ease with which they process information (Oppenheimer, 2008). In the financial domain, previous studies show that laypeople consider familiar currency having greater purchasing power than unfamiliar ones (Adam L. Alter & Oppenheimer, 2008); they prefer investing in firms closer to home than those farther from home (Coval & Moskowitz, 1999); stocks with easier-to-pronounce names tend to outperform those with hard-to-pronounce names (A. L. Alter & Oppenheimer, 2006). In the health domain, previous studies have also identified low numeracy and health literacy – incapable of processing information with ease – as two constraining factors for making sound decisions (Peters, Dieckmann, Mertz, Västfjäll, &

Slovic, 2009; Reyna et al., 2009). The difference of this research is that evaluability can be enhanced by an *ad hoc* situational factor – JE – rather than through long-term familiarization process or educational programs.

Furthermore, this research relates to research that embraces the idea of “more is not necessarily better” when it comes to the amount of information (Gigerenzer & Gaissmaier, 2011; Gigerenzer, Todd, & ABC Research Group., 1999; Marewski & Gigerenzer, 2012). The fact that laypeople do not feel more confident about their decisions in JE than in SE suggests that additional information or enhanced evaluability may not necessarily build confidence. As Heath and Gonzalez (1995) finds in interactive decision-making, it is the process of rationale construction rather than information collection during interaction that boosts confidence. Similarly, scholars have found that laypeople are more likely to make worse decisions (S. S. Iyengar, Wells, & Schwartz, 2006; Sheena S. Iyengar & Lepper, 2000; Peters et al., 2013) or feel more regretful (Schwartz et al., 2002) about their decisions when they face too many options.

Relationship with previous research on risk communication. The present research also joins a growing body of research that strives to improve risk communication for better medical decision-making. Scholars in this field have recognized low numeracy skills (or health literacy) of the public and poor presentation formats that risk communicators use as two major barriers that hinder the public from grasping or de-biasing risk information (Reyna & Brainerd, 2008; Reyna et al., 2009). In essence, both barriers reveal the hard-to-evaluate nature of some risk attributes.

To overcome low numeracy/literacy and elucidate what makes risk communication work, risk communicators have proposed and tested the fuzzy

trace theory, which distinguishes two types of mental representation of risk information: verbatim and gist (Reyna, 2008; Stone, Yates, & Parker, 1994). While verbatim representation captures the “surface form of information” in a precise and detailed manner, gist representation captures the “essential meaning of the information” in a rough and fuzzy manner (p. 111), yet laypeople more often rely on gist than verbatim in decision-making (Reyna et al., 2015). The implication of this theory is that communication should focus on conveying the gist rather than presenting detailed and precise risk information, and this implication has been applied to communication programs on HIV prevention, surgical risks, and cancer control (Reyna, 2008, 2012; Reyna & Adam, 2003). I infer that the gist is often easy-to-evaluate, whereas verbatim is often hard-to-evaluate, and I speculate that though laypeople will be more sensitive to gist in SE, they will become more sensitive to verbatim in JE.

To improve presentation formats, risk communicators have increasingly started to illustrate health risks using visual aids, such as pie charts, bar charts, icon arrays, and infographics (Balcetis & Granot, 2015; Galesic, Garcia-Retamero, & Gigerenzer, 2009; Garcia-Retamero & Cokely, 2013; Hildon, Allwood, & Black, 2012; Lipkus, 2007; Soll et al., 2015). Compared to verbal and numerical formats of risk probabilities, visual aids present the same risk information in a concrete way that makes it easier to grasp the essence of the message (Spiegelhalter, Pearson, & Short, 2011; Trevena et al., 2013). Accordingly, I speculate that the mechanism of how visual displays enhance information evaluability might be similar to how JE enhances attribute evaluability.

In sum, risk communicators might add evaluation mode to the theoretical framework and toolbox of risk communicators.

6.4.2 **Open questions.**

Despite the key findings, this research has left a few questions unanswered that we wish to clarify now and investigate in the future.

The first question is about the main effects of evaluation mode on risk perceptions. As mentioned earlier, I observe amplified risk perceptions from SE to JE when the trade-off is between two risk attributes, but I observe lessened risk perceptions from SE to JE when the trade-off is between a risk attribute and a non-risk attribute. This finding is reminiscent of an earlier study in risk communication. I will first introduce this study and then speculate possible reasons behind it.

In this study (Amsterlaw et al., 2006), participants evaluated two surgery options that are equivalent in cure rate but differ in mortality and complication rates (see

Table 6.1). Around half of them (51%) chose surgery 2 (20% mortality rate with no complications whatsoever) over option 1 (16% mortality rate with 4% chance of complications), which implied that surgery 1 was perceived riskier. However, the overwhelming majority of pilot participants (>90%) preferred each complication to dying of colon cancer. The authors attributed participants' choices to the fear of complications and considered this finding as an example of biased healthcare decisions.

Table 6.1

Summary Table of the Two Surgery Options for Colon Cancer Treatment

Possible outcome	Surgery 1	Surgery 2
Cure without complication	80%	80%
Cure with complication		
- Colostomy	1%	
- Chronic diarrhoea	1%	
- Intermittent bowel obstruction	1%	
- Wound infection	1%	
No cure (death)	16%	20%

Note. Adapted from Amsterlaw et. al. (2006), p. 66, Table 1.

I believe the notion of loss multiplicity elaborated in Section 4.4.1 and Section 6.2 explains why surgery 1 with 4% complications and 16% mortality was perceived riskier than surgery 2 with 20% mortality rate even though most people prefer living with any complications to death. Likewise, loss multiplicity also explains why participants in study 1 were less willing to travel to both countries and rated both magic pill deals fairer in JE.

The heightened risk perceptions in JE may also be attributed to humans' deep-grained psychological tendency – loss aversion – people dread losses more than they yearn for gains. (Kahneman & Tversky, 1979). According to Tversky (1991), loss aversion implies that the evaluability of losses differ systematically from that of gains: “a given difference between two options will generally have greater impact when it is evaluated as a difference between two losses (disadvantages) than when it is viewed as a difference between two gains (or advantages) (p. 1045)”. In this sense, in JE, participants would be more keenly aware of the losses that each option incurred, become more averse to them, and

manifest their loss aversion by reporting less willingness to travel and higher price-fairness of the hazard-prevention deals.

Similarly, while loss multiplicity alone cannot adequately explain why participants in study 2 considered both vaccines more acceptable in JE (see Section **Error! Reference source not found.** for the main effect of evaluation mode), loss aversion perhaps can. Vaccines are generally considered efficacious and safe despite being falsely associated with autism (Gerber & Offit, 2009). Given that the chance of side effects of both options is under 5%, participants might feel that both are safe enough in JE. In other words, participants were likely to interpret the difference between the two vaccines as a difference between two advantages (gains) rather than two disadvantages (losses). Therefore, since they could better appreciate the fair price of vaccine B and safer quality of vaccine A in JE, they rated both options higher in JE than in SE. This argument is not definite: I cannot rule out the possibility that the results are contingent on the vaccine scenario now, but I can replicate this study using alternative scenarios in the future to determine how generalizable the findings are.

Another question is whether the findings on JE/SE preference reversals are generalizable to situations that do not involve trade-offs. All decision-making scenarios of this search involve trade-offs, and one may wonder why. Granted, some decisions do not involve trade-offs. Suppose a patient faces two hospital options (see

Table 6.2): hospital B is superior to hospital A in both safety and convenience. Such superiority, however, may be obfuscated in SE and only becomes salient in JE, in which case, participants will perhaps be indifferent between the two hospitals in SE, but overwhelmingly prefer the dominant option

– hospital B – in JE. In those situations where one option dominates the other, I believe the degree of JE/SE preference reversals will be stronger.

Table 6.2

Illustration of Health-Related Decisions with No Trade-Off

	Hospital A	Hospital B
MRSA blood infections (hard-to-evaluate)	4.2 in 10,000	0.6 in 10,000
Distance to home (easy-to-evaluate)	6 km	4 km

Note. The scenario is adapted from (Boyce et al., 2010).

6.5 Practical Implications

Apart from the theoretical implications, this research also offers some practical implications for laypeople and risk communicators.

6.5.1 Advice for laypeople

For laypeople, one implication is that they should be more aware of the evaluation mode when making important health-related decisions. They can reflect on which evaluation mode they are in, and whether they pay fair proportion of attention towards the easy-to-evaluate and hard-to-evaluate risk/non-risk attributes.

It may be tempting to ask which evaluation mode is better: SE or JE. However, there is no definite answer; each has its own pros and cons depending on the nature and purpose of health-related decisions in question. One distinctive feature of JE is that it enables laypeople to discern differences of certain hard-to-evaluate attributes that they may not be sufficiently sensitive to in SE. If discerning such differences is meaningful and necessary, then laypeople might be better off making decisions in JE. In contrast, if such differences are

unnecessary or even misleading, then laypeople might be better off making decisions in SE (Shafir, 2002).

Let us take Angelina Jolie’s decision to have mastectomy as an exemplar to illustrate when health-related decisions can be better made in JE. In 2013, Jolie (2013), who had a defect in BRCA₁ gene, explained in an opinion piece titled “my medical choice” why she made this decision:

“I wanted to write this to tell other women that the decision to have a mastectomy was not easy. But it is one I am very happy that I made. My chances of developing breast cancer have dropped from 87 percent to under 5 percent.”

Jolie’s bold decision, together with other celebrities that have cured from breast cancer, has spurred a surge of public interest in breast cancer screening, BRCA gene test, and mastectomy (Sabel & Cin, 2016). The media and the medical community coined the term “Angelina Jolie Effect” to refer to this phenomenon (Troiano, Cozzolino, Bagnoli, & Nante, 2017). However, this was a classic case of SE, where people mistook mastectomy as the sole treatment option for curing or preempting breast cancer. They could have considered an alternative option — lumpectomy, which only removes part of the breast, and its recurrence rate is only slightly higher than that of mastectomy (see Table 6.3).

Table 6.3
Summary Table of the Two Surgery Options for Breast Cancer Treatment

	Lumpectomy (breast-conserving surgery)	Mastectomy (total removal of a breast)
Aesthetics (easy-to-evaluate)	The cancer lump is removed with a margin of tissue	The whole breast is removed

Recurrence rate (hard-to-evaluate)	Breast cancer will come back in the breast in about 10 in 100 women in the 10 years after a lumpectomy	Breast cancer will come back in the area of the scar in about 5 in 100 women in the 10 years after a mastectomy
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Note. The information on surgery options is adapted from (Elwyn et al., 2013, p. 1045).

For those women who have no gene defect nor family history of breast cancer, lumpectomy might be a better option (Sabel & Cin, 2016). Women may be better able to recognize lumpectomy as an equally good option for cancer prevention if they evaluate them in JE.

However, sometimes the differences that JE highlights might be exaggerated or even delusional, in which case laypeople might be better off making or simulating decisions in SE (Shafir, 2002). Many health-related decisions, like consumer-buying decisions, are made in JE but experienced in SE, which may result in *choice-experience inconsistency* (Hsee & Zhang, 2004, p. 686). For example, pregnant women usually need to decide in advance whether to use epidural during labor or not. Epidural is the most effective analgesia to relieve labor pain (Anim-Somuah, Smyth, & Jones, 2011), though it is associated with a slightly higher rate (43% vs. 35%) of vaginal instrumental delivery (Shennan, 2001). Many women decided not to use epidural for fear of potential side effects even if they are rare (World Health Organization, 2018b). Naturally, they were in JE and quickly discerned the difference of side effects between epidural and no epidural. When the labor pain came, however, they experienced the consequence of their decisions in SE, and often regretted it. In this case, women might have made a better decision had they simulated SE (by imagining the labor pain) during advance decision-making.

6.5.2 Advice for risk communicators

I do not confine risk communicators to those who strictly specialize in risk communication. I use this term broadly, referring to health campaigners, physicians, teachers, and parents – anyone who engages in risk communication – routinely or sparingly.

For risk communicators, in general, they should consider evaluation mode when communicating risk information, presenting health-related options, and designing decision aids (Bowen et al., 2006; International Patient Decision Aids Standards Collaboration, 2005; Peters, 2017; van Weert et al., 2016).

One advice is that they can take into account how evaluation mode influences laypeople's sensitivity to certain attributes and choose the evaluation mode that aligns better with the communication purpose. As mentioned above, if they fear that laypeople might dismiss certain hard-to-evaluate attributes that have high instrumental justifiability, they should design communication plan that facilitates JE. In contrast, if they fear laypeople might be too sensitive to certain differences during decision-making that might mean less in the actual experience, they should facilitate SE instead. For example, given the growing safety concerns towards vaccine (Larson et al., 2011) and the failure of mitigating vaccine hesitancy by educational efforts (Arnold, 2013; Larson et al., 2011), risk communicators may try to remedy this situation by re-engineering the choice architecture. Physicians may prescribe a flu vaccine along with other medications for flu patients to facilitate JE for vaccine evaluation, which is likely to highlight the high cost-effectiveness of vaccine compared with other medications—an advantage of vaccine that may have been overlooked in SE.

Another advice is that they also need to think about whether an attribute has enough justifiability to be included when presenting several options. For

example, the UK national health service provides an online portal where residents could choose hospitals by more than a dozen attributes (e.g. waiting time, cleanliness, safety, quality of care, efficiency of admin, etc.)(Boyce et al., 2010). Although those attributes are unlikely to be equally justifiable, residents may be too distracted to consider their justifiability in JE.

They also need to consider some attributes' justifiability in relation to other attributes. The relative justifiability of certain attributes could be highlighted or abated. Take the vaccine for example, most medical staff and lay people would consider side effects to be categorically more justifiable than costs when evaluating vaccines, under-estimating the importance of budgeting in health service planning. In fact, neither the public nor the national health service has a steep pocket, and given that the cost-effectiveness of various interventions could vary by a hundred fold (Owen et al., 2012; Owen, Pennington, Fischer, & Jeong, 2018), it is sometimes necessary to highlight the justifiability of costs for better planning and resourcing of health service for all.

The third advice is that they should heed the overall riskiness of the option when choosing evaluation mode. As elaborated in Section 6.4.2, when comparing two highly risky hazards in JE, they may dread them more when comparing them together than examining them one by one. And if the dreadfulness exceeds what they could bear, they may avoid or postpone making a decision (Lerner, Li, Valdesolo, & Kassam, 2015). In this case, risk communicator may engage laypeople in sequential SE, asking them to do something similar to distraction tasks (see Section 5.4.3) in between. They also need to consider some attributes' justifiability in relation to other attributes. The relative justifiability of certain attributes could be highlighted or abated. Take the vaccine for example, most

medical staff and lay people would consider side effects to be categorically more justifiable than costs when evaluating vaccines, under-estimating the importance of budgeting in health service planning. In fact, neither the public nor the national health service has a steep pocket, and given that the cost-effectiveness of various interventions could vary by a hundred fold (Owen et al., 2012, 2018), it is sometimes necessary to highlight the justifiability of costs for better planning and resourcing of health service for all.

The final advice is that they need to be more cautious when using relative terms, labels and “affective tags” (Slovic, Finucane, Peters, & MacGregor, 2002, p. 1347), all of which make attributes easier to evaluate by evoking pseudo-JE. For example, to say the relative risk of one option implicitly compares it with another option. Labels like “over-the-counter (OTC)”, “small”, “large”, “rare”, “common” (Paivio, 1990) can translate hard-to-evaluate quantitative information into gist that is easy-to-evaluate even in SE (Johnson et al., 2012). Affective tags such as “eat light option”, “organic”, and “98% fat free” make information on calorie, pesticide residue, and sugar level not only easy-to-evaluate, but also make the corresponding products more distinctive and attractive.

Such distinctiveness may be unnecessary or even misleading for comparison among low-probability events, in which case, sticking to absolute terms may be a wiser choice. For example, one study (Stone et al., 1994) found that laypeople were willing to pay substantially more money for safer tires when the risk information was presented in relative terms rather than absolute terms (see Table 6.4). However, given the extremely low base rate of injury, expressing risk information in relative terms might seem fishy.

In addition, such unnecessary distinctiveness is particularly likely to arise when medical statistics are involved. One example is women’s decision in taking annual/bi-annual mammography. In relative terms, breast cancer screening can reduce mortality risk by 25%, which might prompt women to do regular screening, but they may decide not to if they realize that in absolute terms, screening can reduce the risk from 0.5% to 0.4% (Gigerenzer, 2016). Another example is stomach cancer patients’ decision in choosing surgery type. They typically have two surgery options: total gastrectomy (TG) or subtotal gastrectomy (SG) (American Cancer Society, 2019). Many patients preferred to have total gastrectomy, presumably because they saw the amount of stomach removed (which is easy-to-evaluate) as a proxy of survival rate – the more the better (Shin, Lee, Hong, & Chang, 2016). However, the difference in five-year survival rate of the two options is not statistically significant 65.3% for SG and 62.4% for TG (Bozzetti et al., 1999). In this case, it will be better to accompany the medical statistics of the two options with the same label “fairly high”.

Table 6.4

Risk Information Presented in Relative vs. Absolute terms

	Standard Tire	Improved Tire
Absolute terms	Annual blowout injury risk 0.00006	Annual blowout injury risk 0.00003
Relative terms	About average	Half of that for standard tires

Note. The statistics are adapted from (Stone et al., 1994, p. 394)

In addition, I would like to offer some advice in light of the COVID-19 pandemic that plagued the globe from in 2020 (World Health Organization, 2020).

Risk communicators need to take precautions in choosing the reference option when communicating new health risks to the public in joint evaluation

mode. When the COVID-19 outbreak started in Wuhan during Jan 2020, limited epidemiological and clinical data were available on how severe the new coronavirus was and how widely it could spread (Li et al., 2020). In other words, both severity and magnitude of spread were hard to evaluate. Expert opinions were divergent: the case fatality rate was estimated to be between 1.0 and 3.4% (Rajgor, Lee, Archuleta, Bagdasarian, & Quek, 2020); the basic reproductive number R_0 , between 2 and 3 (S. Zhang et al., 2020; Zhao et al., 2020).

To help the public quickly grasp how risky COVID-19 was, national leaders and public health agencies compared it to viruses that the public were more familiar with. Despite the differences in estimations, scholars had reached a consensus that COVID-19 was more severe and contagious than seasonal flu, but less severe and contagious than SARS (Aylward, Bruce (WHO); Liang, 2020; Ferguson et al., 2020). Accordingly, COVID-19 was either framed as a big flu (e.g. United Kingdom) or as a small SARS (China, South Korea etc) (Cyranoski, 2020; ROK Ministry of Economy and Finance, 2020; UK Department of Health, 2020).

Essentially, they unanimously invited the public to engage in joint evaluation mode to learn about COVID-19, comparing it to either flu or SARS. Countries that saw COVID-19 as a big flu became more sensitive to how widely it could spread, and enacted mitigation policies that aimed to slow down the spread, whereas countries that saw COVID-19 as a small SARS became more sensitive to how severe the symptoms could be, and enacted containing policies that aimed to eradicate the spread (Gt Walker et al., 2020). Those policies — judging by the trajectories of total cases and deaths (Dong, Du, & Gardner, 2020) — had a huge impact on how well countries managed the pandemic. Therefore,

choosing a good reference option could be a deal breaker when communicating risk in joint evaluation mode.

6.5.3 Evaluation mode as a nudge

Earlier I loosely introduced nudges as situational factors imbedded in the decision environment that are seemingly irrelevant to the target of evaluation, which could predictably change people's behaviors (Thaler, 2016) (see Section 1.2). My emphasis then was to distinguish nudges from educational efforts and emotional appeals. Now, having shown the role that evaluation mode plays in laypeople's health-related decisions, I would like to define nudges more precisely and explain how evaluation mode fits as a nudge.

Surely, many approaches other than nudges could also predictably change people's behaviors (Glanz et al., 2008). What differentiates nudges is that nudges could achieve this goal "without forbidding any options or significantly changing their economic incentives" (Thaler & Sunstein, 2008, p. 6). For example, health communicators could promote a healthier diet by launching anti-obesity campaigns (Emery, Szczypka, Powell, & Chaloupka, 2007) or health promotion initiatives such as "Choose MyPlate" to remind the public to consume an adequate amount of fruit and vegetables (USDA Center for Nutrition Policy and Promotion, 2016). Those campaigns are usually costly and pain-taking to launch. They could also *nudge* the public to eat a healthier diet by re-arranging how healthy food are positioned, such as putting vegetables and fruit at eye level in the canteens (Thaler & Sunstein, 2008), or placing them at the cash register in the supermarkets, both of which make healthier food more effortless to access to without incurring significant costs or efforts (Kroese, Marchiori, & de Ridder, 2016).

In other words, the defining characteristic of nudges lies in their gentleness. For example, reducing students' calories intake in schools can be achieved by banning chocolate milk (Hanks, Just, & Wansink, 2014) or sugar soda (Taber, 2012) altogether from school cafeterias. Those approaches, though effective, resort to legislation which is more like a "shove" (a strong push) rather than a nudge (a gentle push). To achieve the same goal, a nudge would not restrict food availability; instead, it would seek to change food arrangement such as placing junk food in less convenient places or arranging food categories more carefully so as not to unintentionally stimulate students' appetite. Research has shown that "trigger food" (some side dishes), though healthy, might increase the consumptions of unhealthy food items by its mere presence (Hanks, Just, & Wansink, 2012). For example, Hanks and colleagues' study (2012) revealed that students might consume more ice-cream when celery is served. In short, when people are nudged, they should not be too consciously aware of being nudged.

After outlining the defining characteristics of nudges, health communicators may refer to Hollands and colleagues (2013) for a more rigid and easier-to-operationalize definition of nudges. According to them, nudges refer to "interventions that involve altering the properties or placement of objects or stimuli within micro-environments with the intention of changing health-related behavior. Such interventions are implemented within the same micro-environment as that in which the target behavior is performed, typically require minimal conscious engagement, can in principle influence the behavior of many people simultaneously, and are not targeted or tailored to specific individuals." (p. 3)

In this sense, evaluation mode can count as a nudge that can be readily

incorporated into the design of choice architecture. As shown by the three experiments, laypeople's preferences may shift or even reverse between SE and JE, which they may not even be conscious of. I can also infer from the findings of an earlier study (Okada, 2005) that laypeople are likely to prefer the low-fat healthier desserts when they were presented with high-fat ones (JE) than if they were presented in different sections of the menu (SE).

It should be noted that a nudge is not a panacea for better decision-making, and it may fail when used in improper situations (Sunstein, 2016). For a nudge to work, there are several boundary conditions to be met (Thaler & Sunstein, 2008). First, the decisions test one's self-control at a certain point, especially those decisions that involve trade-offs between hedonic experience and instrumental utility. Second, the trade-offs are complex – at least a few attributes that are difficult to evaluate. Third, the trade-offs are rarely made, especially those surgical decisions that are high in stake, in which case people have little prior experience and information for reference. Last but not least, the consequences of trade-offs either have little, poor, or delayed feedback, in which case there are few opportunities for learning. Therefore, risk communicators need to consider the above restraints when planning to use evaluation mode as a nudge.

6.5.4 Ethical concerns of nudges

Even if a nudge could work, it does not automatically ensue that it *should* be used. As nudges gradually find their place in public policy (Seymour & Vlaev, 2012) debates have emerged on the ethical implications of nudges (Blumenthal-Barby & Burroughs, 2012; Felsen, Castelo, & Reiner, 2013; Sunstein, 2014; Vlaev et al., 2016).

The ethical debates ultimately boil down to two questions. First, who should be defining whether a decision is good or bad for an individual? Second, even if there is a general consensus on what decisions are good for an individual, to what extent can risk communicators (or policymakers and public health workers) nudge individuals toward making the good ones?

The first question is reminiscent of the ethical debates on public health campaigns and health education interventions that have occurred for decades (Guttman, 1996; Kelman, 1969; Salmon, 1989; Witte, 1994). Behavioral scientists and health communication researchers have long faced a similar dilemma as nudge practitioners now do. The psychologist B. F. Skinner (1948, p. 183) once exclaims, "...the good life is waiting for us – here and now! At this very moment, we have the necessary techniques, both material and psychological, to create a full and satisfying life for everyone." Reflecting on Skinner's claim, Witte (1994, p. 288) ponders, "but who decides what the good life or healthy life is?" In fact, Kelman (1969) addressed this question was by identifying "two horns" to this ethical dilemma: "On the one hand, for those of us who hold the enhancement of man's freedom of choice as a fundamental value, any manipulation of the behaviors of others constitutes a violation of their essential humanity. "(p. 33) Yet as Salmon (1989) summarizes, Skinner nevertheless acknowledges that society cannot exist in the absence of any influence on human behavior and notes that "...efforts to improve society through planned social change are predicated on the need to influence others" (p. 29).

Witte (1994) notes that the nature of communicating about health and diseases renders it impossible not to manipulate. Any form of information dissemination involves decisions pertaining to the amount of information to be

shared, the framing of message, the order of communication, message appeals to be used, references to family, peers, and social groups, etc. Therefore, the communicators can never be fully exempted from accusations of engaging in selective presentation, or taking advantage of framing, primacy, and recency effects. Therefore, a feasible guideline on ethics would not necessarily be not to manipulate at all; instead it would be to manipulate for good. In this sense, Witte (1994) proposes health communicators to abide by at least two rules. The first is the generic utilitarian rule: aiming for “the greatest good for the greatest number of people”. And the second is to decide health-related goals in advance, preferably with stakeholders from the local communities. More specifically, Guttman and Salmon (2004) suggest that before public health communication interventions are carried out, health institutes and practitioners should review the ethical dilemmas embedded in those interventions to pre-empt potential harm. And after the interventions are carried out, they should monitor the unforeseen unintended effects and address ethical problems promptly if and when they arise.

In the same spirit, the above principles developed for health communication practices also apply to the designs and practices of nudges.

The second question is reminiscent of paternalism, i.e. making decisions on behalf of someone even if that person may eventually agree that the decision is good for his/her own interest. To some, the idea of nudges evokes an image of “nanny state” like Singapore (Ng, 2015), which has been known to promulgate policies that intervene with personal choices as small as the right to chewing gum. Such interference, though seemingly trivial, nevertheless intrudes on individual sovereignty, which is highly cherished by many. Although nudges carry a connotation of paternalism, they are actually not forced upon individuals, and

individuals can always make active choices regardless of how the options are presented. However, it is questionable whether active choosing is always meaningful and desirable. When individuals find the decision situations highly complex and unfamiliar, they may feel frustrated by the necessity to choose, in which case, as Sunstein (2014, p. 80) argues, “active choosing can be a burden, not a benefit”.

In fact, whether nudges are embedded or not, individuals will always face some kinds of choice environment. As pointed out by Vlaev and colleagues (2016, p. 557), “the choice environment is rarely neutral, and choice architects will always be shaping decisions, whether people like it or not”. Perhaps the more important question to ask is what the guiding principles of should be when designing nudges, to which scholars have offered a tentative answer. A nudge should be designed in such a way to “maximize the likelihood that individuals will engage in behaviors that are beneficial” (Loewenstein et al., 2007, p. 2417), and the choice environment should be constructed in a way “that is more likely to improve health and wellbeing than to worsen it” (Vlaev et al., 2016, p. 557).

6.6 Limitations and Future Directions

This research has a few limitations that need to be addressed.

First, the scenarios used for hypothesis-testing are highly simplified—they only have two risk options and two trade-off attributes with at least something valuable at stake (Luce, Payne, & Bettman, 2001). Presumably, health-related decisions in real life usually involve more options and more complex trade-offs. However, the simplified design can also be seen as a strength as it allows researchers to design cleaner experimental stimuli that enable them to rule out potential confounding factors (Martin, 2007). In fact, many seminal works in

behavioral economics (Kahneman & Tversky, 1979; Tversky & Kahneman, 1974) research adopt similarly simplified designs.

Second, I tested the hypotheses in hypothetical situations in study 1a and study 1b, though in more realistic decision-making scenario in study 2, and one may wonder whether findings based on hypothetical cover stories can be replicated in the real-life settings. The answer is that the hypothetical situations are meant to capture the tension of real-life trade-off decisions (which is not necessarily contingent on the authenticity of the trade-off situations) while warding off any potential preconceptions that participants might associate with real-life situations. One may also wonder whether the stake of hypothetical situations is high enough to simulate decision-making in the real life. I believe hypothetical situations could create simulations that are perceived real enough. Take pain intensity for example, one can argue that pain stimuli can only be sensed and processed by the systematic network of nociceptors that spread over the human body. However, apart from directly responding to stimuli of pain, the sensation of pain is also highly controlled by the cognitive system (Bear et al., 2014), which renders it possible to manipulate intensity of pain by engaging participants in hypothetical thinking. In addition, I endeavored to maintain high standard of internal validity by creating vivid cover stories imbued with a realistic flavor, designing multiple pretesting sessions, and incorporating participants' feedback. Nevertheless, it might be necessary to test the hypotheses in the real life using field experiments.

Third, I have only tested the hypotheses using a few scenarios, and more replications might be needed to consolidate the findings. I can address some limitations and unanswered questions in future research. One direction is to

consolidate findings by replicating this research in more diverse trade-off scenarios where evaluability of risk attributes is operationalized in other ways. Another direction is to test the hypotheses using field experiments to stretch the generalizability of the findings and identify new boundary conditions along the way. For example, the scenarios of study 2 can be readily adapted into a field experiment using the design illustrated in Figure 6.1. There will certainly be challenges in ethical and logistical concerns, but should be doable in principle.

Figure 6.1. Illustrative design diagram of potential field experiment

The third direction is to investigate additional moderators of the JE/SE preference reversals. This dissertation only examines the *ad hoc* preference construction process, whereas previous research on intertemporal choice has revealed how people's preferences fluctuate with time and circumstances

(Andreou, 2017; Frederick, Loewenstein, & O'donoghue, 2002; Read, Frederick, & Airoldi, 2012; Trope & Liberman, 2003; Weber et al., 2007). Derek Parfit's (1984) famous thought experiment also neatly demonstrates people's tendency to discount past pain more than future pain, which implies that the approaching pain will be easier to evaluate. This tendency explains why laypeople often regret their decision of registering for advance medical directive (Ho, 2016). Presumably, they make the decision while they are still healthy, and they usually do not grasp what risks they are taking. Back then, the easiest risk attribute to evaluate is the pain intensity of undergoing long-dragging medical treatment, which they consider unworthy to bear, and their decision is based on this attribute, which resembles decision-making in SE. However, as they approach the end of life, the risk of losing loved ones become easier to evaluate, and they face a trade-off between two risk attributes, which resembles decision-making in JE. Therefore, their regret on advance care registration seems to be a case of JE/SE preference reversal induced by time.

It will be interesting to investigate in depth how the temporal dimension affects the effects of evaluation mode on health-related preferences. For example, women diagnosed with breast cancer typically have two surgery options (Elwyn et al., 2013) that involve a trade-off between beauty and survival rate (see Table 6.3). According to my findings, they would be more likely to prefer lumpectomy in SE, and more likely to prefer mastectomy in JE. However, one may wonder, will the degree of JE/SE preference shifts be persistent with time, i.e., will it be different before the surgery day and on the surgery day?

Decision style (maximiser vs. satisficer) could also be another moderator of SE/JE preference reversals. Maximizers aim to achieve the optimal outcomes

and minimize regrets, thus typically exert lots of efforts in evaluating options. In contrast, satisficers only look for something that is good enough and seldom feel regretful once decisions are made, thus they exert fewer efforts in evaluating options (Schwartz et al., 2002). As maximisers spend more time and cognitive efforts in evaluating options, they might invoke internal or try recalling whatever available reference information available when evaluating options in single evaluation mode, whereas satisficers are less likely to search for such reference information. Although maximisers may not be able to evoke sufficient information to make hard-to-evaluate attribute much easier to evaluate in SE, their efforts are likely to be useful to some extent. Therefore, it implies that the degree of SE/JE preference reversals (when the hard-to-evaluate attribute is also more justifiable) might be smaller among maximisers than satisficers.

6.7 Coda

All roads lead to Rome, but some are more crowded than the others. Much research has focused on the routes that engage in reason or emotion to help laypeople make better health-related decisions. The present research explores the less travelled route and offers initial evidence that evaluation mode could subtly yet predictably influence laypeople's preferences and nudge them to make better health-related decisions with little costs and efforts. Hopefully, evaluation mode can join a growing family of nudges (e.g. designing default option, mapping choice, and providing feedback), nudges that have affected our health, from health insurance plans choosing, healthy eating, to organ donation (Dolan, Hallsworth, Halpern, King, & Vlaev, 2010; Hallsworth, 2016; Matjasko et al., 2016; Thaler & Sunstein, 2008).

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APPENDICES

Appendix A

IRB Approval Letter for Study 1a and Study 1b

Research Integrity and Ethics Office

Reg. No. 200604393R

IRB-2017-08-039

12 September 2017

Professor Charles Thomas Salmon
Wee Kim Wee School of Communication and Information

NTU INSTITUTIONAL REVIEW BOARD APPROVAL

Project Title: How to nudge people's risk preference?– Extending the general evaluability theory to risk communication

(Amount Approved: SGD\$2,950; to be funded by WKWSCI)

I refer to your application for ethics approval with respect to the above project.

The Board has considered your application and noted from your application that your research involves collecting behavioral data from participants through surveys.

You have also confirmed that informed consent will be obtained from the participants and you have guaranteed the confidentiality of your participants' biodata obtained from them.

The documents reviewed are:

- a) NTU IRB application form dated **24 August 2017**
- b) Participant information sheet and consent form: version 1 dated **24 August 2017**
- c) Data collection form: version 1 dated **24 August 2017**

The Board is therefore satisfied with the bioethical consideration for the project and approves the ethics application under **Expedited** review. The approval period is from **12 September 2017** to **01 October 2018**. The NTU IRB reference number for this study is **IRB-2017-08-039**. Please use this reference number for all future correspondence.

The following protocol and compliances are to be observed upon NTU IRB approval

1. All research involving procedures greater than minimal risk on minors (individuals who are less than the legal age of 21 years old) requires IRB approved written Parental Consent and assent from the participant to be obtained before any research protocols can be administered. Minimal risk refers to an anticipated level of harm and discomfort that is no greater than that ordinarily encountered in daily life, or during the performance of routine educational, physical, or psychological examination.
2. Only the approved Participants Information Sheet and Consent Form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject should be given a copy of the signed consent form.

Research Integrity and Ethics Office

3. Consent forms are important documents therefore they should be stored in the strictest arrangement. Loss of consent form would result in disciplinary action.
4. No deviation from, or changes of, the protocol should be initiated without prior written NTU IRB approval of an appropriate amendment.
5. The Principal Investigator should report promptly to NTU IRB regarding:
 - a. Deviation from, or changes to the protocol.
 - b. Changes increasing the risk to the subjects and/or affecting significantly the conduct of the trial
 - c. All serious adverse events (SAEs) which are both serious and unexpected.
 - d. New information that may affect adversely the safety of the subjects of the conduct of the trial.
 - e. Completion of the study.
6. Continuing Review Request/ Notice of Study completion form should be submitted to NTU IRB for the following:
 - a. Annual review: Status of the study should be reported to the NTU IRB at least annually using the Continuing Review Request/ Notice of Study completion form.
 - b. Study completion or termination: Continuing Review Request/ Notice of Study completion form is to be submitted within 4 to 6 weeks of study completion or termination.
7. All Principal Investigators should comply with existing legislation that would have an impact on the domain of their research.

A handwritten signature in black ink, appearing to read "Lionel Lee".

Professor Lionel Lee
Chair, NTU Institutional Review Board
encl.

IRB Approval Letter for Study 2

Reg. No. 200604393R

IRB-2019-03-029

27 March 2019

Assistant Professor Sonny Ben Rosenthal
Wee Kim Wee School of Communication and Information

NTU INSTITUTIONAL REVIEW BOARD APPROVAL

Project Title: How to Nudge People's Risk Preference? – Extending The General Evaluability Theory To Risk Communication [Stage 2]

I refer to your application for ethics approval with respect to the above project.

The Board has considered your application and noted from your application that your research involves collecting behavioral data from participants through questionnaire, survey and experiments.

You have also confirmed that informed consent will be obtained from the participants and you have guaranteed the confidentiality of your participants' biodata obtained from them.

The documents reviewed are:

- a) NTU IRB application form dated **18 March 2019**
- b) Participant information sheet and consent form: version 1 dated **18 March 2019**
- c) Data collection form: version 1 dated **18 March 2019**

The Board is therefore satisfied with the bioethical consideration for the project and approves the ethics application under **Expedited** review. The approval period is from **27 March 2019** to **26 March 2020**. The NTU IRB reference number for this study is **IRB-2019-03-029**. Please use this reference number for all future correspondence.

The following protocol and compliances are to be observed upon NTU IRB approval

1. Any research involving subjects less than 21 years old would require IRB approved written Parental Consent and consent from the participant before any research protocols can be administered unless waiver of consent is given by IRB. Minimal risk refers to an anticipated level of harm and discomfort that is no greater than that ordinarily encountered in daily life, or during the performance of routine educational, physical, or psychological examination.
2. Only the approved Participants Information Sheet and Consent Form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject should be given a copy of the signed consent form.
3. Consent forms are important documents therefore they should be stored in the strictest arrangement. Loss of consent form would result in disciplinary action.
4. No deviation from, or changes of, the protocol should be initiated without prior written NTU IRB approval of an appropriate amendment.

Research Integrity and Ethics Office, NTU Institutional Review Board

62 Nanyang Drive, Block N1.2-B1-02A, Singapore 637459, T: (65) 6592-2495, www.ntu.edu.sg

5. The Principal Investigator should report promptly to NTU IRB regarding:
 - a. Deviation from, or changes to the protocol.
 - b. Changes increasing the risk to the subjects and/or affecting significantly the conduct of the trial
 - c. All serious adverse events (SAEs) which are both serious and unexpected.
 - d. New information that may affect adversely the safety of the subjects of the conduct of the trial.
 - e. Completion of the study.
6. Continuing Review Request/ Notice of Study completion form should be submitted to NTU IRB for the following:
 - a. Annual review: Status of the study should be reported to the NTU IRB at least annually using the Continuing Review Request/ Notice of Study completion form.
 - b. Study completion or termination: Continuing Review Request/ Notice of Study completion form is to be submitted within 4 to 6 weeks of study completion or termination.
7. All Principal Investigators should comply with existing legislation that would have an impact on the domain of their research.
8. Advertisements/ Notices for recruitment of subjects must meet the following requirements:
 - a. Advertisements must clearly state that volunteers are being recruited to participate in an NTU research project with proper research title and NTU logo.
 - b. Name and contact details of Principal Investigator (usually a faculty member), and NTU-IRB contact details (Tel: 6592 2495; Email: IRB@ntu.edu.sg) should be provided.
 - c. The NTU-IRB project reference number should be stated.
 - d. Advertisements should include eligibility criteria.
 - e. Advertisements recruiting Minors must explicitly state that parental consent is required for participation (unless NTU-IRB has granted approval for a waiver of parental consent).

Advertisements/ Notices should NOT contain the following:

 - a. State or imply a certainty of favourable outcome or other benefits beyond what is outlined in the informed consent form and the application/protocol.
 - b. Make claims, either explicitly or implicitly, that a procedure or intervention is safe or effective or superior to other standard procedures or interventions.
 - c. Use catchy words like "free" or "exciting."
 - d. Advertisements may state that participants will be paid, but should not emphasize the payment or the amount to be paid (e.g. by such means of larger or bold type)

Professor Lionel Lee
Chair, NTU Institutional Review Board
encl.

Appendix B

Study Information Sheet for Study 1a and 1b

INFORMED CONSENT for M-Turk Workers

You are invited to participate in a survey, entitled "A survey about general health hazards".

Purpose of the research: The purpose of this study is to examine people's perception of certain health hazards. The study is supervised by Prof Charles T. Salmon and is being conducted by PhD candidate Yihan Xu at the Wee Kim Wee School of Communication and Information, Nanyang Technological University.

Eligibility: You must be 18 years old or older to take part in this study.

What you will do in this study: We estimate that it will take about a minute of your time to complete each question. Your participation in the survey will contribute to a better understanding of effective risk communication.

Risks: Risks to participants are considered minimal. There will be no costs for participating.

Compensation: You will be paid for each HIT you complete, but will not otherwise benefit from participating.

Voluntary Withdrawal: Your participation in this survey is voluntary. You may decline to answer any question and you have the right to withdraw from participation at any time without penalty. If you wish to withdraw from the study or have any questions, contact the investigator listed above. All data and consent forms will be stored in safe keeping long-term. Results of this study may be presented at conferences and/or published in print or online media.

Confidentiality: Your Amazon account information will be kept while we collect data for tracking purposes only. A limited number of research team members will have access to the data during data collection. This information will be stripped from the final dataset.

Further Information: If you have questions about the study or your rights as a participant in this study, please contact Yihan Xu at yihanxu01@gmail.com Wee Kim Wee School of Communication and Information, Nanyang Technological University.

Who to contact about your rights in this study: This study has been reviewed and approved by WKWSCI Institutional Review Board (IRB Approval Number: 2017-08-039). If you have questions about your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact - anonymously, if you wish - the School's Research Integrity Point of Contact at WKWSCI-IRB@ntu.edu.sg or call (+65) 6792 7526.

Thank you so much for your time and effort. We highly appreciate your help in this research project.

Agreement: The purpose and nature of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty.

Agree ☐ Disagree ☐

Study Information Sheet for Study 2 – for M-turk Workers

Study Information sheet

Please read this consent agreement carefully. You must be 21 or older to participate.

Name of PI: Sonny Ben Rosenthal

Institution: Wee Kim Wee School of Communication and Information

Phone: (+65) 67904070

Email: SONNYROSENTHAL@NTU.EDU.SG

IRB reference number: IRB-2019-03-029

Title of Study: Survey on People's Perception Of Common Risks and Health-Related Decisions

Objective: This study seeks to understand how can we create a decision-making environment (re-arrange choice architecture) or develop decision-making aids that help people make better health-related decisions.

Procedures: If you take part in this study, you will be randomly assigned to a version of online survey regarding certain health hazards and health-related decision-making tasks. Each session will take about 20-30 mins. You only need to answer this survey once, and there is no follow-up. Your personal records will be kept strictly confidential.

Right to Refuse or Withdraw: Your participation in this study is completely voluntary, and you may withdraw from the study at any time without penalty. However, it is important to us that you fully answer as many questions as possible. You may skip any questions you do not wish to answer. You may withdraw from the study by informing the project officer that you no longer wish to participate. Your decision to participate, decline, or withdraw participation will have no effect on your status or relationship with the researchers or with Nanyang Technological University.

Risks and Discomforts: There are no more than minimal risks associated with participating in this study. Participants may experience minor stress or discomfort when they answer questions concerned with health-related risks. Such discomfort will be constrained to the lowest level where possible. Overall, the anticipated risks for participants are considered minimal.

Benefits: There are no direct anticipated benefits from participating in this study. However, participants might gain some knowledge regarding health hazards by reading the experimental stimuli.

Compensation: You will be paid for each HIT you complete regardless whether you decide to withdraw or not. Your payment will be equivalent to USD\$6 per hour.

Anonymous and Confidential Data Collection: All data collection will be kept confidential, and the consent forms will be stored in safe keeping long-term, up to 3 years.

Confidentiality of records: Your Amazon account information will be kept while we collect data for tracking purposes only. A limited number of research team members will have access to the data during data collection. This information will be stripped from the final dataset. Results of this study may be presented at conferences and/or published in print or online academic publications.

Study Information sheet

Personal Data: By signing the Consent Form attached, you (*or your legally acceptable representative, if relevant*) are authorizing (i) collection, access to, use and storage of your "Personal Data", and (ii) disclosure to, and use and storage by, authorised service providers and relevant third parties, whether located in Singapore or overseas, for the purposes of the study. "Personal Data" means data about you which makes you identifiable: (i) from such data; or (ii) from that data and other information which an organisation has or likely to have access. Research arising in the future, based on this "Personal Data", will be subject to review by the relevant institutional review board. Data collected are the property of *Wee Kim Wee School of Communication and Information*. In the event of any publication regarding this study, your identity will remain confidential.

Who to contact with questions: If you have questions about the study or your rights as a participant in this study, please contact Ms Xu Yihan at yxu020@e.ntu.edu.sg (Mobile: +65 - 83550169) or Dr. Sonny Ben Rosenthal at sonnyrosenthal@ntu.edu.sg (Phone: +65 - 67904070), Wee Kim Wee School of Communication and Information, Nanyang Technological University. Should you have questions on participants' rights in the study, please contact: NTU-Institutional Review Board, Research Integrity and Ethics Office, 50 Nanyang Avenue, North Spine NS4-05-92A, Singapore 639798
Email: irb@ntu.edu.sg Phone: (+65) 6792 7526.

Consent Form

I have read, discussed and understand the information and procedures in the study information sheet attached to this consent form. My questions concerning the study have been answered to my satisfaction, and I acknowledge that I am participating in this study of my own free will. I understand that I may refuse to participate or stop participating at any time.

Consent to participate in the research

- ☐ Yes I agree to participate in this research.
- ☐ No, I do not agree to participate in this research.

Name of Participant

Signature

Date

Study Information Sheet for Study 2 – for NTU Students

Study Information sheet

Please read this consent agreement carefully. You must be 21 or older to participate.

Name of PI: Sonny Ben Rosenthal

Institution: Wee Kim Wee School of Communication and Information

Phone: (+65) 67904070

Email: SONNYROSENTHAL@NTU.EDU.SG

IRB reference number: IRB-2019-03-029

Title of Study: Survey on People's Perception of Common Risks and Health-Related Decisions

Objective: This study seeks to understand how can we create a decision-making environment (re-arrange choice architecture) or develop decision-making aids that help people make better health-related decisions.

Procedures: If you take part in this study, you will be randomly assigned to a version of online survey regarding certain health hazards and health-related decision-making tasks. Each session will take about 20-30 mins. You only need to answer this survey once, and there is no follow-up. Your personal records will be kept strictly confidential.

Right to Refuse or Withdraw: Your participation in this study is completely voluntary, and you may withdraw from the study at any time without penalty. However, it is important to us that you fully answer as many questions as possible. You may skip any questions you do not wish to answer. You may withdraw from the study by informing the project officer that you no longer wish to participate. Your decision to participate, decline, or withdraw participation will have no effect on your status or relationship with the researchers or with Nanyang Technological University.

Risks and Discomforts: There are no more than minimal risks associated with participating in this study. Participants may experience minor stress or discomfort when they answer questions concerned with health-related risks. Such discomfort will be constrained to the lowest level where possible. Overall, the anticipated risks for participants are considered minimal.

Benefits: There are no direct anticipated benefits from participating in this study. However, participants might gain some knowledge regarding health hazards by reading the experimental stimuli.

Compensation: You will receive SGD \$5 (cash) for your participation in the study. You might win a bonus up to SGD \$5, depending on how you complete it. You will receive your cash payment at the end of experimental session, regardless whether you decide to withdraw or not.

Anonymous and Confidential Data Collection: All data collection will be kept confidential, and the consent forms will be stored in safe keeping long-term, up to 3 years.

Confidentiality of records: Your participation in this study will remain confidential. Results of this study may be presented at conferences and/or published in print or online academic publications.

Personal Data: By signing the Consent Form attached, you (or your legally acceptable representative, if relevant) are authorizing (i) collection, access to, use and storage of your

Study Information sheet

"Personal Data", and (ii) disclosure to, and use and storage by, authorised service providers and relevant third parties, whether located in Singapore or overseas, for the purposes of the study. "Personal Data" means data about you which makes you identifiable: (i) from such data; or (ii) from that data and other information which an organisation has or likely to have access. Research arising in the future, based on this "Personal Data", will be subject to review by the relevant institutional review board. Data collected are the property of *Wee Kim Wee School of Communication and Information*. In the event of any publication regarding this study, your identity will remain confidential.

Who to contact with questions: If you have questions about the study or your rights as a participant in this study, please contact Ms Xu Yihan at yxu020@e.ntu.edu.sg or Dr. Sonny Ben Rosenthal at sonnyrosenthal@ntu.edu.sg Wee Kim Wee School of Communication and Information, Nanyang Technological University. Should you have questions on participants' rights in the study, please contact:

NTU-Institutional Review Board, Research Integrity and Ethics Office, 50 Nanyang Avenue, North Spine NS4-05-92A, Singapore, 639798

Email: irb@ntu.edu.sg Phone: (+65) 6792 7526.

Consent Form

I have read, discussed and understand the information and procedures in the study information sheet attached to this consent form. My questions concerning the study have been answered to my satisfaction, and I acknowledge that I am participating in this study of my own free will. I understand that I may refuse to participate or stop participating at any time.

Consent to participate in the research

- ☐ Yes I agree to participate in this research.
- ☐ No, I do not agree to participate in this research.

Name of Participant

Signature

Date

Appendix C

Questionnaire for Pilot 1

1. Attention Check

Abraham Lincoln (Feb 12, 1809 – Apr 15, 1865) was an American politician and lawyer who served as the 16th President of the United States from March 1861 until his assassination in April 1865. Lincoln previously served in the Illinois House of Representatives from 1834 to 1842 and in the U.S. House of Representatives from 1847 to 1849.

To show that you could firmly grasp the instructions, please answer since when did the former US president Abraham Lincoln start to serve in the U.S. State Senate.

- 1834 ☐
- 1842 ☐
- 1847 ☒
- 1849 ☐
- 1809 ☐
- 1865 ☐

2. Severity of Health Hazards

2.1 High-stake Hazard conditions (Mobile-stolen vs. Ebola-infection)

- a. A close friend of you was assigned a business trip to a foreign country. During the trip, s/he got [the mobile phone stolen / infected with the Ebola virus]. Do you have any idea how much emotional pain that your friend experienced? (0 = No idea, 10 = Clear idea).
- b. This friend once travelled to a famous touristic island expecting to take plenty sunbath, but it was raining non-stop for the whole stay. Assuming the **emotional pain caused by the non-stop rain were 10**, how much emotional pain do you think your friend would feel for **[having the mobile phone stolen/ contracting Ebola]**? Please indicate your answer by sliding or clicking the bar below (0 = No loss at all, 100 = Unbearable loss).

2.2 Low-stake Hazard conditions (Music-player-stolen vs. Diarrhoea-infection)

- a. A close friend of you was assigned a business trip to a foreign country. During the trip, s/he got [the music player stolen / infected

with diarrhoea]. Do you have any idea how much emotional pain that you friend experienced? (0 = No idea, 10 = Clear idea).

- b. This friend once travelled to a famous touristic island expecting to take plenty sunbath, but it was raining non-stop for the whole stay. Assuming the **emotional pain caused by the non-stop rain were 10**, how much emotional pain do you think your friend would feel for **[having the music player stolen/ contracting diarrhoea]**? Please indicate your answer by sliding or clicking the bar below (0 = No loss at all, 100 = Unbearable loss).

3. Likelihood of Health Hazards

3.1 Mobile-stolen

Suppose you were assigned a business trip to Country X that you knew little about. After a quick research, you found that in the past year, [**1,200 / 12,000 / 120,000**] **cases of mobile phone theft** were reported in this country.

- a. Do you have any **idea** how safe this country is? (0 = No idea, 10 = Clear idea)
- b. How **safe** would you consider this country to be? (0= Very unsafe, 10 = Very safe)

3.2 Ebola-infection

Suppose you were assigned a business trip to Country X that you knew little about. After a quick research, you found that in the past year, [**2 / 6 / 12**] **cases of Ebola infection** were reported in this country.

- a. Do you have any **idea** how safe this country is? (0 = No idea, 10 = Clear idea)
- b. How **safe** would you consider this country to be? (0= Very unsafe, 10 = Very safe)

3.3 Music-player-stolen

Suppose you were assigned a business trip to Country X that you knew little about. After a quick research, you found that in the past year, [**600 / 1,200 / 6,000**] **cases of Ipod (music player) theft** were reported in this country.

- a. Do you have any **idea** how safe this country is? (0 = No idea, 10 = Clear idea)
- b. How **safe** would you consider this country to be? (0= Very unsafe, 10 = Very safe)

3.4 Diarrhoea-infection

Suppose you were assigned a business trip to Country X that you knew little about. After a quick research, you found that in the past year, [**120 / 600 / 1,200**] **cases of diarrhoea infection** were reported in this country.

a. Do you have any **idea** how safe this country is? (0 = No idea, 10 = Clear idea)

b. How **safe** would you consider this country to be? (0= Very unsafe, 10 = Very safe)

4. **Demographics**

a. What is your age?

b. What is your gender?

- ☐ Male
- ☐ Female
- ☐ Prefer not to answer

c. What is your education level?

- ☐ High school or below
- ☐ Some college (no diploma)
- ☐ College degree
- ☐ Postgraduate degree
- ☐ Prefer not to answer

Appendix D

Questionnaire for Pilot 2

1. Attention Check

Recent research shows that individuals' preference is affected by the mood. Differences in how people feel can affect choices they make. To help us understand the mechanisms behind it, we are interested in knowing your current mood. To show that you have read the instructions, please ignore the question below and instead check only the "none of the above" option as your answer.

Please describe how you are feeling now.

happy	proud	depressed
alert	active	thrilled
interested	afraid	attentive
excited	enthusiastic	stressful
sad	surprised	none of the above ☒

Note. Those who check options other than “none of the above” are assumed not having paid full attention.

2. Prevalence of Health Hazards

We are interested in learning how do you perceive certain health hazards.

2.1 Acute conditions (Snake bite vs. Severe flu)

- i. How many people are dying of [**snake bite / severe flu**] annually? Do you think the **death tolls** are high or low relative to other general causes of death? (0 = Very low, 10 = Very high).
- ii. How sure are you of your estimation? (0 = Not sure at all, 10 = Very sure).

2.2 Chronic conditions (Stroke vs. Stomach cancer)

- a. How many people are dying of [**stroke / stomach cancer**] annually? Do you think the **death tolls** are high or low relative to other general causes of death? (0 = Very low, 10 = Very high).
- b. How sure are you of your estimation? (0 = Not sure at all, 10 = Very sure).

3. Pain Intensity of Health Hazards

3.1 Acute conditions (Snake bite vs. Severe flu)

- a. How painful would it be for a person dying of [**snake bite / severe flu**] relative to other general causes of death? (0 = Not painful at all, 10 = Extremely painful).
- b. How sure are you of your estimation? (0 = Not sure at all, 10 = Very sure).

3.2 Chronic conditions (Stroke vs. Stomach cancer)

- a. How painful would it be for a person dying of [**snake bite / severe flu**] relative to other general causes of death? (0 = Not painful at all, 10 = Extremely painful).
- b. How sure are you of your estimation? (0 = Not sure at all, 10 = Very sure).

4. Demographics

- a. What is your age?
- b. What is your gender?
 - Male
 - Female
 - Prefer not to answer
- c. What is your education level?
 - High school or below
 - Some college (no diploma)
 - College degree
 - Postgraduate degree
 - Prefer not to answer

Appendix E

Questionnaire for Study 1a

1. Scenario presentation

Imagine your employer has assigned you an important field project, requesting you to travel to a foreign country for a few months. If you take the assignment, you will get a **promotion**. After some background checking, however, you realize that this assignment involves some **risks**.

- a. Before indicating your answer, are you aware that this business assignment entails certain risks?
 - Yes, it has some safety concerns
 - No, it's risk free
- b. Before indicating your answer, are you also aware that this business assignment also promises certain rewards?
 - Yes, it has some career opportunities
 - No, it doesn't promise any rewards

2. Evaluation of high-stake travelling hazards

a. Single evaluation – Ebola infection / Mobile theft (counter-balanced)

You found out that this country has a **higher** incidence of infectious diseases than where you live. Within the past year, [**six cases of Ebola infection / 12,000 cases of mobile phone theft**] were reported in this country.

- i. Faced with this situation, how much are you willing to take this business assignment? (0 = Not willing at all, 10 = Very willing).
- ii. Could you explain, in a few lines, how did you make the above evaluation?

b. Joint evaluation

You found out that **Country A** has a higher incidence of infectious diseases than where you live. Within the past year, **six cases of Ebola infection** were reported in this country.

You found out that **Country B** has a higher rate of theft than where you live. Within the past year, **12,000 cases of mobile phone theft** were reported in this country.

- i. Faced with this situation, and if you had to take this assignment, which country do you prefer to travel?

- Country A
- Country B
- ii. How much are you willing to take this assignment to each country (assuming they are similar in all other aspects)? (0 = Not willing at all, 10 = Very willing).
- iii. Could you explain, in a few lines, how did you make the above evaluation?

3. Evaluation of low-stake travelling hazards

a. Single evaluation – Diarrhoea infection / Music player theft (counter-balanced)

You found out that this country has a **higher** incidence of acute digestive diseases than where you live. Within the past year, [**600 cases of diarrhoea infection / 6,000 cases of mobile phone theft**] were reported in this country.

- i. Faced with this situation, how much are you willing to take this business assignment? (0 = Not willing at all, 10 = Very willing).
- ii. Could you explain, in a few lines, how did you make the above evaluation?

b. Joint evaluation

You found out that **Country A** has a higher incidence of acute digestive diseases than where you live. Within the past year, **600 cases of diarrhoea infection** were reported in this country.

You found out that Country B has a higher rate of theft than where you live. Within the past year, **6,000 cases of digital music player theft** were reported in this country.

- i. Faced with this situation, and if you had to take this assignment, which country do you prefer to travel?
 - Country A
 - Country B
- ii. How much are you willing to take this assignment to each country (assuming they are similar in all other aspects)? (0 = Not willing at all, 10 = Very willing).
- iii. Could you explain, in a few lines, how did you make the above evaluation?

4. Risk Attitude

Riskiness is a very personal and intuitive notion, and we are interested in your gut feeling of how risky each situation or behavior is.

- a. For each of the following statements, please indicate **how risky** you perceive each
Situation to be. (1 = Not at all risky, 7 = Extremely risky)
- b. For each of the following statements, please indicate the **likelihood** that you would engage in the described activity or behavior if you were to find yourself in that situation (1 = Extremely unlikely, 7 = Extremely likely)
 - Drinking heavily at a social function.
 - Engaging in unprotected sex.
 - Driving a car without wearing a seat belt.
 - Riding a motorcycle without a helmet.
 - Sunbathing without sunscreen.
 - Walking home alone at night in an unsafe area of town.

5. Attention check

- a. You have answered several questions regarding a business assignment. To ensure that you have paid attention to the instruction, please tick the hazard(s) that you have just read about (select all relevant choice(s)).
 - Mobile phone theft ☒
 - Music player theft ☒
 - Severe diarrhoea ☒
 - Ebola infection ☒
 - Zika infection ☒
 - Digital camera theft ☒

5. Demographics

- a. What is your age?
- b. What is your gender?
 - Male
 - Female
 - Prefer not to answer
- c. What is your education level?
 - High school or below
 - Some college (no diploma)
 - College degree
 - Postgraduate degree

- Prefer not to answer
- c. What is your household income? Please choose the option that includes your entire household income (in previous year) before taxes.
 - Less than \$32,000
 - \$32,001 to \$56,000
 - \$56,001 to \$90,500
 - \$90,500 or more
 - Prefer not to answer

Appendix F

Questionnaire for Study 1b

1. Perception of two health hazards

We are interested in learning how you perceive certain health hazard(s).

- a. How likely do you think you would get [stroke / stomach cancer] during your lifetime compared to other general causes of death? (0 = Very unlikely, 10 = Very likely).
- b. How sure are you of your estimation? (0 = Not sure at all, 10 = Very sure).
- c. How painful do you think a person dying of [stroke / stomach cancer] would experience relative to other general causes of death? (0 = Not painful at all, 10 = Extremely painful).
- d. How sure are you of your estimation? (0 = Not sure at all, 10 = Very sure).
- e. How many people do you think are dying of [stroke / stomach cancer] annually? Are the death tolls high or low relative to other general causes of death? (0 = Very low, 10 = Very high).
- f. How sure are you of your estimation? (0 = Not sure at all, 10 = Very sure).

2. Scenario presentation and evaluation of two hazard-prevention deals

a. Single evaluation – Stroke (counter-balanced)

Please read the following paragraph carefully:

Stroke is one of the common causes of death globally. According to the World Health Organization, it causes 6.0 ~ 6.5 millions of deaths worldwide per year. Stroke is mostly painless, only certain types of stroke (e.g. hemorrhagic stroke) cause moderate pain, which affect less than one third of patients. Its intensity of pain can be illustrated by the following figure:

Imagine there is a magic pill, which can protect you from **stroke**. If you buy it, you will never suffer from **stroke** in your lifetime. Suppose you could buy it with USD \$5,000 (about 1.5 months' median personal income in the U.S.). Do you think the deal is worth it?

- i. How would you consider the deal to be? (0 = Poor deal, 10 = Superb bargain).
- ii. Could you explain, in a few lines, why do you think the magic pill is (or isn't) worth it? What factors did you consider when answering the previous question?

b. Single evaluation – Stomach cancer (counter-balanced)

Please read the following paragraph carefully:

Stomach cancer is one of the common causes of death globally. According to the World Health Organization, it causes 0.8 ~ 1.0 million of deaths worldwide per year. Stomach cancer also has a reputation for being one of the most painful forms of cancer. Its intensity of pain can be illustrated by the following figure:

Imagine there is a magic pill, which can protect you from **stomach cancer**. If you buy it, you will never suffer from **stomach cancer** in your lifetime. Suppose you could buy it with USD \$5,000 (about 1.5 months' median personal income in the U.S.). Do you think the deal is worth it?

- i. How would you consider the deal to be? (0 = Poor deal, 10 = Superb bargain).
- ii. Could you explain, in a few lines, why do you think the magic pill is (or isn't) worth it? What factors did you consider when answering the previous question?

c. Joint evaluation

Please carefully read the following paragraphs:

Stroke and Stomach cancer are two of the common causes of death globally. According to the World Health Organization, stomach cancer causes 0.8 ~ 1.0 million of deaths, whereas stroke causes 6.0 ~ 6.5 million of deaths worldwide per year.

Stomach cancer has a reputation for being one of the most painful forms of cancer. In contrast, Stroke is mostly painless, only certain types of stroke (e.g. haemorrhagic stroke) cause moderate pain, which affect less than one third of patients. The intensity of pain can be illustrated by the following figure:

Imagine there is a magic pill which can protect you from one and only one health hazard: Stomach cancer or Stroke. If you buy it, you will never be exposed to this health hazard in your lifetime. Suppose you could buy it with USD \$5,000 (about 1.5 months' median personal income in the U.S.). Do you think the deal is worth it?

- a. Which deal of the magic pill do you think is more worth it: to prevent stomach cancer, or to prevent stroke?
 - ☐ To prevent stroke
 - ☐ To prevent stomach cancer
- ii. If you could buy the magic pill to prevent stomach cancer, how would you consider the deal to be? (0 = Poor deal, 10 = Superb bargain).

If you could buy the magic pill to prevent stroke, how would you consider the deal to be? (0 = poor deal, 10 = superb bargain).

NOTE: Please consider both deals, however, if you think option A is more worthy than option B in the previous question, you should score option A higher than option B in this question.

- iii. Could you explain, in a few lines, why do you think the magic pill is (or isn't) worth it? What factors did you consider in ranking your preference?

3. Risk Attitude

Riskiness is a very personal and intuitive notion, and we are interested in your gut feeling of how risky each situation or behavior is.

- c. For each of the following statements, please indicate **how risky** you perceive each Situation to be. (1 = Not at all risky, 7 = Extremely risky)
- d. For each of the following statements, please indicate the **likelihood** that you would engage in the described activity or behavior if you were to find yourself in that situation (1 = Extremely unlikely, 7 = Extremely likely)
- Drinking heavily at a social function.
 - Engaging in unprotected sex.
 - Driving a car without wearing a seat belt.

 - Riding a motorcycle without a helmet.
 - Sunbathing without sunscreen.

 - Walking home alone at night in an unsafe area of town.

4. Attention check

- a. You have answered several questions regarding health hazards. To ensure that you have grasped the instruction, please tick the health hazards that you have just read about (select all relevant choice(s)).
- Stomach cancer ☒
 - Stroke ☒

- ☐ Heart disease ☒
- ☐ Kidney disease ☒
- ☐ Diabetes ☒
- ☐ Liver cancer ☒

b. How much does the magic pill cost?

- ☐ \$500 ☒
- ☐ \$1,000 ☒
- ☐ \$5,000 ☒
- ☐ \$10,000 ☒

5. Demographics

a. What is your age?

b. What is your gender?

- ☐ Male
- ☐ Female
- ☐ Prefer not to answer

c. What is your education level?

- ☐ High school or below
- ☐ Some college (no diploma)
- ☐ College degree
- ☐ Postgraduate degree
- ☐ Prefer not to answer

d. What's your household income? Please choose the option that includes your entire household income (in previous year) before taxes.

- ☐ Less than \$32,000
- ☐ \$32,001 to \$56,000
- ☐ \$56,001 to \$90,500
- ☐ \$90,500 or more
- ☐ Prefer not to answer

Appendix G

Questionnaire for Study 2

1. Introduction

In this survey, we are particularly interested in some aspects of your health care. Please find a quiet place, use a big screen device, read carefully and answer questions responsibly.

- ☐ Sure, I'll read carefully and answer questions responsibly

2. Familiarity with flu vaccines

- a. Do you have any idea what price is considered fair for a typical flu vaccine?
(1 = No idea at all, 10 = Very clear idea)
- b. Do you have any idea what chance of side effects (%) for a typical flu vaccine is considered safe by the clinical standards? (1 = No idea at all, 10 = Very clear idea)
- c. Which did you find it easier to evaluate?
 - Standard chance of side effects is easier to evaluate
 - Price fairness is easier to evaluate

3. Subjective social economic status manipulation

- a. Think of this ladder as representing where people stand in Singapore. Now, please compare yourself to the people at the very bottom (top) of the ladder. These are the people who are the worst (best) off—those who have the least (most) money, least (most) education, and least (most) respected jobs. In particular, we'd like you to think about how YOU ARE DIFFERENT FROM THESE PEOPLE in terms of your own income, educational history, and job status. Where would you place yourself on this ladder relative to these people at the very bottom (top)? Please select the number that corresponds to the ladder where you think you stand in relation to these people. (9 = upper class, 1 = lower class).
- b. Now imagine yourself in a getting acquainted interaction with one of the people you just thought about from the very bottom (top) of the ladder. Think about how the DIFFERENCES BETWEEN YOU might impact what you would talk about, how the interaction is likely to go, and what you and the other person might say to each other. Please write a brief description about how you think this interaction would go (at least 25 words).

4. Vaccine evaluation

a. Scenario presentation

Imagine that in your residence city, there is recently an outbreak of influenza (flu), which is a new strain of flu virus that is particularly serious. Although generally not fatal, this new strain of the flu is associated with longer periods (two to three weeks) of severe illness. Various pharmaceutical companies have developed different vaccines to combat the spread of this disease.

Because this virus is highly contagious, however, it is likely that anyone not vaccinated will contract the disease and become seriously ill. Although all vaccines are relatively new, they have all gone through similar clinical trials and have been researched to the same degree.

- ☐ I have read the above passage carefully and understood its gists
- ☐ I didn't pay any attention to the above passage and it made no sense to me

b. Single evaluation – Vaccine A (counter-balanced)

Suppose you're considering taking a flu shot because this flu virus has spread around your neighborhood. Below is the detailed information of one vaccine.

Information of Vaccine A

Price	Chance of side effects
\$75	0.9%

1. Overall, how acceptable does this vaccine seem to you? (1 = Not acceptable at all, 10 = Very acceptable)
2. How affordable (i.e. reasonably-priced for the public) do you think this vaccine is? (1 = Not affordable at all, 10 = Very affordable)
3. How safe (considering the chance of side-effects) do you think this vaccine is? (1 = Not safe at all, 10 = Very Safe)
NOTE: The lower the chance of side-effects, the safer the vaccine
4. When you evaluated the vaccine's overall acceptability, which factor were you more concerned with?
 - ☐ Cost
 - ☐ Chance of side-effect
5. Please rate the relative importance between costs and chance of side-effects. (1 = cost is much more important, 9 = chance of side effects is much more important)

6. While you were deciding the acceptability of the vaccine... how much you agree or disagree with each of the following
- The acceptability of the vaccine is easy for me to evaluate
 - I'm sure whether I've made a good evaluation of the vaccine
 - It's clear how acceptable the vaccine is to me

c. *Distraction task 1*

Please take a reading task before continuing the survey.

Please read the following passage carefully:

We hold these truths to be self-evident, that all men are created equal, that they are endowed by their creator with certain unalienable rights, that among these are life, liberty and the pursuit of happiness, that to secure these rights, governments are instituted among men, deriving their just powers from the consent of the governed. That whenever any form of government becomes destructive of these ends, it is the right of the people to alter or to abolish it, and to institute new government, laying its foundation on such principles and organizing its powers in such form, as to them shall seem most likely to effect their safety and happiness.

1. How many times does the word “and” appear?
 - 2 times
 - 3 times
 - 4 times
 - 5 times
2. How many times does the word “to” appear?
 - 5 times
 - 6 times
 - 7 times
 - 8 times

d. *Single evaluation – Vaccine B (counter-balanced)*

Now besides the vaccine that you just evaluated, another option is also available. Below is the detailed information of one vaccine.

Information of Vaccine B

Price	Chance of side effects
\$25	4.5%

1. Overall, how acceptable does this vaccine seem to you? (1 = Not acceptable at all, 10 = Very acceptable)
2. How affordable (i.e. reasonably-priced for the public) do you think this vaccine is? (1 = Not affordable at all, 10 = Very affordable)

3. How safe (considering the chance of side-effects) do you think this vaccine is? (1 = Not safe at all, 10 = Very Safe)
NOTE: The lower the chance of side-effects, the safer the vaccine
4. When you evaluated the vaccine's overall acceptability, which factor were you more concerned with?
 - Cost
 - Chance of side-effect
5. Please rate the relative importance between costs and chance of side-effects. (1 = cost is much more important, 9 = chance of side effects is much more important)
6. While you were deciding the acceptability of the vaccine... how much you agree or disagree with each of the following
 - The acceptability of the vaccine is easy for me to evaluate
 - I'm sure whether I've made a good evaluation of the vaccine
 - It's clear how acceptable the vaccine is to me

e. *Distraction task 2*

Please take another reading task before continuing the survey.

Please read the following passage carefully:

Prudence, indeed, will dictate that Governments long established should not be changed for light and transient causes; and accordingly all experience hath shewn that mankind are more disposed to suffer, while evils are sufferable than to right themselves by abolishing the forms to which they are accustomed.

1. How many words start with the letter “s” or “S”?
 - 3 words
 - 4 words
 - 5 words
2. How many words start with the letter “a” or “A”?
 - 8 words
 - 9 words
 - 10 words

f. *Joint evaluation (for both Vaccine A and Vaccine B)*

Previously, you evaluated two vaccine options one by one. Now you could read their detailed information side by side. They differ in price and chance of side-effects. If you were to choose one of them, which do you prefer?

Vaccine Information of Both Options

	Price	Chance of side effects
Vaccine A	\$75	0.9%

Vaccine B	\$25	4.5%
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- I prefer Vaccine A
- I prefer Vaccine B

1. Overall, how acceptable does each vaccine seem to you? (1 = Not acceptable at all, 10 = Very acceptable)
NOTE: You should rate your preferred vaccine more acceptable here.
2. How affordable (i.e. reasonably-priced for the public) do you think each vaccine is? (1 = Not affordable at all, 10 = Very affordable)
3. How safe (considering the chance of side-effects) do you think each vaccine is? (1 = Not safe at all, 10 = Very Safe)
NOTE: The lower the chance of side-effects, the safer the vaccine
4. When you evaluated the vaccines' overall acceptability, which factor were you more concerned with?
 - Cost
 - Chance of side-effect
5. Again, please rate the relative importance between costs and chance of side-effects. (1 = cost is much more important, 9 = chance of side effects is much more important)
6. While you were deciding the acceptability of the vaccine... how much you agree or disagree with each of the following
 - The acceptability of the vaccine is easy for me to evaluate
 - I'm sure whether I've made a good evaluation of the vaccine
 - It's clear how acceptable the vaccine is to me
7. How well does each of these adjectives describe how you felt while you were evaluating the vaccines? (1 = Describes poorly, 10 = Describes very well).
 - Emotional
 - Concerned
 - Interested
 - Confident
8. Now you have evaluated each vaccine a few times. Have changed your evaluation? Please justify why if you did (at least 10 words)..

5. Health care background

- a. In your opinion, how successful is general vaccine in preventing diseases? (1 = Not successful at all, 10 = Very successful)

- b. In the last 12 months, have you got a flu vaccine?
 - ☐ Yes
 - ☐ No
 - ☐ Unsure
 - c. How often do you get a flu vaccine?
 - ☐ Almost every year
 - ☐ Every two years
 - ☐ Every three years or above
 - d. In the past 12 months, not counting times you went to an emergency room, how many times did you go to a doctor, nurse, or other health professional to get care for yourself?
 - ☐ None
 - ☐ 1~2 times
 - ☐ 3~4 times
 - ☐ 5-9 times
 - ☐ 10 or more times
 - e. Overall, how would you rate the quality of health care you received in the past 12 months?
 - ☐ Excellent
 - ☐ Very good
 - ☐ Good
 - ☐ Fair
 - ☐ Poor
6. Numeracy tests [Items adopted from (Boyce et al., 2010; Lipkus, Samsa, & Rimer, 2001)]
- a. Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even (2, 4, or 6)?
 - ☐ 333 ☒
 - ☐ 500 ☒
 - ☐ 167 ☒
 - b. In the BIG BUCKS LOTTERY, the chance of winning a \$10.00 prize is 1%. What is your best guess about how many people would win a \$10.00 prize if 1,000 people each buy a single ticket?
 - ☐ 100 ☒
 - ☐ 10 ☒
 - ☐ 1 ☒

- c. In the ACME publishing sweepstakes, the chance of winning a car is 1 in 1,000. What percent of tickets to ACME publishing sweepstakes win a car?

- ☐ 1% ☐
- ☐ 0.1% ☒
- ☐ 1.1% ☐

7. Decision style: Maximizer vs. satisficer [Items adapted from Schwartz et al. (2002)]

Please read the following statements carefully and indicate how much you agree or disagree with each of them (1 = Strongly Disagree, 7 = Strongly Agree).

- ☐ When I watch TV, I channel surf, often scanning through the available options even while attempting to watch one program.
- ☐ When I am in the car listening to the radio, I often check other stations to see if something better is playing, even if I'm relatively satisfied with what I'm listening to.
- ☐ I treat relationships like clothing: I expect to try a lot on before I get the perfect fit.
- ☐ No matter how satisfied I am with my job, it's only right for me to be on the lookout for better opportunities.
- ☐ I often fantasize about living in ways that are quite different from my actual life.
- ☐ I'm a big fan of lists that attempt to rank things (the best movies, the best singers, the best athletes, the best novels, etc.).
- ☐ I often find it difficult to shop for a gift for a friend.
- ☐ When shopping, I have a hard time finding clothing that I really love.
- ☐ Renting videos is really difficult. I'm always struggling to pick the best one.
- ☐ I find that writing is very difficult, even if it's just writing a letter to a friend, because it's so hard to word things just right. I often do several drafts of even simple things.
- ☐ No matter what I do, I have the highest standards for myself.
- ☐ I never settle for second best.
- ☐ Whenever I'm faced with a choice, I try to imagine what all the other possibilities are, even ones that aren't present at the moment.

8. Decision style: Regret [Items adapted from Schwartz et al. (2002)]

Please indicate how much you agree or disagree with each of the following statements (1 = Strongly Disagree, 7 = Strongly Agree).

- Whenever I make a choice, I'm curious about what would have happened if I had chosen differently.
- Whenever I make a choice, I try to get information about how the other alternatives turned out.
- If I make a choice and it turns out well, I still feel like something of a failure if I find out that another choice would have turned out better.
- When I think about how I'm doing in life, I often assess opportunities I have passed up.
- Once I make a decision, I don't look back. (Reversed coding)

9. Decision style: Control preference [Items adapted from Degner, Sloan and Venkatesh (1997)]

When you consult with your physicians, what's your preferred degree of control in treatment decision-making? Please indicate how much you agree or disagree with each of the following statements. (1 = Strongly disagree, 7 = Strongly agree)

- I prefer to make the decision about which treatment I will receive
- I prefer to make the final decision about my treatment after seriously considering my doctor's opinion
- I prefer that my doctor and I share responsibility for deciding which treatment is best for me
- I prefer that my doctor makes the final decision about which treatment will be used, but seriously considers my opinion
- I prefer to leave all decisions regarding treatment to my doctor

10. Risk Attitude

Riskiness is a very personal and intuitive notion, and we are interested in your gut feeling of how risky each situation or behavior is.

- d. For each of the following statements, please indicate **how risky** you perceive each Situation to be. (1 = Not at all risky, 7 = Extremely risky)
- e. For each of the following statements, please indicate the **likelihood** that you would engage in the described activity or behavior if you were to find yourself in that situation (1 = Extremely unlikely, 7 = Extremely likely)
- Drinking heavily at a social function.
 - Engaging in unprotected sex.
 - Driving a car without wearing a seat belt.

 - Riding a motorcycle without a helmet.
 - Sunbathing without sunscreen.

 - Walking home alone at night in an unsafe area of town.

11. Attention Check

- a. Do you recall what this vaccine is for?
- To prevent influenza (flu) ☒
 - To prevent Zika ☒
 - To prevent measles ☒
- b. Do you recall the price of the two vaccines? **Please select ALL that applies.**
- a. \$25 ☒
 - b. \$75 ☒
 - c. \$80 ☒
 - d. \$100 ☒
 - e. \$150 ☒

12. Demographics

- a. What's your age?
- b. What's your gender?
- f. Male
 - g. Female
 - h. Prefer not to answer

- c. What is the education level that you are currently pursuing?
- Polytechnic diploma
 - Professional qualification and other diploma e.g. ITE Diploma, ACCA, CFA, SIM Diploma
 - Bachelor's degree or equivalent
 - University postgraduate degree
 - Other
- d. What is your annual household income? Please indicate the answer that includes your entire household income in previous year before taxes.
- Less than \$10,000
 - \$10,000 to \$19,999
 - \$20,000 to \$29,999
 - \$30,000 to \$39,999
 - \$40,000 to \$49,999
 - \$50,000 to \$59,999
 - \$60,000 to \$69,999
 - \$70,000 to \$79,999
 - \$80,000 to \$89,999
 - \$90,000 to \$99,999
 - \$100,000 to \$149,999
 - \$150,000 or more

13. Debriefing

Artificiality of the scenario information:

Please note that the information about the influenza (flu) virus and vaccines, though resembles real flu virus and vaccines, is designed specifically for this research. The information presented should not be taken as a form of legitimate medical advice in any way.

- Yes, I understand and consent to my data being used for the above-mentioned research
- No, I do not consent to my data being used for the above-mentioned research

Appendix H

Sensitivity analysis for outlier handling procedure

Table 1.

Sensitivity analysis for outlier handling procedure for study 1a— Unadjusted means and unadjusted standard deviations of outcome variables, and repeated-measure results.

Outlier Handling	Outcome: Willingness to travel (<i>I</i> = not at all willing, <i>10</i> = very willing)	<i>Ms and SDs</i>				<i>F values and effect sizes</i>			
		Option		Evaluation mode		Main effects		Interaction effects	
		Country A	Country B	SE	JE	Option	Mode	Option × Mode	
Outlier <i>imputed</i> N = 180	High-stake hazards: A Ebola vs. B mobile theft	6.20 (3.09)	7.53 (1.54)	7.66 (1.38)	6.11 (3.06)	12.5*** $\eta^2 = 0.097$	9.36** $\eta^2 = 0.074$	6.18** $\eta^2 = 0.050$	
	Low-stake hazards: A Diarrhoea vs. B music-player theft	6.53 (2.86)	7.46 (2.05)	7.35 (2.07)	6.66 (2.86)	2.97+ $\eta^2 = 0.025$	3.54+ $\eta^2 = 0.03$	1.24 $\eta^2 = 0.011$	
Outlier <i>removed</i> N = 173	High-stake hazards: A Ebola vs. B mobile theft	6.15 (3.09)	7.51 (1.57)	7.62 (1.43)	6.11 (3.06)	12.0*** $\eta^2 = 0.095$	8.53** $\eta^2 = 0.07$	5.82** $\eta^2 = 0.097$	
	Low-stake hazards: A Diarrhoea vs. B music-player theft	6.63 (2.81)	7.54 (2.06)	7.41 (2.03)	6.75 (2.87)	2.76+ $\eta^2 = 0.025$	3.04+ $\eta^2 = 0.027$	0.65 $\eta^2 = 0.006$	

Note. Standard deviations are in parentheses. + $p < .1$ * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2.
Sensitivity analysis for outlier handling procedure for study 1b – Unadjusted means and unadjusted standard deviations of outcome variables, and repeated-measure results

Outlier Handling	Outcome: Deal fairness (1 = not at all fair, 10 = very fair)	Ms and SDs			F values and effect sizes		
		Health hazard		Evaluation mode	Main effects		Interaction effects
		Stroke	Stomach cancer	SE	Hazard	Mode	Hazard × Mode
Outlier <i>imputed</i> N = 215		7.65 (2.52)	6.31 (2.70)	6.34 (2.89)	7.69 (2.27)	3.64+ $\eta^2 = 0.013$	15.8*** $\eta^2 = 0.055$ 1.59 $\eta^2 = 0.006$
Outlier <i>removed</i> N = 185		7.74 (2.58)	6.15 (2.74)	6.25 (2.98)	7.67 (2.32)	4.42* $\eta^2 = 0.018$	13.8*** $\eta^2 = 0.055$ 1.01 $\eta^2 = 0.004$

Note. Standard deviations are in parentheses. + $p < .1$ * $p < .05$. ** $p < .01$. *** $p < .001$