Exploring the role of emotion on health decision-making: Case studies in cancer screening, vaccination, and nutrition

by

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Author’s Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Statement of Contributions

This thesis consists in part of five manuscripts that are being submitted to peer reviewed journals for publication. Exceptions to sole authorship include:

Chapter 2. Study 1: Investigating the role of emotions on health decisions: A narrative review

Mehrnaz Mostafapour conceptualized the manuscript; sourced, reviewed, collated, and synthesized the literature; drafted and edited the manuscript for publication.

Samantha B. Meyer reviewed, copyedited, and provided feedback.

Chapter 3. Study 2: Vaccines and emotions: Investigating how emotions shape vaccination decisions

Mehrnaz Mostafapour designed and conceptualized the study, obtained ethics approval, conducted the study and collected data, conducted data analysis, conceptualized the manuscript; synthesized the literature; drafted and edited the manuscript for publication.

Samantha B. Meyer provided guidance on the study design, reviewed and edited the manuscript.

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Chapter 4. Study 3: A breast cancer screening embarrassment scale: Psychometric development

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Chapter 5. Study 4: Emotions, fruits and vegetables: Investigating the effect of emotions on message framing

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Samantha B. Meyer provided guidance on the study design, reviewed, provided feedback, and copyedited the manuscript.

Selcuk Onay provided guidance on conceptualizing the manuscript.

Chapter 6. Study 5: Sugary drinks and emotions: Investigating the effect of emotions on the persuasiveness of health warnings regarding sugary drinks

Mehrnaz Mostafapour designed and conceptualized the study, obtained ethics approval, conducted the study and collected data, conducted data analysis, conceptualized the manuscript; synthesized the literature; drafted and edited the manuscript for publication.

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Selcuk Onay provided guidance on conceptualizing the manuscript.

Abstract

Introduction

One of main the objectives of public health is to promote behaviors that improve mental and physical health. Consequently, public health researchers have been studying models of behavior-change/decision-making for decades in order to understand how to propel people's behavior. However, most of the traditional health behavior models are consequentialist models that view decision-making mostly as a cognitive process, in which an individual evaluates a set of alternatives based on certain criteria (i.e., perceived risks, perceived benefits, perceived cost, etc.) to choose the option that holds the best health outcomes. However, during the past two decades a growing stream of research has considered and examined the role of emotions on health decisions and behavior. The results of this stream of research demonstrate the significant role that emotions play in making health decisions. Therefore, understanding how emotions influence health decisions is critical to inform effective health interventions and policies. This thesis contributes to the existing body of the literature that examines the role of emotions on health decisions by investigating how emotions affect health decisions in the domains of vaccination, breast cancer screening, and nutrition.

Background

Decision and behavioral researchers have proposed a variety of emotional theories to explain how emotions affect judgement and decisions. Some of these theories are recognized as valence-based theories, such as affect transfer theory or affect as information hypothesis, that demonstrate how positive or negative emotions affect the decision-making process. However, the valence-based theories of emotions lack the explanatory power to address the difference that the-same-valence emotions (e.g., fear and sadness) have on judgement and decisions. Therefore, decision researchers adapted and advanced cognitive appraisal theories of emotions to illustrate how various discrete positive/negative emotions influence judgement and decisions based on cognitive appraisal tendencies associated with the emotions.

This thesis utilizes both valence-based and cognitive appraisal theories of emotions to further the understanding of how emotions affect health decisions. More specifically, this thesis includes the

following independent studies that all explore the role of emotions on health decisions in various domains.

Research problems and methods

The first study is a narrative review of the literature on the role of emotions on judgement and decisions with a focus on health decisions that 1-presents a highlight of the new findings and theories regarding the role of emotions in judgment and decision-making in an organized way, and 2- presents a broad range of examples and published work demonstrating how to apply these findings to inform more effective health interventions and policies.

The second study investigates how affective evaluation of a vaccine can influence child vaccination, utilizing the affect as information hypothesis as a lens. The study examines the research question through a survey based experimental manipulation study run through Amazon Mechanical Turk (n=368) in which the researcher manipulated the affective impression of a vaccine to understand how affective impressions influence the perception of risks and benefits of a vaccine and the intention to vaccinate. The research findings showed that emotions both directly and indirectly (i.e., through a change in the perception of risks and benefits) influence the intention to vaccinate.

The third study intends to understand the role of the emotion of embarrassment on the intention to undergo a mammogram. In this work, through a comprehensive review of the literature on breast cancer screening barriers, especially embarrassment, and consultation with experts, the researcher developed a 14-item questionnaire to evaluate mammography embarrassment considering the factors that contribute to a person feeling embarrassed in terms of both social embarrassment and bodily embarrassment. The scale was examined through conducting a survey-based study through Amazon Mechanical Turk with women older than 45 years old (the recommended age to start breast cancer screening in the US), who were residing in the US, with medical insurance to cover annual mammography (n= 402). The study compared the scale against other validated measures such as General Medical Embarrassment, Susceptibility to embarrassment scale, etc. The researchers validated the scale and showed that the breast cancer embarrassment score is significantly correlated with the participants' past screening behavior and their intention for future screening.

The fourth study, which utilized a 2 (loss- and gain- frames) by 5 (emotions: happiness, sadness, fear, disgust, and anger) factorial design, investigated whether relative persuasiveness of a gain- versus loss-framed message regarding fruits and vegetables consumption would depend upon the emotional state (i.e., happiness, sadness, fear, disgust, and anger) of the individual receiving the message. The study was conducted through Amazon Mechanical Turk. Participants (n=644), who were all able to financially afford the recommended amount of fruits and vegetables yet were consuming less than the recommended amount, were randomly assigned to one of the five emotional conditions. The target emotions were induced through validated methods. The participants were then presented with either a loss/gain message regarding the side-effects/benefits of inadequate/adequate consumption of fruits and vegetables. The results of this study showed a significant main effect of emotion, and the interaction between emotions and message framing on the intention to increase the consumption of fruits and vegetables. More specifically, participants who were primed with the emotion of happiness and fear had a significantly higher intention to increase their consumption of fruits and vegetables than sadness, disgust, and anger. In addition, the results suggested a significant frame by emotion interaction that showed participants primed with sadness, happiness, and anger were more likely to have a higher intention to increase their fruits and vegetables consumption when presented with the gain framed message, compared to the loss framed message. However, participants in the fear and disgust conditions were more likely to have a higher intention to increase their fruits and vegetables consumption when presented with the loss-framed message compared to the gain framed message. We explained how the cognitive appraisals of the certainty, control and valuation and choice associated with each of the emotions contributed to the results. The practical implications in health intervention and policies were also discussed.

The fifth study looks at the effect of discrete emotions including sadness, fear, disgust, and anger on the persuasiveness of health messages regarding the consumption of sugar sweetened beverages (SSBs) through a randomized between subject design (including the emotional states and a neutral condition). The participants (n=392), who were all drinking four or more sugary drinks per week, were randomly assigned to one of the five conditions, in which the target emotion (i.e., sadness, fear, disgust, and anger) was induced through validated methods. The subjects then were presented with a health message regarding the health consequence of SSBs to examine how a combination emotions and health messages can influence their intention to reduce SBBs' consumption. The results, which

were analyzed through the lens of the Appraisal Tendency Framework (ATF), revealed that the intention to decrease the consumption of SSBs was higher when participants were primed with disgust and fear compared to sadness and anger. A detailed discussion demonstrating how these results are related to the cognitive appraisals of valuation and choice, certainty and personal control associated with any of the emotions was presented in the paper. Also, the practical implications in health intervention and policies were discussed.

Conclusion

This dissertation investigates the role of emotion on health decisions and contributes to our understanding of how affect and emotions can influence health decisions.

The first study presented a broad framework on the role of emotions in health decisions through an organized narrative review that can serve as a lens through which more informed health interventions and policies can be designed. Then, in the next studies we focused on exploring the role of emotions in specific health domains. For instance, through the development of a scale for breast cancer screening we showed the significant impact of the emotion of embarrassment on the intention to get breast cancer screening. Furthermore, we explored how emotions affect decisions regarding vaccination and choice of nutrition by utilize existing lenses and theories in the (behavioral economic) and decision-making literature. More specifically, these studies investigated how affects and emotions impact the perception of health messages and the intention to engage in the advised health behaviors. The findings of the later studies contribute 1- to a better understanding of the original theories by exploring them in a different domain (i.e., health domain) and also 2- to expand the comprehension of how emotions can influence health decisions.

All in all, the studies presented in this thesis indicate the significant role that emotions play in health decisions and demonstrate how they can be utilized to inform more effective health interventions and policies.

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List of Abbreviations

ATF – Appraisal Tendency Framework
RDD – Respiratory Discoloration Disease
MMR – Measles, Mumps and Rubella
MES – Mammography Embarrassment Scale
SSBs – Sugar Sweetened Beverages

Chapter 1

Introduction

1.1 Introduction

Charles-Louis de Secondat put it perfectly: "A man of intelligence feels what others can only know" -- Montesquieu (1736-1743/1892). Charles-Louis de Secondat was not only a great political philosopher; he also had a great understanding of human behavior. In the quote above, he suggests that feelings and emotions are a superior form of intelligence. This is a perspective that has recently been embraced by social psychologists, consumer psychologists, marketing researchers, behavioral economists, sociologists, anthropologists, and other behavioral scientists (e.g., Andrade, 2006; Beatty, 2014; Bless et al., 1996; Finucane et al., 2000; Johnson & Tversky, 1983; Keer et al., 2010; Kelly & Barker, 2016; Rick & Loewenstein, 2008; Scheer, 2012; Weiner, 1986; Wettergren, 2017; Worthy et al., 2014; Zeelenberg, 1999)

Until recently, research on the role of emotions in decision-making was limited in its scope and not all-encompassing. For example, the role of emotions in decision-making in Behavioral Economics, a widely known area of research on decision theory, only became of such prominence as of the 20th century (Loewenstein & Lerner, 2003). Most of the behavioral models were consequentialist models in which the role of emotions was limited to considering the so-called "anticipated" emotions associated with various choice alternatives. However, in the last several years, research has shown that emotions can directly influence judgement and decisions beyond just anticipated emotions (Angie et al., 2011; Lerner & Keltner, 2001; Lerner & Keltner, 2010; Pham, 1998). Nowadays many psychologists and behavioral scientists consider emotions as the dominant factor that guides most meaningful decisions in life (for example see: Ekman, 2004; Lazarus, 1991; Lerner & Keltner, 2010; Loewenstein & Lerner, 2003; Wettergren, 2017). Indeed, new research suggests that compared to cognition, affect (emotion) can better predict both intention (Finucane et al., 2000; Lowe et al., 2002) and actual behavior (Kiviniemi et al., 2007; Lawton et al., 2009).

One of the main objectives of public health is to promote behaviors that improve, sustain, and manage mental and physical health. Public health researchers have been studying models of behavior-change/decision-making for decades in order to understand how to propel people's behavior. However, most of the traditional health behavior models are consequentialist models that view decision-making

mostly as a cognitive process, in which an individual evaluates a set of alternatives to choose the option that holds the best health outcomes (e.g., Ajzen, 1991; Fishbein, 1979; Kiviniemi et al., 2007; Lawton et al., 2009; Rosenstock, 1974). In the majority of traditional cognitive models of behavior, people are assumed to cognitively evaluate a target based on certain criteria to make a decision (e.g., (Schoemaker, 1982). More specifically, the traditional models assume that people assign a perceived value to various health decision's components (i.e., perceived risks, perceived benefits, perceived social desirability, etc.) and will make a decision based on maximizing the positive criteria such as perceived benefits or efficacy and minimizing the negative criteria such as associated costs or risks (Rosenstock, 1974; Schoemaker, 1982). Similarly, the role of emotions in the traditional models was limited to anticipated emotions (Caplin & Leahy, 2001). That is, traditional models of decision-making assumed that people make decisions to maximize positive emotions such as joy or pride, while minimizing negative emotions such as regret or shame.

As research on the role of emotions on judgement and decision-making progressed, research evidence strongly indicated that emotions play a significant role on judgement and decisions beyond just anticipatory emotions (Loewenstein & Lerner, 2003). Indeed, research revealed that emotions experienced at the time of decision-making are potent, pervasive, and predictable drivers of decisions (Andrade & Ariely, 2009; Han et al., 2007; Loewenstein & Lerner, 2003; Yang et al., 2020; Zhao et al., 2016). However, what was less clear in the research was *the mechanism* through which emotions affect judgement and decisions. Subsequently, various theories such as valence-based theories and cognitive appraisals theories of emotions have been proposed to address this fundamental question.

In short, valence-based theories of emotions intended to address this question by only considering the valence of emotions (i.e., positive vs. negative emotions) (Fishbach et al., 2004; Isen, 1987; Schwarz, 2001). They demonstrated that the positive vs. negative emotions experienced towards a choice can influence subsequent judgement and decisions. These theories suggest that the way a person feels towards a subject is associated with how they evaluate the subject. That is, experiencing positive/negative feelings towards a subject leads to a relatively more positive/negative evaluation of the subject. However, valence-based theories of emotions lacked the predictive power to explain why/how same-valence discrete emotions (e.g., sadness vs. anger, or happiness, vs. pride) can differently influence judgements and decisions. Subsequently, cognitive appraisal theories of emotions

emerged to extend the predictive power of emotional theories (e.g., Smith & Ellsworth, 1985; Smith & Lazarus, 2008). Cognitive appraisal theories of emotions have employed a more comprehensive and sophisticated approach in which they indicate that each emotion can be deconstructed into several cognitive appraisal dimensions that each carries information-rich association underlying the emotional experience, that can predict subsequent judgement and decisions. Due to identifying the cognitive appraisal associated with each emotion, cognitive appraisals theories of emotions have a greater explanatory power to demonstrate the difference between various same-valence emotions.

In general, recent emotional theories and research findings suggest that emotions can affect judgement and decisions in a variety of ways such as influencing the way choice alternatives are perceived and evaluated, the depth of information processing, the direction of attention and memory, the judgement of risks/benefits, the motivation to take certain actions, etc.

As comprehension of the role of emotions on judgement and decisions has advanced, public health researchers have utilized the theories and findings regarding the role of emotions on judgment and decision in behavioral science to inform more effective health policies and interventions related to medical decisions-making and health promotion (Ferrer et al., 2016; Ferrer & Mendes, 2017). However, although recent research has tried to fill the gap between behavioral theories of emotions and health promotion/interventions, particularly during the last decade, we believe the gap is still significant and requires extensive work to make a more concrete bridge between the two fields. This thesis contributes to the current flow of the work that intends to create the bridge between the two fields by studying the role of affect and emotions on health decisions in three health domains, namely, cancer screening, vaccination, and nutrition.

1.2 Structure of the thesis

This thesis follows the format of an integrated paper-based thesis. Each research article presented in this work is a standalone scholarly manuscript that is formatted for submission to an academic peer-reviewed journal.

This thesis includes six chapters. Chapter 1, the current chapter, provides an overview of the research presented in this work. Chapter 2 presents a narrative review on the role of emotions in health decisions. Although the review is a standalone manuscript that extensively elaborates on recent findings

in emotion research and how they have been or can be applied in health settings, it also provides a solid and comprehensive background foundation for other research papers presented in this work. Chapters 3, 4, 5, and 6 present four research studies that I have conducted during the course of my PhD studies (among others). The research papers presented in this work do not investigate a specific research question through a series of sequential studies, but rather investigate different research questions regarding the role of emotions on health decisions in various health domains. That is, the research studies presented in this dissertation are independent but collectively substantially contribute to further the understanding of the role of emotions in health decisions by investigating emotional theories in various health domains including vaccination, breast cancer screening, and nutrition. In the final chapter, Chapter 7, I summarize the overall findings of the research, their applications in health promotion, practical limitations, and future research directions.

In the following, I explain the research problems discussed in Chapters 2, 3, 4, and 5 and demonstrate how these research questions were developed through the course of my PhD studies, in more detail.

1.2.1 Chapter 2 (Study 1)

Chapter 2 presents a narrative review of the literature on the role of emotions in judgement and decision-making, with a focus on health decisions. Initially this review was conducted with the intention to inform my research studies, however, the structured narrative and the format in which various findings have been linked together and depicted in this review provide a valuable and substantial contribution that can serve as a structured framework to inform more effective health interventions/policies.

Narrative reviews may not fully capture the literature with the rigor of systematic reviews, and hence are shaped by the authors' biases in shaping the narrative and conclusions. However, the purpose of a narrative review is to provide the reader with an overview of the literature with the intention to deepen their understanding of the field and its practical implications, which this review has accomplished. The papers discussed in this study range approximately from 1970 until the present. Due to the unusually long (four decades) span of the materials, we intentionally highlighted prominent theories/findings and restricted ourselves to selectively provide one or two examples of how these theories/findings are applied in health settings. More specifically this review makes the following contributions:

- Highlights recent findings and theories in behavioral science regarding the role of emotions on judgment and decision-making, in a comprehensive and structured format.
- Presents a broad range of examples and published work that have utilized (or can utilize) these findings/theories in the domain of health decisions/promotion.

Besides the specific contribution of this narrative review to health promotion research, the theories discussed in this review, especially the affect-as-information hypothesis and the appraisal tendency framework, serve as a foundation for the readers of this thesis to better understand the research questions investigated in Chapters 3, 4, 5, and 6.

1.2.2 Chapter 3 (Study 2)

Chapter 3 presents a study that aims to understand the impact that the overall emotional evaluation of a vaccine has on the perception of risks and benefits of the vaccine and the intention to vaccinate. The study examines the research question through a survey based experimental manipulation study conducted through Amazon Mechanical Turk (n=368), in which the researcher manipulated the affective impression of a vaccine to understand how affective impressions influence the perception of risks and benefits of a vaccine and the intention to vaccinate. Structural Equation Modeling was utilized to analyze the structural relationships between the variables.

Consistent with the affect-as-information hypothesis (Schwarz, 2001), the research findings showed that the overall emotional evaluation of the vaccine both directly and indirectly (i.e., through a change in the perception of risks and benefits) influences the intention to vaccinate. That is, experiencing more positive/negative affect about a vaccine results in an increase/decrease in the perception of the benefits/risks of the vaccine, and ultimately affects the intention to vaccinate.

The results of this study have important implications for health promotion and specifically for vaccination interventions. This study showed that the way the target audience *feels* about an advised health behavior is more predictive of their intention to engage in the advised behavior compared to how they cognitively evaluate a decision. Therefore, health promotors can further explore how to change the way their target audience *feels* about certain health decisions (in this case vaccination) in order to influence their behavior more effectively.

Study 2 utilized a valence-based theory of emotions (i.e., the affect-as-information theory) to explore how the overall emotional evaluation of a vaccine (i.e., positive or negative) influences the intention to vaccinate. However, in the subsequent studies, we mostly focused on exploring the role of discrete emotions on health decisions. For instance, in the following, I will explain Study 3 that specifically investigates the role of the emotion of embarrassment on the intention for breast cancer screening. And then, I continue with demonstrating study 4 and 5 in which we explore the role of disgust, anger, fear, sadness, and happiness on decisions related to nutrition.

1.2.3 Chapter 4 (Study 3)

The study presented in Chapter 4 investigates the role of the emotion embarrassment on the intention to undergo a mammogram. Given the lack of a validated scale to measure mammography embarrassment, this study first developed a 14-item questionnaire to evaluate mammography embarrassment through a comprehensive review of the literature and consultation with experts to evaluate mammography embarrassment, considering both social and bodily factors contributing to mammography embarrassment. The scale was examined through conducting a survey-based study through Amazon Mechanical Turk with women older than 45 years old (the recommended age to start breast cancer screening in the US), who were residing in the US, with medical insurance to cover annual mammography ($n= 402$) ($\alpha= 0.94$). The study compared the scale against other validated measures such as the General Medical Embarrassment scale, Susceptibility to embarrassment scale, etc. to ensure construct validity. Furthermore, the analysis showed that the breast cancer embarrassment score is significantly correlated with the participants' past screening behavior and their intention for future screening.

Consistent with previous qualitative findings (e.g., Engelman et al., 2012; Stein et al., 1991; Tsai et al., 2011) that had suggested that mammography embarrassment acts as an emotional barrier to breast cancer screening, study 3 quantitively showed a significant negative correlation between expected mammography embarrassment and the intention to undergo a mammogram. The results from this study motivated us to further investigate the impact of discrete emotions on the intention to engage in certain health behaviors, beyond just expected emotions. Therefore, we utilized the cognitive appraisal theories of emotions to investigate the impact of the emotions of disgust, anger, fear, sadness,

and happiness on the intention to adhere to nutrition advice regarding the consumption of fruits and vegetables in Study 4.

1.2.4 Chapter 5 (Study 4)

Chapter 5 presents study 4 that investigated how the emotional states of an audience including fear, disgust, anger, sadness, and happiness, emotions that are frequently utilized in the context of health promotion (Dorison et al., 2020; Halkjelsvik & Rise, 2015; Leshner et al., 2011; Staicu & Cuţov, 2010; Veenhoven, 2008), influence the effectiveness of a health message regarding the consumption of fruits and vegetables. This study, which utilized a 2 (loss- and gain- frames) by 5 (emotions: happiness, sadness, fear, disgust, and anger) factorial design, investigated whether relative effectiveness of a gain- versus loss-framed message regarding fruit and vegetable consumption would depend upon the emotional state (i.e., happiness, sadness, fear, disgust, and anger) of the individual receiving the message. The study was conducted through Amazon Mechanical Turk. Participants (n=644), who were able to financially afford the recommended number of fruits and vegetables yet were consuming less than the recommended amount, were randomly assigned to one of the five emotional conditions and the target emotions were induced through previously validated methods. The participants were then presented with either a loss/gain message regarding the side-effects/benefits of inadequate/adequate consumption of fruits and vegetables. Utilizing the cognitive appraisal theories of emotions and previous findings (Gerend & Maner, 2011; Han et al., 2007; Smith & Lazarus, 2008), we hypothesized that emotions that are associated with reward seeking behavior are more likely to enhance the effectiveness of gain-framed messages, whereas, emotions associated with hesitancy and disposal tendencies enhance the effectiveness of loss-framed messages. As predicted, the results confirmed a significant frame by emotion interaction that showed participants primed with sadness, happiness, and anger (which are associated with reward seeking tendencies) were more likely to have a higher intention to increase their fruits and vegetables consumption when presented with the gain framed message, compared to the loss framed message. However, participants in the fear and disgust conditions (associated with hesitancy and disposal tendencies) were more likely to have a higher intention to increase their fruits and vegetables consumption when presented with the loss-framed message compared to the gain framed message. Our results also showed a significant main effect of emotion.

That is, participants who were primed with the emotion of happiness and fear had a significantly higher intention to increase their consumption of fruits and vegetables than sadness, disgust, and anger.

The results of this study contribute to the design of more effective health promotion and communication plans (specifically regarding the consumption of fruits and vegetables), by showing how to best combine emotions and message framing to promote health behaviors, more effectively.

Considering that the design of this study did not allow to further investigate the main effect of emotions on the intention to attend to the advised health behavior (i.e., how emotions influence the intention to engage in an advised health behavior), we conducted study 5 in which we specifically focused on understanding how emotions may motivate certain action tendencies.

1.2.5 Chapter 6 (Study 5)

Study 5 looks at the effect of discrete emotions including sadness, fear, disgust, and anger on the persuasiveness of a health message about the consumption of sugar sweetened beverages (SSBs) through a randomized between subject design. This study was conducted through a survey-based experimental manipulation study in Amazon Mechanical Turk in which the participants (n=392), who were all drinking four or more sugary drinks per week, were randomly assigned to one of the five conditions (four emotional conditions and one neutral condition). In each condition, we first induced the target emotions (i.e., sadness, fear, disgust, and anger) through presenting 5 static images related to the target emotions and then asking the participants to select the image that makes them feel the target emotion the most, compared to other images. In addition, the participants were asked to write about an event in which they felt the target emotions. In the neutral condition, the participants were presented with neutral images and were asked to write about a normal daily event that happened the day before. The subjects then were presented with a health message regarding the health consequence of SSBs consumption to examine how priming the target emotions in the subjects can influence their intention to reduce the consumption of SSBs. Utilizing the cognitive appraisal theories of emotions and previous findings (Gerend & Maner, 2011; Han et al., 2007; Smith & Lazarus, 2008), we showed that emotions that are associated with disposal and hesitancy tendencies (i.e., fear and disgust) are more likely to encourage the participants to reduce the consumption of SSBs compared to the emotions that are characterized by reward seeking behavior even in the presence of risks (i.e., anger and sadness). Furthermore, we showed that the certainty and control appraisals and the appraisal of

choice and valuation associated with emotions can reinforce or moderate each other's effects on the intention to reduce the consumption of SSBs. More specifically, the findings showed that in fear and disgust that are characterized by disposal and hesitancy tendencies, the lower perceived personal control associated with fear would reinforce the disposal tendencies towards the consumption of SSBs; whereas, higher levels of the certainty and control appraisals associated with disgust would moderate the disposal tendencies towards the consumption of SSBs. On the other hand, in sadness and anger which are associated with reward seeking appraisal, higher levels of personal control and certainty appraisals associated with anger would reinforce the reward seeking tendencies by reducing the intention to reduce the consumption of SSBs; whereas, lower levels of certainty and control appraisals associated with sadness would moderate the reward seeking tendencies towards the consumption of SSBs.

The results of this study contribute to understanding of the impact of incidental emotions on the intention to engage in a health behavior. The applications of the findings and limitation are discussed in the paper, in more detail.

1.2.6 Chapter 7 (Conclusion)

Chapter 7 presents the summary of main findings and their implications for health promotion and policy. We also discuss the limitations of the studies and potential future directions to further investigate the research problems discussed in this dissertation.

1.3 Conclusion

In closing, this dissertation investigates the role of emotion on health decisions and contributes to our understanding of how affect and emotions can influence health decisions. Although the studies presented in this work are independent, they all contribute to further the understanding of the effect of emotions on health decisions, in several domains of health promotion. All of the studies presented in this dissertation have substantial contributions to inform more effective health intervention/promotion plans that are discussed to a greater extent in each chapter and summarized in chapter 7.

Chapter 2
Investigating the role of emotions on health decisions: A narrative review

Abstract

Despite the significant advancements in identifying the role of emotions in judgement and decision-making in other fields such as psychology and behavioral economics, until recently, there has been little effort in incorporating these findings in health decisions. As such, this work intends to 1-presents a highlight of the new findings and theories regarding the role of emotions in judgment and decision-making in a structured format, and 2- presents a broad range of examples and published work demonstrating how to apply these findings to inform more effective health interventions and policies. However, due to the long (four decades) span of the materials, we restricted ourselves to discuss the more prominent emotional theories and we only presented one or two work that to illustrate the application of a given behavioral finding in the health domain.

Particularly, this review provides an overview of the evolution of various emotional theories over time, and explains how these theories are applied or can be utilized in health promotion. That is, this review highlights the advances in the role of expected emotions on decisions, discusses the valence based and cognitive appraisals theories of emotions, and demonstrates how expected emotions, decision-related emotions, and incidental emotions can shape the emotions experienced at the time of decision-making (i.e., immediate emotions). Then, it demonstrates recent research findings to illustrate the mechanisms through which immediate emotions affect subsequent judgement and decisions. Throughout the review, we demonstrate how these findings can inform more effective health intervention/promotion plans and policies. Indeed, the main contribution of this review is the integration of various pieces of research in a structured format to provide a framework to illustrate how emotional theories can be applied in health settings and also to highlight the existing gaps.

2.1 Introduction

In an era of unprecedented focus on health behavior change and disease prevention interventions, the importance of utilizing behavioral science to develop more effective health policies/interventions is

undeniable (Bartholomew et al., 2006; Glanz & Bishop, 2010). Besides considering and addressing the impacts of socio-ecological determinants of health to improve public health, many causes of diseases and mortality (e.g., diabetes, cardiovascular problems, or cancer) can be reduced/prevented by behavioral modifications. Integrating the findings from behavioral science into health interventions can lead to the development of more effective health interventions/policies, and ultimately, better health outcomes. There is numerous research evidence that shows how system-level interventions can benefit from behavioral science and change theories (Bartholomew et al., 2006; Glanz & Bishop, 2010; Glass & McAtee, 2006). Researchers in health promotion have long utilized the findings from behavioral science to develop more effective health interventions/policies (Glanz et al., 2015). For instance, theories of behavior changes such as the health belief model (Rosenstock, 2000), social cognitive theory (Schunk, 2012), theory of reasoned action (Fishbein, 1979), etc. all have integrated the findings from behavioral science to predict and influence health behaviors in various domains such as cancer prevention (Klein et al., 2014; Vernon et al., 2006), drinking behavior (Murphy et al., 2007; Murphy et al., 2012), vaccination (Betsch et al., 2015; Brewer, 2021; Mostafapour et al., 2019), etc.

In the last three decades, the fields of behavioral science and behavioral economics have made important connections between affective states and subsequent judgements and decisions (Angie et al., 2011a; Lerner & Keltner, 2000; Schwarz, 2000; So et al., 2015a). However, traditionally, decision-making was known to be a cognitive process in which individuals would make a decision based on maximizing their expected utility (i.e., an optimized expected outcome) which could be both monetary and emotional. It was assumed that decision makers would consider various options and would make decisions solely based on considering the overall utility (both emotional and monetary) that each option holds (Schoemaker, 1982). Therefore, the role of emotions in decision-making was limited to considering the expected emotions that one was likely to experience as a result of making a choice. However, in recent years, research shows that emotions influence decision-making beyond just expected emotions (Loewenstein, George & Lerner, 2003; Schwarz, 2000). That is, emotions are no longer considered simply the outcome of the decision but rather, play a role in the decision-making process. Emotions are identified as both as a source of information and a separate system of judgement that can systematically affect the content of thoughts, depth of information processing, judgement of risks, the perception of outcomes, etc. in the decision-making process (Han et al., 2007; Loewenstein & Lerner, 2003; Slovic, Paul et al., 2007; So et al., 2015). However, despite significant advancements

in identifying the role of emotions in judgement and decision-making in behavioral science, until recently, there has been little effort in incorporating these findings in health settings (please see (Ferrer et al., 2016) for recent applications of emotional theories applied in health settings). This review intends to highlight and organize findings from behavioral science that explore the role of emotions on judgement and decision-making, and discuss how these findings are or can be applied in health promotion.

The papers discussed in this review range approximately from 1970 until the present. Our objective is to organize the main and state-of-the-art findings/theories in emotional research in an organized narrative structure to provide an overview of the progression/advances of new theories in the field of judgement and decision-making and how to apply them in health settings. Despite the significant progress in the comprehension of the role of emotions on judgement and decision, this field is still in its infancy (Angie et al., 2011b; Lerner et al., 2015; So et al., 2015b). The theories, findings, and applications discussed in this review vary in the amount of research conducted to deduce concrete conclusions, and the findings and theories may have competing theories that are not discussed as part of this review due to the limited scope of this work. Subsequently, this work explains the evolution of emotional theories in the field and how different theories led to the evolution of subsequent theories and will also present examples of how these theories/findings have been or can be applied in the health domain. Due to the qualitative nature of the review and the vast literature that explores the role of emotions on judgement and decisions, we intentionally only discuss more prominent and relevant findings and theories such as the affect transfer theory (Machleit & Wilson, 1988), feeling-as-information hypothesis (Schwarz, 2001), the cognitive appraisals theories of emotions (Smith & Ellsworth, 1985; So et al., 2015), etc. Furthermore, due to the long (four decades) span of the materials, the health applications we discuss here are very selective; for instance, we intentionally restricted ourselves to one or two works that studied the application of a given behavioral finding in the health domain. The aims of this review paper therefore are to:

- Highlight recent findings and theories in behavioral science regarding the role of emotions in judgment and decision-making, in a comprehensive and structured format.
- Present a broad range of examples and published work that have utilized (or can utilize) these findings/theories in the domain of health decisions/promotion.

To achieve these aims, we first discuss the more prominent emotional theories from a psychological perspective to explain and define the nature of emotions. Then, we present a framework through which we discuss the role of expected and immediate emotions (i.e., the emotions that are experienced at the time of decision-making) on judgements and decisions.

Particularly, we discuss advances in the comprehension of the role of *expected* emotions on judgement and decisions, and explain how expected emotions, decision-related emotions, and incidental emotions can impact the immediate emotions experienced at the time of decision-making. Subsequently, we demonstrate the role of immediate emotions on judgement and decision-making based on the recent research. Furthermore, we discuss the potential applications of the findings and theories in health settings.

This review serves as a framework to demonstrate the application of current theories/findings regarding the role of emotions in judgement and decisions in health settings, in a structured way, that can further help with identifying potential future research directions about how to apply these theories/findings in the health domain.

2.2 Introduction to emotions

The words emotion and mood are usually used interchangeably in the literature. However, emotions are a subjective or affective state that happen as a result of a perceived or an experienced trigger and are usually intense and short lived. Mood, however, is a prolonged affective state that is not necessarily intense or the result of something we experience. Mood is not usually *consciously* experienced (Beedie et al., 2011). For instance, someone may feel the emotion of fear when facing a physical attack, while someone may have an anxious/depressed mood as a result of a hormonal imbalance or as a result of suppressing their emotions for a long time. In this work, the word emotion is used to refer to emotions as a short-lived subjective state of being that is intentional and consciously experienced (Barrett et al., 2007).

2.3 How do emotions affect physiological and behavioral responses, from a psychological perspective?

We all feel emotions as we go through our daily lives. For instance, we feel angry when betrayed, scared when attacked, sad when we lose a loved one, or happy when we receive a gift. This section

intends to review the main psychological theories about how emotions are generated and experienced in the body.

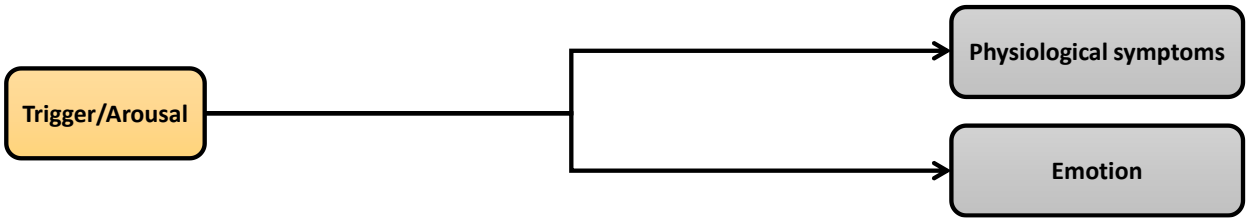
Emotions are composed of physiological arousal, psychological appraisal, and subjective experiences (Levenson et al., 1991). However, there are four main theories that propose different views about the order in which these components interact with each other. In the following, we will review these theories in detail.

One of the primary theories of emotions is the James-Lange theory of emotion which posits that emotions arise from physiological arousal (Dewey, 1895). That is, as a result of a perceived/experienced trigger, one may experience certain physiological symptoms which then lead to feeling a specific emotion. For instance, one may see a tiger (i.e., the trigger), and then the physiological response would be something such as an increased heartbeat, which can lead them to experience "fear" (see Figure 2-1).

Figure 2-1 James-Lange theory of emotions

Other theories such as Cannon Brad theory suggest that physiological arousal and emotional experience occur simultaneously, but *independently*. That is, after the exposure to a trigger, such as seeing a tiger, one's heartbeat would increase, and the person would feel scared (Cannon, 1927; Lang, 1994). These theories imply that although there are physiological arousals while feeling an emotion, they are independent of each other (see Figure 2-2).

Figure 2-2 Cannon Brad theory of emotions

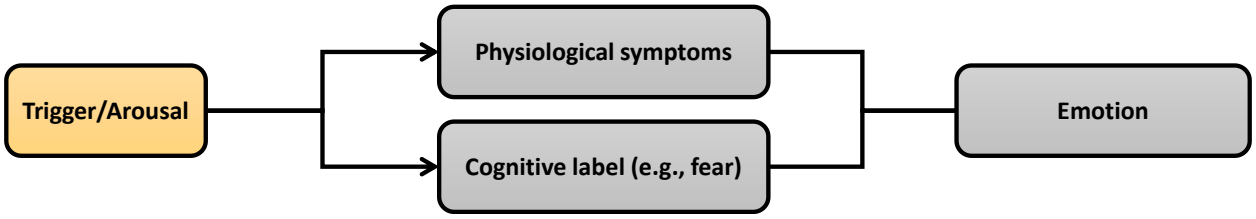


However, recent research has shown contradicting evidence that questions the validity or generalizability of the Cannon Brad theory. For instance, the facial feedback hypothesis suggests that

suppressing facial expression lowers the intensity of some of the emotions such as sadness or happiness (Adelmann & Zajonc, 1989; Boiger & Mesquita, 2012; Buck, 1980; Strack et al., 1988). So, if the Cannon Brad theory was always true, then facial expressions and emotions should not reinforce or suppress each other, as they are assumed to be independent. However, a number of works support the facial feedback hypothesis by showing that the intensity of facial expressions influences the emotional reactions (e.g., (Soussignan, 2002; Strack et al., 1988). For instance, several works have shown that people who have been injected with BOTOX showed a significant decrease in the strength of emotional experience (e.g., (Davis et al., 2010; Havas et al., 2010; Neal & Chartrand, 2011) which confirms that emotions and bodily expressions/physical symptoms may not be independent.

The third category of emotional theories suggests that an emotional experience is composed of physiological arousal and a cognitive label that is a subjective evaluation of the physical symptoms (Cornelius, 1991). One of the famous theories in this category is the Schachter-Singer two-factor theory of emotion which posits that after an exposure to a trigger we may feel physical arousal in the body and will assign a cognitive label (e.g., fear) to these physical symptoms (Schachter & Singer, 1962). They believed physiological symptoms are almost similar across a broad range of emotions, and that it is the subjective cognitive evaluation that creates the emotional label, not the physiological symptoms. Therefore, while two individuals may experience similar physiological symptoms, they may assign different emotional labels to these symptoms and have different subjective emotional experiences (see Figure 2-3).

Figure 2-3 Schachter-Singer two-factor theory of emotion



In a study done by Schachter and Singer (1962), the subject in the study were given epinephrine, a hormone that causes the body to be in a fight-or-flight state. Some of the subjects were told to expect the associated physical symptoms (e.g., heart pounding, muscle tensions, etc.), while others were told that either the injection has no side effects, or it has irrelevant side effects such as

itching, or headaches. The study subjects were then exposed to a similar condition in which they had an encounter with a confederate of the researchers, that acted in a scripted way to induce anger. The subjects were then asked about their emotional change. The ones who were told about the physical symptoms reported no anger (i.e., they associated the symptoms with the injection, as opposed to interpreting them in any other way), while others reported that they felt anger. This result showed that while all participants experienced similar physical symptoms, only those who did not expect the physical symptoms interpreted them as anger, using the context.

Building upon the previous theories, the fourth category of emotional theories emerged, known as cognitive appraisal theories of emotions (Roseman & Smith, 2001). The key idea in appraisal theories of emotion is that one's thoughts and perceptions trigger the emotions one experiences. This basically means that emotions are a function of thoughts (Frijda, 1988; Lazarus, 1991a). For instance, thinking about something positive/negative results in experiencing positive/negative emotions. Therefore, cognitive appraisal theories of emotions posit that people can feel different types of emotions in similar situations depending on how they interpret the situation (i.e., think about it). See Figure 2-4.

Figure 2-4 Cognitive appraisal theories of emotions

It is worth mentioning two other prominent views of emotions which suggest that emotions are independent of thoughts (Cunha et al., 2010; LeDoux, Joseph, 1996; LeDoux, Joseph E., 2002; LeDoux, Joseph E., 2012). Zajonc (1998) suggests that emotions occur separate to thoughts. For instance, when we hear a loud sound from above or when we see someone for the first time and feel like/dislike towards them, these feelings are spontaneous and separate from conscious thoughts. Along the same lines, Ledoux (1996) looked at emotions from a neuroscientific view and states that emotions can be independent from thoughts. He posits that an emotion (e.g., fear) can be processed through two main brain paths, one from the thalamus directly to amygdala, and one from the thalamus to prefrontal cortex and then to amygdala. The first path is so quick that is almost uncatchable by thoughts, while in the second path, the emotions can be the result of thoughts.

2.4 How do emotions affect judgement and decisions, from the perspective of judgement and decision-making literature?

In consequentialist models of decision-making, decision-making was known to be a cognitive process in which individuals would make a decision based on maximizing their expected utility which could be both monetary and emotional. It was assumed that decision makers would consider various options and would make decisions solely based on considering the overall utility that each option holds (Schoemaker, 1982). Therefore, the role of emotions in decision-making was limited to considering the expected emotions that one was likely to experience as a result of making a choice. However, as the field advanced, research evidence showed that the effect of emotions on judgement and decisions is beyond just considering the utility of the expected emotions. The fact that emotions significantly influence decisions beyond the expected emotions is now very clear in the literature; however, what has been less clear is *how* emotions affect the decision-making process. In the following, we first present valence-based emotional theories, and then emotional theories that look at emotions beyond valence to discuss how the understanding of the role of emotions on judgement and decision-making have progressed over the years.

2.4.1 Valence-based theories of emotions

In order to understand how emotions influence perception and decisions, Isen and colleagues (1978) introduced a theory that suggested emotions influence the decision process by changing a person's beliefs and perspectives about a target. For instance, feeling frustration towards a target, for instance, a health clinic may trigger negative evaluation cognitive such as "they don't care about the patients" or that "they are not reliable". They concluded that a negative emotion can influence the evaluation process and affect one's perceptions and beliefs through the activation of feeling-consistent cognition (i.e., a cognitive evaluation that is in line with how one feels). Along the same line, in a comprehensive study (Finucane et al., 2000) showed that having negative feelings towards a target (e.g., X-rays or vaccination) makes people perceive the risks of the targets as more prominent and perceive it as less beneficial. Later, the "affect transfer" hypothesis was introduced which posits that the emotions one experiences at the time of decision-making are automatically transferred to how one feels about and evaluates choice alternatives (Fishbach et al., 2004; Machleit & Wilson, 1988; Mitchell, 1980). That is, if someone experiences negative/positive emotions regarding a target, then they are more likely to

evaluate the target as being less/more desirable (Gorn, 1982). Building on these findings, subsequent work suggested that people follow a simple analogy when making a judgement; that is, the direction and intensity of their attitude and preferences towards and their cognitive evaluation of a target are informed by their immediate feelings towards the target (Schwarz, 1990). In doing so, people may lack awareness of this process, and the emotions that they experience at the time of decision-making, regardless of whether the emotions are related to the decision in hand or are incidental, affect subsequent judgement and decisions. These findings led to the development of affect-as-information hypothesis that posits that people evaluate a choice based on the answer to the "how-do-I-feel-about-it" question (Schwarz, 1990). The idea that feelings can be treated as a source of information has been revolutionary and has provided a quite strong explanatory power in understanding how emotions affect judgement and decision-making. Unlike the "affect transfer" hypothesis, the feeling-as-information hypothesis suggests that feelings are not purely and automatically transferred to the decision-making process, but people treat their emotions as a source of information to evaluate the target. The difference between what Isen et al. (1978)'s work suggests and the feeling-as-information hypothesis is that the feeling-as-information hypothesis states that emotions directly enter to the evaluation process and not only through a conscious cognitive evaluation of what feelings may mean for the target evaluation (Loewenstein & Lerner, 2003; Schwarz, 1990).

2.4.2 Theories of emotions beyond valence

All aforementioned theories of emotions are considered valence-based theories. A valence-based approach mostly focuses on the pleasantness/unpleasantness (positive vs. negative) dimension of emotions. For instance, affect transfer theory (Machleit & Wilson, 1988) and the affect-as-information hypothesis (Schwarz, 1990) are both valence-based approaches that suggest that the valence of the emotions that a person experiences at the time of decision-making affects the way they evaluate a choice. They posit that experiencing positive/negative emotions leads to a relatively more positive/negative evaluation of a choice. Although valence-based approaches provide strong explanatory power regarding how emotions influence judgement and decision-making, they are criticized as not explaining how the same valence emotions may have different influences on judgement and decisions. That is, these approaches do not consider the differences between the effect of various discrete negative (e.g., sadness or disgust) or positive (e.g., happiness or pride) emotions on judgement

and decision-making. For instance, emotions of the same valence, such as disgust or anger, are associated with different action tendencies (Lerner et al., 2007) , depth and style of information processing (Verhulst & Lizotte, 2011), central nervous system activities (Kreibig, 2010), facial expressions (Kohler et al., 2004), etc. but the valence-based theories are limited in their capacity to explain these differences. Later research included the arousal/intensity dimension to explore if the difference between the same valence emotions can be explained (Branscombe, 1985; Greenwald et al., 1989; Russell, 1980; Vrana et al., 1988). The arousal dimension is that which shows where the emotion is placed on the spectrum of fight-or-flight (sympathetic nervous system) and freeze (parasympathetic nervous system) responses. For instance, anger or fear are high on the arousal dimension while sadness or disgust are lower on the arousal dimension. Adding the arousal dimension was still less than ideal to explain the broad range of differences between the effect of the same valence emotions on judgement and decision-making (Mellers et al., 1998). Therefore, two broad classes of emotion theories emerged to further the understanding of the difference between the same-valence emotions, namely, functional theories of emotion and cognitive appraisal theories of emotion.

Functional approaches to emotions suggest that emotions trigger a set of physiological and behavioral responses that enable an individual to react to a given situation (Keltner & Gross, 1999). These approaches investigate how emotions affect the cognitive processes and alter the direction of attention, memory, judgement, etc., to deal with the emotion-eliciting event.

Cognitive appraisal theories of emotion posit that a set of cognitive dimensions (including, but not limited to the valence and arousal dimensions) can better explain the difference between various discreet emotions. There are several models of emotional appraisals such as action readiness (Frijda et al., 1989), the goal relevance and goal congruence framework (Lazarus, 1991b; Lazarus, 1991c), causality attribution (Weiner, 1985) agency and accountability (Smith & Lazarus, 1993), and self-discrepancy (Higgins, 1987) theories which identified specific cognitive appraisals to differentiate between emotions. Other work included a broader range of cognitive appraisals associated with emotions to further demonstrate the difference between emotions, such as the work by (Roseman, 1984) that identified five cognitive appraisals, namely: motivational, situational, probability, legitimacy and agency, or the work by (Scherer, 1984) that identified the appraisals of novelty, pleasantness, goal relevance, and compatibility with standards. Among all practical theories of cognitive appraisal of

emotions, the cognitive appraisal dimensions studied by Smith & Ellsworth (1985)' work prevail in the literature and are thus our focus herein.

In an empirical examination of cognitive dimensions of emotions, Smith and Ellsworth (1985) defined six cognitive dimensions to explain the underlying appraisal dimensions of emotion that differentiate various emotions. These dimensions are:

1. Pleasantness: Refers to the degree to which something is pleasant (high on this dimension) vs. unpleasant (low on this dimension). For instance, fear and sadness are low on pleasantness while pride and happiness are highly pleasant.

2. Certainty of the situation: Refers to the degree to which the outcomes of a situation are perceived as predictable (high on this dimension) vs. unpredictable (low on this dimension). For instance, fear and surprise are low on the certainty appraisal dimension; while anger and happiness have high levels of certainty appraisals.

3. Attentional activity: Refers to the degree to which one is motived to pay attention (high on this dimension) vs. looking away from a situation (low on this dimension). For instance, boredom and frustration are low on the attentional activity appraisal, while happiness and pride are high in this dimension.

4. Anticipated effort: Refers to the degree to which a situation seems challenging (high on this dimension) vs. not (low on this dimension). For instance, guilt is high on anticipated effort; while happiness is low.

5. Control potential: Refers to the degree to which events are perceived to be caused by individual agency (high) vs. situational agency (low). For instance, fear and regret are low in control while anger is the opposite.

6. Responsibility: Refers to the degree to which someone or something other than oneself (high) vs. oneself (low) seems to be responsible in a given situation. For instance, guilt is low on responsibility while anger is high.

It is worth noting that as research has progressed, more cognitive appraisals such as global vs. local appraisals (i.e., the degree to which an individual attributes certain outcome to self vs. others), temporal

focus appraisals (the degree to which an individual focuses on near vs. future outcomes), etc. have been introduced to further differentiate between various discrete emotions (So et al., 2015). Reviewing these appraisals is beyond the scope of this review.

In order to further the understanding of the role of emotions on judgement and decision-making, (Lerner & Keltner, 2000; Lerner & Keltner, 2001) built upon these two approaches (i.e., functional and cognitive appraisal approaches) and proposed the Appraisal Tendency Framework (ATF) in which they introduced a multi-dimensional view of emotions through which they could differentiate various discrete emotions. The ATF has three main assumptions: 1- The difference between emotional experiences is the result of the difference between a discrete set of cognitive dimensions that triggered them, 2- Any discrete emotion (e.g., sadness, anger, or happiness) can trigger a set of associated responses such as physiological, perceptual, behavioral, experiential and communication tendencies that enable an individual to respond to the environment, and 3- Emotions have motivational tendencies that depend on their intensity and core appraisals (Han et al., 2007).

The appraisal tendency framework suggests that each discrete emotion activates a cognitive predisposition to appraise a target in line with the central-appraisal dimensions that triggered the emotion. Put it simply, according to ATF, once an emotion is activated, it leads to a cognitive predisposing to evaluate events in line with the core cognitive appraisal dimension that triggered that emotion. For instance, one of the earlier studies aiming to test the predictive power of ATF compared the risk perception among fearful and angry individuals (same valence emotions) ATF (Lerner & Keltner, 2001). They found that individuals experiencing fear, which is low on the certainty dimension, are more likely to perceive the risks of choice alternatives as higher and so are more likely to avoid risky decisions; whereas, individuals who were angry, which is an emotion that is high on the certainty dimension, are more likely to evaluate the risks of choice alternatives as lower and so were more likely to make riskier decisions (Lerner & Keltner, 2001). There have been many other findings in various contexts consistent with how the ATF predicts judgments and decisions influenced by emotions (Ferrer et al., 2016; Lerner et al., 2015). So, unlike the valence-based approach, the ATF, which is a combination of functional and cognitive appraisal approaches to emotions, provides a greater explanatory power of behavior prediction with regards to emotions.

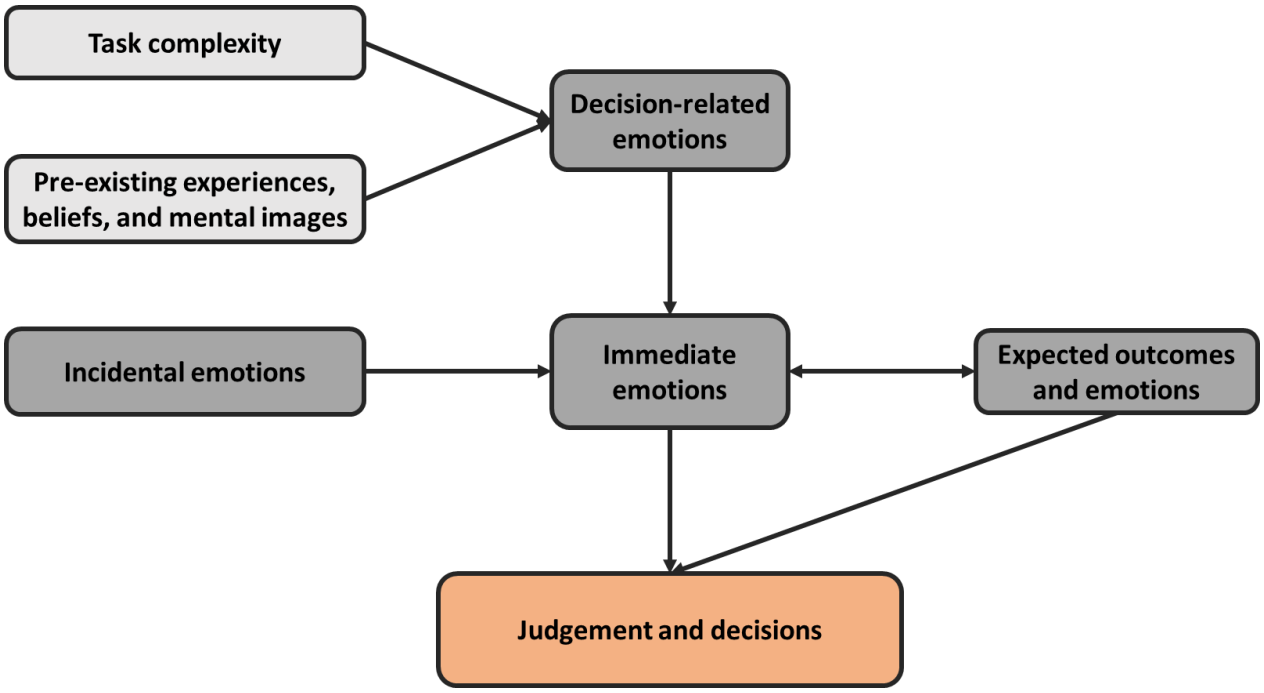
Integrating the aforementioned theories/findings (i.e., traditional theories of emotions, valence-based theories of emotions, and cognitive appraisal theories of emotions), we will continue this review by focusing on the role of emotions on *health decisions*, in the following.

2.5 Role of emotions in health decisions

As we explained in the previous sections, recent research has revealed that the role of emotions in decision-making is not limited to the role of expected/anticipated emotions in the evaluation of utility, but that emotions experienced at the time of decision-making also have a significant role in how choices are perceived, processed, and acted on.

Figure 2-5 integrates various research findings (e.g., (Lerner et al., 2015; Loewenstein & Lerner, 2003) to demonstrate how emotions can influence judgments and decisions. As displayed in Figure 2-5, judgement and decisions not only are influenced by expected emotions, but also are influenced by immediate emotions (emotions that are felt/experienced at the time of decision-making). In the following, we review highlights of advances in the role of expected emotions on judgement and decision-making beyond just the expected utility model and provide examples of how they can be utilized in health interventions; and then, we demonstrate the factors affecting immediate emotions including expected outcomes, decision related emotions and incidental emotions. Subsequently, we explain how immediate emotions can influence judgement and decision-making, in more detail.

Figure 2-5 Emotional factors influencing judgement and decision-making



Note. This diagram is derived from several works including the work done by Lerner et al., (2007) & Loewenstein & Lerner (2003)

2.5.1 Expected emotions

As mentioned earlier, until the last four decades, the role of expected emotions in consequentialist models of decision-making was limited to the comparison of choices with regards to their emotional utility. For instance, an individual would make a choice that would minimize/maximize the *expected/anticipated* negative/positive emotions. However, recent research has shown that expected emotions can affect the *decision-making process*, as well. In the following, we present several prominent findings that show how expected emotions impact judgement and decisions beyond the role of emotions in the expected utility model (Schoemaker, 1982), and discuss the implications of these findings in health promotion.

2.5.1.1 Incremental feelings of losses and gains

Previous theories on the role of expected emotions on decisions assumed that what people consider when making a decision is their anticipated overall emotional state after all the consequences of a decision have already happened. However, recent findings show that when people evaluate the consequences of their decisions, they do not only think about their overall feelings after the consequences of a decision happen, but they also consider the incremental types of emotions that they expect to experience as a result of making the decision (Loewenstein & Lerner, 2003)(Loewenstein, George F. et al., 2001). For instance, a person who is making a decision about whether to do *regular* exercise would not just think about the final emotional outcomes that one would experience *after* doing exercise for a period of time, but they would also consider the emotional utility (i.e., emotional loss vs. emotional gains) they experience during and after *each* exercise session (i.e., the incremental positive or negative feelings one expects to experience after each session). If the expected incremental positive emotions (e.g., experiencing the feeling of pain or shame in the gym) is more than the expected incremental negative emotions (e.g., experiencing the feeling of joy or competence in the gym), then one is more likely to do regular exercise, or vice versa. One of the ways to understand why people do not continue their health-related plans (e.g., dieting, regular checkups, treatment plans, etc.) is to gain an insight about how they expect to feel *during* the plan, as opposed to just considering their overall expected emotion after a health plan is done (i.e., understanding the perceived incremental positive/negative emotions). Understanding the effect of the perceived incremental loss and gains has important implications in medical decision-making, as well. For instance, patients with cancer who want to choose between various treatment options with different degrees of side effects and efficacy, would not only consider *the overall* expected health status and emotions as a result of a given treatment, but also would take the incremental pain, side effects, and negative/positive feelings one may experience during the treatment into account when making a treatment choice. Research has shown that incorporating these findings can provide a stronger explanatory power in the prediction of health behavior; and therefore, this new insight should be considered when designing health interventions. (Keer et al., 2010a; Keer et al., 2010b; Ortony et al., 1990; Tiedens & Linton, 2001; Weiner, 1986; Zeelenberg et al., 2000).

2.5.1.2 Counterfactual comparison

Another recent finding regarding the role of expected emotions in decision-making is that not solely the expected emotions associated with a specific choice that affect the decisions, but also the counterfactual comparisons *between* the expected emotions of each choice that affect how the choices are evaluated. People make a counterfactual comparison between the expected emotions associated with various choice alternatives to make a decision (Mellers et al., 1997). The way people expect to feel about the outcomes of a choice is dependent on how they feel about the outcomes of the alternative choices. For instance, people may feel more positive about undergoing a treatment that results in a 50% chance of survival with no side effects if the alternative is another treatment with a chance of 50% survival with severe side effects. However, people may not feel as positive about the first treatment if the alternative treatment has 70% chance of survival with severe side effects. So, the choices that one is presented with affect how one *feels* about the outcomes of each choice. Understanding these findings can help with designing more effective health communication methods in various health contexts. As far as we know, there is little research investigating how these findings may be utilized in medical/health decision-making to minimize framing biases or to promote more informed health decisions. A possible future direction could be to explore how these findings can be applied in health promotion, health communication, or medical decision-making to better understand how counterfactual alternatives may influence people's health decisions.

2.5.1.3 Expected self-image

A series of studies published in the past few years suggests that people consider how their decision outcomes impact the way they *feel* about *themselves* with regards to being a competent and intelligent person (Loomes & Sugden, 1987; Zeelenberg, 1999). Health promotion research has identified a similar concept called expected social image that affects one's health-related decisions. For instance, there are numerus studies investigating the role of expected social image in adolescents' risky behavior (e.g., (Gardner & Steinberg, 2005; Maggs et al., 1995) or research investigating the role of masculinity (as an expected social image) on various health behavior (Courtenay, 1998). However, new findings in the field of emotions and decision-making have shown that it is not only one's perceived social image that influences their decisions, but also how one internally feels about themselves after making a choice. That is, people like to make choices that make them feel competent and intelligent. For instance, the

decision to adhere to breast cancer screening guidelines may make one feel like an intelligent person who is committed to self-care, but at the same time it may make one feel old and vulnerable. Or for instance, when parents make health-related decisions for their children, they not only do think about the consequences of their decisions, but also, they would consider how they would feel about *themselves* as a parent as a result of the decisions they make (Hoelzl & Loewenstein, 2005; Ross, 1998; Zikmund-Fisher et al., 2006). The overall feelings one experiences about him/her-self as a result of making a choice can significantly affect their decisions. This finding has critical implications when it comes to health promotion. Understanding that we should address/take into account how people would *feel about themselves* as a result of engaging in a health behavior can greatly contribute to the design of more effective health interventions. A potential future direction could be to further explore the implications of these findings in various health contexts with the intention to inform more effective health intervention/communication.

2.5.1.4 Expected regret

Of all the emotions that one may expect to experience as a result of making a decision, expected regret and disappointment seem to play a more critical role. These emotions are identified as the expected emotions that people usually try to minimize when making a decision (Loewenstein & Lerner, 2003; Loomes & Sugden, 1987; Zeelenberg et al., 2000). Specifically, the effect of regret on decision-making is very systematic and robust, when the possibility of regret is highly salient to decision makers (Loewenstein & Lerner, 2003; Loomes & Sugden, 1987; Zeelenberg, 1999; Zeelenberg et al., 2000; Zikmund-Fisher et al., 2006); that is, if the expected perceived regret is high for a particular choice, that choice is very unlikely to be selected. For instance, if the expected regret of vaccination seems to be more salient (e.g., through the constant exposure to different sources of information), compared to the expected regret of not vaccinating, then it is very likely that the decision maker chooses not to vaccinate. Therefore, considering the role of expected regret on health decisions is crucial in developing effective health interventions that intend to promote certain health decisions where regret is relevant. That is, health promoters can utilize these findings in designing more effective health interventions in which they provoke/mediate the anticipated regret in the target audience in order to discourage/encourage certain health choices.

2.5.1.5 Forecasting future emotions

Another important finding regarding the role of expected emotions in decision-making is "affective forecasting". It is a widely studied phenomenon that people are not good at remembering past emotions or forecasting future emotions (Gilbert et al., 1998; Halpern & Arnold, 2008; Loewenstein, George, 1996; Loewenstein, George et al., 2003). Emotions that are the result of going through an experience have unique characteristics that are not available to a person who is not going through the exact experience (Loewenstein, 1996). A considerable amount of research has shown that people make systematic errors when forecasting their future emotions (Loewenstein, George & Schkade, 1999; Loewenstein et al., 2003). Two sources of misprediction error in people come from: 1- undermining their power of adaptation to both favorable and unfavorable situations (Loewenstein & Schkade, 1999) and 2- the tendency to exaggerate the emotions related to a situation that is more salient at the time of decision-making (Loewenstein et al., 2003). Affective forecasting error can play a crucial role when it comes to health decisions. Particularly, affective forecasting error becomes very important when patients make critical health-decisions based on how they *expect to feel* about the outcomes of various health alternatives. According to (Loewenstein & Lerner, 2003)the reason behind forecasting errors usually is derived from two reasons, 1- people undermine their power of emotional adaptation to new circumstances (Gilbert et al., 1998), and 2- they exaggerate their current emotions induced by focusing on a particular outcome (Wilson et al., 2000). For instance, Halpern and Arnold (2008) discussed several cases in which patients preferred death over leg amputations because they could not imagine living without a leg, while ignoring their emotional/physical adaptation ability to the new situation. In another study, (Sieff et al., 1999) investigated the accuracy of participants' prediction of how they would react regarding HIV testing. The results suggested that people anticipate more/less distress given a positive/negative result than they *actually* experience after being informed about the results. The overestimation of distress following a positive HIV test result can significantly influence people's intention to get tested.

On the other hand, there is research showing that some people discount or underestimate the intensity of their future emotions, and so make riskier or less flexible decisions that they cannot adhere to, when the time comes (Loewenstein & Schkade, 1999; Slevin et al., 1988; Slovic, Paul Ed, 2000) . That is, as the time of an event gets closer one may experience more intense emotions regarding the decisions that they made in the past (that they could not predict), and so they cannot follow through

with their decisions. For instance, one may decide to go through a surgery or speak in public, but when the time arrives one may experience various intense emotions that lead them to not follow through with what they had decided to do. Understanding this phenomenon can inform designing more effective health interventions/policies to help people make more informed decisions that they can adhere to.

Moreover, research evidence shows that at the time of decision-making, the perceived control over the consequences is higher compared to when the decision is made; and therefore, the decisions are usually influenced by a falsely presented sense of control over the outcomes (Johnson & Tversky, 1984; Seligman & Maier, 1967). For instance, several studies in the domain of vaccination suggest that the false perception of a higher-level control over the complications of various viral infections has a significant role in the rejection of vaccines (Brewer et al., 2007; Prislin, Dyei, Blakely, & Johnson, 1998).

In general, gaining an insight about the potential inaccuracy of expected future emotions can inform the design of more effective health interventions/policies. Therefore, an important future research direction would be to investigate the degree to which these forecasting errors can influence various health decisions and investigate ways to mediate their effects.

2.5.1.6 The difference in the expected emotions in near and future outcomes

The recognition of the difference between how people feel about/perceive the details and the utility of near vs. future outcomes is another important finding that changed the way consequentialist models viewed decision-making (Loewenstein, George & Prelec, 1992; Trope & Liberman, 2010). The way people feel about the consequences of a near future outcome is different from the way they feel about it if the same outcome happens later in the future. The far future outcomes (whether positive or negative) are usually discounted to some degree compared to the near future outcomes. For instance, an unhealthy behavior that results in experiencing negative consequences in the near future is more likely to be avoided than an unhealthy behavior whose negative outcomes will be experienced in the far future. People are very likely to perceive the near future outcomes as more severe; while the perception of the severity of the far future outcomes is more likely to be discounted. Similarly, people are more motivated to engage in a behavior whose positive outcomes are expected to be experienced in *near* future as opposed to engaging in a behavior where positive outcomes will be experienced in the *far* future. Therefore, in order to encourage/discourage people to engage in a behavior, it is helpful to

communicate about both the near and future outcomes. For instance, in order to motivate people to do more exercise, it may be more compelling to also emphasize the positive outcomes that one may experience during and right after exercising (near future outcomes) as opposed to just talking about the long-term benefits one gains by doing regular exercise.

It is not only the temporal distance from the consequences that influences how the consequences are perceived; but, according to construal level theory, the way options and events are constructed in one's mind depends on their psychological distance which includes temporal, spatial, social, and certainty-level distance from those options or events (Trope & Liberman, 2010). More specifically, construal level theory suggests that the same information about an option is more likely to be perceived in terms of its superordinate features rather than its subordinate features when the event or option is psychologically distant than near. Subsequently, health information can be communicated in a high-level format (e.g., this behavior significantly increases your chances of having different types of cancer) or can be presented with low levels of details (e.g., this behavior results in increasing your chance of bowel cancer by 60% and lung cancer by 70%). Although applications of construal level theory in health promotion/communication have been investigated in recent years (Achar et al., 2020; Ahn, 2015; Carrera et al., 2014; Kim et al., 2016; Lee, 2019; Lutchyn & Yzer, 2011; Park & Morton, 2015; Young, 2015), as far as we know, the applications of this theory are still underutilized/under-investigated in health interventions concerning medical decision-making and preventative behaviors.

2.5.1.7 Expected risk

Another significant theoretical breakthrough in decision-making, which is not directly related to expected emotions but rather directly impacts the expected emotions, is the recognition of how people perceive the probability of various outcomes of choice alternatives. This section serves as an introduction on the interaction of risk perception and emotions, which we will further discuss in this review.

Although traditional models of decision-making (i.e., the expected utility models) assumed that people consider the raw probability of various outcomes when making decisions, recent research shows that people follow a non-linear probability weighting function when assessing the chances of various outcomes occurring (Tversky & Kahneman, 1992). More specifically, the framework proposed by Kahneman and Tversky (1979) suggests that: 1- people overweight small probabilities, 2- underweight

moderate and high probabilities, and 3- are less sensitive to variations of probability in the mid-range. Understanding how people perceive and feel about small, midrange, and large probabilities, and in general risks, can be critical in effective health and risk communication. For instance, it is important to consider that a person who is told that there is a 2% chance of side effects associated with a particular health choice (e.g., a vaccine or a cancer treatment option) would overestimate the chances of the side effects occurring; hence, when the expected risk is perceived as higher, the audience would be more likely to be scared of engaging in the recommended behavior. Again, although this cognitive bias has been appreciated in health promotion research (e.g., (Rothman & Salovey, 1997; Schwartz et al., 2008; Winter et al., 2003), there is still a lot of room to investigate the systematic effect of this cognitive bias in health and risk communication, in various health domains, with the intention to inform more effective health communication.

2.5.2 Immediate emotions

As previously explained, immediate emotions are the emotions that are experienced *at the time of decision-making*. These emotions play a significant role in how information/choices are perceived, processed/appraised, and acted upon. In the following, we explain how immediate emotions are triggered/induced, and then explain how immediate emotions can affect health decisions.

2.5.2.1 Factors affecting immediate emotions

As displayed in Figure 2-5, immediate emotions can be triggered/induced by: 1- the thought of expected emotions/outcomes, 2- decision-related emotions, and 3 carried over incidental emotions. In the following, we explain these factors, in more details.

2.5.2.1.1 Expected emotions/outcomes

As illustrated in Figure 2-5, immediate emotions can be influenced by the thought of expected emotions. Immediate emotions are different in nature from expected emotions since they are experienced at the time of decision-making; however, as illustrated in Figure 2-5, immediate emotions can be influenced by the thought of expected emotions. Thinking about expected emotions can induce similar emotion or different types of emotion, at the time of decision-making. For instance, thinking about expected joy can induce joy at the time of decision-making, while thinking about potential regret in the future may make a person feel anxious at the time of decision-making (but not regretful). The

two-way relationship between immediate emotions and expected emotions indicates that immediate emotions and expected emotions influence each other. Thinking about the expected outcomes/emotions can induce certain emotions at the time of decision-making, and these induced emotions can then influence how both the *current* information (choices) and the *future* outcomes are perceived and processed. For instance, a person who is choosing between different cancer treatments associated with differing degrees of efficacy and side effects may feel sad, anxious, scared, hopeful, etc. while thinking about certain treatment outcomes. Then these emotions can also affect how the choice alternatives are perceived and appraised. We will elaborate more on how immediate emotions affect the judgement and decision later in this review.

2.5.2.1.2 Decision-related emotions:

Decision related emotions are decisions that are induced during making a decision either because of the complexity of decision-making, or because of pre-existing experiences, beliefs, and mental images that may be evoked during the decision-making process:

Task complexity: As depicted in Figure 2-5, the task of decision-making itself can induce various decision-related emotions. For instance, (Luce et al., 1999)'s work showed that negative emotions can be induced as a result of going through voluminous and complex information. They showed that making a decision between conflicting choices (e.g., making treatment choices that involves making a choice between the quality or longevity of life) would provoke negative emotions (e.g., anxiety). These negative emotions would result in a relatively negative evaluation of choice alternatives. Additionally, voluminous and complex information not only provokes negative emotions, but also can result in a heuristic evaluation of choice alternatives, as opposed to a rational evaluation in which one precisely considers all the alternatives and their consequences. Therefore, it is very important in health settings, to recognize that providing information in complex/voluminous formats can negatively impact the audience's emotional states and ultimately influence their capacity for cognitive processing of the information. For instance, the format of some medical test reports (e.g., blood test) or the way health information is communicated by doctors should be *easy* to understand, so that patients do not experience negative emotions (e.g., anxiety, or embarrassment) that can negatively impact subsequent judgements and decisions. The recognition of the mechanisms through which emotions can negatively affect judgement and decisions can inform the design of more effective interventions that can mitigate

the unwanted negative effect of emotions on health decisions. For instance, (Schwarz & Clore, 1983)work showed that the effect of negative emotions on the evaluation process can be mitigated by helping the decision makers to attribute the negative emotions to their *real* source, which can be unrelated to the decision at hand. For instance, by attributing one's negative emotions to the complexity of the decision-making task, one can dampen the effect of the unwanted emotions on his/her decisions. That is, a patient can be helped through counseling sessions or other means to navigate their emotions and understand the real source of the frustration or anxiety that they experience. In this way the effect of anxiety or frustration on decision-making can be mitigated.

Pre-existing experiences, beliefs, and mental images: As depicted in Figure 2-5, another factor affecting decision-related emotions is the associations/links the decision makers make between the current information/situation and previous beliefs or experiences, either consciously or subconsciously. A set of choice alternatives or the way the problem is framed may remind the decision makers of their previous experiences or beliefs which may induce certain emotions in them. For instance, providing a person with choices, some of which may contradict his/her religious beliefs, may induce certain emotions that can ultimately impact the judgement of choice alternatives. In another example, having to make decisions about treatment plans may remind a person about previous difficult experiences and provoke unwanted emotions that influence their judgement and decisions. Again, designing interventions with the intention to help patients recognizing the source of their emotions and enabling them to differentiate, navigate, and understand their emotions can mitigate the unwanted effect of emotions on health decisions.

Additionally, the target audience may associate health messages with certain mental images in their minds. Mental images are shown to be quite powerful in triggering certain emotions and driving one's behavior. Affective images have been shown to be good predictors of individuals' decisions regarding taking part in health-promoting or health-threatening behaviors (Peters & Slovic, 1996; Peters & Slovic, 2000). Existing mental images that people have about certain subjects are highly powerful in inducing emotions which can ultimately encourage or discourage people to engage in certain behaviors. Several studies have shown the impact of mental images on health decisions (Gibbons et al., 1991; Gibbons et al., 2005; Peters & Slovic, 1996). For instance, a series of studies demonstrated that by reducing the favorability of the image of a typical person who sunbathes or uses a tanning booth, the

willingness of being exposed to UV ways was reduced for people in the beach (Gibbons et al., 2005). In another similar study, researchers studied the role of mental images in changing sun protection behaviors among male road maintenance crews who are constantly exposed to sun and so have a higher risk of developing sun-related skin problems. The findings showed that affective mental images of men who use sunscreen were relatively negative among the target group (i.e., not very masculine or self-confident) (Gerrard et al., 2008). An increase in the perceived favorability of this affective image created by a health intervention resulted in a significant change in the target audience's self-reported UV protection and their skin tone (measured with spectrophotometry) at a one-year follow-up (Gerrard et al., 2008). Indeed, changing the mental image associated with the advised health behavior resulted in experiencing positive emotions, that then impacted how the target behavior (i.e., using sunscreen) was evaluated. In another study, an intervention encouraged the adults who were trying to quit smoking to engage in a gradual creation of a new mental image in which they distanced themselves from the smoker image over time. Subsequently, the change in the mental image of a smoker significantly contributed to the process of quitting smoking (Gibbons et al., 1991).

In short, changing the target audience's affective mental image can change their decision-related emotions and ultimately result in making different decisions. Although the importance of mental images is prominent in health-decisions, there is little work investigating the ways in which mental images can be changed to nudge the target audience's behavior. An important future research direction could be to investigate how to create/distort mental images, in order to contribute to better health decisions.

2.5.2.1.3 Incidental emotions

Incidental emotions are the emotions that are experienced at the time of decision-making but are not related to the decision at hand. In other words, incidental emotions are the emotions that are induced by external triggers not related to the decision-making process. Although incidental emotions are carried over from external sources, they can still influence the process of judgement and decision-making (Worthy et al., 2014). For instance, a happy person who just had a great conversation with a friend and a sad person who just heard bad news are likely to make different inferences/judgments about the risk of playing a gamble (although their emotions are not related to the gamble). More specifically, although incidental emotions are not induced by the process of decision-making, they can distort how an individual receives and decodes information and ultimately affect how they make

decisions. The way incidental emotions affect the decision-making process, both directly and indirectly, is very similar to decision-related emotions. There have been numerous studies showing how incidental emotions that are irrelevant to the decision at hand affect the decision-making process (e.g., Loewenstein, Hsee, Weber, & Welch, 2001; Loewenstein & Lerner, 2003; (Pham, 1998). It is shown that people usually are not good at differentiating between their incidental emotions and the decision-related emotions; therefore, no matter what the source of their emotions is, the emotions one experiences at the time of decision-making can influence the decision-making process. For instance, (Raghunathan & Pham, 1999) found that in choices between a high risk/high reward option and a low risk/low reward option, sad individuals are significantly more likely to choose the high risk/high reward option while anxious individuals were more likely to choose the low risk/low reward option. This pattern of choice selection was consistent even when the sadness and the anxiety were purely incidental.

Incidental emotions can be carried over from what happened before one is presented with choice alternatives or can be provoked by the environment in which one is making a decision. For instance, a person who is in a stressful environment (e.g., heavy and noisy traffic or an emergency room) may feel anxious or stressed; and therefore, his/her decisions are likely to be affected by the incidental emotions imposed by the environment.

It is important to note that not all incidental emotions affect decisions, but they are more likely to influence the decisions to which the emotions are relevant (e.g., see (Loewenstein & Lerner, 2003). For instance, one's positive emotions would probably affect what movie they choose to watch; however, they do not affect which statistical test they choose to run on a set of data. Having said that, recent studies show that the relevance of an emotion towards a subject can be manipulated. For instance, one study found that participants' emotions influenced their decisions about whether to watch a movie when the instruction emphasized the benefits they get from *relaxing* at the movie and not when the instruction emphasized the benefit of *learning* new things by watching the movie (Pham, 1998).

In conclusion, unlike decision-related emotions which are induced by factors related to the decision-making process (e.g., information presentation, choice alternatives, evaluation process, previous experiences, etc.), and so are more difficult to transform, incidental emotions are easier to change, since they are caused by external factors. External factors such as music, an affective short clip, images, or narratives, etc., can be utilized to prime the audience with appropriate/persuasive emotions

with the intention to influence/nudge their decisions. Research in marketing and advertisement has significantly exploited incidental emotions to influence consumers' behaviors. For instance, (Leonard, 2008) discusses that affect-poor representation of a subject (e.g., foods) promotes greater patience and ability to delay gratification, while affect-rich representation of the same subject promotes impatience; and subsequently, promotes heuristic processing which results in hedonic decisions-making. Indeed, advertisement industry usually present affective-rich presentations of certain products to trigger heuristic and quick processing when they do not want their potential customers to pay attention to details. For instance, it is very common to see that a happy/proud/cool/etc. person/family/group/etc. is the opening to the introduction of a product/service/etc. in order to increase the product's favorability. Similarly, incidental emotions can be greatly utilized in health promotion/intervention to influence health behaviors. In recent years, the utilization of emotions and affect in health policies and interventions are more prevalent (Ferrer et al., 2016). For instance, the use of affective images that induce disgust or fear on cigarette packages has been shown to be an effective strategy that influences smoking behavior (Hammond, 2011; Leonard, 2008).

In the following, we highlight relevant research regarding how immediate emotions can affect judgement and decision-making, in more detail.

2.5.2.2 How do immediate emotions affect judgement and decision-making?

As mentioned previously, this review discusses the effect of immediate emotions on subsequent judgement and decision through the lens of the Appraisal Tendency Framework (ATF). The reason for choosing the ATF to explain how emotions affect judgement and decision-making is due to its multi-dimensional view of emotions beyond just valence and arousal dimensions, and that it can provide a strong explanatory power for how emotions affect judgment and decisions. The ATF has three main assumptions: 1- The difference between emotional experiences is the result of the difference between a discrete set of cognitive dimensions that triggered them, 2- Any discrete emotion (e.g., sadness, anger, or happiness) can trigger a set of associated responses such as physiological, perceptual, behavioral, experiential and communication tendencies that enable an individual to respond to the environment, and 3- Emotions have motivational tendencies that depend on their intensity and core appraisals (Lerner & Keltner, 2000; Lerner et al., 2007). In other words, the ATF suggests that each discrete emotion activates a cognitive predisposition to appraise a target in line with the central-appraisal

dimensions that triggered the emotion. According to ATF (Lerner et al., 2007), immediate emotions affect the decision-making process through four main ways: namely, 1-shaping the narrative and meanings (i.e., content of thought), 2- depth of information processing, 3- perception of risk, and 4-valuation and choice (i.e., motivational tendencies). In the following, we will explain these ways in more details.

2.5.2.2.1 Shaping the narrative and meanings of events

According to ATF, emotions' core appraisal dimensions affect the content of thought and how an event is perceived in one's view. For instance, (Keltner et al., 1993) showed that the effect of sadness and anger are different on the judgement of blame. Although sadness and anger are both high in the appraisal dimension of control, sadness co-occurs with the appraisal of *situational* control while anger activates perceived *personal* control. Therefore, sad people are more likely to blame the situation while angry individuals are more likely to blame others, when an unforeseen event happens. In a similar work, a study that intended to understand how Americans perceive the 9/11 attack, a national representation of American people was randomly assigned to two random conditions, in which some participants read real news that intended to provoke fear, while some read real news that intended to provoke anger. The participants were then asked about their risk preferences and associated policies. The results showed that angry individuals (high on the certainty appraisal dimension) perceived lower risk in the world, whereas, individuals who were primed by fearful news (low on the certainty appraisal dimension) perceived a higher threat in the world (Lerner et al. 2003). That means the emotions we experience can actually alter the narrative in our mind as to why certain outcomes have happened and what to expect.

Gaining an insight about how emotions can shape narratives and content of thoughts can shed light on how to navigate health communication, in an effective way. For instance, experiencing anxiety (associated with low certainty and personal control) by a patient may lead them to perceive an upcoming surgery as riskier than it is. So, by understanding the effect of anxiety on judgement and decisions, health care providers can help an anxious patient who is making a decision about whether to undergo a risky but critical surgery make a less biased decision. As such, it is significantly important to understand the extent to which various emotions can affect health decisions and to develop appropriate communication methods, procedures, and policies to mitigate the unwanted effects of emotions on health decisions.

2.5.2.2.2 Depth of information processing

The type and the intensity of emotions can affect a person's ability to process information. In the following, we will discuss these factors in more details:

Types of emotions: According to ATF, certainty and appraisal dimensions associated with emotions can affect the information processing method. That is, emotions higher on the certainty and control appraisals can lead to a more heuristic processing of information as opposed to a systemic/logical processing of information and vice versa. For instance, emotions such as anger and happiness which are higher on the certainty/control appraisal are more likely to lead to a heuristic processing of information while emotions that are lower on the certainty/control appraisal such as fear are more likely to lead to a more systemic processing of information with more attention to details (Lerner et al., 2007; Lerner et al., 2015; Loewenstein & Lerner, 2003).

Intensity of emotions: While low and moderate levels of emotion intensity mostly play an advisory role in forming a judgement, higher levels of emotion intensity can exert an ever-increasing influence on one's judgement and behavior by overwhelming one's cognitive processing (Loewenstein, 1996). So, experiencing intense emotions can hinder one's ability to make rational and informed decisions.

Therefore, it is crucial for health providers/promoters to recognize how emotions may impair one's judgement. Understanding these mechanisms helps with developing more effective interventions/policies to help people make less biased health-decisions. For instance, nowadays, the idea of patient centered care, and in particular, the idea of involving patients in clinical decisions, has received ample attention (Bertakis & Azari, 2011; Epstein & Street, 2011; Oates et al., 2000). However, there is little work around how difficult emotions/situations that patients may experience can influence the quality of their decisions. The intensity of emotions such as anxiety, stress, anger, etc., which are expected to be experienced by patients, may overwhelm their cognitive processing power and impair sound judgement. It is critical for healthcare providers to understand the effects of these emotions on patient's decisions, so that they can provide appropriate emotional regulation supports to help patients make less biased decisions.

2.5.2.2.3 Risk perception

Research shows that risk perception or the judgement about the probability of various outcomes can greatly be influenced by emotions (Lerner & Keltner, 2001; Lerner et al., 2015), so it is critical to understand how emotions affect risk perception in health contexts. Research shows that uncertainty about the outcomes and the perceived control over the potential negative outcomes play important roles in the perception of risks (Slovic, 2000). Consistent with these findings, research has shown that emotions which are characterized by the appraisal dimensions of certainty and control can influence risk perception (Lerner & Keltner, 2001). Research investigating the role of emotions on risk perception has consistent findings suggesting that anger, happiness, and fear can systematically affect risk perception. According to appraisal theories of emotions (Lerner & Keltner, 2001), anger and happiness are both high on the certainty and control appraisal dimensions, whereas fear is low on both the certainty and control appraisal dimensions. People experiencing anger or happiness are more likely to be more optimistic about the outcomes since they are prompted to perceive the uncertainty to be lower and also are more likely to have a higher perceived control over the outcomes. On the other hand, people experiencing fear are cognitively predisposed to feel more uncertain and have a lower perceived control over the possible negative outcomes. Hence, they are more likely to be pessimistic and more conservative when it comes to judgements and decisions about risky options (Lerner & Keltner, 2001).

Health communication research has built on these findings to explore how emotional states affect the persuasiveness of messages containing risk information. Research has shown that individuals respond differently to loss vs. gain framed messages, and that these differences can be increased/mitigated by emotional states (e.g., (DeSteno et al., 2004; Wegener et al., 1994). Consistent with this prediction, in a recent example (Gerend & Maner, 2011) studied the effect of emotions on the effectiveness of loss vs. gain framed nutritional messages regarding fruits and vegetable consumption and showed that fearful individuals are more persuaded by loss-framed messages while angry individuals are more likely to be persuaded by gain-framed messages. According to the ATF, decisions that are associated with high-risk/high reward (i.e., high risk of side effects and high reward of the efficacy of the treatment) would be facilitated/hinder by anger/fear (Ferrer et al., 2016). Also, in situations where the risk of a disease is salient, the detection/screening decisions are likely to be facilitated by fear and hindered by anger (Ferrer et al., 2016). Given that most health decisions are somehow involved in risk perception and judgement (e.g., the risk of not following a healthy diet, risk of smoking, or risk of choosing a treatment with possible side effects, perceived risk associated with an unhealthy behavior, etc.),

understanding how emotional states can influence risk decisions in health contexts can significantly contribute to the design of more effective health policies and interventions. Furthermore, although the effect of certain emotions such as fear, anger, and happiness on the perception of risk have been studied in several health contexts (Ferrer et al., 2016; Gerend & Maner, 2011; Hammond, 2011; Keer et al., 2010), there is not as much research on the effect of other emotions such as pride, surprise, shame, guilt, etc. on the perception of risk, especially in health settings. A possible future direction would be to further investigate how various discrete emotions can affect the perception of risk in more realistic and complex health decisions.

2.5.2.2.4 Valuation and choice

Emotions affect how we value different choices/options. The effect of emotions on the valuation of options is more prominent in intertemporal choices (i.e., choices between lower but immediate rewards vs. higher but delayed rewards). Research has shown that people tend to discount the value of future health benefits compared to immediate rewards (Chapman, 1996). Many health decisions are related to intertemporal evaluations. For instance, an individual may value the immediate gratification of unhealthy delicious foods, drinking alcohol, or smoking cigarettes more than the delayed health benefits that comes from avoiding these behaviors. This cognitive biased (i.e., temporal discounting) tends to be significantly influenced by emotions. The appraisal tendency framework suggests that the core appraisal theme associated with an emotion drives certain action /motivational tendencies. For instance, sadness is associated with the core appraisal theme of an irrevocable loss, and so sad individuals are more likely/motivated to take actions to compensate the perceived loss (i.e., to show reward seeking behavior). Consistent with the ATF prediction, several studies have shown that sad individuals value immediate gratification more than delayed benefits (Lerner et al., 2013), compared to anxious individuals (Raghunathan & Pham, 1999), happy individuals (Chuang & Lin, 2007), or disgusted individuals (Cryder et al., 2008; Han et al., 2010; Han et al., 2012; Lerner et al., 2004). For instance, in the context of food choices, sadness which is associated with high valuation/high reward-seeking behavior would lead to more consumption of hedonic foods while disgust, which is more characterized by disposal and hesitancy tendencies, or happiness, which is already high on the pleasantness appraisal and does not encourage immediate compensation, would lead to less consumption of hedonic foods (Garg et al., 2007; Garg & Lerner, 2013; Wansink et al., 2003).

Emotions can affect other health decisions that involve intertemporal valuation and reward seeking such as drinking alcohol or smoking, as well. For instance, (Reyna & Farley, 2006) showed that sadness increases negative health behaviors specially among adolescents and young adults who prioritize immediate gratification over delayed benefits. Another common example of how emotions are utilized to influence health choices is the use of disgusting/scary images on cigarette labels (Hammond et al., 2004; Hammond, 2011). The use of disgusting or scary images on cigarette labels, which can delay the tendency for immediate gratification, decreases the tendency to smoke cigarettes. Although, recent work posits that when designing/picking an image to provoke certain emotions, it is important to consider all the emotions that the target image can potentially provoke. For instance, the image of a dying person on a cigarette package, that is intended to provoke fear, can also induce *sadness* along with fear, which can potentially increase the tendency for immediate gratification.

Up until now, we discussed how the emotions experienced at the time of decision-making can influence judgement and decisions. Indeed, the role of emotions on health decisions is now very evident in the literature; therefore, health promotors should carefully study their audience and how various emotions may influence their health decisions in each specific domain, in order to develop more effective and informed health interventions/policies. In the following, we discuss a few strategies on how to mitigate the unwanted effect of immediate emotions on decisions.

2.6 How to reduce the unwanted effect of emotions on decisions

It is clear from the literature that emotions can be utilized to positively influence health decisions (e.g., the use of disgust to discourage smoking), but can also negatively affect health decisions (e.g., the effect of sadness on the consumption of hedonic food). The unwanted effect of immediate emotions on health decisions can sometimes be so critical. For instance, (Isen, 2000) showed that negative emotions after a cancer diagnosis can lead to avoidance to make a decision and cause a delay in going through treatment. Depending on the type and the severity of the unwanted effects of emotions, (Lerner et al., 2015) proposed four general strategies that can be employed to reduce the unwanted impact of emotions:

1. Asking the decision maker to explain why he/she has made a particular choice (or no choice at all). It is shown that making a person to review/analyze the reasons for making a choice cognitivizes one's decision-making process and reduces the impact of emotions on decisions

(Wilson et al., 1993). This can be practiced by providing patients who are likely to experience negative emotions with counseling sessions in which they can regulate their emotions and make more rational and less biased decisions.

2. Reappraisal of emotions is another strategy that reduces the unwanted effects of emotions. Reappraisal of emotions is done through changing one's perception/attitude about what has happened which consequently leads to experiencing different emotions. In other words, reappraisal of emotions is about changing how one sees and interprets an event so that they feel different emotions looking back at what has happened (Gross, 2002). For instance, one could see a job layoff as an unfortunate event or an opportunity to seek for better jobs (Gross, 1998; Gross, 2002). Similarly, an example in health settings could be to nudge an audience to see a health problem caused by an unhealthy diet/behavior as an opportunity to not only fix the current problem but also helping to prevent potential future health problems. In another example, Pitts et al., (1996) showed that the shame associated with sexual behavior prevents many patients from seeking medical help. In this case, understanding how patients may feel and *normalizing* it for them may mitigate their feeling of shame and its negative consequences on the subsequent health decisions. Hence, having effective communication methods in which the target audience can adopt new perspectives about their current health problems, and as such experiencing different types of emotions, can greatly help with mitigating the negative effects of their emotions.

3. Time delay is another strategy that can mitigate the unwanted effects of immediate emotions. Several studies have shown that a time delay of 10 minutes or more can reduce the unwanted effects of immediate emotions on decisions (Gneezy et al., 2014; Morewedge et al., 2005). Given the context, this strategy can be practical and cost-effective. For instance, a patient who has just received a positive cancer/HIV/etc. test results should be given enough time to process their emotions, before discussing medical information and having them make critical health/treatment decisions.

4. Inducing an opposing emotion is another strategy that can be utilized to dampen the negative effects of unwanted immediate emotions. For instance, as previously discussed, sadness increases the tendency for immediate gratification (Raghunathan & Pham, 1999). Perhaps by

inducing happiness, through playing a happy music, having happy images in a clinic, or having a light and happy conversation with a person prior to decision-making, it may be possible to mitigate the negative effect of sadness on their health-related decisions. Of course, utilizing this strategy requires an insightful understanding of emotions that a person experiences and knowing how to induce the opposite emotion in them. So, this strategy is more applicable in certain health settings where certain emotions are more likely to be experienced, so that we can utilize policies/resources to induce the appropriate emotions in the target audience to mitigate the unwanted/negative effect of other emotions.

2.7 Discussion

Considering the significant impact of affective states on judgement and decision-making, we presented a narrative review to highlight the theories/findings regarding the role of emotions on judgement and decisions in behavioral science and discuss how these theories/findings have been or can be applied in health settings. We achieved the research objectives by: 1- Presenting recent findings and theories in behavioral science regarding the role of emotions in judgment and decision-making, in a comprehensive and structured format, and 2- Presenting a broad range of examples and published work that have utilized (or can utilize) these findings/theories in the domain of health decisions/promotion.

Particularly, this review first defined what emotions are and then discussed how the understanding of the effect of emotions on decisions has progressed over the years from a traditional view, in which the role of emotions on judgement and decisions was limited to expected emotions, to more recent theories of emotions that demonstrate how emotions can directly influence judgement and decisions. We reviewed the progression of the understanding of the effect of emotions on judgement and decisions from the valence-based theories of emotions to cognitive appraisal theories of emotions. Subsequently, we demonstrated how expected emotions, decision related emotions, and incidental emotions can affect the immediate emotions experienced at the time of decision-making, and then demonstrated how immediate emotions can impact judgement and decisions, in more details. We particularly discussed how these findings have been applied or can be applied in health contexts.

We understand that narrative reviews may not fully capture the literature with the rigor of systematic reviews, and hence, this study definitely has been affected by the authors' biases in shaping the narrative and conclusions. However, the purpose of a narrative review is to provide the reader with

an overview of the literature with the intention to deepen their understanding of the field and its practical implications, and set the stage for specific research questions.

In closing, although recent research has extensively advanced to fill the gap between behavioral theories of judgement and decision-making and health promotion, particularly during the last decade, we believe the gap is still significant and requires extensive work to make a more concrete bridge between the two fields through which the theories can be tested and applied in health settings. This narrative review can serve as a structured framework that identifies potential future directions in order to create a bridge between the two fields.

Chapter 3

Vaccines and emotions: Investigating how emotions shape vaccination decisions

Abstract

The emergence of vaccines has greatly contributed to the population health. However, in recent years there has been a growth in the vaccine hesitant population. Hence, vaccine promotion research has identified several factors contributing to vaccine hesitancy including overall knowledge about vaccines, subjective norms, affective impressions of vaccine, etc. Although recent research identifies emotions towards vaccines as an important factor that contributes to the uptake of vaccines, there is little research about *how* emotions influence vaccination decisions. As such, this research investigates how affective evaluation of a vaccine influence child vaccination, utilizing the affect-as-information hypothesis and affect heurist model as a lens. The study examines the research question through a survey-based experimental manipulation study (n=368) in which the researcher manipulated the affective impression of a vaccine to understand how affective impressions influences the perception of risks and benefits of a vaccine and the intention to vaccinate. The research findings showed that emotions both directly and indirectly, through a change in the perception of risks and benefits, influence the intention to vaccinate.

3.1 Introduction and background

Vaccines are among many scientific advances that have greatly contributed to population health (Andre et al., 2008). However, in recent years there are growing number of people who are hesitant about vaccination and specifically child vaccination (Dubé et al., 2013). Vaccine hesitancy is a critical area for public health as it can jeopardize population health and even more so with the emergence of new vaccine-preventable diseases. For example, COVID-19 vaccine hesitancy is a current critical public health concern in relation to ending the pandemic. Previous literature has identified several factors affecting vaccination decisions such as the evaluation of risk-benefit of vaccines (Larson et al., 2014; Mostafapour et al., 2019), overall knowledge about vaccines (Collins et al., 2014; Larson et al., 2014), vaccine policies and trust in public health (Larson et al., 2014; Ozawa & Stack, 2013) , past experiences with vaccination (Collins et al., 2014; Costantino et al., 2021), subjective norms (Quinn et al., 2017;

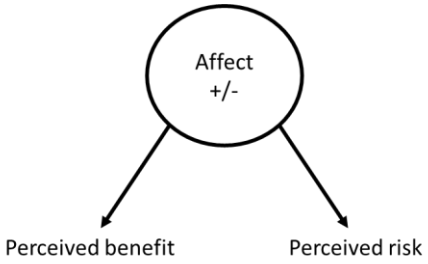
Winter et al., 2021), and demographics of a population (Gilkey et al., 2014; Rozbroj et al., 2018; Sukumaran et al., 2015). Indeed, recent advancement in the area of judgement and decision making indicate the significant role of affect on judgement and decisions (Loewenstein & Lerner, 2003). Along the same lines, research concerning vaccination behavior has identified the significant roles that affective states play in vaccination decisions (e.g., Chapman, 2006; Tsuda & Renee Muis, 2018). However, there is little work that systematically examines how affective impressions of vaccines can influence vaccination decisions. Therefore, this work contributes to the understanding of vaccination decisions by exploring the role of affective reactions to vaccines, on vaccination decisions.

The idea that affect and emotion exert a powerful influence on behavior has received ample attention and support in the decision-making literature (Collins et al., 2014; Ozawa & Stack, 2013; Pham, 1998; Schwarz, 2010a; Slovic & Peters, 2016). However, what was less clear in the literature was *how* emotions influenced decision-making. But recent research shows that emotions have both direct effects on decisions as well as indirect effects through changes in perceptions of risks and benefits (Hussain et al., 2018; Larson et al., 2014; Mostafapour et al., 2019; Quinn et al., 2017; Winter et al., 2021). In a pioneering series of studies, Isen and colleagues (1978) showed that emotions affect how events are perceived and evaluated based on a person's affective state. That is, they showed that emotions influence the decision process by changing a person's beliefs and perspectives about a target through the activation of feeling-consistent cognition (i.e., a cognitive evaluation of a target that is in line with how one feels about the target) (Isen et al., 1978). In simple words, they showed that experiencing positive feelings is interpreted as the evidence of liking and approval, whereas experiencing negative feelings is interpreted as evidence of disliking and disapproval. For instance, if an individual experiences negative emotion towards a potential treatment, this may lead them to perceive that the treatment has a higher risk, and thus be less likely to consent to it. Indeed, subsequent work showed that people often follow a simple analogy when making judgements; that is, the direction and intensity of their emotions towards a target is informed by their immediate response to the *how-do-I-feel-about-it* question (Schwarz, 1990).

The impact of affective states on the perception of risks and benefits have been documented in several domains (e.g., Finucane et al., 2016; Lerner & Keltner, 2001; Pham, 1998). For instance, Finucane et al.'s (2016) studied the effect of affective impressions to various hazardous population-

level activities (e.g., Floridization or making nuclear facilities) on the perception of risks and benefits associated with the activities (Finucane et al., 2016). Consistent with previous theories, the results of their study suggested that positive affective states are linked to perceptions of higher perceived benefits and lower perceived risks, whereas negative affective states are linked to perceptions of lower perceived benefits and higher perceived risks (please see Figure 3-1).

Figure 3-1 Depicting how affective impressions can influence the perceptions of risks and benefits



Note: This figure is borrowed from Finucane et al., (2016)'s work

Considering the advancement in the understanding of the role of affect and emotions on decisions, the number of research studies looking at the effect of emotions on health decisions has significantly increased in recent years (Consedine & Moskowitz, 2007; Ferrer et al., 2015; Gengler, n.d.; Mazzocco et al., 2019). Consequently, recent research concerning vaccination decisions has also explored the role of emotions on vaccination decisions and has confirmed that emotions can significantly influence vaccination intention/behavior (e.g., Chapman, 2006; Featherstone & Zhang, 2020; Tsuda & Renee Muis, 2018). However, what has been less explored in the literature is *how* affects/emotions influence vaccination decisions. Therefore, the present work intends to investigate if previous theories on how emotions affect decisions would apply to child vaccination decisions. That is, to test if the overall affective evaluation of a vaccine may affect the decision to vaccinate both directly and indirectly through changing the perception of the risk and benefit associated with the vaccine.

The current study was part of a larger project; the research questions, reported analyses, and conclusions reached in this article do not overlap with prior published work with this data set (Mostafapour et al., 2019). In order to investigate our research problem, respondents were given a

hypothetical scenario about a disease and its vaccine at the first phase of the study (i.e., time 1) and were asked to state their perceived risks and benefits of the vaccine, their overall affective impression of the vaccine (i.e., how they feel about the vaccine), and their intention to vaccinate their kid. In order to manipulate the respondents' affect, we followed (Finucane et al., 2016)'s method in which they utilized *information provision* to manipulate respondents' affective impressions of several targets (i.e., hazardous activities or technologies such X-rays). Particularly, they provided risk and benefit information to manipulate affective impressions of respondents regarding the targets. Utilizing their method, in the second phase of the study (i.e., time 2), we randomly assigned respondents to one of four different conditions, each providing either risk or benefit information about the vaccine. Each condition was designed to provide information that revealed that the vaccine had either high or low risks, or high or low benefits. Then, we again measured participants' perceived risks and benefits of the vaccine, affective impression of the vaccine, and intention to vaccinate. This design allowed us to examine if and how moving from the baseline condition, in which we provided general information about the vaccine, to any other condition, in which the participants were exposed to either high or low risks/benefits information, would change the participant's affective impression of the vaccine, their perceived risks and benefits of the vaccine, and their intention to vaccinate. Determining the *changes* in affective impressions, risks and benefits perceptions, and vaccination intentions would allow us to explore *the relationships* between *the changes* in the aforementioned variables from the baseline (time 1) to the second phase (time 2); that is, how a change in one variable (e.g., affective impression) may influence the changes in other variables (e.g., perceived risks, or benefit).

In order to understand the relationships between the changes in the variables, we first defined the variables as the changes in the perceived risks/benefits, affective impressions, and the intention to vaccinate from time 1 to time 2 (manipulation). We then developed five different structural equation models, that included all the possible logical relationships between the variables, to see which model can best describe the relationships between the variables (Figure 3-3 to 3-7). However, Model 1 (Figure 3-3) was specifically developed based on both the feeling-as-information theory (Schwarz, 2010) and affect as heuristic model (Slovic et al., 2007) and illustrates that the overall affective impression of the vaccine influences the intention to vaccinate both directly and also indirectly through affecting the perceived risks/benefits of the vaccine. The other four structural equation models (Figure 3-3 to 3-6) considered all other possible combinations of how affective impression of a vaccine, perceived risks,

and perceived benefits can influence each other, and vaccination intentions. Building upon the aforementioned theories, we predict the following hypotheses:

1. We hypothesize that the overall affective impression of the vaccine influences the intention to vaccinate both directly and also indirectly through affecting the perceived risks/benefits of the vaccine. This hypothesis is depicted in Model 1 (Figure 3-3). More specifically, we hypothesize that Model 1 will fit very well with the study's data and show acceptable goodness of fit for popular goodness of fit indices including Normed Fit Index (NFI), the confirmatory factor analysis (CFI), and the root mean square error of approximation (RMSEA).
2. We hypothesize that, compared to other models, Model 1 best describes the structural relationships between the variables. More specifically, we hypothesize that the structural relationships between the overall affective impression of the vaccine, the perception of risks and benefits and the intention to vaccinate illustrated in Model 1 (Figure 3-3) will have better goodness of fit indices including NFI, CFI, RMSEA, and Akaike Information Criterion (AIC) compared to the other possible structural relationships between the variables depicted in other models (Figure 3-4 to 3-7).

3.2 Method of study

Participants were recruited through Amazon Mechanical Turk (www.mturk.com) (n=400). We only recruited participants who were parents as it is usually the parent(s) who make vaccination decisions for their children, and thus there may be differences between how a parent and a non-parent make vaccination decisions for children. 32 respondents were eliminated due to failing the attention-check question. Table 3-1 displays the demographic information of the 368 remaining participants (*Mdn* age = 35-44 years old; *Mdn* number of children=1).

Table 3-1 Descriptive statistics of the respondents' demographic information

		Total	
Age		**n**	**%**
	18-24	9	2.5
	25-34	141	38.5
	35-44	113	30.9
	45-54	58	15.8
	55-64	33	9.0
	65-74	10	2.7
	75 and older	2	0.5
Education			
	Completed some high school	2	0.5
	High school graduate	18	4.9

	Completed some college	65	17.7
	Associate degree	34	9.2
	Bachelor's degree	172	46.7
	Completed some postgraduate	14	3.8
	Master's degree	53	14.4
	Ph.D., law, medical degree, or other advanced degree beyond a Master's degree	10	2.7
Number of Children			
	Zero	0	0
	One	187	50.9
	Two	126	34.3
	Three	36	9.8
	Four or more	18	4.9
Age of the youngest child			
	0 to 4 years	138	37.6
	5 to 9 years	97	26.4
	10 to 14 years	51	13.9
	15 to 19 years	27	7.4
	19 and older	54	14.7
Household income			
	Less than $25,000	74	20.1
	$25,000 to $34,999	63	17.1
	$35,000 to $49,999	53	14.4
	$50,000 to $74,999	86	23.4
	$75,000 to $99,999	53	14.4
	$100,000 to $149,999	31	8.4
	$150,000 or more	8	2.2
Gender			
	Male	191	51.8
	Female	176	47.7
	Other	2	0.5

Note: Since this study was part of a larger study aiming to answer several other research questions, the demographic information of the participants is similar to Mostafapour et al., (2019)

At the beginning of the survey, the subjects read a description about a novel and highly contagious disease and its vaccine. We intentionally described the disease and its vaccine to be similar to Measles, Mumps and Rubella (MMR) vaccine, and named it Respiratory Discoloration Disease (RDD), as the MMR vaccine has provoked vaccine hesitancy among parents, in recent years. So, we decided to present this information as our baseline to see how parents would evaluate the information, not knowing that it is related to the MMR vaccine. The description included all the information about the symptoms and complications associated with the disease and the efficacy and side effects of the

vaccine, which all were drawn from the content presented on the Center for Disease and Control and Prevention's website about measles and the MMR vaccine ("Vaccine Information Statement | MMR | Measles-Mumps-Rubella | VIS | CDC," 2018).

After respondents read the baseline information, they were asked to indicate how beneficial/risky they thought the RDD vaccination was on a 7-point scale from "*not beneficial/risky at all* to *extremely beneficial/risky"*. The order in which these questions were presented to the subjects were counterbalanced.

Then, the subjects' affective impression of the vaccine was measured through an adapted version of the Finucane et al., (2016)'s and Osgood, Suci, & Tannenbaum (1957)'s approach, in which they used a series of bipolar measures (e.g., positive-negative, good-bad) and asked the participants to rank a hazardous activity (e.g., fluoridization or chemical plants) against these bipolar measures on a 5-point scale. Although, traditionally, research would consider emotions based on their valence as either negative (e.g., anger, fear) and positive (e.g., happiness, pride), in recent years, emotions have been studied beyond only valence. That is, the research has shown that identifying the degree to which an emotion is negative or positive (i.e., its valence) does not provide enough explanatory power to predict the action tendencies associated with that emotion (Fontaine et al., 2007; Han et al., 2007). For instance, anger and fear are both considered negative emotions; however, research has shown that fearful individuals pay more attentions to details while angry individuals are more likely to pay attention to the big picture (Lerner & Keltner, 2001). Consequently, current research in emotions aims to better understand the action tendencies caused by emotions through identifying other possible emotional dimensions beyond valence. To better capture the effect of affective states on the perception of a vaccine and the intention to vaccinate, we decided to adapt the affective impression scale used by Finucane et al., (2016) to include other possible emotional dimensions beyond valence. In order to adapt the affective impression scale to capture other dimensions of emotions most suitable for this work, we followed a more recent approach suggested by (Fontaine et al., 2007) that looks at emotions beyond valence and introduces four dimensions to emotions. More precisely Fontaine et al., (2007) studied a broad range of emotions and proposed that emotions are composed of four dimensions that influence how an emotional state may affect one's perceptions and actions. These dimensions are valence (i.e., pleasantness), controllability (i.e., feeling of power or weakness), arousal (i.e.,

sympathetic arousal and readiness to take action), and predictability (i.e., feeling of familiarity). For instance, an emotional/affective state in which a person feels a lower level of controllability (e.g., fear) may increase risk aversion tendencies, while another emotion which is high on the controllability dimension (e.g., anger) may increase risk-taking tendencies. Recognizing these dimensions would allow us to better understand the nature of participants' affective states. As such, we adapted the Finucane et al., (2016)' scale based on Fontaine et al., (2007)'s work and came up with a 14-bipolar scale to better reflect these dimensions (Please see Table 3-2). We then performed principal component analysis to test and identify the affective dimensions in the scale, beyond just valence.

Next, the subjects were asked to respond to the following question on a 5-point Likert scale from "*yes, I would vaccinate my child* to *no, I would not vaccinate my child"* using the following:

"Imagine that you have a 1 year old child, would you vaccinate your child with the RDD vaccine?"

As mentioned previously, we followed Finucane et al., (2016)'s method in which they manipulated the affective impression regarding a target, through information provision, to manipulate affective states. More specifically, they provided risk and benefit information about a target to influence people's affective impressions of the target. So, after reading the baseline information at time 1, the subjects were presented with the following:

"Further studies have provided new findings regarding the RDD disease and its vaccine. In the following page, you will be presented with a complementary piece of information. Please read it carefully, as you will be asked to answer similar questions based on this new extra piece of information."

Next, during the second phase of the study (i.e., time2), the subjects were randomly assigned to one of the four conditions in which they were presented with new information that implied that the vaccine was either high in risk (n=89), low in risk (n=90), high in benefit (n=96), or low in benefit (n=93).

The information about the risks and benefits of the vaccine were composed after reviewing the grey literature on the arguments and anecdotal examples that pro- and anti- vaccine groups share online ("Arguments For & Against Vaccinations:," n.d., "Should Any Vaccines Be Required for Children?," 2018, "Vaccines ProCon.org," 2018, "WHO | Six common misconceptions about

immunization," 2013; Kunzmann, 2017). The risk scenarios were composed after reviewing the concerns which were mostly about issues related to the possible side effects of the vaccine. Benefit scenarios were designed based on the information around the efficacy and immunity of the vaccines. Please see Figure 3-2, for a full description of the scenarios.

After the provision of the new pieces of information, the subjects were asked to respond to the same questions they received after they read the main description about the disease and the vaccine, at time 1. Please see Appendix A for the full list of questions in the survey.

Figure 3-2 The scenarios presented in each condition

Condition	Scenario
High-benefit	RDD vaccination is highly effective in protecting an individual from the RDD virus without causing the suffering of the sever consequences of the disease itself. RDD vaccination is the only way to protect a person from the dangerous and highly contagious RDD virus as there is no treatment for it. RDD vaccine creates immunity by boosting the body's own immune system. In recent years, all the individuals who received the vaccine have been 100% immune towards the disease.
Low-risk	Since the complications of the vaccine are extremely rare, there is not enough evidence for scientists to be sure if the complications are even caused by the vaccination; and therefore, there is not any meaningful link between the RDD vaccine and these consequences. In a set of reliable recent studies, the risk of the RDD vaccination have been shown to be almost zero. In recent years there has not been any documented complications of the vaccination.
High-risk	In recent years, several severe problems have been reported following RDD vaccine, these include severe allergic reactions, and problems such as permanent brain damage, long-term seizures, coma, or lowered consciousness, and deafness. Scientists state that these complications are very rare, but recently several cases of these severe complications have been reported.
Low-benefit	Although physicians believe that vaccination is the only scientific way to protect a person from the dangerous and highly contagious RDD virus, some people claim that there is no need in getting the vaccine as they can control the consequences of the infection by other methods such as herbal medicines. Moreover, it is shown that 10% of the vaccinated individuals who take the RDD vaccine do not develop immunity. In recent years, there have been some individuals who received the vaccine and still were affected by the virus.

Note: Since this study was part of a larger study aiming to answer several other research questions, part of the study's methodology including these scenarios are the same as <remove for blind peer review>.

3.3 Analysis and Results

3.3.1 Vaccine emotional scale development

The reliability alpha for the 14-item vaccine affective impression scale was 0.943, exceeding the established acceptable criteria for internal consistency of .70 (Nunnally & Bernstein, 1994).

Principal component analysis using oblique rotation was performed on the intercorrelations among the 14 bipolar affective scales to discover coherent subgroups. Three components with eigenvalues greater than 1 were retained. These three components accounted for 78% of the total variance in the measures. After oblique rotation, the loadings of the variables on their corresponding factors were high (.637<x<.938), and the variables grouped together in a way predicted by prior research (Fontaine et al., 2007). As previously mentioned, Fontaine et al., (2007) looked at the dimensions of emotions beyond valence and showed that emotions consist of four dimensions including valence, arousal, predictability, and controllability.

The principal component analysis retained three components. Component 1 accounted for 59% of the total variance (eigenvalue=9.537). This component represented the valnce dimension and was most strongly defined by the following adjectives: positive, good, acceptable, useful, and beneficial on one pole and negative, bad, unacceptable, useless, and harmful on the other pole. The second component, which accounted for 11% of the total variance (eigenvalue=1.28), was defined by the following scales: worrying/comforting, stressful/relaxing, scary/safe, disturbing/calming. The second factor thus represents an arousal dimension that evaluates the degree to which the vaccine can be perceived as a threat that may evoke a fight-or-flight response. The third component accounted for 8% of the variance (eigenvalue=1.02) which represents the predictability dimension. It consisted of the following scales: familiar/unfamiliar, predictable/unpredictable, controllable/uncontrollable, manageable/unmanageable, and known/unknown. The controllability component did not appear as a separate component in the principal component analysis. The reliability alpha for the statements included in valence, arousal, and predictability components were .949, .852, and .854, respectively,

exceeding the established acceptable criteria for internal consistency of .70 (Nunnally & Bernstein, 1994). Thus, we calculated a mean score (i.e., the average score of all the statements in each component) for each of the three components to simplify building a structural equation model. The changes in the affective impression of the vaccine were considered to be positive if the emotional valence's score increased (i.e., higher pleasantness), the arousal component's score decreased (i.e., lower stress and fear), and the predictability component's score increased (i.e., higher degree of feeling of knowing).

Table 3-2 Bipolar statements in the affective impression scale of the vaccine

	Components (pattern matrix)		
	Valence	Predictability	Arousal
Beneficial-Harmful	0.933	0.636	0.469
Useful-Useless	0.925	0.609	0.47
Acceptable-Unacceptable	0.911	0.64	0.51
Good-Bad	0.897	0.602	0.407
Positive-Negative	0.846	0.573	0.198
Unpredictable-Predictable	0.541	0.878	0.295
Controllable-Uncontrollable	0.635	0.821	0.077
Known-Unknown	0.512	0.82	0.216
Unmanageable-Manageable	0.658	0.798	0.374
Familiar-Unfamiliar	0.556	0.637	-0.14
Scary-Safe	0.535	0.44	0.778
Disturbing-Calming	0.604	0.502	0.75
Stressful-Relaxing	0.645	0.472	0.74
Worrying-Comforting	0.504	0.42	0.688

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

3.3.2 Variables

We calculated the changes in the perceived risks, perceived benefits, the average score of each of the affective impression's components (i.e., valence, arousal, and predictability), and the intention to vaccinate, for each participant, before and after information provision. That is, the changes in these

variables were calculated by subtracting these variables at time 2 (phase 2 of the study after the participants read the complementary piece of information) from time 1 (baseline).

In this work perceived risks, perceived benefits and the intention to vaccinate are all observed variables as they are measured through a single question. However, the affective impression of the vaccine is a latent variable composed of three components, namely, valence, arousal, and predictability.

3.3.3 Creating the models

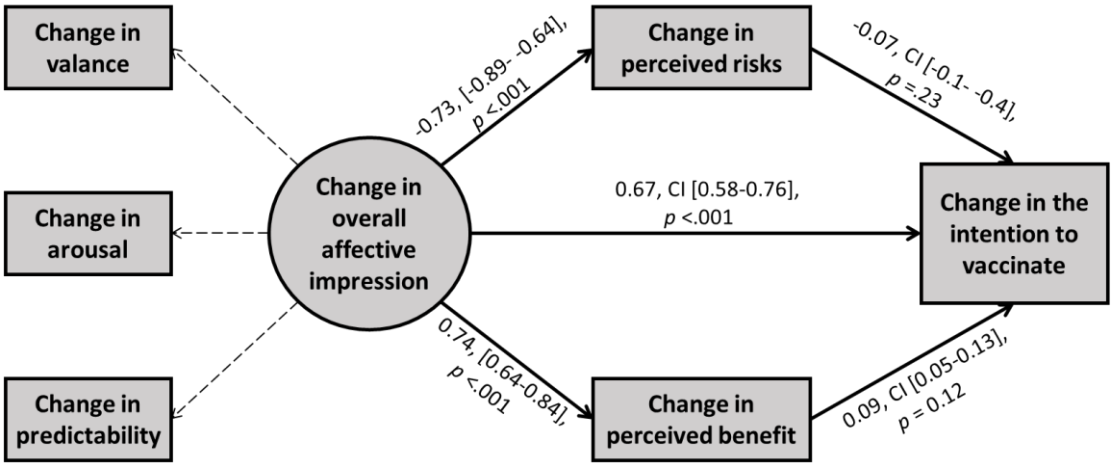
Before creating the models, a Pearson correlation analysis showed that both the changes in the perceived risks $r(366) = -.607$, $p<.001$, and the perceived benefits $r(366) = -.620$, $p<.001$ are significantly correlated with the change in the intention to vaccinate. That means the intention to vaccinate is significantly related to the perceived risks and benefits of the vaccine. However, we expect that these correlations would be affected by the affective impressions of the vaccine. Particularly, we intend to understand how affective impression of a vaccine may affect the relationship between the perceived risks and benefits of the vaccine and also the intention to vaccinate. Our first hypothesis proposes that a change in the affective impression a vaccine affects the perception of the risks and benefits of the vaccine and ultimately influences their relationship with the intention to vaccinate. Therefore, we developed Model 1 based on these assumptions (please see Figure 3-3) to test if this model meets the recommended criteria to be a good fit for our data; that is, to have enough explanatory power to approve this hypothesis.

The second hypothesis proposes that among the possible logical relationships between the variables (i.e., affective impression, perceived risks, perceived benefits, and the intention to vaccinate), Model 1 has the best goodness of fit (i.e., explanatory power). That means, Model 1 which is derived from the affect-as-information theory (Schwarz, 2010b) and also affect heuristic model (Slovic et al., 2007) can better explain how affective impressions influence the vaccination decisions.

In order to test our hypotheses, we developed the following models in the form of Structural Equation Models and analyzed their goodness of fit using IBM AMOS 27. The maximum likelihood model was utilized to impute the missing data. The models are developed in order to investigate the relationships between the changes in variables to see how a change in one variable can potentially affect the changes in other variables, and see if our hypotheses can be accepted.

- Model 1 assumes the changes in the affective impression of the vaccine (i.e., how people feel about the vaccine) influence the intention to vaccinate both directly and also indirectly through the changes in the perceived risks and benefits of the vaccine. Furthermore, it influences the relationship between the perceived risks and benefits of the vaccine and the intention to vaccinate. Please see Figure 3-3.

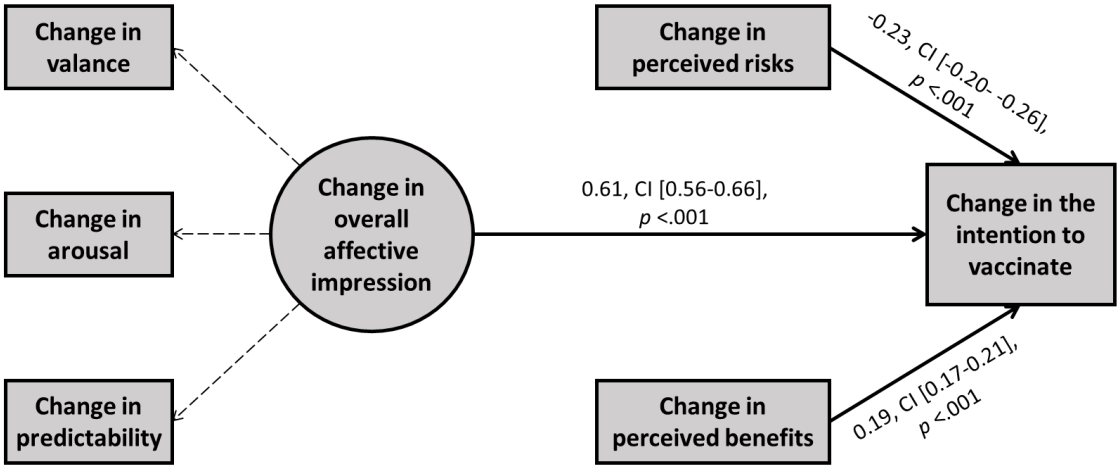
Figure 3-3 Model 1



Note: Numbers on pathways are standardized coefficients followed by the confidence interval and *P* value

- Model 2 assumes that the changes in the perceived risks, the perceived benefits, and the affective impression of a vaccine are independent and each independently affects the changes in intention to vaccinate. Please see Figure 3-4.

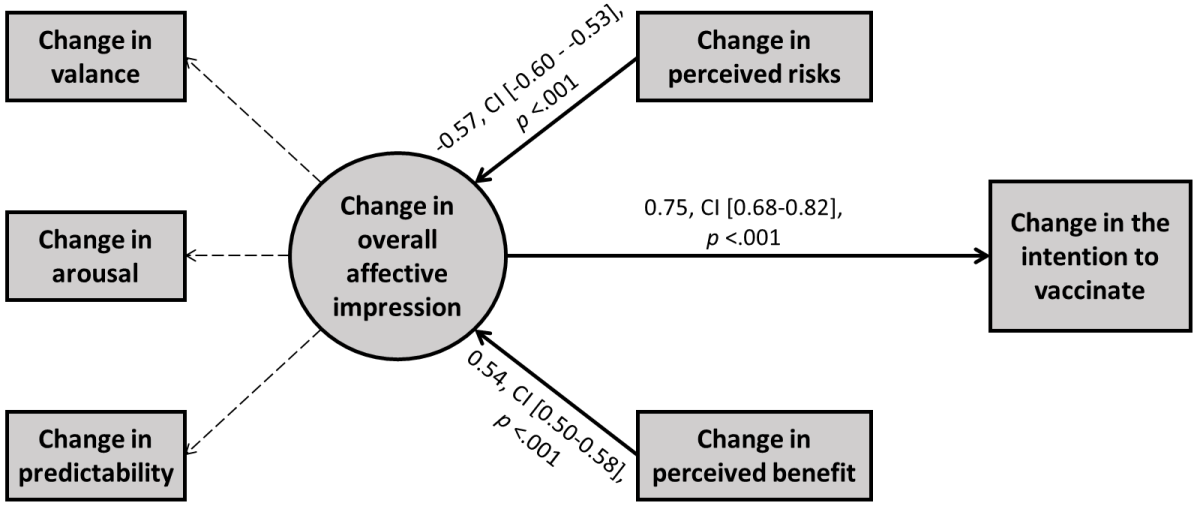
Figure 3-4 Model 2



Note: Numbers on pathways are standardized coefficients followed by the confidence interval and *P* value

- Model 3 assumes that the changes in the perceived risks and benefits of the vaccine affect the changes in the affective impression of the vaccine, and then the changes in the affective impression of the vaccine directly affects the changes in the intention to vaccinate. Please see Figure 3-5.

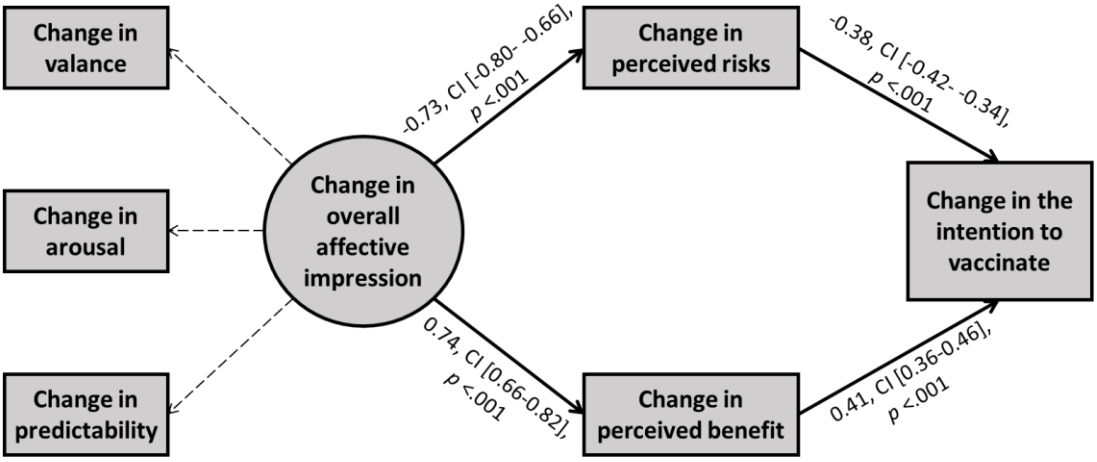
Figure 3-5 Model 3



* Numbers on pathways are standardized coefficients followed by the confidence interval and *P* value

- Model 4 assumes that the changes in the affective impression of the vaccine indirectly affects the intention to vaccinate through changing the perception of risks and benefits of the vaccine. That is, the changes in the affective impression of the vaccine affects the changes in the perceived risks and benefits of the vaccine. And ultimately the changes in the perceived risks and benefits affect the changes in intention to vaccinate. Please see Figure 3-6.

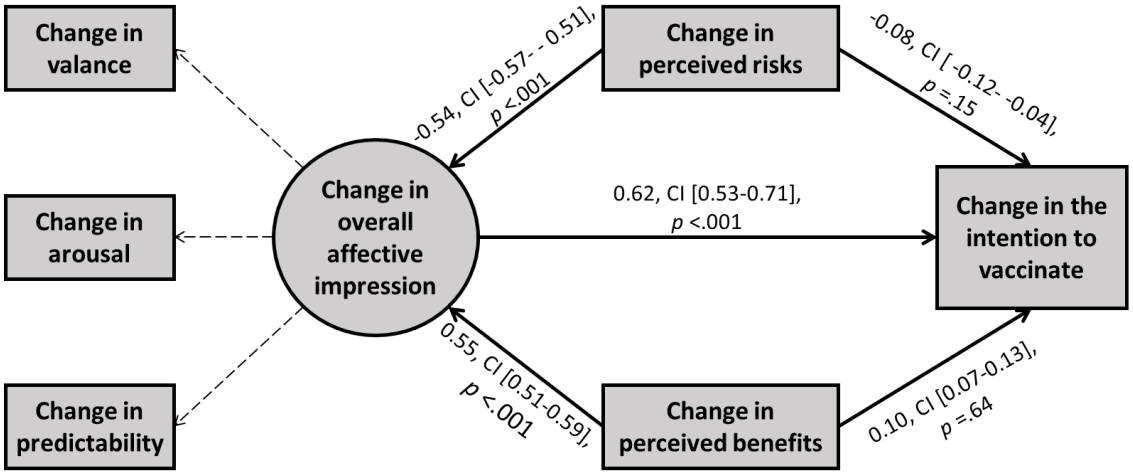
Figure 3-6 Model 4



Note: Numbers on pathways are standardized coefficients followed by the confidence interval and *P* value

- Model 5 assumes that, contrary to Model 1, the changes in the perceived risks and benefits of the vaccine affects both the changes in the affective impression of the vaccine and also the vaccination intention. Besides, the changes in the perceived risks and benefits moderates the relationship between the changes in the affective impression of the vaccine and the changes in the intention to vaccinate. Please see Figure 3-7.

Figure 3-7 Model 5



Note: Numbers on pathways are standardized coefficients followed by the confidence interval and *P* value

3.3.4 Comparison between the goodness of fit of the models

In order to test our hypotheses, we analyzed the goodness of fit of the models using four common fit indices measures, namely, the Akaike Information Criterion (AIC), confirmatory factor analysis (CFI), the root mean square error of approximation (RMSEA), and Normed Fit Index (NFI). Table 3-3 displays the amount of each of the fit indices for each model.

Table 3-3 The goodness of fit associated with the models

	AIC	CFI	RRMSEA	NFI	DF
Model 1	59.872	0.991	0.071	0.986	7
Model 2	545.045	0.639	0.389	0.638	9
Model 3	198.106	0.89	0.215	0.885	9
Model 4	130.628	0.939	0.17	0.934	8
Model 5	198.183	0.891	0.242	0.888	7

Considering the analysis displayed in Table 3-3, we can conclude Model 1 has the best fit, which means that, consistent with our prediction, affective impressions of vaccines influence vaccination intentions both directly and also indirectly through changing the perception of risks and benefits. The following is a detailed description of the analysis of the fit indices.

- AIC is an estimator of prediction error that evaluates how well a statistical model fits with a given set of data. A smaller ACI indicates that the model fits better with the data. Therefore, based on AIC, Model 1, which has the smallest AIC among other models, shows the best fit.
- CFI is used to test whether the data fit a hypothesized measurement model that is derived from previous theories/research. The CFI measure ranges from 0 to 1. A CFI measure that is closer to 1 indicates a better fit with the data. The cut-off criterion for CFI is CFI $\geq$.90. Model 1' CFI index is the closest to 1; and hence, it fits the data better than other models.
- RMSEA, unlike other indices which are used to compare models together, is an absolute fit index that tests how close a hypothesized model is to a perfect model. RMSEA ranges from 0 to 1. An RMSEA measure close to 0 indicates that the model is a better fit for the data. The cut-off criterion for RMSEA is RMSEA < 0.08. As displayed in Table 3-3, model 1 has the smallest RMSEA and therefore is the best model that fits with the data.
- NFI indicates the degree to which the target model improves the fit relatively to the null model. The recommended cut-off for NFI is NFI $\geq$ 0.95, which means the model improves the fit by 95% relative to the null model. Model 1 has the largest NFI and the only NFI that fits the cut-off criterion.

As noted earlier, considering the above analyses, we can conclude Model 1 shows the best fit with the data; as such, we can approve hypothesis 1. In addition, the comparison between the fit indices of the models implies that model 1 is a better fit for the data (i.e., has the strongest explanatory power) compared to the other possible models, which means that Model 1 best describes *how* affective impressions influence vaccination intentions; hence, we also approve hypothesis 2.

In sum, our results indicates that affective impressions of vaccines influence vaccination intentions both directly and also indirectly through changing the perception of risks and benefits.

3.4 Discussion

This work aimed to understand how and if the affective impression of a vaccine affects the judgements and decisions about a vaccine. We developed a model (i.e., Model 1) based on both the feeling-as-information theory (Schwarz, 2001) and the affect heuristic model (Slovic et al., 2007) that illustrated

that affective impression of a vaccine influences the intention to vaccinate, the judgement of risks and benefits of the vaccine, and also influences the relationship between the perceived risks/benefits of the vaccine and the intention to vaccinate. As mentioned earlier, both the perceived risks $r(366) = -.607$, $p<.001$ and the perceived benefits $r(366) = -.620$, $p<.001$ were significantly correlated with the intention to vaccinate, separately; however, our model (Model 1) showed that by incorporating the affective impression in the model, the correlation of the perceived risks and benefits with the intention to vaccinate significantly changed (i.e. the correlations became insignificant); and, the intention to vaccinate was heavily influenced by the affective impression of the vaccine.

Furthermore, in order to explore if there may be other models that can also explain the relationship between these variables, we created four other structural equation models in which the main variables were related to each other in different orders. We showed that the model developed based on the feeling-as-information hypothesis (Schwarz, 2001) had a significantly better explanatory power of our data compared to other models.

The findings from this paper demonstrate important implications of the affective impression of a vaccine on its acceptance. That is, more positive emotional evaluation of vaccines results in an increase/decrease in the perceived benefits/risks of the vaccines; and also, an increase in the intention to vaccinate. On the other hand, experiencing negative emotions towards a vaccine can result in a decrease/increase in the perceived benefits/risks of the vaccines; and also, a decrease in the intention to vaccinate. Given the growth of the vaccine hesitant population, the interventions designed to increase vaccines' uptake should further investigate how the target population *feel* about a vaccine as opposed to their cognitive judgements. Many health interventions that intend to promote vaccination invest on changing an audience's cognitive evaluation of vaccines; that is, to change the audience's perception of their susceptibility to disease, or the risks/benefits of the vaccines, etc. (Jarrett et al., 2015). However, our study shows that increasing the emotional favorability of the vaccine may be more influential in persuading people to vaccinate. So, related interventions may also utilize various methods to increase the emotional favorability of the vaccine through different means such as images, narratives, music, videos, normalization, etc.

3.5 Limitations and future work

This study was done based on a hypothetical scenario; therefore, the subjects did not have exiting beliefs about the vaccine. So, a possible future work of this study is to explore how the affective impression of a real vaccine plays a role in vaccination decisions where people hold existing beliefs and attitudes towards the vaccine. In addition, this study only utilized information provision to change the participants' emotions toward a vaccine. A next step could be to investigate how other means of communications such as images, music, personal narratives, etc. may change the audience's feelings toward a vaccine and ultimately affect their decision to vaccinate. Furthermore, this work investigated the overall affective impression of the vaccine on vaccination decisions, so a possible future direction could be to study the effect of discrete emotions such as compassion, fear, anger, worry, etc. on vaccination decisions.

Chapter 4

A breast cancer screening embarrassment scale: Psychometric development

Abstract

Breast cancer is the most frequent cancer among women and impacts about 2.1 million women each year. Early detection and diagnosis of breast cancer can significantly increase the chance of survival and minimize the adverse side effects associated with cancer treatment. Therefore, it is important to understand the factors affecting the decision regarding breast cancer screening, for early detection. Embarrassment is identified as an important emotional barrier to breast cancer screening. However, there is no validated scale to measure mammography embarrassment. This research intends to develops a quantitative scale to measure perceived embarrassment during mammography. In this work, researchers performed a comprehensive review of the literature regarding embarrassment during mammography and consulted with several professionals in the field in order to develop 14 statements to measure mammography embarrassment. 420 female US-resident participants were recruited through Amazon Mechanical Turk who were older than 45 years old and had medical insurance that covered breast cancer screening. The participants were presented with mammography embarrassment scale and several other scales to evaluate construct and concurrent validity of the scale. The reliability alpha for the 14-item Mammography Embarrassment Scale (MES) was 0.936. The factor analysis identified two factors including embarrassment about social judgement and bodily embarrassment. The MES was tested against general medical embarrassment and dispositional embarrassment questionnaires and showed robust concurrent validity. Testing the predictability power of MES against participants' past screening behavior and their intention for breast cancer screening suggests that participants' MES score significantly affected their breast cancer screening behavior.

4.1 Introduction

Performing breast cancer screening, specifically mammography, for early detection has significantly reduced breast cancer mortality and the adverse side effects of potential treatments (for example, see Humphrey, Helfand, Chan, & Woolf, 2002; Jin, 2014; Myers et al., 2015). Although mammography

embarrassment has been recognized as a critical barrier to breast cancer screening (Alexandraki & Mooradian, 2010; Annette E. Maxwell et al., 1998; Miller et al., 2018; Moy et al., 2006; Stein et al., 1991), there is an absence of a validated instrument to measure mammography embarrassment. This work intends to develop an instrument to quantitatively evaluate the embarrassment women may experience during a mammogram. This tool can then be used to determine the extent to which embarrassment experienced during a mammogram acts as a barrier to breast cancer screening. Indeed, this scale can be utilized to inform interventions that intend to promote breast cancer screening.

4.2 Background

Breast cancer is the most frequent cancer among women and impacts about 2.1 million women each year. In 2018 only, approximately 627,000 women died from breast cancer – that is approximately 15% of all cancer deaths among women, while the rates of breast cancer among women is consistently increasing (*WHO | Breast Cancer*, n.d.) . About 1 in 8 U.S. women (about 12%) will develop invasive breast cancer over the course of her lifetime (*U.S. Breast Cancer Statistics | Breastcancer.Org*, n.d.). Early detection and diagnosis of breast cancer can significantly increase the chance of survival and minimize the adverse side effects associated with cancer treatment (*Epidemiology, Prevention, and Early Detection of Breast Canc... : Current Opinion in Oncology*, n.d.; Leitch et al., 1997; Moss et al., 1992). The American Cancer Society Guidelines for the Early Detection of Cancers suggests that women 45 to 54 years old get a mammogram every year and women older than 54 should adhere to breast cancer screening at least every two years ("American Cancer Society Guidelines for the Early Detection of Cancer," n.d.). Therefore, it is critical to understand the barriers that may lead women to avoid or postpone their mammograms. Previous work has identified several barriers including access to health units that perform mammograms, financial barriers, cultural/religious barriers, lack of time, poor health literacy, and perceived risks as influential barriers for breast cancer screening (George, 2000; Lo et al., 2013; McCool, 1994). In addition, emotions, such as embarrassment and fear, have been shown to act as barriers to breast cancer screening (Consedine, Magai, Krivoshekova, et al., 2004; Kawar, 2013; Lerman et al., 1990; Magai et al., 2007). Considering the importance of fear on breast cancer screening behavior, Champion et al., (2004) have developed a validated scale to measure the fear of breast cancer screening that has been successfully used to predict the uptake of mammography screening among various populations (for example see Cronan et al., 2008; Kim, Menon, Wang, &

Szalacha, 2010; Vrinten, Wardle, & Marlow, 2016). However, there is still a lack of a validated instrument to evaluate embarrassment in breast cancer screening.

Embarrassment is defined as the feeling a person experiences in relation to others in social situations, in which the person feels exposed and awkward while highly self-aware and usually uncertain about what to do (Lewis, 2008; Tangney, 1999). Embarrassing situations usually happen when a person's social image of his/her-self does not fit with his/her perceived social norms or expectations. However, embarrassment in medical settings is narrowed down to the emotion that a person may experience as a result of being physically exposed to - or being judged by - health-care providers (Harris, 2006; Lewis, 2008; Tangney, 1999). The threat of embarrassment in medical settings is highly important as people usually avoid embarrassment-eliciting situations in medical settings by avoiding seeking medical assistance even when they experience serious symptoms (for instance see, Consedine, Krivoshekova, & Harris, 2007; Cooper, Palmedo, Cooper, & Palmedo, 2017; Hinchliff & Gott, 2011; Medina-Perucha, Yousaf, Hunter, & Grunfeld, n.d.; Niksic et al., 2016; Nusbaum, Gamble, & Pathman, n.d.; Reynolds, Bissett, & Consedine, 2018; Shaw, Tansey, Jackson, Hyde, & Allan, 2001; Teng et al., 2014; Yap, Reavley, & Jorm, 2013).

Embarrassment in medical settings can be experienced in various situations such as having private parts touched by health-care providers, being in clinic settings that lack privacy, sharing private experiences with a health-care provider, and having concerns about the appearance of one's body (Consedine et al., 2007). This suggests that in order to evaluate embarrassment in patients, we may need to consider more than just one area of concern. Consedine et al., (2007) developed a general medical embarrassment scale in which they considered both physical and social components as different emotional dimensions for evaluating embarrassment in medical settings. However, the scale is very general, and the statements are not specific to a particular domain. The present work intends to build upon the dimensions of embarrassment in medical settings identified in previous work, to develop a scale specific to measure mammogram embarrassment, which will be called Mammography Embarrassment Scale (MES), in this work.

4.3 Method

4.3.1 Survey development

Building upon the theoretical framework developed by Consedine et al., (2007) to evaluate general medical embarrassment, we considered bodily judgment and social judgement as two important factors contributing to patients' expected embarrassment in breast cancer screening. Bodily judgement is defined as experiencing embarrassment as a result of an anticipated judgement from others about one's bodily state (e.g., body's appearance or smell). Social judgement is defined as an anticipated judgement from others about one's social status or behavior (e.g., one's negligence towards his/her body). Having these two components in mind, we performed a comprehensive review of the literature (including the following work: Rosenkrantz et al., 2016, Ahmadian & Samah, 2012; Alexandraki & Mooradian, 2010, 2010; Azami-Aghdash et al., 2015; Consedine, Magai, & Neugut, 2004; Friedman et al., 2012; Goldman & Risica, 2004; Kim et al., 2010; Krouwer & Poels, 2017; Kwok et al., n.d.; Lee, 2015; Lerman et al., 1990; Magai et al., 2007; Mardi et al., 2019; A E Maxwell et al., 1997; McCool, 1994; Miller et al., 2019; Püschel et al., 2009; Schoenberg et al., 2013; Shirzadi et al., 2020; Thomas & Usher, 2009; Tsai et al., 2011) that discussed embarrassment in mammography, looking for social and bodily related factors contributing to mammography embarrassment. Drawing on the previous work on barriers to breast cancer screening and women's experience about breast cancer screening, we identified several themes related to the experience of embarrassment. These include: the presence of any other person during the mammogram, when the mammogram is done by a male, being touched, being in uncomfortable positions, concerns about the appearance of the body and the breasts, being watched in a vulnerable position, not being comfortable with the person doing the test, being judged for being overdue for mammograms by health-care professionals, because of their age (i.e., not wanting to be perceived as old), being perceived as not knowledgeable or adequate when they don't know how it is done or what to do during a mammogram, etc. Following the review, a preliminary list of 20 items was developed. The initial items were then carefully reviewed by a team of experts in the field for clarity and redundancy and 14 items were agreed upon to be included in the scale 1. The developed items were

[1] Scientist at a cancer organization, professors with a background in investigating barriers to cancer screening programs, and researchers with experience in psychological scale development.

drafted in a way to be in line with the themes expressed in the general medical embarrassment questionnaire (Consedine et al., 2007) but more specific to mammography embarrassment.

4.3.2 Procedure

This study was part of a larger project investigating the role of emotions on breast cancer screening behavior. Four hundred and twenty female US-resident participants were recruited through Amazon Mechanical Turk (*Amazon Mechanical Turk*, n.d.). to participate in this study. The recommended age for breast cancer screening in the United States is 45 years old ("American Cancer Society Guidelines for the Early Detection of Cancer," n.d.); therefore, the conditions for recruiting participants in this study was defined as being a female older than 45 years old with medical insurance that covers annual breast cancer screening. The condition for obtaining a medical insurance that covers mammography was included as an eligibility criterion to make sure that the decision to have a mammogram is not affected by financial barriers. To ensure the eligibility of participants, three questions about their gender, age, and medical insurance status were asked in the beginning of the survey, and only the participants who were eligible to participate in the study could continue with the survey. At the beginning of the survey a written consent form was presented to the participants explaining the study purpose, conditions, duration and remuneration. Only participants who agreed with the terms of the consent form could proceed with the survey. In order to ensure the quality of the responses, two attention check questions were included at two different sections of the survey and the participants who failed to correctly answer the attention check questions were removed. The final number of participants who correctly answered the two attention check questions was 402. Table 4-1 displays basic demographic information about the participants.

Table 4-1 Participants' demographic information (N=402)

Variables	Percentage
Age	
45-54	67
55-70	30
70 and older	3
Education	
Some high school	0.5
High school graduate	9.5

Some college	17
Associate degree	12
Bachelor degree	37.3
Some post graduate	5.8
Master's degree	14.5
PhD, law, or medical degree	3.3
Other advanced degree beyond master's degree	0.3
Employment status	
Full time	56.7
Part time	9.5
Self employed	9.5
Out of work and looking for work	3
Out of work but not looking	2.2
Work from home	2.7
Student	0.5
Retired	12.9
Unable to work	3
Annual income before tax	
Less than $25000	14
$25000-$34999	9.8
$35000-$49000	15.8
$50000-$74000	30
$75000-$99999	15.8
$100000-$149999	12.8
$150000 or more	2
Health status	
Very good	21.5
Good	46.8
Fair	28
Poor	3.8
Have a sexual partner	
Yes	68.3
No	31.7
Have a gynecologist	
Yes	67.2
No	32.8
Had appointment to discuss cancer history	
Yes	10
No	90
Had breast biopsy	
Yes	14
No	86

The eligible participants started the survey by answering to a yes or no question asking about whether they had a mammogram in the past. They then proceeded to the mammography embarrassment questionnaire, which included 14 questions that were presented in a random order to the participants. The participants were presented with "*I would feel embarrassed to have a mammogram:"* accompanied by the following statements:

- If a male does the test
- If a trainee is in the room during the procedure
- Because I would have to pose/stand in ways that expose my body
- Because someone would be touching my breast
- Because I don't feel comfortable when someone looks at my breast
- Because I feel uncomfortable when I am topless
- Because of the size or the appearance of my breast
- If I had to talk to the doctor or nurse about abnormalities with my breast
- If I was not able to follow the instructions given to me and do exactly what I am told to do
- Because nurses/technicians will see that I am uncomfortable
- Because the doctor/nurse would judge me if I am overdue for a mammogram
- Because a person that I know may see me in the clinic and learn that I am old enough to require a mammogram
- Because having a mammogram reveals that I am old
- If I don't know the nurse/technician doing the test

Participants were asked to indicate the degree to which they agreed or disagreed with the statements, in a 5-point scale from strongly agree to strongly disagree. Therefore, *higher scores on this scale (i.e., Mammography Embarrassment Scale) indicate less potential for embarrassment*.

Next, the participants responded to two validated questionnaires, namely, general medical embarrassment (Consedine et al., 2007) and dispositional embarrassment questionnaires (Kelly & Jones, 1997), in order to test for concurrent validity of the scale. The participants then were asked to respond to a series of demographic questions, presented in Table 4-1. The demographic questions were controlled in testing the construct validity. The participants were instructed to skip any question that

they felt unsure about or uncomfortable with. This study received ethics approval from the ethics review board at the institution in which the research was performed.

4.4 Analysis

The reliability alpha for the 14-item Mammography Embarrassment Scale (MES) was 0.936, exceeding the established acceptable criteria for internal consistency of .70 (Nunnally & Bernstein, 1994).

As previously discussed, we designed the MES to capture both the bodily and social judgement embarrassment factors. The bodily embarrassment factor intends to capture how women may feel embarrassment as a result of exposing their naked body during a mammogram. The social judgement factor intends to capture how women may experience embarrassment about their social image as a result of being judged by nurses, doctors, or other people in the clinic. In line with our expectations, a principal component analysis with Oblimin rotation of the 14 MES statements identified two components, which we call social judgement and bodily components. All the items loaded more strongly in one or the other components, except for the statement asking the participants if they would feel embarrassed because of the size or the appearance of their breast (i.e., "Because of the size or the appearance of my breast"). This statement could reflect one's vulnerability to embarrassment as a result of exposing their naked body, as well as the embarrassment one may feel as a result of being judged by others because of the appearance of her breasts. Although the item was loaded almost equally on both components, we decided to include this item in the bodily component, as we think the item mostly captures how one may feel embarrassed as a result of exposing their naked body to the judgement of others. Table 4-2 displays how the statements loaded on the two components in the pattern matrix. The structure matrix of the Oblimin rotation is included in Appendix B-2. Both matrices show a similar pattern in terms of how each statement loaded on each component.

Table 4-2 Pattern Matrix using Principal Component Analysis with Oblimin rotation.

Statements	**Components**	
	Social judgement component	Bodily component
If a male does the test	-0.206	0.825 [b]

If a trainee is in the room during the procedure	0.247	0.661 [b]
Because I would have to pose/stand in ways that expose my body	0.169	0.786 [b]
Because someone would be touching my breast	0.139	0.813 [b]
Because I don't feel comfortable when someone looks at my breast	0.09	0.848 [b]
Because I feel uncomfortable when I am topless	-0.01	0.903 [b]
Because of the size or the appearance of my breast	0.466	0.447 [b]
If I had to talk to the doctor or nurse about abnormalities with my breast	0.699 [s]	0.211
If I was not able to follow the instructions given to me and do exactly what I am told to do	0.666 [s]	0.119
Because nurses/technicians will see that I am uncomfortable	0.689 [s]	0.264
Because the doctor/nurse would judge me if I am overdue for a mammogram	0.743 [s]	0.045
Because a person that I know may see me in the clinic and learn that I am old enough to require a mammogram	0.949 [s]	0.225
Because having a mammogram reveals that I am old	0.935 [s]	0.129
If I don't know the nurse/technician doing the test	0.665 [s]	0.260

Note. Using Principal Component Analysis with Oblimin rotation with Kaiser Normalization, the statements were analyzed to determine if the statements are more loaded on the social judgement or bodily components. The Rotation converged in 9 iterations.

[b] The associated statement is loaded on the bodily component.

[s] The associated statement is loaded on the social judgement component.

Since the internal consistency of the MES was high (alpha=0.936), we calculated an overall average MES score for each participant, using the average of all 14 items. We also came up with an average embarrassment score for each of the bodily and the social judgment embarrassment components. We have used these average scores to further investigate the concurrent and the construct validity of the Mammography Embarrassment Scale.

4.4.1 Concurrent validity

In order to test the concurrent validity of the MES, we tested the scale against two well-known scales, namely, Assessment of Dispositional Embarrassment (Kelly & Jones, 1997), and General Medical Embarrassment scales (Consedine et al., 2007).

4.4.1.1 Assessment of dispositional embarrassment

4.4.1.2 Kelly and Jones (1997) developed a scale to measure embarrassability in which they defined embarrassability as individuals' susceptibility to experience embarrassment. The embarrassability test had an internal consistency of α=0.95 in our sample; therefore, we calculated an average score of embarrassability for each participant. We hypothesized that people with higher scores on the Kelly and Jones embarassability scale (i.e., higher tendency to feel embarrassed) would have a lower MES score (i.e., higher expected embarrassment during a mammogram). Subsequently, a bivariate correlation analysis showed that the participants' average score of the susceptibility to embarrassment score was significantly correlated with the total average of the MES $r(380)=-.299$, $p<0.001$, the social component of the MES score $r(392)=-.293$, $p<0.001$), and the bodily component of the MES score $r(386)=-.234$, $p<0.001$.

4.4.1.3 General medical embarrassment

Another scale that was utilized to evaluate the concurrent validity of the MES was the General Medical Embarrassment scale (Consedine et al., 2007) which intends to measure the degree to which people have the tendency to experience embarrassment during medical encounters. The General Medical Embarrassment questionnaire consists of two main components, including bodily embarrassment and concerns about being judged by others which use a 5-point scale format from (Very much/Always) to (Not at all/ Never). Consedine et al., (2007) tested their scales on two different samples, and observed that some of the statements were not loaded more than 0.5 on any of the components, in one of the samples. Hence, eliminated the statements that were not loaded more than 0.5 on either of the samples. (Please see Appendix B-1 for the list of statements adopted from the General Medical Embarrassment Scale). The reliability of the scale in our sample was 0.95 for the bodily subscale and 0.91 for the judgement concern subscale.

We hypothesized that the bodily and social factors of the MES would significantly correlate with the bodily and social components of the Medical Embarrassment scale, respectively. In order to test these hypotheses, we calculated an average score for each of the bodily and social concern subscales of the Medical Embarrassment scale for each participant and compared them with the average score of the bodily and social components of the MES. A bivariate correlation analysis showed a significant correlation between the average score of the Medical Embarrassment's bodily subscale and the MES bodily component's $r(386)=0.517$, $p<0.001$, and between the average score of the Medical Embarrassment's social concern subscale and the MES social judgement component $r(392)=0.448$, $p<0.001$.

4.4.2 Construct validity

In order to evaluate the construct validity of the MES, we analyzed whether participants' embarrassment score is significantly associated with their past behavior and whether it is significantly correlated with their intention to get screened.

4.4.2.1 Past behavior

Participants' past behavior was utilized to test the construct validity of our scale. Through a bipolar scale (i.e., yes and no), the participants were asked whether they had a mammogram before. Only 10% of the participants in our sample had not gone through a mammogram before. A series of Chi Square analysis showed that there was no significant difference between the demographic information of the participants who had and did not have a mammogram before, except for having a gynecologist and having had a breast biopsy before. That is, the participants who had a breast biopsy before were more likely to have had a mammogram X^2 (1, N = 402) = 7.156, p =.03. Similarly, the participants who had a gynecologist were more likely to have had a mammogram X^2 (1, N = 402) = 16.026, p <0.001. A univariate analysis while controlling for having had a breast biopsy and having a gynecologist, showed that the overall average MES score was significantly lower for the participants who did not have a mammogram (M = 2.56, SD = 1.12) compared to participants who had a mammogram before (M = 3.65, SD = .98), $F(1,378)=34.706$, $p<0.001$, $\eta_p^2=.09$). As noted, that lower scores of MES suggest a lower potential for feeling embarrassment. A partial eta square of 0.09 suggests an approximately medium effect of MES score on participants' past behavior (Cohen, 1988). In the following, we further

analyze the social and bodily components of the MES with regards to the participants' past history of mammogram.

An analysis of covariance, while controlling for having had a breast biopsy and having a gynecologist, showed that the participants who did not have a mammogram before (M = 2.26, SD = 1.04) had a significantly lower score in the social component of the MES compared to the participants who had a mammogram before (M = 3.98, SD = .94), $F(1,390)=102.999$, $p<0.001$, $\eta_p^2=.21$. A partial eta square of 0.21 suggests an approximately large effect of the social component of the MES score on participants' past behavior (Cohen, 1988). However, a similar analysis, while controlling for having had a breast biopsy and having a gynecologist, showed no significant difference between the bodily component of the MES score of the participants who had (M = 3.01, SD = 1.43) and did not have (M = 3.20, SD = 1.22) a mammogram before (p=.6).

Since about 90% of the participants in our sample did not have a mammogram before, the sample size for the group of people who had a mammogram before was small so our analysis may not have enough power to satisfy the construct validity of the scale based on past behavior. Therefore, we further evaluated the construct validity of the MES through testing it against participant's *intention* for breast cancer screening.

4.4.2.2 Intention for breast cancer screening

In order to further evaluate the construct validity of the MES, we also investigated the effect of embarrassment on the intention to undergo a mammogram in the advised time in the future. Expected embarrassment in medical settings usually causes people to postpone their medical examination even if they intend to do so at some point (Consedine, Krivoshekova, & Harris, 2007; Cooper, Palmedo, Cooper, & Palmedo, 2017; Hinchliff & Gott, 2011). Therefore, we decided to also ask the participants whether they would do their mammogram *at this moment*, if it was time to do their breast cancer screening test. We evaluated the participants' intention of breast cancer screening through asking the following questions:

- Are you planning to have your mammogram in the advised time? (Yes-No)

- If it was the time to undergo a mammogram, and you could stop the survey right now and do it in a safe, private, and convenient location (e.g., next room), would you have a mammogram "right now"? (Yes-No)
- If it was the time to undergo a mammogram, and there was a mobile mammography van in front of your building, in which you could do the test, would you have a mammogram "right now"? (Yes-No)

We hypothesized that women who score lower in the MES (i.e., higher potential for embarrassment) would be less willing to do their mammograms both in the future and now. In the following, we analyze participants' responses to each of the questions regarding their intention to undergo a mammogram.

4.4.2.2.1 Are you planning to have your mammogram in the advised time?

A series of Chi Square analyses showed that there was no significant difference between the demographic information of the participants who stated that they intend and do not intend to have a mammogram in the advised time except for having a gynecologist. That is, the participants who had a gynecologist were more likely to have the intention to have a mammogram at the advised time X^2 (1, N = 402) = 23.351, p <0.001. An analysis of covariance, while controlling for having a gynecologist, showed that the overall average of the MES score was significantly lower for the participants who stated that they do not intend to have a mammogram (M = 3.25, SD = 1.05) compared to participants who stated that they intend to have a mammogram (M = 3.68, SD = 1) at the advised time (F(1,297)=5.265, p=0.02, η_p^2=.02). A partial eta square of 0.02 suggests an approximately small effect size of the MES score on the intention to get screened at the advised time (Cohen, 1988). This finding confirmed our hypothesis that the individuals were less likely to want to go for a mammogram if they anticipated experiencing embarrassment.

We also analyzed the correlations between the MES's social and bodily and their intention for mammography. An analysis of covariance, while controlling for having a gynecologist, showed that the social component's score of the MES was significantly lower for the participants who stated that they do not intend to have a mammogram (M = 3.50, SD = 1.01) compared to those who stated that they intend to have a mammogram (M = 4.01, SD = .98) at the advised time F(1,297)=8.923, p=0.03, η_p^2=.03). A partial eta square of 0.02 suggests an approximately small effect size of the MES score on

the intention to get screened at the advised time (Cohen, 1988). An analysis of covariance, while controlling for having a gynecologist, showed that although the score of expected embarrassment in the bodily component of the MES was lower among participants who did not intend to go for a mammogram (M = 2.98, SD = 1.26), at the advised time compared to the participants who did (M = 3.24, SD = 1.23) there was no significant difference in the bodily component's score of the MES between the participants who stated that they intend and do not intend to have a mammogram at the advised time (p=0.318). The small effect size of the MES score on the intention to get screened in the future may suggest that the expected embarrassment did not play a significant role when the decision is made for the future. However, previous studies show that people postpone their medical examination due to embarrassment (e.g., Medina-Perucha, Yousaf, Hunter, & Grunfeld, n.d.; Niksic et al., 2016; Nusbaum, Gamble, & Pathman, n.d.; Reynolds, Bissett, & Consedine, 2018). Therefore, our findings may be due the temporal discounting of future embarrassment. Hence, we explored the effect of perceived embarrassment when one is making a decision to undergo a mammogram, *now*.

4.4.2.2.2 If it was the time to undergo a mammogram, and you could stop the survey right now and do it in a safe, private, and convenient location (e.g., next room), would you have a mammogram "right now"?

A series of Chi Square analyses showed that there was no significant difference between the demographic information of the participants who stated that they would do and would not do a mammogram in a safe and private room, right now. Subsequently, a T-test analysis showed that the overall average of the MES score was significantly lower in the participants who stated that they would not do a mammogram in a safe and private room (M = 3.25, SD = .96), right now, than in those who were willing to do so (M = 3.68, SD = 1.05), t(380)= 3.824, p<0.001, d=0.42. Furthermore, a T-test showed that the social component's score of the MES was significantly lower for the participants who stated that they would not undergo a mammogram in a safe room right now (M = 3.50, SD = 1.04) compared to the ones who said they would do it (M = 3.96, SD = 1.07), t(392)=2.849, p<0.001, d=0.44. Similarly, a T-test analysis showed that the bodily component's score of the MES was significantly lower for the participants who stated that they would not have a mammogram in a room (M = 2.92, SD = 1.19) compared to the participant who stated that they are willing to have a mammogram at the moment in a room (M = 3.30, SD = 1.25), t(386)=4.041, p=0.005, d=0.31.

4.4.2.2.3 If it was the time to undergo a mammogram, and there was a mobile mammography van in front of your building, in which you could do the test, would you have a mammogram "right now"? We asked this question, as providing a mobile van for mammography is a common practice in the US. A series of Chi Square analyses showed that there was no significant difference in demographic information of the participants between those who stated that they intend and those who do not intend to have a mammogram in a mammography van, right now.

A T-test analysis showed that the overall average of the MES score was significantly lower in the participants who stated that they would not do a mammogram in a mammography van (M = 3.25, SD =.95) right now, if it was the time to do the screening, than in those who were willing to do so (M = 3.69, SD = 1.06), t(380)= 3.397, p<0.001, d=0.43. Furthermore, a T-test showed that the social component's score of the MES was significantly lower for the participants who stated that they would not undergo a mammogram at a mammography van right now (M = 3.51, SD = 1.07) compared to the ones who said they would do it (M = 3.97, SD = 1.06) ,t(392)= 4.070, p<0.001, d=0.44. Similarly, another T-test analysis showed that the bodily component's score of the MES was significantly lower for the participants who stated that they would not have a mammogram in a mammography van (M = 2.90, SD = 1.17) compared to the participant who stated that they are willing to have a mammogram (M = 3.32, SD = 1.25) at the moment in a mammography van t(386)=3.129, p<0.001, d=0.34.

The analyses above show that the average score for the 14-item MES was significantly correlated with the participants' past behavior and their intention for mammography in the advised time in the future and right now. Similarly, the social component of the MES was a significant contributor to the participants' past behavior and their intention to get screened at the advised time and right now. Although the bodily component was not significantly correlated with the participants' past behavior and their intention to get screened at the advised time (in the future), it was a significant contributor to the participants' intention for undergoing a mammogram at the moment, whether in a private room or a mobile van. This result may be due to the fact that thinking about bodily embarrassment becomes more prominent when making a decision at the moment when a woman thinks about all the steps she needs to go through during the mammogram, in more details. Furthermore, the effect size of MES score on breast cancer screening behavior was larger when the participants were making a decision about whether they would undergo a mammogram, *now*, if it was the time to do so. Again, this could be due

to the fact that people will be thinking more about the details and emotional barriers when they are psychologically closer (as opposed to distant) with having to do a task (for more details please see (Trope & Liberman, 2010).

4.5 Discussion

Although previous qualitative work identified mammography embarrassment as an important factor affecting the decision to undergo breast cancer screening, there was a lack of an instrument to quantitatively measure perceived mammography embarrassment. As such, this work developed a scale to quantitatively measure perceived embarrassment regarding doing a mammogram. To the best of our knowledge, this scale is the first to measure mammography embarrassment. Through a comprehensive review of the literature on breast cancer screening barriers, especially embarrassment, and consultation with experts, we developed a 14-item questionnaire to evaluate mammography embarrassment considering the factors that contribute to a person feeling embarrassed in terms of both social and bodily factors. The questionnaire developed in this work provides a detailed understanding of why some women may feel embarrassed during a mammogram, and as a result may hesitate or avoid mammography. The Mammography Embarrassment Scale (MES) shows significant concurrent validity with established questionnaires such as General Medical Embarrassment, and Susceptibility to embarrassment questionnaires. Furthermore, the MES questionnaire showed solid construct validity with regards to participants' past behavior and their intention for breast cancer screening. Therefore, MES can be utilized in understanding the extent to which embarrassment plays a role as a mental barrier to breast cancer screening, among other factors. In addition, the significant association between the MES score and the participants' past behavior and their intention to undergo a mammogram indicates critical importance of providing an environment for women during a breast cancer screening session so that *they feel comfortable and not embarrassed*. Particularly, the results of this research suggest that we should develop more effective interventions/policies that consider how women *feel* (specifically in terms of embarrassment) during a mammogram, in order to promote breast cancer screening.

4.6 Limitation

Although we employed purposive sampling to recruit eligible women who had diverse breast cancer screening behavior, we were unable to recruit an equal number of participants who had and had not

gone through mammograms before. This difference could potentially affect our analysis regarding the correlation between the MES and the participants' past screening behavior. Furthermore, the research design did not allow us to control for the participants' previous diagnosis of breast cancer which may have affected the results of this study. Nevertheless, given that the scale showed both construct and concurrent validity against other measures, the MES still provides solid validity to be utilized in health interventions/research that intend to promote/understand breast cancer screening behavior.

Chapter 5

Emotions, fruits and vegetables: Investigating the effect of emotions on message framing

Abstract

Objective: This work contributes to the understanding of the factors affecting the persuasiveness of health messages regarding the consumption of fruits and vegetables. Particularly, this work further investigates how the emotional states of an audience influences the effectiveness of loss vs. gain framed messages. We examined the effect of the emotions of happiness, fear, disgust, anger, and sadness on the effectiveness of message framing, with the intention to identify the cognitive appraisal dimensions associated with these emotions that lead to the outcomes.

Methods: The survey utilized a 5 (emotional state: happiness, fear, sadness, anger, and disgust) X 2 (message frame: gain vs. loss) between-subjects factorial design with 644 subjects who did not consume the recommended number of fruits and vegetables. After the emotional manipulation task, the subjects read either a gain or loss framed message regarding fruit and vegetable consumption. Afterwards, the subjects' intention to increase their consumption was measured.

Results: The findings revealed that the valuation and choice appraisal associated with emotions was more influential in determining the effectiveness of loss vs. gain farmed messages. That is, gain-framed messages were more effective when combined with the emotions associated with reward-seeking tendencies (happiness, anger, and sadness); while loss-framed messages were more effective when combined with the emotions associated with disposal tendencies.

Conclusions: Extending previous research, this work identified the appraisal of choice and valuation associated with an emotion as the more influential appraisals influencing the effectiveness of message framing.

5.1 Introduction and background

Fruits and vegetables are essential parts of a healthy diet. According to the current evidence, people who follow a diet that is rich in fruits and vegetables have a lower risk of developing heart disease by up to 70% (Bazzano et al., 2002; Bhupathiraju et al., 2013; Dauchet et al., 2005; Dauchet et al., 2006; Hartley et al., 2013; He et al., 2006; Hung et al., 2004; Yu et al., 2014), a reduction in the risk of stroke (Dauchet et al., 2005; Hartley et al., 2013; He et al., 2006), a reduction in the risk of dying prematurely by 25% to 32% (Oyebode et al., 2014; Wang, Xia, Ouyang, Liu, Zhu, Zhao, Bao, & Hu, 2014), a lower risk of developing type 2 diabetes (Gordon, 1996; Wang, Ping-Yu et al., 2016; Weickert & Pfeiffer, 2008), more regulated blood sugar levels and improved insulin sensitivity (Carter et al., 2010; He et al., 2007; Matough et al., 2012; Wu et al., 2015), a reduction in the risk of certain types of cancer such as colorectal cancer (Park et al., 2005; Terry et al., 2001; Van Duijnhoven et al., 2009), oral cancer (Pavia et al., 2006), and lung cancer (Vieira et al., 2016), among other health benefits (for a review please see (Alinia et al., 2009; Ledoux et al., 2011; Vieira et al., 2016; Wang, Xia, Ouyang, Liu, Zhu, Zhao, Bao, & Hu, 2014). On the other hand, inadequate consumption of fruits and vegetables is linked to noncommunicable diseases such as cardiovascular problems and certain types of cancer, diabetes, etc. (Wang et al., 2014). In 2017 approximately 3.9 million deaths worldwide were related to inadequate consumption of fruits and vegetables (WHO, 2019). In fact, this number was 6.7 million in 2010, (Lim et al., 2012). Subsequently, most of the 8 global dietary recommendations suggest the consumption of at least two servings of fruits and three servings of vegetables per day for adults (*2015-2020 Dietary Guidelines 8th Edition.* 2015; *Government Dietary Recommendations.*2016; Nishida et al., 2004). However, only approximately 1 in 10 people in Canada and the US consume the recommended number of servings of fruits and vegetables (*Only 1 in 10 Adults Get Enough Fruits or Vegetables.* 2021; Lee-Kwan, 2017) . As such, public health intends to promote the consumption of fruits and vegetables through effective health communication. Understanding the factors affecting the persuasiveness of a health message is critical to its effectiveness in propelling people's behavior. Therefore, this work intends to extend the understanding of the factors influencing the effectiveness of the health messages regarding fruits and vegetables consumption in individuals not currently meeting the recommended daily intake, by looking at how a combination of emotions and message framing can be utilized to nudge people to consume more fruits and vegetables.

Message framing is a well-known (health) communication method that impacts judgement and decisions by highlighting the benefits (gains) or the costs (losses) associated with a decision. Message framing was comprehensively demonstrated through Prospect Theory which posits that people are more likely to be risk-seeking when considering losses and are more likely to be risk-averse when considering gains (Tversky & Kahneman, 1981). Research in health communication further explored the implications of prospect theory in promoting health behaviors. Although early studies suggested that gain-framed appeals are more effective when targeting behaviors that preventative behaviors (e.g., skin cancer prevention or physical activity), and loss-framed appeals are more effective when targeting detection behavior (e.g., cancer screening) (Rothman et al., 1999), later studies showed that the conclusions about the effectiveness of gain- and loss-framed health messages can largely differ (Gallagher & Updegraff, 2012). Specifically, research in nutrition promotion has remained inconclusive as to which framing is more persuasive (Churchill & Pavey, 2013). However, recent research shows that this maybe because there are mediating factors affecting the likelihood of the effectiveness of gain vs. loss framed health messages. Some of the mediating factors include demographic, cultural, and personality characteristics of the recipients of the message (Bosone & Martinez, 2017; Updegraff & Rothman, 2013; Wansink & Pope, 2015), the perceived level of involvement in the issue (Cheng & Wu, 2010), the level of the certainty of the outcomes (Malenka et al., 1993; Rothman & Salovey, 1997), risk preference (Druckman, 2001; Wang, Xiao-Tian & Johnston, 1995), processing style of the audience (i.e., heuristic vs piecemeal processing) (Shiomura & Atsumi, 2001), and central to this study: the emotional state of the recipient of the message (Bosone & Martinez, 2017; Gerend & Maner, 2011a; Updegraff & Rothman, 2013; Wansink & Pope, 2015), etc. The present work intends to contribute to the current body of knowledge by further exploring the effect of the emotional state of the audience on the effectiveness of message framing regarding fruits and vegetables consumption.

Emotions are powerful and pervasive factors of decision making. Traditionally, in consequentialist view of decision making, the role of emotions in decisions was limited to the drive for making decisions that would optimize positive emotions and minimize negative emotions (Mellers et al., 1999; Schoemaker, 1982). However, further studies on the role of emotions in decision-making showed that it is not only the desire to increase (decrease) positive (negative) emotions that drives our decisions, but also the incidental emotions that are experienced at the time of decision-making can

impact the evaluation process and decisions, while people may lack awareness of how emotions influence their decisions (Keltner & Lerner, 2010; Lerner et al., 2015). As such, valence based theories of emotions, such as affect transfer (Machleit & Wilson, 1988) or feeling-as-information hypothesis (Schwarz, 1990), emerged that generally demonstrate that people treat the emotions, that they experience at time of decision making, as a source of information to evaluate a target. That is, when one feels negative/positive emotions towards a target, they are more likely to evaluate the target more negatively/positively. However, valence-based theories of emotions could not explain the effect of emotions on message framing. For instance, Keller et al. (2003) studied the effectiveness of loss- vs. gain framed messages and showed that experiencing positive emotions makes loss-framed messages more likely to be effective and vice versa, while other work such as (Wegener et al., 1994) showed the opposite effect. The inconsistency between the results may be due to the fact that valence-based theories of emotions, which mostly focus on the general mood as opposed to specific emotions, lack enough explanatory power to differentiate between the impact of specific discrete emotions. As such, researchers utilized cognitive appraisals theories of emotions to explore the difference between the effect of distinct positive/negative emotions on the effectiveness of message framing (e.g., Keller et al. (2003)). Cognitive appraisal theories of emotions posit that emotions have cognitive appraisals associated with them that can explain the difference between various discrete positive/negative emotions (Lerner & Keltner, 2000). For instance, Roseman & Smith (2001) introduces six cognitive appraisal dimensions associated with each emotion, namely: pleasantness, certainty, control (personal agency or situational agency), attentional activity, anticipated effort, and responsibility associated with each emotion, in order to differentiate between emotions. So, a way to differentiate between discrete emotions would be to identify the degree to which each emotion is associated with any of these appraisal dimensions. For instance, fear and anger are similar in terms of pleasantness (both negative), but are on the opposite side of the spectrum in terms of the certainty and personal control appraisals, with fear being low on these appraisals while anger being high. Among many great works that have explored various cognitive appraisals of emotions, the Appraisal Tendency Framework (ATF), suggested by Han et al. (2007) draws on the previous cognitive appraisal theories to propose a comprehensive framework that suggests the cognitive appraisals associated with each discrete emotion cause the difference between them through influencing factors such as the content of thought (e.g., risk perception, valuation and reward seeking, and interpersonal attribution), depth of thought (i.e., depth of information

processing: heuristic vs. systemic processing), and goal activation (i.e., motivation to take certain actions or choice). As such, this work utilizes the Appraisal Tendency Framework (ATF) to map out the related cognitive appraisals associated with the emotions studied in this work.

Along the same line, utilizing cognitive appraisal theories of emotions, Gerend & Maner (2011) studied the effect of the interaction between emotions and message framing regarding fruits and vegetables consumption, by exploring whether the persuasiveness of a loss- vs. gain- framed messages is related to the emotional state of the recipient of the message. They studied this research question to explored the effect of anger and fear on the effectiveness of loss- vs. gain- framed messages regarding fruits and vegetable consumption. Their findings showed that the loss-framed appeal was significantly more effective when the subjects were primed with anger prior to reading the health messages, compared to the gain-framed appeal. On the other hand, the gain-framed appeal showed to be significantly more effective in increasing fruits and vegetables consumption when the subjects were primed with fear prior to reading the health messages, compared to the gain-framed appeal. They posited that the difference between the impact of fear and anger on the effectiveness of loss vs. gain frame messages could be related to the difference between the certainty and personal control appraisals associated with anger and fear (Gerend & Maner, 2011). That is, building upon the findings from Lerner & Keltner (2001) and Slovic (1987), they suggested that higher levels of certainty and control appraisals associated with anger resulted in a lower perceived risk, while lower levels of certainty and control appraisals associated with fear resulted in a higher perceived risk. Consequently, they posited that the lower/higher perceived risk associated with anger/fear might have caused the difference in their impact on the effectiveness of loss vs. gain framed messages. Also, referring to the work done by Harmon-Jones & Allen (1998) and Öhman & Mineka (2001), they suggested that this difference could be related to the role of action tendencies (i.e., approach vs. avoidance) induced by anger and fear. They explained that fear typically leads to avoidance of potential negative outcomes while anger motivates approach-oriented actions. However, given that anger and fear are on the opposite sides of the spectrum in terms of all the aforementioned appraisals, their study was inconclusive in terms of specifying if any of these appraisals or a combination of them is causing the difference between the emotions' impact on the effectiveness of loss vs. gain framed messages. More specifically, their study did not identify whether 1- the approach versus avoidance tendencies, which is similar to the appraisal of valuation and choice in the ATF, associated with an emotion is the more influential appraisal in determining the

effectiveness of loss vs. gain framed messages, 2- the appraisals of certainty and personal control associated with emotions, which are related to perception of risk, are more influential in determining the effectiveness of loss vs. gain framed messages, or 3- a combination of these appraisals (i.e., valuation and choice, certainty, and personal control appraisals) associated with an emotion may be causing the difference between the impact of the emotions on the effectiveness of loss vs. gain framed messages.

Extending the work done by Gerend & Maner (2011) and utilizing the appraisal tendency framework (Han et al., 2007), we intend to further identify which cognitive appraisals may be influencing the effectiveness of loss vs. gain framed messages. Subsequently, between the three possible explanations mentioned above, we hypothesize that the appraisal of choice and valuation associated with an emotion may be the more influential factor in determining the effectiveness of loss vs. gain framed messages. We propose this hypothesis based on the following reasons: 1-As noted, the basic difference between loss vs. gain framed messages is that the loss framed messages emphasize the potential losses whereas gain-framed messages emphasize the potential gains. As such, the valuation and choice appraisal associated with an emotion, which reflects the behavioral tendency towards rewards seeking (seeking causes of gains) or disposal (disposing causes of loss), is likely to influence the effectiveness of loss vs. gain framed messages. That is, combining the emotions that are characterized by high valuation and reward seeking with gain framed messages, which highlight the rewards, would make the gain-framed message more effective. Whereas, emotions characterized by low valuation and disposal may enhance the effectiveness of loss-framed messages, which highlight the loss (Ferrer et al., 2016). 2- This prediction is in line with previous findings that imply that the choice and valuation appraisal associated with emotions is more influential in subsequent choices. For instance, Morales et al. (2012) showed that disgust enhances the effectiveness of loss messages regarding the use of illegal drugs. Considering that fear (low in certainty and personal control appraisals) and disgust (high in certainty and personal control appraisals) are on the opposite sides of the certainty and personal control appraisals' spectrum, the reason that disgust enhances the fear appeals (and does not neutralize it) could be that they both motivate disposal tendencies. Therefore, the choice and valuation appraisal associated with fear and disgust may have been more influential in subsequent choices compared to the certainty and control appraisals. 3- In addition, previous research has not found a significant link between the effectiveness of message framing and the perception of risk (Van't Riet

et al., 2014; Van't Riet et al., 2016), in the health domain. Therefore, the certainty and control appraisals associated with an emotion, which are related to the perception of risk (Lerner & Keltner, 2001; Slovic, 1987), may not have a significant impact on the effectiveness loss vs. gain framed messages.

In order to investigate this hypothesis, we selected three additional emotions besides anger and fear, including disgust, sadness, and happiness to compare and understand whether emotions associated with similar tendencies regarding the choice and valuation appraisals result in a similar outcome. The reasons for picking these emotions are that: 1- these emotions are commonly utilized in health promotion and are common to be experienced in health settings (Consedine & Moskowitz, 2007; Leshner et al., 2011; Trnka & Lorencova, 2020) and 2- these emotions are different in terms of the appraisals of certainty, personal control, and valuation and choice (i.e., motivation). As such, by comparing the effect of these emotions on the effectiveness of loss- vs. gain- framed messages, we can investigate which appraisals may be more contributing to the outcome. Please see Table 5-1 that displays how these emotions are different in terms of the aforementioned cognitive appraisals. Subsequently, we designed a 5 (emotional state: happiness, fear, sadness, anger, and disgust) by 2 (message frame: gain vs. loss) between-subjects study, in which we randomly assigned the subjects into one of the emotional and message framing conditions to investigate this research problem.

Table 5-1 Cognitive appraisal dimensions associated with the emotions

	Happiness	**Anger**	**Disgust**	**Sadness**	**Fear**
Certainty	High	High	High	Medium	Low
Personal control	Medium	High	High	Low	Low
Risk perception	Perceive low "unknown" risk	Perceive low risk	Perceive low risk	-	perceive high risk
Valuation and choice	Reward seeking	High valuation and reward seeking	Low valuation and disposal	High valuation and reward seeking	Low valuation and disposal

Note. The table is adapted from Ferrer et al., (2016). There are more dimensions associated with each emotion, however this table only displays the dimensions related to the current subject.

5.2 Method

5.2.1 Participants, Procedures, and Materials

The survey, which used a 5 (emotional state: happiness, fear, sadness, anger, and disgust) X 2 (message frame: gain vs. loss) between-subjects factorial design, was conducted through Amazon Mechanical Turk (*Amazon Mechanical Turk.*). Participants who were older than 18 years old and residing in the US could participate in the survey. However, before starting the survey, participants were asked about their consumption of fruits and vegetables, and only participants who were consuming less than the recommended number of fruits and vegetables (i.e., three servings of vegetables and two servings of fruits), and self-identified as being able to financially afford consuming the recommended number, were recruited through Amazon Mechanical Turk. (Please see Appendix C-1 to review the survey).

The minimum number of participants to meet an 80% power considering a small effect size (0.14) was calculated at 590, using G-Power 3.1.9.7 (*University of Düsseldorf: G*Power.*). Subsequently, 706 participants who met the eligibility criteria were recruited. However, 62 participants were eliminated due to either failing the attention-check question or not properly engaging in the manipulation tasks/questions designed to induce the target emotions. Table 5-2 displays the demographic characteristics of the participants (M_{Age} = 42.06, SD = 12.99, M_{BMI} = 26.30, SD = 19.82).

Table 5-2 Demographic characteristics of the participants

		Total	
Education		N	%
	Completed some high school	2	0.3
	High school graduate	42	6.3
	Completed some college	88	13.2
	Associate degree	54	8.1
	Bachelor's degree	295	44.4
	Completed some postgraduate	15	2.3
	Master's degree	143	21.5

	Ph.D., law, medical degree, or other advanced degree beyond a Master's degree	26	4
Household income			
	Less than $25,000	59	8.9
	$25,000 to $34,999	66	9.9
	$35,000 to $49,999	109	16.4
	$50,000 to $74,999	172	25.9
	$75,000 to $99,999	112	16.8
	$100,000 to $149,999	99	14.9
	$150,000 or more	48	7.2
Gender			
	Male	301	45.4
	Female	359	54.1
	Different identity	3	0.5
Ability to make ends meet			
	Very difficult	22	3.3
	Difficult	88	13.4
	Neither easy or difficult	182	27.6
	Easy	221	33.5
	Very easy	146	22.2
Health Status			
	Very good	116	17.5
	Good	348	52.6
	Fair	159	24
	Poor	31	4.7
	Very poor	8	1.2

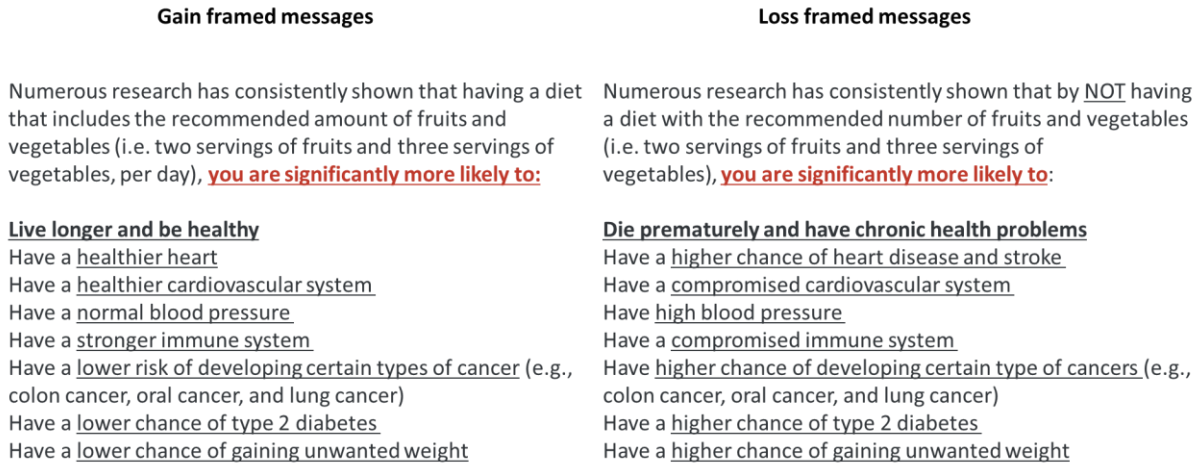
To induce the target emotions including happiness, fear, sadness, anger, and disgust, we utilized two validated methods including the use of static images (Siedlecka & Denson, 2019) and also the method validated by Lerner & Keltner (2001) and Smith & Ellsworth (1985). After surveying participants about their baseline consumption of fruits and vegetables, they were randomly assigned to one of the 5 emotional condition groups. In each group, the participants were first presented with 5 images and were asked “Of the following images, which one makes you feel the most happy/fearful/sad/angry/disgusted?”. The 5 images included in each emotional group were selected by

asking a group of 15 graduate students to rank 20 images based on the degree to which they would feel the target emotion after seeing each image from 1 to 5 (total of 100 images for the five emotional groups). The average of ranking for each image was calculated, and the images with the highest ranks were included in each group, in the survey.

Then, the participants were asked to described 4–5 things that would make them very happy/fearful/sad/angry/disgusted. They were then asked to "write an essay (at least 10 sentences) about one situation that makes you or has made you very happy (fearful/sad/angry/disgusted). Please write it in such detail that someone would feel happy (fearful/sad/angry/disgusted) just from reading it". The participants had been told that they would receive a bonus if they respond to the aforementioned questions (i.e., the questions designed to induce the target emotions). The participants who did not respond or responded poorly to these questions were eliminated from the study.

Next, the participants were randomly assigned to either a gain-framed or a loss-framed message group in which they were presented with one of the messages displayed in Figure 5-1.

Figure 5-1 The loss and gain farmed messages presented to the participants.



5.2.2 Measures

In the beginning of the survey, the participants were presented with the examples of what would be considered a serving of fruit/vegetables. and then were asked to indicate their current consumption of fruits and vegetables through a single item question adapted from the Block Food Frequency questionnaire (Block et al., 1986). This measure has been utilized in several related studies (e.g., (Gerend & Maner, 2011; Williams-Piehota et al., 2006)). Please see Figure 5-2.

Figure 5-2 The question presented to the participants to measure their consumption of fruits and vegetables

Examples of one serving of fruits:
1/2 cup fresh fruit
1 medium size fruit
1/2 cup fruit juice

Examples of one serving of vegetables:
One cup of leafy vegetables
1/2 cup of raw vegetables (excluding leafy vegetables)
1/2 cup of cooked vegetables
1/2 cup of fresh vegetable juice

Given the above definitions, over the past 2 weeks, about how many servings of vegetables did you eat or drink on an average day? (Please write it in numbers only)

After the emotional induction task, the intention to increase the consumption of fruits and vegetables was measured through the following single item question adapted from Bogers et al. (2004).

"On a scale from 1 (strongly disagree) to 6 (strongly agree), please indicate the extent to which you agree/disagree with the following statement: "I intend to consume two servings of fruits and three servings of vegetables, on an average day."

Participants were also asked a few other questions regarding the perceived benefits, susceptibility, and difficulty of consumption of fruits and vegetables, that are not analyzed as part of this work. Please see Appendix C-1 to review the survey. Immediately after responding to these questions, participants were asked to respond to the following questions to test the emotional and the message framing manipulation methods:

"On a scale from 1 (very negative) to 6 (very positive), how positive/negative were the health messages regarding the consumption of fruits and vegetables that you just read?"

"Please indicate which emotions (if any) you felt after writing the essay, and to what degree? (I will either add the details or add an image for this question)." Please see Figure 5-3.

Figure 5-3 Emotional manipulation check

Please indicate which emotions (if any) you felt after writing the essay, and to what degree?

	(1) Not at all	2	3	4	5 (Very much)
Fear	○	○	○	○	○
Anger	○	○	○	○	○
Sadness	○	○	○	○	○
Happiness	○	○	○	○	○
Disgust	○	○	○	○	○

In order to control for trait anger and anxiety and dispositional disgust and happiness, participants completed the trait anxiety (Spielberger, 1983) and anger (Spielberger, 2010) scales, besides the scales regarding dispositional disgust (Haidt et al., 1994) and hope (Snyder et al., 1991) (adopting the pathway" subscale). An adapted version of the self reported measure of depression (Haroz et al., 2014) was utilized to control for dispositional feeling of sadness or other negative moods. We included all the scale's statements in the survey except for the statement "I wish I were dead", since we would ethically be responsible to follow up with the participants who would agree with that statement, yet we were not equipped to do so through MTurk. These scales were used to control for the potential individual differences in the intensity of the target emotions felt by the participants, that could potentially influence the results of the study.

The participants were also asked to respond to the health locus of control scale (Norman et al., 1998) to control for the potential differences between their perceived control over their health. The participants were also surveyed about their demographic background such as age, gender, health status, etc., as presented in Table 5-2.

5.3 Analysis and results

5.3.1 Manipulation check and control variables

An independent T-test conducted on the framing manipulation check confirmed that participants in the gain-framed condition (M = 5.01, SD = 1.00), compared to the loss-framed condition (M = 3.88, SD = 1.54), reported that the gain-framed message was more positive than the loss-framed message t (643) = 12.117, p < .001.

Furthermore, as mentioned, in order to check the emotional manipulation, participants were asked to indicate to what degree they felt any of emotions of sadness, fear, disgust, anger, and happiness, after writing the essay, from 1 (not at all), to 5 (very much). An Analysis of Variance (ANOVA) conducted on the emotional manipulation check confirmed that the target emotion was felt significantly more compared to any of the other studied emotions, in each of the target emotion groups. For instance, fear was reported to be more intensely felt compared to sadness, disgust, anger, and happiness (p <.001), in the fear group.

A series of Analyses of Variance showed that there was no significant difference between 1- the participants' baseline level of fruits and vegetables consumption, 2- demographic variables, and 3- control variables among the different conditions. Furthermore, a set of bivariate and logistic correlations showed that there were no significant correlations between 1-demographic variables and 2- control variables and the dependent variable (i.e., the intention to increase fruit and vegetables consumption to the recommended amount, during the next two weeks), except for the participants' trait anxiety score $r(637) = .09$, $p = .035$, current health status $r(640) = .11$, $p = .006$ and their perceived health locus of control $r(638) = .15$, $p < .001$. Besides, there was a significant correlation between the baseline consumption of fruits $r(642) = .16$, $p < .001$ and vegetables $r(643) = .15$, $p < .001$ and the intention to increase the consumption.

Therefore, in order to test our hypotheses, we ran an Analysis of Covariance (ANCOVA) using SPSS version 27 (*SPSS Statistics - Overview*. 2021), controlling for the participants' current health status, their perceived health locus of control, their trait anxiety, and their baseline consumption of fruits and vegetables. The results showed a main effect of emotion on the intention to increase the consumption of fruits and vegetables and also a significant interaction between message framing and emotions.

5.3.2 Main effect of emotions

Analysis of Covariance (ANCOVA) while controlling for the participants' current health status, their perceived health locus of control, their trait anxiety, and their baseline consumption of fruits and vegetables showed a main effect of emotions on the intention to increase fruits and vegetables consumption to the recommended amount during the next two weeks $F(4, 615) = 16.287$, $p < .001$, partial $\eta^2 = .096$. The posthoc analysis using Benferonni correction showed that the participants in the happy (covariate-adjusted means: $M_{adj} = 5.78$; SE = .13) and fear ($M_{adj} = 5.55$; SE = .12) conditions were significantly more likely to intend to increase their consumption of fruits and vegetables compared to the participants in the sadness ($M_{adj} = 4.90$; SE = .12), anger ($M_{adj} = 4.93$; SE = .12), and disgust ($M_{adj} = 4.58$; SE = .12) conditions. However, there was no significant difference between happy and fear conditions in terms of the intention to increase consumption of fruits and vegetables. Similarly, there was no significant difference between sadness, anger, and disgust in terms of the intention to increase the consumption of fruits and vegetables. Table 5-3 shows the *p*-values associated with the differences between the emotional conditions.

Table 5-3 Comparison between the *p*-values of the differences between the emotional condition

	Happiness	Anger	Sadness	Fear	Disgust
Happiness		*p*<.001	*p*<.001	*p*=1	*p*<.001
Anger			*p*=1	*p*=.004	*p*=.45
Sadness				*p*=.002	*p*=.68
Fear					*p*<.001
Disgust					

5.3.3 Main effect of message framing

An analysis of Covariance (ANCOVA) while controlling for the participants' current health status, their perceived health locus of control, their trait anxiety, and their baseline consumption of fruits and vegetables showed that there was no significant difference between gain-framed messages (covariate-

adjusted means: M_{adj} = 5.24; SE = .08), and loss-framed messages (M_{adj} = 5.06; SE = .07), (*p* =.12), partial η^2 = .004.

5.3.4 Interaction between message framing and emotions

An analysis of Covariance (ANCOVA) while controlling for the participants' baseline consumption of fruits and vegetables, trait anxiety, health status, and perceived health locus of control showed that loss-framed messages were more effective in increasing participants' intention to increase their consumption of fruits and vegetables when participants were primed with fear and disgust while gain-framed messages were more effective when participants were primed with happiness, sadness, and anger.

The analysis confirmed that, in the fear condition, the participants who read the loss-framed message had a significantly higher intention to increase the consumption of fruits and vegetables (covariate-adjusted means: M_{adj} = 6.11; SE = .17) than those who read the gain-framed message (M_{adj} = 4.99; SE = .18), F (1, 615) = 21.422, p < .001, partial η^2 = .034. Similarly, the participants in the disgust condition were more likely to intend to increase their consumption of fruits and vegetables (M_{adj} = 5.28; SE = .17) after reading the loss-framed message compared to the gain-framed message (M_{adj} = 3.89; SE = .18), F (1, 615) = 14.397, p < .001, partial η^2 = .023.

On the contrary, in the sadness, anger and happy conditions, participants primed with happiness who read the gain-framed message (M_{adj} = 6.25; SE = .17) were more likely to intend to increase their consumption of fruits and vegetables than those who read the loss-framed message (M_{adj} = 5.03; SE = .18), F (1, 615) = 14.397, p < .001, partial η^2=.023; similarly, the participants primed with anger who read the gain-framed message (M_{adj} = 5.55; SE = .17) were more likely to intend to increase their consumption of fruits and vegetables than those who read the loss-framed message (M_{adj} = 4.32; SE = .18), F (1, 615) = 24.467, p < .001, partial η^2=.038; also, the participants primed with sadness who read the gain-framed message (M_{adj} = 5.50; SE = .18) were more likely to intend to increase their consumption of fruits and vegetables than those who read the loss-framed message (M_{adj} = 4.30; SE = .17), F (1, 625) = 23.357, p < .001, partial η^2=.037.

The results of our study confirmed our hypothesis. That is, by comparing the cognitive appraisal dimensions associated with the emotions that enhanced the effectiveness of gain-framed messages (i.e., happiness, anger, and sadness), we realize that all of these emotions are similar in terms

of the choice and valuation appraisal (i.e., all of them are associated with reward seeking tendencies). However, these emotions have different levels of certainty and personal control appraisals, with anger and happiness being associated with high levels of certainty and personal control appraisals, and sadness being associated with lower levels of certainty and personal control appraisals. Similarly, considering disgust and fear, we realized that both of these emotions are similar in terms of the choice and valuation appraisal (i.e., associated with disposal behavior). However, they are associated with different levels of certainty and control appraisals, with fear being associated with a lower certainty and control appraisal, and disgust being associated with higher levels of certainty and control appraisals. Therefore, given that the choice and valuation appraisal was the common cognitive appraisal dimension between the emotions that enhanced the effectiveness of either loss or gain framed messages, we confirm our hypothesis that posits that the appraisal of valuation and choice associated with an emotion is the more influential appraisal in determining the reason behind the impact of emotions on the effectiveness loss vs. gain framed messages.

5.4 Discussion

This study investigated the effect of the emotions including happiness, anger, sadness, disgust, and fear on the persuasiveness of loss- vs. gain- framed messages regarding the consumption of fruits and vegetables.

Our results confirmed the findings from the previous research regarding the factors affecting the effectiveness of loss- vs. gain- framed messages (Ferrer et al., 2016; Gerend & Maner, 2011) by showing that emotional state of the recipient of the message has a significant influence on the effectiveness of loss- vs. gain- framed messages. That is, our results showed that framing effects can be influenced by the audience's current emotional state, with fearful and disgusted participants being more persuaded by a loss-framed message, and angry, sad, and happy participants being more persuaded by a gain-framed message.

Also, our findings extended the understanding of how cognitive appraisals associated with emotions can influence the effectiveness of a message by showing that among the appraisals of certainty, personal control, and valuation and choice, the valuation and choice appraisal associated with the emotional state of the audience is more influential in determining the effectiveness of loss- vs. gain-framed messages. That is, priming the audience with the emotions that are associated with disposal

tendencies such as fear and disgust would make loss framed messages more persuasive, while gain-framed messages are more likely to be persuasive when the subjects are primed by emotions that are associated with reward seeking tendencies, such as happiness, sadness, and anger.

In addition, our results inform the design of more effective interventions that intends to promote fruits and vegetables consumption. Indeed, previous work suggests that interventions that only focus on educating people about the risks/benefits of not-consuming/consuming enough fruits and vegetables are limited in their capacity to change eating behavior; therefore, integrating behavioral science and behavioral economics techniques can enhance the efficacy of these interventions (Thomson & Ravia, 2011). Along the same line, the findings from this study showed how to best integrate emotions and message framing to optimize the effectiveness of messages regarding fruits and vegetables consumption. Besides findings regarding the effect of emotions on message framing, one of the findings of this study was the main effect of emotions on the intention to engage in the advised behavior, regardless of message framing. Our results showed that happiness and fear motivated the subjects to intend to increase their fruits and vegetables consumption more significantly than sadness, anger, and disgust. Although, exploring the reason behind this observation is out of the scope of the current work, this finding has important practical implications for future health interventions that intend to promote the consumption of fruits and vegetables.

In closing, findings from the current study contributes to both extending the understanding of how emotion influence the framing effect and also demonstrating how these findings can be utilized in future interventions to design more persuasive communication methods.

5.5 Limitation and future work

The limitations of the current study can outline future directions to further investigate the research problems discussed in this work. The current study only measured the *intention* to increase the consumption of fruits and vegetables. So, a future direction could be to measure the participants' actual behavior to understand their behavior in a realistic setting. Additionally, although we measured and controlled for several variables such as the participants' current health status or financial ability to afford the recommended number of fruits and vegetables, we understand that dietary behavior is very complex and influenced by other factors such as time, perceived norm, potential allergies, culture, geography, environment etc., so a future research direction could be to conduct this study in a more

controlled design. Also, given that the context can potentially impact the findings of message framing, the results of this study can be further investigated in other health contexts to see how emotional states of the recipient of a health message may impact the persuasiveness of the message in other health contexts (e.g., detection/screening messages, doctor-patient communication, etc.). Moreover, this work only compared the degree to which valuation and choice, certainty, and personal control cognitive appraisal dimensions associated with the emotions (i.e., anger, happiness, fear, disgust, sadness) influence the effectiveness of loss vs. gain framed messages; however, we acknowledge that there might be other cognitive appraisal dimensions associated with an emotion that can impact the effectiveness of loss vs. gain framed messages. Therefore, a potential future direction could be to explore the effect of a broader range of emotions including self-conscious emotions (such as pride, shame, or guilt) to better specify the cognitive appraisal(s) associated with emotions that may influence the effectiveness of loss- vs. gain- framed messages. Finally, an incidental but critical finding of this study was the main effect of emotions on the intention to increase the consumption of fruits and vegetables. Therefore, an important future direction of this work would be to investigate how the emotional state of an audience can influence the intention to adhere to an advised health behavior, regardless of message framing.

Chapter 6

Sugary drinks and emotions: Investigating the effect of emotions on the persuasiveness of health warnings regarding sugary drinks

Abstract

Objective: This work intends to understand how emotional states of an audience impact the persuasiveness of health warnings regarding the consumption of sugar sweetened beverages (SSBs). Particularly, this work contributes to identifying the cognitive appraisals associated with fear, disgust, anger, and sadness that impact the persuasiveness of health warnings regarding the consumption of SSBs.

Methods: We examined this research problem through a manipulation between subject design (n=392) where the subjects, who were all drinking four or more than four SSBs per week, were randomly assigned to one of the emotional conditions (i.e., sadness, fear, disgust, or anger), or the neutral condition. After the manipulation, the subjects' intention to decrease their consumption of SSBs was measured.

Results: Findings revealed that the valuation and choice appraisal associated with emotions was more influential in determining the effectiveness of health warnings regarding the consumption of SSBs. That is, fear and disgust, which are associated with disposal tendencies, increased the effectiveness of health warnings regarding SSBs; whereas, anger and sadness, which ware associated with reward-seeking tendencies, had the opposite effect. Furthermore, the findings revealed that the cognitive appraisals of valuation and choice, certainty, and control associated with the emotions can reinforce/moderate each other's impacts on the effectiveness of health warnings regarding SSBs.

Conclusions: This work identified the influential cognitive appraisals associated with emotions that impact the effectiveness of health warnings regarding the consumption of SSBs.

6.1 Introduction and background

One of the main objectives of health communications is to understand how to communicate health information in an effective way in order to help people make healthier decisions (Rimal & Lapinski, 2009). Recent research has shown that one of the influential factors affecting the effectiveness of health messages is the emotions one experiences at the time of decision-making (i.e., incidental emotions) (Ferrer et al., 2016). Consequently, in recent years, health communication has started to explore how to utilize emotions to enhance the effectiveness of communicating health information. Although the impact of emotions on the effectiveness of health messages has been explored in various health domains (e.g., (Gengler, 2020; Gerend & Maner, 2011; Hammond, 2011; Mazzocco et al., 2019), to the best of our knowledge, there is little work exploring the effect of negative incidental emotions beyond fear, on the effectiveness of health messages that intend to discourage the consumption of sugar-sweetened beverages (SSBs). Most studies have explored the effect of various health warnings on SSBs products (e.g., (Billich et al., 2018; Grummon & Hall, 2020; Miller, 2002; VanEpps & Roberto, 2016) but not the combination of health messages/warning and negative emotions. This work intends to contribute to the existing literature by understanding how negative emotions including fear, sadness, anger, and disgust impact the effectiveness of health messages regarding the consumption of SSBs.

Sugar-sweetened beverages refer to any beverages with added sugar or other sweeteners such as "brown sugar, corn sweetener, corn syrup, dextrose, fructose, glucose, high-fructose corn syrup, lactose, malt syrup, maltose, molasses, raw sugar, sucrose, etc." (*Sugar Sweetened Beverage Intake.* 2021; Sousa et al., 2020). SSBs include a wide range of beverages such as pop, soda, energy drinks, tonic, fruits juice with added sugar, etc. (Sousa et al., 2020). These drinks are usually very high in calories but do not provide much nutritional value. Consumption of more than 4 sugary drinks per week is linked to weight gain (Chen et al., 2009; Malik et al., 2009; Pan et al., 2013; Qi et al., 2012; Vartanian et al., 2007) and an increased risk of type 2 diabetes (Drouin-Chartier et al., 2019; Malik et al., 2010; Palmer et al., 2008). Consuming more than one sugary drink per day is linked to 20% and 40% increased risk of heart disease in men (de Koning et al., 2012) and women (Fung et al., 2009), respectively, and 75% increased risk of gout in both men (Choi & Curhan, 2008) and women (Choi et al., 2010). According to a large study with 37,716 men and 80,647 women in the U.S, higher amount of consumption of sugary beverages was linked to a higher risk of premature death due to cardiovascular

problems and cancer (Malik et al., 2019). Studies have also shown that SSBs are the single largest source of added sugar in the U.S. diet (Harvard T.H. Chan School of Public Health, 2020). As a result, Dietary Guidelines for Americans advised the public to decrease their consumption of beverages with added sugar (*WHO | Diet, Nutrition and the Prevention of Chronic Diseases.*2014; Popkin & Nielsen, 2003). Considering the negative impacts of SSBs on public health, this research intends to investigate how integrating emotions with health messages regarding the consumption of SSBs can influence the effectiveness of the health messages.

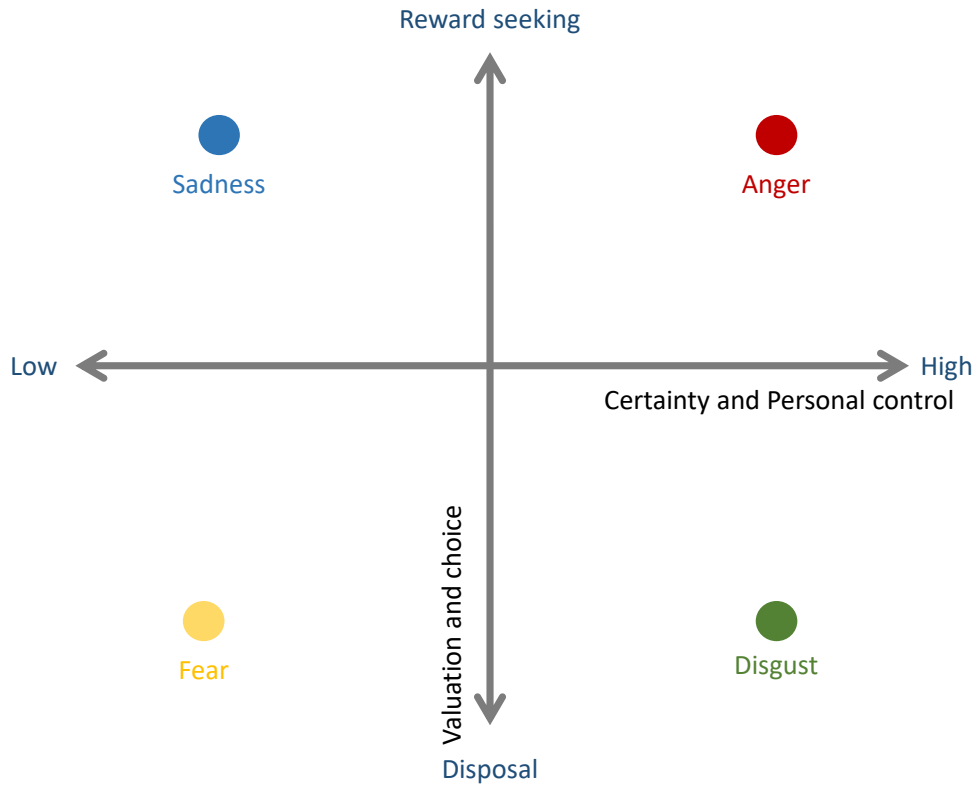
A growing body of research has begun investigating how emotions influence decision-making, even when they are incidental to the decision at hand (Lerner et al., 2007; Lerner et al., 2015; Loewenstein & Lerner, 2003). Recent theories of emotion show the importance of moving beyond a valence-based (i.e., positive vs. negative emotions) approach in order to understand the effect of discrete emotions on decisions (Lerner & Keltner, 2000). Subsequently, cognitive appraisal theories of emotions have emerged (Roseman & Smith, 2001) through which we can systematically predict and differentiate how closely-related discrete emotions (e.g., happiness vs. surprise, or anger vs. fear) may differently influence judgement and decisions. For instance, Roseman & Smith (2001) identifies six cognitive appraisal dimensions associated with emotions that explain the patterns of appraisal underlying each emotion, namely, pleasantness, certainty, attentional activity, anticipation effort, control potential, and responsibility. Each discrete emotion is associated with varying degrees of these appraisal dimensions that impact subsequent judgement and decisions. Indeed, numerous researchers have utilized cognitive appraisal theories of emotions to understand how emotions can systematically affect perception, judgement, and behavior (e.g., (Achar et al., 2016; Lerner et al., 2007; So et al., 2015; Watson & Spence, 2007). As such, cognitive appraisals of emotions have been utilized to demonstrate the difference between discrete emotions. Along the same line, Han et al, (2007) built upon the cognitive appraisal theories of emotions and proposed the Appraisal Tendency Framework (ATF), in which they further demonstrate that patterns of cognitive appraisals along these dimensions provide a basis for differentiating closely related emotions. More specifically, ATF suggests that the appraisal tendencies associated with emotions influence risk perception, valuation and choice, interpersonal attribution, and the depth of information processing (Han et al., 2007).

Previous research has identified several cognitive appraisal dimensions of emotions that can influence the effectiveness of health messages regarding nutrition decisions, including the appraisals of personal control and certainty, which are associated with the perception of risk (Lerner & Keltner, 2001; Slovic, 1987), and the cognitive appraisal of valuation and choice (Gerend & Maner, 2011) & (the findings from Chapter 5). Extending the previous research, this work intends to understand 1- which of these cognitive appraisals associated with emotions (i.e., valuation and choice, certainty, and control appraisals) may increase the intention to reduce the consumption of SSBs, and 2- how the interaction between choice and valuation, certainty, and control appraisals associated with an emotion influence the effectiveness of health messages regarding the consumption of SSBs. It should be noted that this work identifies the effectiveness of the health message by the degree to which the target audience intends to reduce the consumption of SSBs.

In order to investigate these research problems, we designed a randomized between subject design including 4 emotional groups including fear, anger, disgust and sadness and a neutral group. The reason for selecting these emotions is that 1- these emotions are commonly experienced/utilized in health settings/promotion (Consedine & Moskowitz, 2007; Leshner et al., 2011; Trnka & Lorencova, 2020); more importantly 2- these emotions are different in terms of the cognitive appraisals of personal control and certainty and valuation and choice associated with them (Ferrer et al., 2016; Lerner et al., 2007) (Please see Table 6-1 and Figure 6-1). Particularly, fear and disgust both are associated with hesitancy and disposal tendencies (Ferrer et al., 2016; Lerner et al., 2007) but are associated with different levels of personal control and certainty appraisal dimensions. That is, fear is associated with a low personal control and certainty appraisals, while disgust is associated with high personal control and certainty appraisals (Ferrer et al., 2016). On the other hand, sadness and anger both are associated with reward seeking tendencies, but anger is associated with higher levels of personal control and certainty appraisals, while sadness is associated with lower levels of personal control and certainty appraisals (Ferrer et al., 2016) (Please see Figure 6-1 and Table 6-1). These differences between the selected emotions allow us to systematically investigate how these cognitive appraisals may impact the effectiveness of health messages regarding the consumption of SSBs (i.e., the intention to reduce the consumption of SSBs).

It should be noted that, in the interested of the simplicity of the analysis, we decided to combine the appraisals of certainty and control associated with each emotion and treat them as one, as 1- these appraisals are either both high or low in each target emotion, and 2- the appraisals of certainty and personal control are both associated with the perception of risk (Lerner & Keltner, 2001; Slovic, 1987). Please see Figure 6-1.

Figure 6-1 Displaying how the target emotions map on the cognitive appraisals of certainty and control and choice and valuation



Note. We understand that the appraisal of valuation and choice does not always represent a spectrum. This diagram is only created to visualize the approximate differences between the emotions in terms of the aforementioned cognitive appraisals.

Table 6-1 Cognitive appraisal dimensions associated with the emotions

	Anger	**Disgust**	**Sadness**	**Fear**

Appraisal Dimensions				
Certainty	High	High	Medium/low	Low
Personal control	High	High	Low	Low
Valuation and choice	High valuation and reward seeking	Low valuation and disposal	High valuation and reward seeking	Low valuation and disposal

Note. The table is adapted from Ferrer et al., (2016). There are more dimensions associated with each emotion, however this table only displays the dimensions related to the research problem discussed in this paper.

6.2 Research problems and hypotheses

As noted, the first research problem discussed in this paper intends to understand which cognitive appraisal, among the appraisals of choice and valuation and certainty and control associated with the target emotions, may impact the intention to reduce the consumption of SSBs, more than others. According to ATF, each emotion is associated with the appraisal of valuation and choice, which influences the likelihood of specific courses of actions. For instance, sadness, which is associated with the core appraisal of loss, is shown to provoke reward seeking behaviour to compensate for the perceived loss, even in the presence of risk (Lazarus, 1991; Lerner et al., 2013; Raghunathan & Pham, 1999), or fear, which is associated with the core appraisal of being threatened, is associated with risk-aversion, hesitancy, and the disposal of risk-seeking behaviours (Rivers et al., 2008). These findings are in line with previous research that indicate each emotion is associated with a specific behavioral tendency (e.g., (Frijda, 1988; Lazarus, 1991; Roseman et al., 1994; Scherer, 1999; Scherer, 2001). Consequently, it is very plausible that the appraisal of valuation and choice is more prominent in determining subsequent choices. Indeed, previous findings suggest that the appraisal of valuation and choice is more prominent in determining subsequent decisions even in the presence of risk. For instance, Lerner & Keltner (2001) showed that angry individuals are more likely to show reward seeking behavior in the presence of risk compared to fearful individuals. Similarly, the findings from Raghunathan & Pham (1999) suggest that sadness, which is associated with reward seeking tendencies, is more likely to lead to picking high risk/high rewards options compared to low risk/low reward options. These findings suggest that although anger and sadness are different in terms of the cognitive appraisals of certainty and personal control (with anger being high on these appraisals and sadness

being low), both emotions showed reward seeking behavior in the presence of perceived risk, as if the perception of risk had less influence in subsequent choices/behaviors. Similarly, fear and disgust are associated with low and high levels of certainty and personal control appraisals, respectively. Nevertheless, several studies have shown that priming subjects with disgust and fear lead to disposal and hesitancy tendencies (Ferrer et al., 2016; Han et al., 2012; Morales et al., 2012). Therefore, we hypothesize that the appraisal of valuation and choice (i.e., reward seeking vs. disposal tendencies) is more influential in propelling subsequent decisions, in the presence of risk, compared to the appraisals of certainty and personal control. More specifically, we hypothesize that:

> H1: Priming the subjects with emotions associated with disposal tendencies (i.e., disgust and fear) would increase their intention to reduce the consumption of SSBs significantly more, compared to priming them with emotions associated with reward seeking tendencies (i.e., sadness and anger).

The second research question that this work intends to investigate is whether the interaction between choice and reward seeking and the certainty and control appraisals associated with an emotion influences the effectiveness of health messages regarding the consumption of SSBs. In an extensive review of the literature So et al., (2015) indicate that the interaction of two or more cognitive appraisals (as opposed to just one appraisal) may be a more accurate predictor of subsequent judgement and decisions. For instance, Agrawal et al., (2013) showed that the interaction between the agency and valence appraisals associated with emotions influences the preference for consistent vs. inconsistent information.

As noted, according to ATF, the valuation and choice appraisal is a strong predictor of how individuals make choices (Ferrer et al., 2016; Lerner et al., 2007). That is, the ATF posits that emotions associated with reward seeking tendencies are more likely to motivate making choices associated with perceived rewards (e.g., hedonic food consumption); whereas, emotions associated with low valuation and disposal are more likely to motivate the disposal of choices that are perceived to be threatening. Consequently, emotions that are associated with low valuation and disposal tendencies are more likely to lead to a higher intention to decrease the consumption of SSBs; whereas, emotions associated with reward seeking tendencies are more likely to have the opposite effect. On the other hand, previous research has identified perceived risk as a prominent predictor of adherence to an advised health

behavior (O'Brien et al., 1995; Rosenstock, 2000). That is, higher perceived risk associated with a behavior results in a lower intention to engage in that behavior. As such, emotions that can influence risk perception are likely to impact health decisions involved with risk (Lerner & Keltner, 2001). As noted, Slovic (1987) showed that the perception of risk is related to the cognitive appraisals of perceived personal control and certainty. The findings from other studies also confirm their conclusions. For instance, Lerner & Keltner (2001) demonstrated that anger, which is associated with higher levels of certainty and personal control appraisals, leads to optimistic risk perception (i.e., lower perceived risk); whereas, fear, which is associated with lower levels of certainty and personal control appraisals, leads to a pessimistic risk estimate (i.e., higher perceived risk). Consequently, emotions that are associated with lower levels of certainty and personal control appraisals (i.e., higher perception of risk) are more likely to increase the intention to attend to an advised health behavior, compared to the emotions that are associated with lower levels of certainty and control appraisals[2].

Considering the aforementioned findings, we hypothesize that the interaction between the appraisals of valuation and choice (associated with reward seeking/disposal tendencies) and certainty and personal control (associated with perceived risk) may have competing/reinforcing effects on the intention to reduce the consumption of SSBs. That is, we hypothesize that for emotions that are characterized by disposal and hesitancy tendencies (e.g., fear and disgust), a lower perceived personal control and certainty (i.e., higher perceived risk associated with fear) would reinforce the disposal and hesitancy tendencies towards the consumption of SSBs; whereas, higher levels of perceived certainty and control (i.e., lower perceived risk associated with disgust) would moderate the hesitancy and disposal tendencies towards the consumption of SSBs. On the other hand, for emotions that are associated with reward seeking appraisal (i.e., sadness and anger), a higher perceived personal control and certainty (i.e., lower perceived risk associated with anger) would reinforce the reward seeking tendencies towards the consumption of SSBs; whereas lower levels of perceived certainty and control (i.e., higher perceived risk associated with sadness) would moderate the reward seeking tendencies towards the consumption of SSBs. More specifically, we hypothesize that:

[2] As noted, given that each of the emotions was associated with similar degrees of certainty and personal control appraisals, we combined the certainty and personal control appraisals, in the interest of the simplicity of the analysis.

H2 a: Fear (associated with lower levels of certainty and personal control appraisals and disposal tendencies) would significantly increase the intention to reduce the consumption of SSBs compared to the neutral condition.

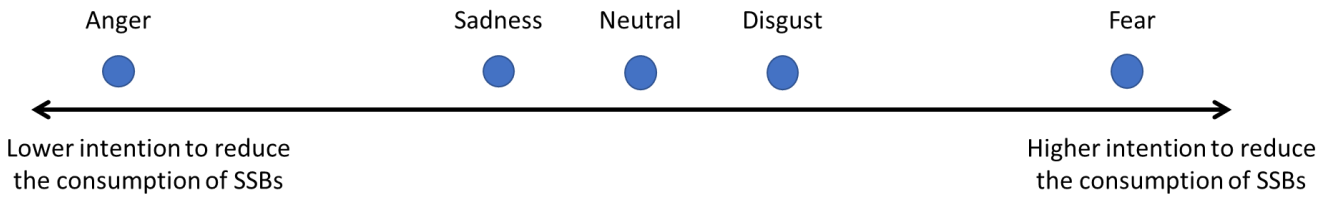
H2 b: Disgust (associated with higher levels of certainty and personal control appraisals and disposal tendencies) would not significantly increase the intention to reduce the consumption of SSBs compared to the neutral condition (as opposed to fear).

H3 a: Anger (associated with higher levels of certainty and personal control appraisals and reward seeking tendencies) would significantly decrease the intention to reduce the consumption of SSBs compared to the neutral condition.

H3 b. Sadness (associated with lower levels of certainty and personal control appraisals, and reward seeking tendencies) would not significantly decrease the intention to reduce the consumption of SSBs compared to the neutral condition (as opposed to anger).

Please see Figure 6-2 that visualizes Hypothesis 2 and 3.

Figure 6-2 Visualizing H2 and H3



6.3 Method

6.3.1 Participants, Procedures, and Materials

The minimum number of participants to meet an 80% power considering a small effect size (0.14) was calculated at 305, using G-Power 3.1.9.7 (*University of Düsseldorf: G*Power*.), Subsequently, 440 participants were recruited from the Amazon Mechanical Turk (MTurk) (*Amazon Mechanical Turk.*). The eligibility criteria for recruiting the participants were to be older than 18 years old, residing in the US, and having a 95% approval rate on MTurk (the approval rate represents the portion of the previous tasks/surveys that were approved). Besides, the participants could only start the survey if they were

consuming four or more than four sugar-sweetened drinks per week. We added this condition to ensure that the participants would find the health messages relevant. However, 48 participants either failed the attention-check question or did not properly engage in the emotional induction task. So, the final number of participants included in the analysis was 392 (M_{Age} = 38.01, SD = 11.35, M_{BMI} = 26.21, SD = 6.83). Table 6-2 displays a summary of the other demographic characteristics of the participants.

Table 6-2 Demographic characteristics of the participants

	Total	
Education	N	%
Completed some high school	1	0.3
High school graduate	23	5.9
Completed some college	57	6.8
Associate degree	48	5.7
Bachelor's degree	158	18.7
Completed some postgraduate	20	2.4
Master's degree	77	9.1
Ph.D., law, medical degree, or other advanced degree beyond a Master's degree	8	0.9
Household income		
Less than $25,000	38	9.7
$25,000 to $34,999	64	16.3
$35,000 to $49,999	68	17.3
$50,000 to $74,999	101	25.8
$75,000 to $99,999	66	16.8
$100,000 to $149,999	41	10.5
$150,000 or more	14	3.6
Gender		
Male	185	47.2
Female	205	52.3
Different identity	2	0.5
Ability to make ends meet		
Very difficult	23	5.9
Difficult	68	17.5
Neither easy or difficult	125	32.1
Easy	107	27.5
Very easy	66	7.8

Health Status		
Very good	56	14.4
Good	192	49.2
Fair	106	27.2
Poor	27	6.9
Very poor	9	2.3

After starting the survey, the participants were asked to indicate their baseline level of SSBs consumption (Please see Figure 6-3), and then they were randomly assigned to one of the five conditions (i.e., fear, disgust, sadness, anger, or the neutral condition).

To induce the target emotions including happiness, fear, sadness, anger, and disgust, we utilized two validated methods including the use of static images (Siedlecka & Denson, 2019) and the method validated by Lerner & Keltner (2001) and Smith & Ellsworth (1985). Subsequently, 20 images were selected from royalty free websites for each target emotion (total of 100 images for the five emotional groups). Then a group of 15 graduate students were asked to rank the images in each emotional group from 1 (not at all induces the target emotion) to 5 (very much induces the target emotion). An average score was calculated for each image in each emotional group and five images with the highest score were selected for each of the emotional groups. For the neutral condition, five simple blank images were chosen.

Next, the participants were presented with the five images in each emotional group and were asked:

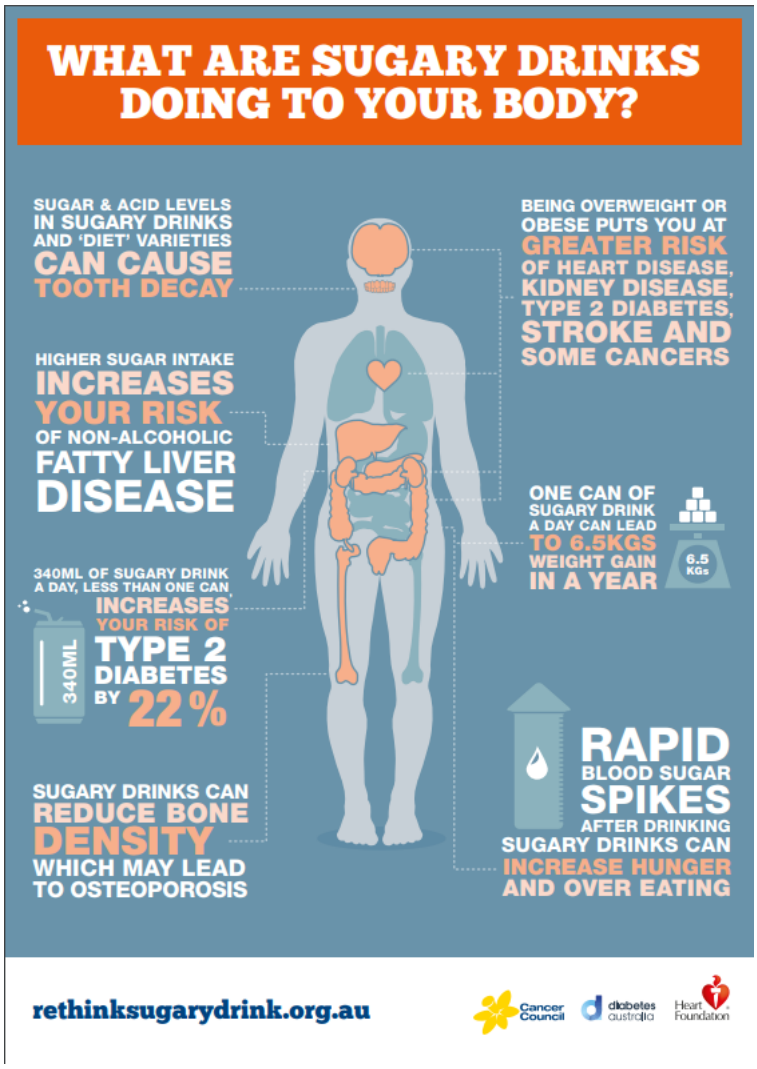
"Of the following images, which one makes you feel the most fearful/sad/angry/disgusted/neutral?".

The reason for including this question was so that participants would look at all the images and pick one that was more relatable to the target emotion from their perspective. Next, utilizing the method validated by Lerner & Keltner (2001), the participants were asked to described 4–5 things that would make them very fearful/sad/angry/disgusted, or they feel neutral towards. And then, they were asked to "write an essay (at least 10 sentences) about one situation that makes you or has made you very fearful (sad/angry/disgusted). Please write it in such detail that someone would feel fearful (sad/angry/disgusted) just from reading it". The participants in the neutral condition were asked to

write about a normal daily event that happened yesterday. The participants were informed that they would receive a bonus if they respond to the aforementioned questions.

Then, the participants were presented with the following poster adopted a well know health campaign aimed at reducing SSBs consumption from (*Rethink sugary drink*). (Please see Figure 6-3). Finally, the participants were asked to respond to a series of questions regarding the dependent and control variables.

Figure 6-3 The poster adopted from (*Rethink sugary drink*)



6.3.2 Measures

In the beginning of the survey, the participants were presented with the examples of what would be considered as a sugar-sweetened beverage, and then were asked to indicate their current consumption of SSBs through a single item question adapted from VanEpps & Roberto (2016). Please see Figure 6-4.

Figure 6-4 The question presented to the participants to measure their SSBs consumption

Sugar-sweetened drinks (sugary drinks) refer to any beverages with added sugar or other sweeteners such as high fructose corn syrup, dextrose, fructose, sucrose, fruit juice concentrates, Aspartame, Neotame, Saccharin, etc. These drinks include a wide range of beverages such as pop, soda, energy drink, tonic, fruits juice with added sugar, etc.

Any drink similar to the following is considered a sugar-sweetened drink (sugary drink):

During the LAST WEEK, how many drinks with added sugar did you have, such as pop, fruit drinks, sports drinks, vitamin waters, energy drinks and specialty coffees? Do NOT count sugar-free drinks. Do NOT include today. (Please write it in numbers only)

After the emotional induction task, the intention to decrease the consumption of SSBs was measured through the following single item question adapted from (VanEpps & Roberto, 2016).

"On a scale from 1 (not at all likely) to 7 (very likely), how likely are you to decrease your consumption of sugary drinks to 1 bottle or less per week, during the next two weeks?"

Participants were also surveyed about a few other questions such as their perceived susceptibility to the consequences of SSBs consumption, perceived difficulty of reducing their SSBs

consumption, and their attitude towards SSBs, among other questions. However, these variables were not analyzed as part of this work. Please see Appendix C-2 to review the survey.

Immediately after responding to these questions, participants were asked to respond to the following questions to test the emotional manipulation methods:

Please indicate which emotions (if any) you felt after writing the essay, and to what degree? (Please see Figure 6-5)

Figure 6-5 Testing emotional manipulation

Please indicate which emotions (if any) you felt after writing the essay, and to what degree?

	(1) Not at all	2	3	4	5 (Very much)
Fear	○	○	○	○	○
Anger	○	○	○	○	○
Sadness	○	○	○	○	○
Disgust	○	○	○	○	○

In order to control for trait anger and anxiety and dispositional disgust, participants completed the trait anxiety (Spielberger, 1983) and anger scales (Spielberger, 2010), besides the scales regarding dispositional disgust (Haidt et al., 1994). Also, an adapted version of the self reported measure of depression was utilized to control for dispositional feeling of sadness or other negative moods (Haroz et al., 2014). We included all the scale's statements in the survey except for the statement "I wish I were dead" due to ethical reasons. These scales were used to control for the potential individual differences in the intensity of the target emotions felt by the participants.

The participants were also asked to respond to the health locus of control scale (Norman et al., 1998) to control for the potential differences between their perceived control over their health. The participants were also surveyed about their demographic background such as age, gender, current health status, education, income, etc., displayed in Appendix C-2.

6.4 Analysis and Results

In order to check the emotional manipulation, participants were asked to indicate to what degree they felt any of the studied emotions (i.e., fear, sadness, anger, disgust) from 1 (not at all), to 5 (very much) after seeing the images and writing the essay. An Analysis of Variance (ANOVA) conducted on the emotional manipulation check confirmed that the target emotion was felt significantly more compared to any of the other studied emotions, in each of the emotional groups ($\alpha = 0.05$). For instance, anger was reported to be felt significantly more compared to sadness, disgust, fear, and happiness ($p < .001$), in the *anger* group. However, there was no significant difference between the emotions in the neutral condition.

A series of Analyses of Variance showed that there was no significant difference between 1- the participants' baseline level of SSBs consumption, 2- demographic variables, and 3- control variables among the different conditions. Furthermore, a set of bivariate and logistic correlations were conducted to determine if any of the aforementioned variables is correlated with the intention to decrease the consumption of SSBs. The results showed that the intention to decrease the consumption of SSBs was significantly correlated with the participants' health value scale $r(390) = .131$, $p = .009$ and health status $r(389) = -.167$, $p < .001$, trait anger score $r(385) = -.106$, $p = .038$, and depression score $r(384) = -.11$, $p = .031$. There was no other significant correlation between the dependent variable and any other control/demographic variables or the baseline consumption.

6.4.1 Intention to decrease the consumption of SSBs

An analysis of covariate while controlling for the trait anger, depression, health status, and health value scale showed a main effect of emotions on the intention to decrease the consumption of SSBs $F(4, 364) = 15.687$, $p < .001$, partial $\eta^2 = .147$.

The results confirmed hypothesis 1 which stated that participants in fear (covariate-adjusted means: $M_{adj} = 5.454$; $SE = .151$) and disgust ($M_{adj} = 5.322$; $SE = .158$) conditions were significantly more likely to intend to decrease their consumption of SSBs, compared to the participants in sadness ($M_{adj} = 4.248$; $SE = .156$), and anger ($M_{adj} = 4.063$; $SE = .160$) conditions. However, there was no significant difference in the intention to decrease SSBs consumption between the sadness and anger conditions ($p = 1$) or between fear and disgust conditions ($p = 1$). Table 6-3 shows the *p*-values

associated with the differences in the intention to decrease the consumption of SSBs between the conditions

The posthoc analysis using Benferonni correction showed that the participants in the fear condition (M_{adj} = 5.454; SE = .151) had a significantly higher intention to reduce the consumption of SSBs compared to the neutral condition (M_{adj} = 4.740; SE = .158) (p =.013); whereas, there was no significant difference between disgust and neutral condition (p =.096) and that the intention to reduce the consumption of SSBs was only marginally higher in the disgust condition compared to the neutral condition. The results confirmed hypothesis 2a that indicated that priming the subjects with fear, which is associated with lower levels of certainty and personal control appraisals and disposal tendencies, would significantly increase their intention to reduce the consumption of SSBs compared to the neutral condition. Similarly, hypothesis 2b was confirmed that stated that priming the subjects with disgust, which is associated with higher levels of certainty and personal control appraisals and disposal tendencies, would not significantly increase their intention to reduce the consumption of SSBs compared to the neutral condition.

Similarly, the posthoc analysis using Benferonni correction showed that the participants in the anger condition had a significantly lower intention to reduce the consumption of SSBs compared to the neutral condition (p =.028); whereas, there was no significant difference between sadness and neutral conditions (p =.269) and that the intention to reduce the consumption of SSBs was only marginally lower in the sadness condition compared to the neutral condition. Tale 6-3 displays the p-values associated with the differences between the conditions. The results also confirmed hypothesis 3a that indicated that priming the subjects with anger, which is associated with higher levels of certainty and personal control appraisals, and reward seeking tendencies, would decrease their intention to reduce the consumption of SSBs significantly more compared to the neutral condition. Similarly, Hypothesis 3b was confirmed which stated that priming the subjects with sadness, which is associated with lower levels of certainty and personal control appraisals, and reward seeking tendencies, would not significantly decrease their intention to reduce the consumption of SSBs compared to the neutral condition.

Table 6-3 Comparison between the p-values of the differences between the conditions

	Anger	Sadness	Fear	Disgust	Neutral
Anger		p=1	p<.001	p<.001	p=.028
Sadness			p<.001	p<.001	p=.269
Fear				p=1	p=.013
Disgust					p=.096
Neutral					

Consistent with the first hypothesis, the results showed that priming the subjects with fear and disgust motivated them to have a significantly higher intention to reduce the consumption of SSBs, compared to sadness and anger (p<.001). Furthermore, as predicted, the findings show that the interaction between the appraisal of valuation and choice and the appraisals of certainty and control can reinforce/moderate the effectiveness of messages regarding SSBs consumption. More specifically, the findings showed that between fear and disgust which are associated with disposal and hesitancy tendencies, fear that is associated with low levels of certainty and control appraisals (i.e., higher perceived risk) enhanced the effectiveness of health messages regarding the consumption of SSBs compared to the neutral condition. Whereas disgust, which is also associated with disposal and hesitancy tendencies but is higher on the certainty and control appraisals (i.e., associated with a lower perceived risk), only marginally increased the effectiveness of health messages regarding the consumption of SSBs compared to the neutral condition, but not to a significant level. On the other hand, the findings showed that between sadness and anger which are both associated with reward seeking behaviors, anger that is associated with higher levels of certainty and control appraisals (i.e., lower perceived risk) significantly reduced the effectiveness of health messages regarding the consumption of SSBs compared to the neutral condition. Whereas, sadness that is lower on the certainty and control appraisals (i.e., associated with a higher perceived risk) did not significantly influence the effectiveness of the health messages regarding the consumption of SSBs, compared to the neutral condition.

6.5 Discussion

This work investigated how integrating the emotions of sadness, fear, anger, and disgust with health information regarding the negative consequences of SSBs consumption can influence the audience's intention to decrease the consumption of SSBs.

The findings from this study confirms the existing evidence that the emotional state of an audience can influence subsequent health decisions (Ferrer et al., 2016). Previous work had identified several cognitive appraisals associated with emotions that can influence nutrition decisions, including the certainty and personal control appraisals and the valuation and choice appraisal. This study extended the existing literature by investigating if any of these appraisals associated with an emotion is more influential in encouraging the audience to reduce SSBs consumption. The findings showed that among these appraisals the valuation and choice appraisal is more influential in propelling subsequent nutrition decisions compared to the certainty and personal control appraisals. That is, emotions such as fear and disgust, which have varying degrees of certainty and personal control appraisals but both are associated with disposal tendencies, can significantly increase the intention to reduce the consumption of SSBs, compared to the emotions such as anger and sadness, that are associated with varying degrees of certainty and control cognitive appraisals but are characterized by reward seeking behavior.

In addition, in line with previous findings that indicated that the interaction between cognitive appraisals associated with emotions can be a more accurate predictor of subsequent judgment and decisions (So et al., 2015), the findings from this work extended the existing literature and showed that the certainty and control appraisals and the appraisal of choice and valuation, associated with an emotion, can reinforce or moderate each other's effects on the intention to reduce the consumption of SSBs. More specifically, the findings showed that in fear and disgust that are characterized by disposal and hesitancy tendencies, the lower levels of certainty and personal control appraisals associated with fear would reinforce the disposal tendencies towards the consumption of SSBs; whereas, higher levels of the certainty and personal control appraisals associated with disgust would moderate the disposal tendencies towards the consumption of SSBs. On the other hand, in sadness and anger which are associated with reward seeking appraisal, higher levels of personal control and certainty appraisals associated with anger would reinforce the reward seeking tendencies by reducing the intention to reduce

the consumption of SSBs; whereas, lower levels of certainty and personal control appraisals associated with sadness would moderate the reward seeking tendencies towards the consumption of SSBs.

The findings presented in this work have important practical implications in health promotion. Research in health communication has explored how information provision methods and various forms of warnings can persuade people to consume less amount of SSBs (e.g., (Billich et al., 2018; Grummon & Hall, 2020; Miller, 2002; VanEpps & Roberto, 2016). However, there has been less emphasis on exploring how integrating emotions with health messages may influence the consumption of SSBs. Our findings showed that eliciting emotions such as anger along with health warnings regarding the consumption of SSBs in a target audience can have a negative impact on the intention to reduce the consumption, compared to presenting the health warning alone. Therefore, health promotors should make sure that unwanted emotions such as anger are not unintentionally elicited through using various means (e.g., graphical images) along with health messages. For instance, sometimes using a disgusting image may annoy the audience and make them angry, and ultimately motivate hedonic consumption of SSBs. On the other hand, we showed that although both disgust and fear can increase the intention to reduce the consumption of SSBs, eliciting fear along with health warnings regarding the consumption of SSBs is more influential in motivating the audience to reduce consumption. Furthermore, considering that our results showed that fear enhances the effectiveness of health warnings regarding SSBs and that disgust is as effective as the health warnings, utilizing other means of communication such as images on the SSBs' packages, instead of texts, may be an effective way to discourage consumption.

6.6 Limitation

Limitations provide important opportunities to extend the current findings. This study only investigated the *intention* to decrease the consumption of SSBs through a single item question, so a potential future step would be to study this research question in a more realistic setting with follow up studies. Although we tried to control for a variety of variables in order to concisely measure our dependent variables, we acknowledge the fact that dietary decisions are more complex than our controlled study allowed to investigate. Moreover, we understand that inducing certain emotions in a target audience in practical settings may not be as easy as in a controlled environment. So, a potential future direction could be to investigate how to effectively induce emotions and incorporate emotions and health messages in

practice to design more persuasive health messages. Furthermore, we acknowledge that we only investigated the impact of the cognitive appraisals of valuation and choice, certainty, and control associated with an emotion on the intention to reduce the consumption of SSBs. However, other cognitive appraisals such as valence, perceived difficulty, temporal discounting, information processing, etc. associated with emotions may also play a role in how emotions interact with health messages. This remains an important question to be explored in future research.

Chapter 7
Conclusion

7.1 Overview

A growing body of research suggests that health promotion and intervention plans that are based on research findings in social and behavioral science are more effective than those that don't follow a theoretical base (Glanz & Bishop, 2010). Therefore, utilizing behavioral science is crucial in the development and evaluation of effective health interventions and policies. In the last three decades, behavioral science has made significant contributions to understanding how affective states influence subsequent judgement, decisions, and behaviors (Ferrer et al., 2016; Keer et al., 2010a). Recent emotional theories and research findings suggest that emotions can affect judgement and decisions in a variety of ways such as influencing the way choice alternatives are perceived and evaluated, the depth of information processing, the direction of attention and memory, the judgement of risks/benefits, the motivation to take certain actions, etc. (Keer et al., 2010b; Lerner et al., 2007; Lerner et al., 2015; Loewenstein & Lerner, 2003; Mellers et al., 1997; Slovic et al., 2007). However, despite significant advancements in identifying the role of emotions in judgement and decisions in behavioral science, until recently, the cumulative progress in the comprehension and adaptation of emotional theories in the development and evaluation of behavioral health interventions has been very slow. That is, although recent research has tried to fill the gap between behavioral theories of emotions and health promotion research, particularly during the last decade, we believe the gap is still significant and requires extensive work to make a more concrete bridge between the two fields (Ferrer et al., 2016). This dissertation contributed to the current flow of the work that intends to create the bridge between the two fields to by presenting five independent studies that intend to investigate the role of affect and emotions on health decisions in several health domains, including cancer screening, vaccination, and nutrition.

7.2 Summary of key findings

This dissertation presented five independent studies that each investigated the role of emotions on health decisions.

Chapter 2 presented a comprehensive narrative review in which the role of emotions on health decisions was illustrated through explaining relevant emotional theories and providing health-related examples to demonstrate how these theories can be applied in health settings, in a structured way. Particularly, the narrative review provided an overview of the progression of various emotional theories over time, and explained how these theories are applied or can be utilized in health promotion. We highlighted the advances in the role of expected emotions on decisions, explained the valence-based and cognitive appraisals theories of emotions, and demonstrated how expected emotions, decision-related emotions, and incidental emotions can shape the emotions experienced at the time of decision-making (i.e., immediate emotions). Then, we discussed recent research findings to illustrate the mechanisms through which emotions affect subsequent judgement and decisions. Throughout the review, we demonstrated how these findings can inform more effective health intervention/promotion plans and policies. Indeed, the main contribution of this review is the integration of various pieces of research in a structured format to provide a framework to illustrate how emotional theories can be applied in health settings and also to highlight the existing gaps.

Chapter 3 presented study 2 that investigated how the overall emotional evaluation of a vaccine affects the judgement and decisions about the vaccine. Consistent with the prediction of feeling-as-information hypothesis (Schwarz, 1990), utilizing structural equation modeling, we showed that how a person *feels* about a vaccine influences the intention to vaccinate both directly and also indirectly through changing the perception of risks and benefits of the vaccine. To the best of our knowledge, this work was the first research that showed *how* emotions influence the intention to vaccinate.

In Chapter 4, which presented study 3, we investigated the role of the emotion of embarrassment on the intention for mammography. Although there were validated scales to measure breast cancer worry or fear, to the best of our knowledge, there was no prior scale to measure breast cancer screening embarrassment, and so a substantial contribution of this work was the development of a scale to measure mammography embarrassment. The scale was developed through a comprehensive review of the literature and consultation with experts. The scale showed significant concurrent validity and construct validity with established questionnaires such as General Medical Embarrassment (Consedine et al., 2007) and Susceptibility to embarrassment questionnaires (Kelly & Jones, 1997), the participants' past behavior, and their intention for breast cancer screening,

respectively. In relation to contributions to bridging the fields of behavioral science and health promotion, the mammography embarrassment scale developed in this work can be utilized in future studies to better comprehend breast cancer screening behavior. Furthermore, consistent with previous qualitative findings that had identified embarrassment as a mental barrier to mammography (e.g., (Azami-Aghdash et al., 2015; Hanson et al., 2009)), our work confirmed that mammography embarrassment is significantly correlated with previous screening behaviour and the intention to undergo a mammogram in the future. So, this study was one of the first quantitative studies that contributed to the understanding of the critical impact of the emotion of embarrassment in breast cancer screening behavior.

Chapter 4 presented study 4, which utilized a 2 (loss- and gain- frames) X 5 (emotions: happiness, sadness, fear, disgust, and anger) factorial design, explored whether the relative persuasiveness of a gain- versus loss-framed message regarding fruits and vegetables consumption would depend upon the emotional state of the recipient of the message. A growing body of literature investigates the specific characteristics of the recipient of a message that can impact the effectiveness of gain- vs. loss appeals (Rothman et al., 2006). Indeed, the findings of this study provided further support that the effectiveness of message framing depend not only on the type of behavior recommended in a message, but also on the emotional state of the recipient of the message. Particularly, the findings of this study showed a significant interaction of message framing by the emotional states of the recipient of the message. That is, gain-framed messages were more persuasive when the audience were primed with the emotions of happiness, anger, and sadness; whereas, loss-framed messages were more effective when the audience were primed with fear and disgust. Utilizing the appraisal tendency framework (Han et al., 2007) and comparing the findings of this study with previous similar studies (Ferrer et al., 2016; Gerend & Maner, 2011), we suggested that the emotions that are associated with reward seeking appraisals can enhance the effectiveness of gain-farmed appeals; whereas, the emotions that are associated with hesitancy and disposal tendencies are more effective in enhancing the loss-framed appeals. That is, findings from the present study showed that the persuasiveness of a framed health message varies as a function of people's current emotional state, even when emotions are incidental to the decision at hand. Furthermore, the findings from this study showed a significant main effect of emotions on the intention to engage in the advised health behavior (i.e., increasing the consumption of fruits and vegetables). That is, our results showed that the participants primed with

happiness and fear were significantly more likely to intend to increase their consumption of fruits and vegetables compared to the participants who were primed with sadness, anger, or disgust. Although, the design of this study did not allow us to further investigate these results in terms of message effectiveness, this finding provides further support regarding the impact of emotional states of an audience on the effectiveness of health messages; moreover, it provides a valuable springboard for investigating this research problem in future research.

With the intention to further explore the main effect of emotions on the effectiveness of health message, study 5, presented in Chapter 6, investigated the role of the emotions of sadness, fear, disgust, and anger on the effectiveness of health messages regarding the consumption of sugar-sweetened beverages (SSBs). More specifically, this study which utilized a randomized between subject design (four emotional conditions including sadness, fear, disgust, and anger and a neutral condition) and employed the Appraisal Tendency Framework (Han et al., 2007) as a lens, to investigate the cognitive appraisal dimensions associated with the emotions that influence the effectiveness of health messages regarding the consumption of SSBs. The findings showed that the emotions that are characterized by disposal tendencies (i.e., fear and disgust) generally increase the intention to reduce the consumption of SSBs compared to the emotions that are characterized by reward seeking tendencies (i.e., sadness and anger). Furthermore, in line with previous findings that indicated that the interaction between cognitive appraisals associated with emotions can be a more accurate predictor of subsequent judgment and decisions (So et al., 2015), the findings from this work extended the existing literature and showed that the certainty and control appraisals and the appraisal of choice and valuation, associated with an emotion, can reinforce or moderate each other's effects on the intention to reduce the consumption of SSBs. More specifically, the findings showed that between fear and disgust which are associated with disposal and hesitancy tendencies, fear that is associated with low levels of certainty and control appraisals (i.e., higher perceived risk) enhanced the effectiveness of health messages regarding the consumption of SSBs compared to the neutral condition. Whereas disgust, which is also associated with disposal and hesitancy tendencies but is higher on the certainty and control appraisals (i.e., associated with a lower perceived risk), only marginally increased the effectiveness of health messages regarding the consumption of SSBs compared to the neutral condition, but not to a significant level. On the other hand, the findings showed that between sadness and anger which are both associated with reward seeking behaviors, anger that is associated with higher levels of certainty and control appraisals

(i.e., lower perceived risk) significantly reduced the effectiveness of health messages regarding the consumption of SSBs compared to the neutral condition. Whereas, sadness that is lower on the certainty and control appraisals (i.e., associated with a higher perceived risk) did not significantly influence the effectiveness health messages regarding the consumption of SSBs, compared to the neutral condition.

7.3 Implications of the research findings in health promotion

The most important take away message of this dissertation is articulating the significant impact that emotions have on health decisions. For instance, in study 1, we presented a detailed narrative review on the role of emotions on decisions, with a focus on health decisions, that can serve as a template framework to inform more effective health intervention/promotion plans. That is, this review clearly demonstrates the critical impact of the expected emotions associated with a health decision, the emotions that making a health decision may provoke in an audience, and the incidental emotions that the target audience may feel when making a health decision, on subsequent judgement and decisions. In addition, this review illustrates how these emotions can influence each other, and form the emotions that one experiences at the time of decision-making. Therefore, by leveraging the theories and the framework articulated in this review, health promotors may be able to plan and evaluate more effective health interventions. In addition, this review has provided many examples on how to apply/utilize these theories in practice that can inform more effective health intervention/promotion plans.

Study 2 demonstrated that the overall emotions towards a vaccine significantly influences the perception of risks and benefits of the vaccines, and also the decision to vaccinate. Therefore, the findings from study 2 convey the importance of the emotional evaluation of a vaccine on its acceptance. Given the growth of the vaccine hesitant population, the interventions that intend to increase vaccines' uptake can leverage available means (e.g., health messages, video clips, images, etc.) to influence how the target population *feels* about the vaccine, as opposed to only focusing on educating them about the benefits/risks associated with vaccines. Currently, many health interventions that intend to promote vaccination only focus on educating the target audience about vaccination (Jarrett et al., 2015). However, our findings show that increasing the emotional favourability of the vaccine may be more influential in persuading people to vaccinate. So, related interventions may also utilize various means such as images, narratives, music, videos, normalization, etc., to increase the emotional favourability of the vaccine.

The Mammography Embarrassment Scale (MES) developed in study 3 demonstrated the significant impact that mammography embarrassment has on the intention to adhere to mammography. Therefore, this scale can be utilized in health promotion planning to understand the extent to which mammography embarrassment acts as a mental barrier to breast cancer screening behavior, among other factors. In addition, the significant association between the MES score and the participants' past behavior and their intention to undergo a mammogram indicates the importance of providing an environment for women during mammography, in which they feel comfortable and not embarrassed. The findings of this research can inform more effective interventions/policies that address how women *feel* about/during a mammogram, in order to promote breast cancer screening.

Study 4 extended the previous research regarding the factors affecting the effectiveness of loss- vs. gain- framed messages (e.g., (Bosone & Martinez, 2017; Cheng & Wu, 2010; Druckman, 2001; Malenka et al., 1993)) by showing that emotional state of the recipient of the message has a significant influence on the effectiveness of loss- vs. gain- framed messages. That is, we showed that framing effects can be moderated by the audience's current emotional state, with fearful and disgusted participants being more persuaded by a loss-framed message, and angry, sad, and happy participants being more persuaded by a gain-framed message. The findings revealed how to best combine emotions with framed-messages to enhance their effectiveness. Understanding the impact of incidental emotions on the effectiveness of framed appeals has important practical implications for the development of more effective health communication methods in various health settings. For instance, in medical settings, being diagnosed with a health problem could induce pervasive emotions in patients which, in turn, could influence how they respond to forthcoming health recommendations. Findings from this study shed light on how to best frame health recommendations such that patients adhere to health recommendations.

Furthermore, the findings showed that happiness is as effective (if not more) in encouraging the audience to attend to an advised health behavior as other negative emotions such as fear. Therefore, given the ethical consideration of the potential negative consequences of incorporating negative emotions such as fear or disgust in health interventions (Guttman & Salmon, 2004; Lupton, 2015), and that happiness is as equally effective to motivate the target audience to attend to the advised health

behaviors, incorporating and utilizing happiness as an incidental emotion in health interventions may be more suitable to promote certain health behaviors.

Relatedly, Study 5 showed that emotional state of an audience can significantly influences their subsequent health decisions. That is, the findings from study 5 indicated that emotions such as anger and sadness can negatively impact the intention to reduce the consumption of Sugar Sweetened Beverages (SSBs) compared to emotions such as fear and disgust. Furthermore, the findings suggested that eliciting emotions such as anger can even decrease the effectiveness of health warnings regarding the consumption of SSBs. On the other hand, we showed that although both disgust and fear can increase the intention to reduce the consumption of SSBs, eliciting fear along with health warnings regarding the consumption of SSBs is more influential in motivating the audience to reduce consumption, compared to eliciting disgust. In general, the results of this work can inform how to effectively integrate emotions and health warnings to enhance the effectiveness of health messages regarding SSBs consumption.

Indeed, findings from both study 4 and 5 can inform the development of more compelling health interventions by providing solid evidence on which incidental emotions may be more persuasive in combination with the forthcoming health messages.

7.4 Limitations and future work

The limitations of the current studies can outline future directions to further investigate the research problems discussed in this dissertation.

Chapter 2 presented a narrative review on the role of emotions on health decisions. However, due to the qualitative nature of the review and the vast literature that explores the role of emotions on judgement and decisions, the narrative review may have not fully captured the all the relevant literature with the rigor of systematic reviews, and hence the review is definitely affected by the authors' biases built into the selected theories, narratives, framing, examples and conclusions. We intentionally only illustrated more prominent and prevailing findings and theories such as the affect transfer theory, affect-as-information hypothesis, the cognitive appraisals theories of emotions, etc. Furthermore, due to the long (four decades) span of the materials, the health applications we discussed were very selective; for instance, we intentionally restricted ourselves to one or two work that studied the application of a given

behavioral finding in the health domain. However, the purpose of a narrative review is to provide an overview of the field with the intention to deepen the understanding of complex concepts in the field and illustrating the relationships between various findings, which is what this review has delivered.

Chapter 3 presented study 2 that was done based on a hypothetical scenario; therefore, the participants did not have exiting beliefs about the vaccine. So, a possible future work of this study is to explore how the affective impression of a real vaccine plays a role in vaccination decisions where people may hold existing beliefs and attitudes towards the vaccine. In addition, this study only utilized information provision to change the participants' emotional states toward a vaccine. A potential next step could be to investigate how other means of communications such as images, personal narratives, videos, etc. may affect the decision to vaccinate. Furthermore, this work only investigated the *overall* affective impression of the vaccine on vaccination decisions; that is, we only explored the degree to which positive or negative emotional evaluation of a vaccine affect the intention to vaccine. However, a possible future direction could be to study the effect of discrete emotions such as compassion, guilt, fear, anger, worry, etc. on vaccination decisions.

Chapter 4 presented study 3 in which purposive sampling was employed to recruit eligible women who had diverse breast cancer screening behavior, but we were unable to recruit an equal number of participants who had and had not gone through mammograms before. As such, the comparison between the participants' past screening behavior and their Mammography Embarrassment Score (MES) was limited. Furthermore, the design of the research did not allow us to control for the participants' previous diagnosis of breast cancer. However, given that the scale showed both construct and concurrent validity against other measures, the scale provides solid validity to be utilized in future research and related health interventions. As noted, this study was also one of the first to contribute evidence regarding the critical impact of the emotion of embarrassment in breast cancer screening behavior.

Study 4 and 5 followed a relatively similar study methodology in the domain of nutrition. Therefore, they share similar limitations. Similar to other studies presented in this dissertation, these two studies only measured the intention to engage in the advised behaviors (i.e., increasing fruits and vegetables consumption or decreasing the consumption of SSBs). Subsequently, we acknowledge that there might be differences in the extent to which the subjects may follow their intention to engage in

the advised behaviors. Furthermore, although both of these studies followed a systemic and controlled test of hypotheses, in which we controlled for several variables such as the participants' current health status, demographic backgrounds, certain health beliefs, etc., we acknowledge that changing dietary behavior is inherently more complex than our study design allowed. Therefore, an important future direction is to investigate these research problems in a more realistic setting in which the actual behavior can be observed and measured through a longitudinal study design.

In addition, our findings from study 4 showed a main effect of emotions on the intention to increase the consumption of fruits and vegetables. That is, the results revealed that fear (and happiness) led to a significantly increased intention to engage in the advised health behavior, compared to disgust, sadness, and anger. Whereas, the results from study 5 indicated that fear, and disgust led to a higher intention to decrease the consumption of SSBs, compared to the neutral, anger, and sadness conditions. We understand that the fact that these studies were conducted independently and that they had different designs limit us in understanding why disgust had opposite impacts on the intention to attend to the advised health behavior, in these two studies. This difference could be due the difference in the nature of the advised behaviors in the two studies. That is, in one study we encouraged the audience to adopt a behavior that they were not already doing (i.e., to increase the consumption of fruits and vegetables); whereas, in the other one, we discouraged the audience from continuing a behavior that they were already doing (i.e., to decrease the consumption of SSBs). Nevertheless, this remains an important question for future research, and the current findings provides valuable insights on how to further investigate this research problem.

Furthermore, both of these studies only considered the impact of the cognitive appraisals of choice and valuation, certainty, and control, associated with the emotions, to investigate the effect of the target emotions on subsequent judgement and decisions. However, other cognitive appraisals such as the temporal focus, information processing, etc., associated with emotions, may also influence subsequent judgement and decisions. Therefore, an important future direction would be to include a broader range of cognitive appraisals associated with emotions to further explore and understand the effect of emotions on subsequent judgement and decisions.

In closing, this dissertation contributed to the comprehension of the effect of emotions on health decisions by reviewing various emotional theories and applying them in different health contexts.

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Chapter 1

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Chapter 2

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Chapter 3

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Chapter 4

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Chapter 7

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Appendix A: Supplementary materials for Chapter 3

Vaccine Survey

Start of Block: Eligibility question

Q1 Do you have any children?

- ○ No
- ○ Yes

End of Block: Eligibility question

Start of Block: Baseline Scenario

Q2 In the following page, you will be presented with information about a disease and its vaccine. **Please read the information very carefully as you will be asked to answer the subsequent questions based on what you have read.**

Page Break

Q3 **Please read this information carefully, you will be asked to answer subsequent questions based on this information.**

Public health agencies have identified a new virus that leads to **Respiratory Discoloration Disease (RDD)**.
The disease is highly contagious and is spread by coughing and sneezing, close personal contact, or direct contact with affected persons. In the following, more information about the RDD disease and its vaccine is described.

Symptoms:
The first sign of RDD is usually a high fever followed by a runny nose, a cough, red and watery eyes, and small white spots inside the cheeks can develop. After several days, the discoloration spreads, eventually reaching the hands and feet. This condition lasts for 5 to 6 days, and then fades. However, there are potential severe complications.

RDD's Complications:
The most serious complications include blindness, brain swelling, severe diarrhea and related dehydration problems, ear infection, or severe respiratory infections such as pneumonia. Most RDD-related deaths are caused by complications associated with the disease. Complications are more common in children under the age of 5, or adults over the age of 20.

Cure:
No specific treatment exists for RDD disease. However, there is a vaccine that protect the individuals from getting the disease.

Vaccination and its associated side effects:
A vaccine, like any other medication, is capable of causing serious health concerns, such as severe allergic reactions. However, the risk of RDD vaccine causing serious harm, or death is extremely small. Getting RDD vaccine is much safer than getting RDD. Most children who get RDD vaccine do not have any problems with it.
The following is the list of potential side effects:

Mild problems:

- Fever (up to 1 person out of 6)
- Mild rash (about 1 person out of 20)
- Swelling of glands in the cheeks or neck (about 1 person out of 75)
- If these problems occur, it is usually after 6-14 days after the vaccine shot

Moderate Problems:

- Seizure (jerking or staring) caused by fever (about 1 out of 3000 doses)
- Temporary pain and stiffness in the joints, mostly in teenage or adult women (up to 1 out of 4)
- Temporary low platelet count, which can cause a bleeding disorder (about 1 out of 30,000 doses)

Severe problems (very rare):

- Serious allergic reactions (less than 1 out of a million doses)
- Several other severe problems have been reported after a child gets this vaccine, including deafness, long-term seizures, coma, lowered consciousness, or permanent brain damage (very rare)

End of Block: Baseline Scenario

Start of Block: Dependent variables

Q5 In general, how beneficial do you think the RDD vaccine is?

- ○ Not at all beneficial
- ○ Minimally beneficial
- ○ Mildly beneficial
- ○ Moderately beneficial
- ○ Somewhat beneficial
- ○ Very beneficial
- ○ Extremely beneficial

Q6 In general, how risky do you think the RDD vaccine is?

- ○ Not at all risky
- ○ Minimally risky
- ○ Mildly risky
- ○ Moderately risky
- ○ Somewhat risky
- ○ Very risky
- ○ Extremely risky

Q7 This question measures your feelings about the RDD vaccine.
Please identify what you feel when you think about the RDD vaccine.

Please identify the degree to which the right or the left words describe how you feel about the RDD vaccine. If the right/left word accurately describes how you feel about the RDD vaccine, tick the

circle the closest to that word that reflects your feelings. If you do not have a strong feeling either way, tick the center point on the scale.

	1	2	3	4	5	6	7	
Beneficial	○	○	○	○	○	○	○	Harmful
Useful	○	○	○	○	○	○	○	Useless
Acceptable	○	○	○	○	○	○	○	Unacceptable
Good	○	○	○	○	○	○	○	Bad
Positive	○	○	○	○	○	○	○	Negative
Unpredictable	○	○	○	○	○	○	○	Predictable
Controllable	○	○	○	○	○	○	○	Uncontrollable
Known	○	○	○	○	○	○	○	Unknown
Unmanageable	○	○	○	○	○	○	○	Manageable

Familiar	○	○	○	○	○	○	○	Unfamiliar
Scary	○	○	○	○	○	○	○	Safe
Disturbing	○	○	○	○	○	○	○	Calming
Stressful	○	○	○	○	○	○	○	Relaxing
Worrying	○	○	○	○	○	○	○	Comforting

Q4 Imagine that you have a one-year old child, would you vaccinate your child with the RDD vaccine?

- ○ Yes, I would vaccinate my child
- ○ It is likely that I would vaccinate my child
- ○ I may or may not vaccinate my child
- ○ It is unlikely that I would vaccinate my child
- ○ No, I would not vaccinate my child

End of Block: Dependent variables

Start of Block: High benefit scenario

Q16 Further studies have provided new findings regarding the RDD disease and its vaccine. In the following page, you will be presented with a complementary piece of information. Please read it carefully, as you will be asked to answer similar questions based on this new extra piece of information.

Page Break

Q17 RDD vaccination is highly effective in protecting an individual from the RDD virus without causing the suffering of the sever consequences of the disease itself. RDD vaccination is the only way to protect a person from the dangerous and highly contagious RDD virus as there is no treatment for it. RDD vaccine creates immunity by boosting the body's own immune system. In recent years, all the individuals who received the vaccine have been 100% immune towards the disease.

End of Block: High benefit scenario

Start of Block: Low benefit scenario

Q9 Further studies have provided new findings regarding the RDD disease and its vaccine. In the following page, you will be presented with a complementary piece of information. Please read it carefully, as you will be asked to answer similar questions based on this new extra piece of information.

Page Break

Q10 Although physicians believe that vaccination is the only scientific way to protect a person from the dangerous and highly contagious RDD virus, some people claim that there is no need in getting the vaccine as they can control the consequences of the infection by other methods such as herbal medicines. Moreover, it is shown that 10% of the vaccinated individuals who take the RDD vaccine do not develop immunity. In recent years, there have been some individuals who received the vaccine and still were affected by the virus.

End of Block: Low benefit scenario

Start of Block: High risk scenario

Q11 Further studies have provided new findings regarding the RDD disease and its vaccine. In the following page, you will be presented with a complementary piece of information. Please read it carefully, as you will be asked to answer similar questions based on this new extra piece of information.

Page Break

Q12 In recent years, several severe problems have been reported following RDD vaccine, these include severe allergic reactions, and problems such as permanent brain damage, long-term seizures, coma, or lowered consciousness, and deafness. Scientists state that these complications are very rare, but recently several cases of these severe complications have been reported.

End of Block: High risk scenario

Start of Block: Lowe risk scenario

Q14 Further studies have provided new findings regarding the RDD disease and its vaccine. In the following page, you will be presented with a complementary piece of information. Please read it carefully, as you will be asked to answer similar questions based on this new extra piece of information.

Page Break

Q15 Since the complications of the vaccine are extremely rare, there is not enough evidence for scientists to be sure if the complications are even caused by the vaccination; and therefore, there is not any meaningful link between the RDD vaccine and these consequences. In a set of reliable recent studies, the risk of the RDD vaccination have been shown to be almost zero. In recent years there has not been any documented complications of the vaccination.

End of Block: Lowe risk scenario

Start of Block: Dependent variables 2

Q19 Considering the new piece of information, how beneficial do you think the RDD vaccine is?

- ○ Not at all beneficial
- ○ Minimally beneficial
- ○ Mildly beneficial
- ○ Moderately beneficial
- ○ Somewhat beneficial
- ○ Very beneficial
- ○ Extremely beneficial

Q20 Considering the new piece of information, how risky do you think the RDD vaccine is?

- ○ Not at all risky
- ○ Minimally risky
- ○ Mildly risky
- ○ Moderately risky
- ○ Somewhat risky
- ○ Very risky
- ○ Extremely risky

Q21 This question measures your feelings about the RDD vaccine.
Please identify what you feel when you think about the RDD vaccine.

Please identify the degree to which the right or the left words describe how you feel about the RDD vaccine. If the right/left word accurately describes how you feel about the RDD vaccine, tick the

circle the closest to that word that reflects your feelings. If you do not have a strong feeling either way, tick the center point on the scale.

	1	2	3	4	5	6	7	
Beneficial	○	○	○	○	○	○	○	Harmful
Useful	○	○	○	○	○	○	○	Useless
Acceptable	○	○	○	○	○	○	○	Unacceptable
Good	○	○	○	○	○	○	○	Bad
Positive	○	○	○	○	○	○	○	Negative
Unpredictable	○	○	○	○	○	○	○	Predictable
Controllable	○	○	○	○	○	○	○	Uncontrollable
Known	○	○	○	○	○	○	○	Unknown
Unmanageable	○	○	○	○	○	○	○	Manageable

Familiar	○	○	○	○	○	○	○	Unfamiliar
Scary	○	○	○	○	○	○	○	Safe
Disturbing	○	○	○	○	○	○	○	Calming
Stressful	○	○	○	○	○	○	○	Relaxing
Worrying	○	○	○	○	○	○	○	Comforting

Q18 Imagine that you have a one-year old child, considering the new piece of information, would you vaccinate your child with the RDD vaccine?

- ○ Yes, I would vaccinate my child
- ○ It is likely that I would vaccinate my child
- ○ I may or may not vaccinate my child
- ○ It is unlikely that I would vaccinate my child
- ○ No, I would not vaccinate my child

End of Block: Dependent variables 2

Start of Block: Attention check

Q22 If you had an option to choose one of the following options, which one would you choose?

- ○ A free lottery ticket with a 50% chance to win $200
- ○ A free lottery ticket with a 80% chance to win $195
- ○ A free lottery ticket with a 40% chance to win $100

End of Block: Attention check

Start of Block: Demographic questions

Q23 Which age group do you belong to?

- ○ 18 to 24
- ○ 25 to 34
- ○ 35 to 44
- ○ 45 to 54
- ○ 55 to 64
- ○ 65 to 74
- ○ 75 and older

Q24 What is your highest level of education

- ○ Completed some high school
- ○ High school graduate
- ○ Completed some college
- ○ Associate degree
- ○ Bachelor's degree
- ○ Completed some post graduate
- ○ Master's degree
- ○ Ph.D., law, medical degree, or other advanced degrees beyond a master's degree

Q25 How many children do you have?

- ○ Zero
- ○ One
- ○ Two
- ○ Three
- ○ Four or more

Q26 What is the age of your youngest children

- ○ 0 to 4 years
- ○ 5 to 9 years
- ○ 10 to 14 years
- ○ 15 to 19 years
- ○ 19 and older

Q27 What is your total household income before taxes during the past 12 months?

- Less than $25000
- $25000 to $34999
- $35000 to $49999
- $50000 to $74000
- $75000 to $99999
- $100000 to $149999
- $150000 or more

Q28 What is your gender

- Male
- Female
- Other

End of Block: Demographic questions

Appendix: B Supplementary materials for Chapter 4

Appendix B-1.

Participants were asked to respond to the following statements adopted from the General Medical Embarrassment Scale (Consedine et al., 2007), using a 5-point scale format from (Not at all/ Never) to (Very much/Always).

If I get sick, I tend to hide from others, even from close people, because I am embarrassed to be sick or ill

I worry that my body looks unpleasant and will disgust the doctor or a nurse during a check-up

I feel embarrassed when doctors use complicated medical words and I don't understand them

I am afraid that I will embarrass myself if I am look like I am in pain

It is embarrassing for me when a doctor or a nurse has to touch me

Having my sexual/reproductive organs or rectum examined is humiliating for me

I feel I must have done something wrong if I am ill

It is embarrassing for me when a doctor examines my body

I find waiting for treatment in a public area embarrassing

It is embarrassing for me to admit that I fear pain

I avoid going to the doctor because I often wait too long and feel awkward knowing that I should have gone sooner

I am generally comfortable showing my body to a doctor

Having my breasts/vagina examined by a medical professional does not bother me

Talking with a doctor about how frequently I use the bathroom and the nature of my faeces or stool is uncomfortable for me

Seeing my body during medical examinations makes me feel silly

I worry about what other people in the waiting room may think of me

I am embarrassed about the condition that I have let my body get to

Being naked in front of the doctor or a nurse is embarrassing

It is embarrassing for me when a doctor who is not of my sex touches my sexual/reproductive organs or my rectum during examination

I feel self-conscious when others know that I am in poor health

I do not find it embarrassing to see acquaintances and friends in the doctor's office

I only go to the doctor when I am very sick, because I worry that they will think I am faking it

I find it difficult to ask a doctor to explain something again, repeat themselves, or use words that I can understand

I am very comfortable telling a doctor that something hurts

I am comfortable when a doctor tells me that I am not looking after myself

Exposing any part of my body for a check up is awkward

I worry that other people will judge me when I'm sick

I feel self-conscious and fear that other people may overhear discussions about my health

I feel shy showing my body to doctors

It is awkward for me to describe medical symptoms when they involve my private parts

I worry that the doctor is going to criticize some of the unhealthy things that I do
Having my body touched during medical check ups is not a problem for me
I worry about what doctors are thinking when they examine my sex organs
Answering questions about my bodily fluids (e.g., describing the colour of my mucus) makes me self-conscious
I fear that the doctor will think badly of me because my own behaviours probably contributed to my health problems
When I have health symptoms, I avoid the doctor because I worry that my concerns will turn out to be nothing
Showing my body to a stranger, even to a doctor, is humiliating
When a doctor describes some medical options and I don't understand, I feel humiliated

Appendix B-2.

Structure Matrix using Principal Component Analysis with Oblimin rotation.

Statements	Components	
	Social judgement component	Bodily component
If a male does the test	0.179	0.729 [b]
If a trainee is in the room during the procedure	0.456	0.776 [b]
Because I would have to pose/stand in ways that expose my body	0.436	0.865 [b]
Because someone would be touching my breast	0.419	0.878[b]
Because I don't feel comfortable when someone looks at my breast	0.488	0.891 [b]
Because I feel uncomfortable when I am topless	0.416	0.900 [b]
Because of the size or the appearance of my breast	0.684	0.669 [b]
If I had to talk to the doctor or nurse about abnormalities with my breast	0.797 [s]	0.437
If I was not able to follow the instructions given to me and do exactly what I am told to do	0.722 [s]	0.431
Because nurses/technicians will see that I am uncomfortable	0.813 [s]	0.486
Because the doctor/nurse would judge me if I am overdue for a mammogram	0.765 [s]	0.393

Because a person that I know may see me in the clinic and learn that I am old enough to require a mammogram	0.844 [s]	0.218
Because having a mammogram reveals that I am old	0.875 [s]	0.218
If I don't know the nurse/technician doing the test	0.786 [s]	0.471

Note. Using Principal Component Analysis with Oblimin rotation with Kaiser Normalization, the statements were analyzed to determine if the statements are more loaded on the social judgement or bodily components.

Appendix C: Supplementary materials for Chapter 5 & 6

The surveys for Study 4 and 5 are attached, respectively. The application that we utilized to create the survey, Qualtrics, did not allow us to export surveys to MS Word in a readable and complete format, separately. As such, we attach the PDF versions to the end of this dissertation as part of the Appendix C. The first survey is for Study 4 (displayed in Appendix C-1), followed by the survey used for Study 5 (displayed in Appendix C-2).

Appendix C-1

Study 4: Emotions, fruits and vegetables: Investigating the effect of emotions on message framing

The following survey is used to conduct study 4.

Information and Consent Letter

Title of Project: Health information

Faculty Investigator:

Dr. Samantha Meyer, University of Waterloo (School of Public Health and Health Systems) – Canada- samantha.meyer@uwaterloo.ca 519-888-4567 x39187

Student Investigator:

Mehrnaz Mostafapour – University of Waterloo (School of Public Health and Health Systems) – Canada- M3mostaf@uwaterloo.ca

Study Overview

You are invited to participate in an online study that includes a short survey about health information. This study is a part of Mehrnaz Mostafapour's PhD thesis.

What You Will Be Asked to Do

If you decide to participate, you may be first presented with two questions asking about your eating habits and if you can afford a specific type of diet. Based on your answers to those questions you will either be led to the study or you will be led to quit the study. If you are eligible to participate in the study, you will be asked to write about a previous emotional experience in detail. You will then be asked to read a health message and respond to several questions related to the health message. The survey is completed anonymously in that it does not ask for your name. In addition, you will be asked to answer a questionnaire that intends to measure your personality traits. This questionnaire is designed to control for individual differences in our study. You will also be asked to respond to questions concerning your attitudes toward health and getting sick. In

addition, you will also be asked to respond to several basic demographic questions (e.g. age, gender, education, height/weight, income, marital status, etc.). Collecting this information helps us understand if any of these variables indirectly affects our results.

You can skip any question that you do not feel comfortable answering.

Please note that you need to keep the Mechanical Turk window open while you complete the study tasks.

Participation and Remuneration

Participation in this study is voluntary. Should you choose to participate, $1.5 in remuneration will be added to your Mechanical Turk account. There is also a $0.5 bonus for people who choose to respond to the open text questions that are especially important to the research. Please answer these questions carefully. These questions will be identified within the survey. This survey will take no more than 25 minutes of your time. During the study you will be presented with five images meant to evoke emotions. You will be asked to select an image that provoke a specific emotion in you. **Please note that some of the images are unpleasant and negative.**

Please set aside 25 minutes before you begin so that you are able to complete the study in one sitting. Limit your distractions as much as possible so you can focus on the questions and give honest and accurate answers. It is very important to the validity of the research that you respond conscientiously. You may decline to answer any questions that you do not wish to answer by leaving them blank and you can withdraw your participation at any time by not submitting responses. To receive remuneration please proceed to the end of the questionnaire, obtain the unique code for this HIT, and submit it. The remuneration will be added to your account in a week. If you had any problems submitting the code for remuneration, contact Mehrnaz Mostafapour at M3mostaf@uwaterloo.ca. Participation in this study is voluntary.

Personal Benefits of the Study

There are no expected personal benefits to participation in this study.

Risks of Participation in the Study

The risks associated with this study are expected to be no greater than what you might experience in your day to day life.

Exclusion Criteria

In order to participate in this study, you will be asked to complete screening questions. The questions are related to your dietary habits and your career because we are looking for a specific audience to take part in this study. Based on your answers, you will be either directed to the study or notified that you are ineligible to participate. You only receive remuneration if you are eligible and take the study.

Confidentiality

This study uses the online survey company Qualtrics. University of Waterloo practices are to turn off functions that collect machine identifiers such as IP addresses. The host of the system collecting the data such as Qualtrics may collect this information without our knowledge and make this accessible to us. We will not use or save this information without your consent. If you prefer not to submit your survey responses through this host, please do not sign up for this study. Data from this study will be stored on a password-protected computer database in a restricted access area of the university (i.e., Dr Meyer's lab in the School of Public Health and Health Systems). The final study dataset will be electronically archived for a minimum of 10 years, but may be shared with other researchers (i.e. potential research collaborators) during this time. Data will be destroyed when there is no need for further investigation.

When information is transmitted over the internet, privacy cannot be guaranteed. There is always a risk your responses may be intercepted by a third party (e.g., government agencies, hackers). University of Waterloo researchers will not collect or use internet protocol (IP) addresses or other information which could link your participation to your computer or electronic device without first informing you.

Questions and Research Ethics Clearance

If after reviewing this letter, you have any questions about this study, or would like additional information to assist you in reaching a decision about participation, please feel free to ask the faculty investigator listed at the top of this page.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #41330). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca. For all other questions contact Mehrnaz Mostafapour at M3mostaf@uwaterloo.ca.

Thank you for your interest in our research and for your assistance with this project.

Consent to Participate

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

By indicating your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

- ○ I am willing to respond to the questions to see if I am eligible for the study
- ○ I would like to exit the study

Examples of one serving of fruits:

1/2 cup fresh fruit
1 medium size fruit
1/2 cup fruit juice

Given the above definitions, over the past 2 weeks, about how many servings of fruits did you eat or drink on an average day?

- ○ Two servings or more of fruits
- ○ One or less than one serving of fruits

Examples of one serving of vegetables:

One cup of leafy vegetables
1/2 cup of raw vegetables (excluding leafy vegetables)
1/2 cup of cooked vegetables
1/2 cup of fresh vegetable juice

Given the above definitions, over the past 2 weeks, about how many servings of vegetables did you eat or drink on an average day?

- Three servings or more of vegetables
- Two or less than two serving of vegetables

The household you are part of **CAN** easily afford to provide on average at least three cups of fruits or vegetables for you and other household members, each day.

- True
- Sometimes true
- Never true

Examples of one serving of fruits:
1/2 cup fresh fruit
1 medium size fruit
1/2 cup fruit juice

Examples of one serving of vegetables:
One cup of leafy vegetables
1/2 cup of raw vegetables (excluding leafy vegetables)
1/2 cup of cooked vegetables
1/2 cup of fresh vegetable juice

Given the above definitions, over the past 2 weeks, about how many servings of vegetables did you eat or drink on an average day? (Please write it in numbers only)

Given the above definitions, over the past 2 weeks, about how many servings of fruits did you eat or drink on an average day? (Please write it in numbers only)

Examples of one serving of fruits:

1/2 cup fresh fruit

1 medium size fruit

1/2 cup fruit juice

Examples of one serving of vegetables:

One cup of leafy vegetables

1/2 cup of raw vegetables (excluding leafy vegetables)

1/2 cup of cooked vegetables

1/2 cup of fresh vegetable juice

Fruits and vegetables contain a broad range of important minerals and vitamins you need to be healthy.

Health research has shown that, on average, the minimum requirement of fruits and vegetables consumption for a person is: two servings of fruits and three servings of vegetables, per day.

You are about to see 5 images.

Of the following images, which one is the most neutral to you?

You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

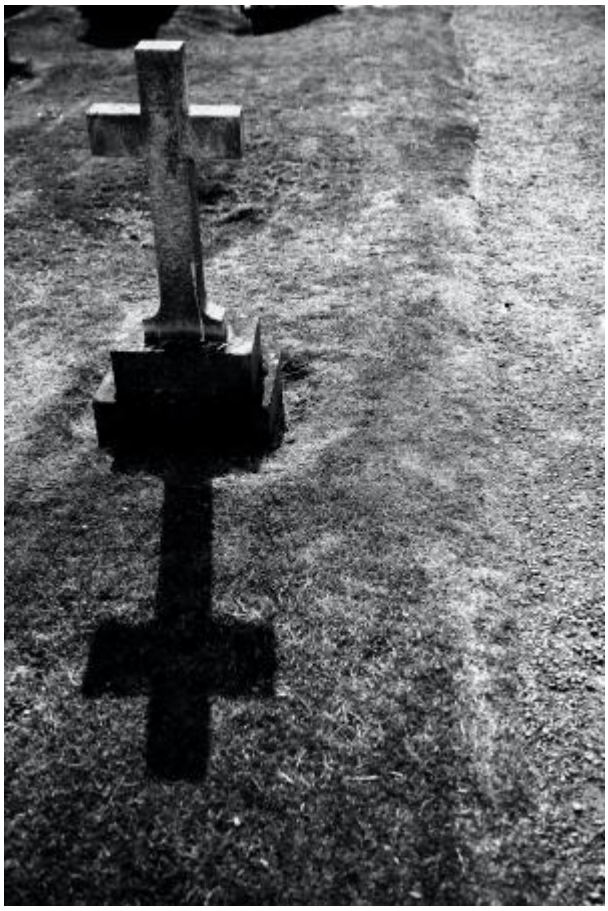
Please briefly describe 4–5 things that you would consider neutral:

Please write an essay (**at least 10 sentences**) about one normal daily situation that

happened yesterday. Please write it in details:

You are about to see 5 unpleasant images. You can skip any questions that you don't feel comfortable with.

Of the following images, which one makes you the most fearful?



You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

I read this statement

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very scared:

Please write a short essay (**at least 10 sentences**) about one situation that makes you or has made you very scared. Please write it in such detail that someone would feel fearful just from reading it.

You are about to see 5 unpleasant images. You can skip any questions that you don't feel comfortable with.

Of the following images, which one makes you feel the most sad?

You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

I read this statement

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very sad:

Please write an essay (**at least 10 sentences**) about one situation that makes you or has made you very sad. Please write it in such detail that someone would feel sad just from reading it.

You are about to see 5 unpleasant images. You can skip any questions that you don't feel comfortable with.

Of the following images, which one makes you feel the most angry?

You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

○ I read this statement

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very angry:

Please write an essay (**at least 10 sentences**) above a situation that makes you or has made you very angry. Please write it in such detail that someone would feel angry just from reading it.

You are about to see 5 images.

Of the following images, which one makes you feel the most happy?

You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

I read this statement

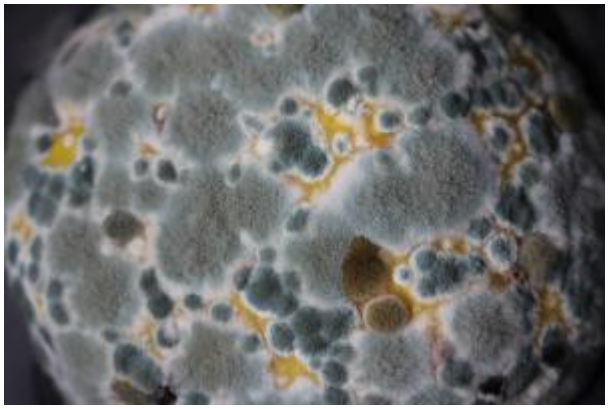
Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very happy:

Please write an essay (**at least 10 sentences**) about one situation that makes you or has made you very happy. Please write it in such detail that someone would feel happy just from reading it.

You are about to see 5 unpleasant images. You can skip any questions that you don't feel comfortable with.

Of the following images, which one makes you feel the most disgusted?



You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

I read this statement

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very disgusted:

Please write an essay (**at least 10 sentences**) about one situation that makes you or has made you very disgusted. Please write it in such detail that someone would feel disgusted just from reading it.

You are about to see a health message regarding fruit and vegetable consumption that summarizes the results of health studies and research. Please read it carefully.

Numerous research has consistently shown that by NOT having a diet with the recommended number of fruits and vegetables (i.e. two servings of fruits and three servings of vegetables), **you are significantly more likely to**:

Die prematurely and have chronic health problems
Have a higher chance of heart disease and stroke
Have a compromised cardiovascular system
Have high blood pressure
Have a compromised immune system
Have higher chance of developing certain type of cancers (e.g., colon cancer, oral cancer, and lung cancer)
Have a higher chance of type 2 diabetes
Have a higher chance of gaining unwanted weight

You are about to see a health message regarding fruit and vegetable consumption that summarizes the results of health studies and research. Please read it carefully.

Numerous research has consistently shown that having a diet that includes the recommended amount of fruits and vegetables (i.e. two servings of fruits and three servings of vegetables, per day), **you are significantly more likely to:**

Live longer and be healthy
Have a healthier heart
Have a healthier cardiovascular system
Have a normal blood pressure
Have a stronger immune system
Have a lower risk of developing certain types of cancer (e.g., colon cancer, oral cancer, and lung cancer)
Have a lower chance of type 2 diabetes
Have a lower chance of gaining unwanted weight

On a scale from 1 (strongly disagree) to 6 (strongly agree), please indicate the extent to which you agree/disagree with the following statement: "I intend to consume two servings of fruits and three servings of vegetables, on an average day."

1 (Strongly disagree)	2	3	4	5	6	7 (Strongly agree)
○	○	○	○	○	○	○

On a scale from 1 (not at all difficult) to 7 (very difficult), how difficult would it be for you to consume the recommended amount of fruits and vegetables (two servings of fruits and three servings of vegetables), per day?

1 (Not at all difficult)	2	3	4	5	6	7 (Very difficult)
	○	○	○	○	○	

On a scale from 1 (strongly disagree) to 6 (strongly agree), please indicate the extent to which you agree/disagree with the following statements:

	1 (Strongly disagree)	2	3	4	5	6 (Strongly agree)
The consumption of the recommended amount of fruits and vegetables (two servings of fruits and three servings of vegetables, per day) contributes to my general health and well-being	○	○	○	○	○	○
Eating the recommended amount of fruits and vegetables may help to decrease my risk of getting chronic diseases such as cardiovascular disease, diabetes, and cancer	○	○	○	○	○	○
Eating the recommended amount of fruits and vegetables provides many of the vitamins and minerals I need to be healthy	○	○	○	○	○	○

On a scale from 1 (not at all) to 7 (very much), how much do you think low fruit and vegetable consumption increases your risk of health problems such as cardiovascular disease, heart disease, diabetes, or cancer?

1 (Not at all)	2	3	4	5	6	7 (Very much)
○	○	○	○	○	○	○

On a scale from 1 (not at all severe) to 7 (very severe), how severely do you think you might suffer from the health consequences of not having enough fruits and vegetables

(two servings of fruits and three servings of vegetables, daily), in the long run?

1 (Not at all severe)	2	3	4	5	6	7 (Very severe)
○	○	○	○	○	○	○

Please describe what you think about consuming the recommended amount of fruits and vegetables based on the following scales?

Good	○ ○ ○ ○ ○ ○ ○	Bad
Wise	○ ○ ○ ○ ○ ○ ○	Unwise
Healthy	○ ○ ○ ○ ○ ○ ○	Unhealthy
Beneficial	○ ○ ○ ○ ○ ○ ○	Harmful
Pleasant	○ ○ ○ ○ ○ ○ ○	Unpleasant
Favorable	○ ○ ○ ○ ○ ○ ○	Unfavorable

What color is the sky? (after reading the choices please choose green)

- ○ Blue
- ○ Dark blue
- ○ Green
- ○ White

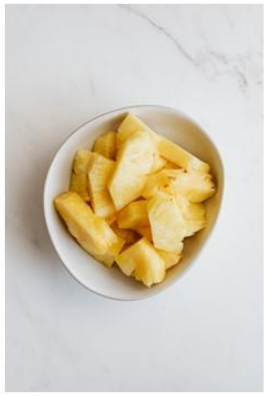
On a scale from 1 (very negative) to 6 (very positive), how positive/negative were the health messages regarding the consumption of fruits and vegetables that you just read?

1 (Very negative)	2	3	4	5	6 (Very positive)
○	○	○	○	○	○

Please indicate which emotions (if any) you felt after writing the essay, and to what degree?

	(1) Not at all	2	3	4	5 (Very much)

	(1) Not at all	2	3	4	5 (Very much)
Fear	○	○	○	○	○
Anger	○	○	○	○	○
Sadness	○	○	○	○	○
Happiness	○	○	○	○	○
Disgust	○	○	○	○	○



1

2

3

4

5

6

7

8

If you wanted to choose a snack at this very moment, which snack would you choose? (please select the number associated with your favorite snack from the drop down menu)

Which snack would you choose to have now? ⌄

Please indicate how often you feel similar to the following statements on a 4-point scale from almost never to almost always.

	Almost never	Sometimes	Often	Almost always
I cannot control unwanted thoughts	○	○	○	○

	Almost never	Sometimes	Often	Almost always
I feel irrelevant thoughts intruding	○	○	○	○
I think the worst will happen	○	○	○	○
I avoid uncomfortable thoughts	○	○	○	○
I feel unorganized over problems	○	○	○	○
I can't make up my mind	○	○	○	○
I picture future misfortunes	○	○	○	○

Please indicate how often you feel similar to the following statements on a 4-point scale from almost never to almost always.

	Almost never	Sometimes	Often	Almost always
I am quick tempered	○	○	○	○
I am a hot-headed person	○	○	○	○
It makes me furious when I am criticized in front of others	○	○	○	○
I get angry when I am slowed down by others' mistakes	○	○	○	○
I feel annoyed when I am not given recognition for doing good work	○	○	○	○
People who think they are always right irritate me	○	○	○	○

During the last two weeks how often did you feel like the following?

	Almost never	Sometimes	Often	Almost always
My appetite was poor	○	○	○	○

	Almost never	Sometimes	Often	Almost always
I could not get going	○	○	○	○
I felt like a bad person	○	○	○	○
I could not focus on important things	○	○	○	○
I lost interest in my usual activities	○	○	○	○
I felt depressed	○	○	○	○
Nothing made me happy	○	○	○	○
I didn't like myself	○	○	○	○
I had a lot of trouble getting to sleep	○	○	○	○

Please indicate the degree to which the following statements are true about you, on a 6-point scale from 1 (definitely false) to 6 (definitely true).

	Definitely false	Mostly false	Slightly false	Slightly true	Mostly true	Definitely true
There are lots of ways around any problem that I am facing now	○	○	○	○	○	○
Right now, I see myself as being pretty successful	○	○	○	○	○	○
I can think of many ways to reach my current goals	○	○	○	○	○	○
If I should find myself in a jam, I could think of many ways to get out of it	○	○	○	○	○	○

On a scale from 1 (strongly disagree) to 6 (strongly agree), please state the extent to which you agree or disagree with the following statements:

	1 (Strongly disagree)	2	3	4	5	6 (Strongly agree)

	1 (Strongly disagree)	2	3	4	5	6 (Strongly agree)
If I don't have my health, I don't have anything	○	○	○	○	○	○
There are many things I care about more than my health	○	○	○	○	○	○
Good health is only of minor importance in a happy life	○	○	○	○	○	○
There is nothing more important than good health	○	○	○	○	○	○

On a scale from 1 (strongly disagree) to 6 (strongly agree), please state the degree to which you agree or disagree with the following statements:

	1 Strongly disagree	2	3	4	5	6 Strongly agree
If I become sick, I have the power to make myself well again	○	○	○	○	○	○
My physical well-being depends on how well I take care of myself	○	○	○	○	○	○
When I become ill, it is because I know I have not been taking care of myself properly	○	○	○	○	○	○
I can pretty much stay healthy by taking good care of myself	○	○	○	○	○	○
Even when I take care of myself it is easy to get sick	○	○	○	○	○	○
Often I feel that no matter what I do, if I am going to get sick, I will get sick	○	○	○	○	○	○

	1 Strongly disagree	2	3	4	5	6 Strongly agree
It seems that my health is greatly influenced by accidental happenings	○	○	○	○	○	○

On a scale from 1 (strongly disagree) to 6 (strongly agree), please state the degree to which you agree or disagree with the following statement:

"Your diet and eating habits significantly affect your health."

1 (Strongly disagree)	2	3	4	5	6 (Strongly agree)
○	○	○	○	○	○

Please rate how disgusting the following statements are for you:

	Not disgusting	Somewhat disgusting	Very disgusting
Seeing someone eating monkey meat, under some circumstances	○	○	○
Seeing someone in a restaurant eating messy food with his fingers	○	○	○
You see someone put ketchup on vanilla ice cream, and eat it	○	○	○
You are about to drink a glass of milk when you smell that it is spoiled	○	○	○

You will now be asked several demographic questions. Please remember that you can skip any questions you do not feel comfortable providing a response for.

What is your age?

What is your gender?

- Male
- Female
- Other

What is your highest level of education?

- Less than high school
- High school graduate
- Some college
- Associate degree
- Bachelor's degree
- Completed some postgraduate
- Master's degree
- Ph.D., law or medical degree
- Other advanced degree beyond a Master's degree

Thinking about your total monthly income, how difficult or easy is it for you to make ends meet?

- Very difficult
- Difficult
- Neither easy nor difficult
- Easy
- Very easy
- Don’t know

How would you describe your current health status?

- Very good
- Good
- Fair
- Poor
- Very poor
- Don't know

What is your annual household income before tax?

- Less than $25,000
- $25,000 to $34,999
- $35,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $149,999
- $150,000 or more

What is your height? Please indicate your height *either* in feet *or* cm:

What is your height in feet?

Feet

Inch

What is your height in cm?

What is your weight? Please indicate your weight *either* in kgs *or* lbs:

What is your weight? (lbs)

What is your weight? (kg)

Thank you for participating in the "Health information" study! Your participation is extremely valuable.

Very broadly, this study investigates whether the persuasive impact of health messages on nutritional decisions depends on the emotional state of the recipient of the message. Understanding how people in various emotional states perceive a health message helps with developing better health communication methods. To examine this research question, we asked you to write about an emotional experience. It was done to elicit a particular emotion in you before answering the next questions.

The research team requires a few weeks to review the responses to the open ended questions before assigning the bonuses.
We recognize that participation in this research may have led you to have negative experiences. If you feel like you need additional mental health support, the following resources are available in the US free of charge:

· You can call Lifeline 1-800-273-TALK (8255) to reach a 24-hour crisis center, or text MHA to 741741 at the Crisis Text Line. The service is free, confidential and available to everyone.
o People who are deaf, hard of hearing, or have hearing loss can contact the Lifeline via TTY at 1-800-799-4889.

· You can also call 1-800-985-5990 or text "TalkWithUs" to 66746 at the SAMHSA Disaster Distress Helpline. Trained crisis workers will listen to you and direct you to the

resources you need.

Additional Information
If you would like a copy of the results when they are eventually published, please contact Mehrnaz Mostafapour at m3mostaf@uwaterloo.ca and a copy will be sent to you.

Your identity is considered confidential; indeed, your name will not be included or in any other way associated, with the data collected in the study. Furthermore, because the interest of this study is in the average responses of the entire group of participants, you will not be identified individually in any way in any written reports of this research. The data, with identifying information removed, will be retained for a minimum of 10 years, and then will completely be destroyed. The data, with identifying information removed, will be retained for a minimum of 10 years, and then will completely be destroyed. The data will be securely stored on a password protected server at the University of Waterloo.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#41330). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca. For all other questions contact Mehrnaz Mostafapour at m3mostaf@uwaterloo.ca.

This consent is also a record that the full purpose of the study was explained to you.

We really appreciate your participation and hope that this has been an interesting experience for you.

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Appendix C-2

Study 5. Sugary drinks and emotions: Investigating the effect of emotions on the persuasiveness of health warnings regarding sugary drinks

The following survey is used to conduct study 5.

Information and Consent Letter

Title of Project: Health information

Faculty Investigator:

Dr. Samantha Meyer, University of Waterloo (School of Public Health and Health Systems) – Canada- samantha.meyer@uwaterloo.ca 519-888-4567 x39187

Student Investigator:

Mehrnaz Mostafapour – University of Waterloo (School of Public Health and Health Systems) – Canada- M3mostaf@uwaterloo.ca

Study Overview

You are invited to participate in an online study that includes a short survey about health information. This study is a part of Mehrnaz Mostafapour's PhD thesis.

What You Will Be Asked to Do

If you decide to participate, you may be first presented with two questions asking about your eating habits and if you can afford a specific type of diet. Based on your answers to those questions you will either be led to the study or you will be led to quit the study. If you are eligible to participate in the study, you will be asked to write about a previous emotional experience in detail. You will then be asked to read a health message and respond to several questions related to the health message. The survey is completed anonymously in that it does not ask for your name. In addition, you will be asked to answer a questionnaire that intends to measure your personality traits. This questionnaire is designed to control for individual differences in our study. You will also be asked to respond to questions concerning your attitudes toward health and getting sick. In

addition, you will also be asked to respond to several basic demographic questions (e.g. age, gender, education, height/weight, income, marital status, etc.). Collecting this information helps us understand if any of these variables indirectly affects our results.

You can skip any question that you do not feel comfortable answering.

Please note that you need to keep the Mechanical Turk window open while you complete the study tasks.

Participation and Remuneration

Participation in this study is voluntary. Should you choose to participate, $1.5 in remuneration will be added to your Mechanical Turk account. There is also a $0.5 bonus for people who choose to respond to the open text questions that are especially important to the research. Please answer these questions carefully. These questions will be identified within the survey. This survey will take no more than 25 minutes of your time. During the study you will be presented with five images meant to evoke emotions. You will be asked to select an image that provoke a specific emotion in you. **Please note that some of the images are unpleasant and negative.**

Please set aside 25 minutes before you begin so that you are able to complete the study in one sitting. Limit your distractions as much as possible so you can focus on the questions and give honest and accurate answers. It is very important to the validity of the research that you respond conscientiously. You may decline to answer any questions that you do not wish to answer by leaving them blank and you can withdraw your participation at any time by not submitting responses. To receive remuneration please proceed to the end of the questionnaire, obtain the unique code for this HIT, and submit it. The remuneration will be added to your account in a week. If you had any problems submitting the code for remuneration, contact Mehrnaz Mostafapour at M3mostaf@uwaterloo.ca. Participation in this study is voluntary.

Personal Benefits of the Study

There are no expected personal benefits to participation in this study.

Risks of Participation in the Study

The risks associated with this study are expected to be no greater than what you might experience in your day to day life.

Exclusion Criteria

In order to participate in this study, you will be asked to complete screening questions. The questions are related to your dietary habits and your career because we are looking for a specific audience to take part in this study. Based on your answers, you will be either directed to the study or notified that you are ineligible to participate. You only receive remuneration if you are eligible and take the study.

Confidentiality

This study uses the online survey company Qualtrics. University of Waterloo practices are to turn off functions that collect machine identifiers such as IP addresses. The host of the system collecting the data such as Qualtrics may collect this information without our knowledge and make this accessible to us. We will not use or save this information without your consent. If you prefer not to submit your survey responses through this host, please do not sign up for this study. Data from this study will be stored on a password-protected computer database in a restricted access area of the university (i.e., Dr Meyer's lab in the School of Public Health and Health Systems). The final study dataset will be electronically archived for a minimum of 10 years, but may be shared with other researchers (i.e. potential research collaborators) during this time. Data will be destroyed when there is no need for further investigation.

When information is transmitted over the internet, privacy cannot be guaranteed. There is always a risk your responses may be intercepted by a third party (e.g., government agencies, hackers). University of Waterloo researchers will not collect or use internet protocol (IP) addresses or other information which could link your participation to your computer or electronic device without first informing you.

Questions and Research Ethics Clearance

If after reviewing this letter, you have any questions about this study, or would like additional information to assist you in reaching a decision about participation, please feel free to ask the faculty investigator listed at the top of this page.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #41330). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca. For all other questions contact Mehrnaz Mostafapour at M3mostaf@uwaterloo.ca.

Thank you for your interest in our research and for your assistance with this project.

Consent to Participate

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

By indicating your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

- ○ I am willing to respond to the questions to see if I am eligible for the study
- ○ I would like to exit the study

Examples of one serving of fruits:

1/2 cup fresh fruit
1 medium size fruit
1/2 cup fruit juice

Given the above definitions, over the past 2 weeks, about how many servings of fruits did you eat or drink on an average day?

- ○ Two servings or more of fruits
- ○ One or less than one serving of fruits

Examples of one serving of vegetables:

One cup of leafy vegetables
1/2 cup of raw vegetables (excluding leafy vegetables)
1/2 cup of cooked vegetables
1/2 cup of fresh vegetable juice

Given the above definitions, over the past 2 weeks, about how many servings of vegetables did you eat or drink on an average day?

- Three servings or more of vegetables
- Two or less than two serving of vegetables

The household you are part of **CAN** easily afford to provide on average at least three cups of fruits or vegetables for you and other household members, each day.

- True
- Sometimes true
- Never true

Examples of one serving of fruits:
1/2 cup fresh fruit
1 medium size fruit
1/2 cup fruit juice

Examples of one serving of vegetables:
One cup of leafy vegetables
1/2 cup of raw vegetables (excluding leafy vegetables)
1/2 cup of cooked vegetables
1/2 cup of fresh vegetable juice

Given the above definitions, over the past 2 weeks, about how many servings of vegetables did you eat or drink on an average day? (Please write it in numbers only)

Given the above definitions, over the past 2 weeks, about how many servings of fruits did you eat or drink on an average day? (Please write it in numbers only)

Examples of one serving of fruits:

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Examples of one serving of vegetables:

One cup of leafy vegetables

1/2 cup of raw vegetables (excluding leafy vegetables)

1/2 cup of cooked vegetables

1/2 cup of fresh vegetable juice

Fruits and vegetables contain a broad range of important minerals and vitamins you need to be healthy.

Health research has shown that, on average, the minimum requirement of fruits and vegetables consumption for a person is: two servings of fruits and three servings of vegetables, per day.

You are about to see 5 images.

Of the following images, which one is the most neutral to you?

You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

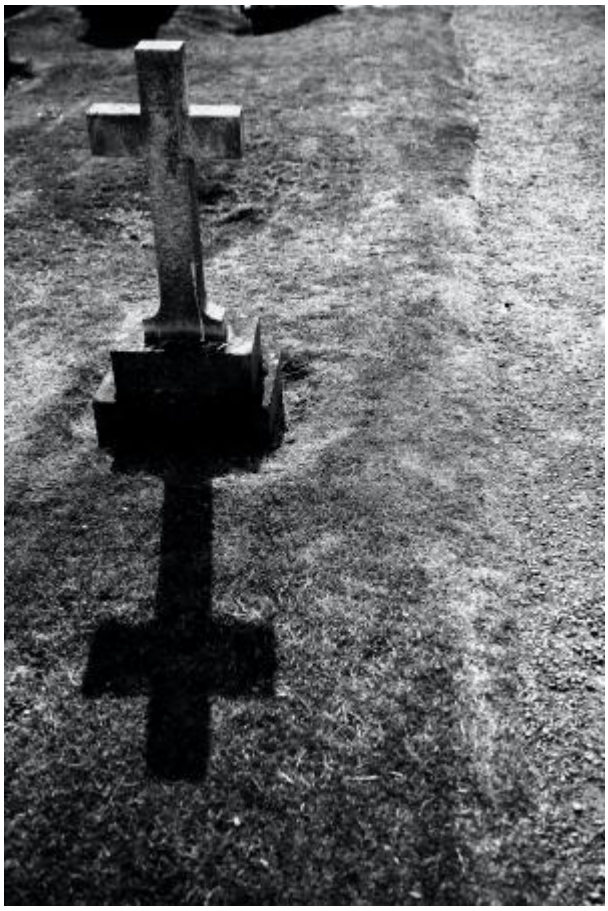
Please briefly describe 4–5 things that you would consider neutral:

Please write an essay (**at least 10 sentences**) about one normal daily situation that

happened yesterday. Please write it in details:

You are about to see 5 unpleasant images. You can skip any questions that you don't feel comfortable with.

Of the following images, which one makes you the most fearful?



You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

I read this statement

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very scared:

Please write a short essay (**at least 10 sentences**) about one situation that makes you or has made you very scared. Please write it in such detail that someone would feel fearful just from reading it.

You are about to see 5 unpleasant images. You can skip any questions that you don't feel comfortable with.

Of the following images, which one makes you feel the most sad?

You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

I read this statement

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very sad:

Please write an essay (**at least 10 sentences**) about one situation that makes you or has made you very sad. Please write it in such detail that someone would feel sad just from reading it.

You are about to see 5 unpleasant images. You can skip any questions that you don't feel comfortable with.

Of the following images, which one makes you feel the most angry?

You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

○ I read this statement

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very angry:

Please write an essay (**at least 10 sentences**) above a situation that makes you or has made you very angry. Please write it in such detail that someone would feel angry just from reading it.

You are about to see 5 images.

Of the following images, which one makes you feel the most happy?

You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

I read this statement

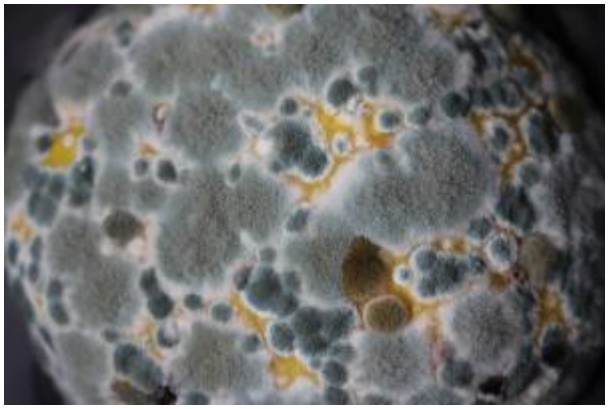
Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very happy:

Please write an essay (**at least 10 sentences**) about one situation that makes you or has made you very happy. Please write it in such detail that someone would feel happy just from reading it.

You are about to see 5 unpleasant images. You can skip any questions that you don't feel comfortable with.

Of the following images, which one makes you feel the most disgusted?



You are about to see two open-ended questions. If you choose to carefully answer the next two questions, you will receive **an extra $0.5 as bonus:**

I read this statement

Please read and respond to the following questions carefully to receive an extra $0.5 as bonus:

Please briefly describe 4–5 things that make you very disgusted:

Please write an essay (**at least 10 sentences**) about one situation that makes you or has made you very disgusted. Please write it in such detail that someone would feel disgusted just from reading it.

You are about to see a health message regarding fruit and vegetable consumption that summarizes the results of health studies and research. Please read it carefully.

Numerous research has consistently shown that by NOT having a diet with the recommended number of fruits and vegetables (i.e. two servings of fruits and three servings of vegetables), **you are significantly more likely to**:

Die prematurely and have chronic health problems
Have a higher chance of heart disease and stroke
Have a compromised cardiovascular system
Have high blood pressure
Have a compromised immune system
Have higher chance of developing certain type of cancers (e.g., colon cancer, oral cancer, and lung cancer)
Have a higher chance of type 2 diabetes
Have a higher chance of gaining unwanted weight

You are about to see a health message regarding fruit and vegetable consumption that summarizes the results of health studies and research. Please read it carefully.

Numerous research has consistently shown that having a diet that includes the recommended amount of fruits and vegetables (i.e. two servings of fruits and three servings of vegetables, per day), **you are significantly more likely to:**

Live longer and be healthy
Have a healthier heart
Have a healthier cardiovascular system
Have a normal blood pressure
Have a stronger immune system
Have a lower risk of developing certain types of cancer (e.g., colon cancer, oral cancer, and lung cancer)
Have a lower chance of type 2 diabetes
Have a lower chance of gaining unwanted weight

On a scale from 1 (strongly disagree) to 6 (strongly agree), please indicate the extent to which you agree/disagree with the following statement: “I intend to consume two servings of fruits and three servings of vegetables, on an average day.”

1 (Strongly disagree)	2	3	4	5	6	7 (Strongly agree)
○	○	○	○	○	○	○

On a scale from 1 (not at all difficult) to 7 (very difficult), how difficult would it be for you to consume the recommended amount of fruits and vegetables (two servings of fruits and three servings of vegetables), per day?

1 (Not at all difficult)	2	3	4	5	6	7 (Very difficult)
	○	○	○	○	○	

On a scale from 1 (strongly disagree) to 6 (strongly agree), please indicate the extent to which you agree/disagree with the following statements:

	1 (Strongly disagree)	2	3	4	5	6 (Strongly agree)
The consumption of the recommended amount of fruits and vegetables (two servings of fruits and three servings of vegetables, per day) contributes to my general health and well-being						
Eating the recommended amount of fruits and vegetables may help to decrease my risk of getting chronic diseases such as cardiovascular disease, diabetes, and cancer						
Eating the recommended amount of fruits and vegetables provides many of the vitamins and minerals I need to be healthy						

On a scale from 1 (not at all) to 7 (very much), how much do you think low fruit and vegetable consumption increases your risk of health problems such as cardiovascular disease, heart disease, diabetes, or cancer?

1 (Not at all)	2	3	4	5	6	7 (Very much)

On a scale from 1 (not at all severe) to 7 (very severe), how severely do you think you might suffer from the health consequences of not having enough fruits and vegetables

(two servings of fruits and three servings of vegetables, daily), in the long run?

1 (Not at all severe)	2	3	4	5	6	7 (Very severe)
○	○	○	○	○	○	○

Please describe what you think about consuming the recommended amount of fruits and vegetables based on the following scales?

Good	○ ○ ○ ○ ○ ○ ○	Bad
Wise	○ ○ ○ ○ ○ ○ ○	Unwise
Healthy	○ ○ ○ ○ ○ ○ ○	Unhealthy
Beneficial	○ ○ ○ ○ ○ ○ ○	Harmful
Pleasant	○ ○ ○ ○ ○ ○ ○	Unpleasant
Favorable	○ ○ ○ ○ ○ ○ ○	Unfavorable

What color is the sky? (after reading the choices please choose green)

- ○ Blue
- ○ Dark blue
- ○ Green
- ○ White

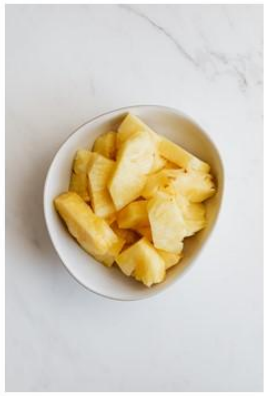
On a scale from 1 (very negative) to 6 (very positive), how positive/negative were the health messages regarding the consumption of fruits and vegetables that you just read?

1 (Very negative)	2	3	4	5	6 (Very positive)
○	○	○	○	○	○

Please indicate which emotions (if any) you felt after writing the essay, and to what degree?

	(1) Not at all	2	3	4	5 (Very much)

	(1) Not at all	2	3	4	5 (Very much)
Fear	○	○	○	○	○
Anger	○	○	○	○	○
Sadness	○	○	○	○	○
Happiness	○	○	○	○	○
Disgust	○	○	○	○	○



1

2

3

4

5

6

7

8

If you wanted to choose a snack at this very moment, which snack would you choose? (please select the number associated with your favorite snack from the drop down menu)

Which snack would you choose to have now? ⌄

Please indicate how often you feel similar to the following statements on a 4-point scale from almost never to almost always.

	Almost never	Sometimes	Often	Almost always
I cannot control unwanted thoughts	○	○	○	○

	Almost never	Sometimes	Often	Almost always
I feel irrelevant thoughts intruding	○	○	○	○
I think the worst will happen	○	○	○	○
I avoid uncomfortable thoughts	○	○	○	○
I feel unorganized over problems	○	○	○	○
I can't make up my mind	○	○	○	○
I picture future misfortunes	○	○	○	○

Please indicate how often you feel similar to the following statements on a 4-point scale from almost never to almost always.

	Almost never	Sometimes	Often	Almost always
I am quick tempered	○	○	○	○
I am a hot-headed person	○	○	○	○
It makes me furious when I am criticized in front of others	○	○	○	○
I get angry when I am slowed down by others' mistakes	○	○	○	○
I feel annoyed when I am not given recognition for doing good work	○	○	○	○
People who think they are always right irritate me	○	○	○	○

During the last two weeks how often did you feel like the following?

	Almost never	Sometimes	Often	Almost always
My appetite was poor	○	○	○	○

	Almost never	Sometimes	Often	Almost always
I could not get going	○	○	○	○
I felt like a bad person	○	○	○	○
I could not focus on important things	○	○	○	○
I lost interest in my usual activities	○	○	○	○
I felt depressed	○	○	○	○
Nothing made me happy	○	○	○	○
I didn't like myself	○	○	○	○
I had a lot of trouble getting to sleep	○	○	○	○

Please indicate the degree to which the following statements are true about you, on a 6-point scale from 1 (definitely false) to 6 (definitely true).

	Definitely false	Mostly false	Slightly false	Slightly true	Mostly true	Definitely true
There are lots of ways around any problem that I am facing now	○	○	○	○	○	○
Right now, I see myself as being pretty successful	○	○	○	○	○	○
I can think of many ways to reach my current goals	○	○	○	○	○	○
If I should find myself in a jam, I could think of many ways to get out of it	○	○	○	○	○	○

On a scale from 1 (strongly disagree) to 6 (strongly agree), please state the extent to which you agree or disagree with the following statements:

	1 (Strongly disagree)	2	3	4	5	6 (Strongly agree)

	1 (Strongly disagree)	2	3	4	5	6 (Strongly agree)
If I don't have my health, I don't have anything	○	○	○	○	○	○
There are many things I care about more than my health	○	○	○	○	○	○
Good health is only of minor importance in a happy life	○	○	○	○	○	○
There is nothing more important than good health	○	○	○	○	○	○

On a scale from 1 (strongly disagree) to 6 (strongly agree), please state the degree to which you agree or disagree with the following statements:

	1 Strongly disagree	2	3	4	5	6 Strongly agree
If I become sick, I have the power to make myself well again	○	○	○	○	○	○
My physical well-being depends on how well I take care of myself	○	○	○	○	○	○
When I become ill, it is because I know I have not been taking care of myself properly	○	○	○	○	○	○
I can pretty much stay healthy by taking good care of myself	○	○	○	○	○	○
Even when I take care of myself it is easy to get sick	○	○	○	○	○	○
Often I feel that no matter what I do, if I am going to get sick, I will get sick	○	○	○	○	○	○

	1 Strongly disagree	2	3	4	5	6 Strongly agree
It seems that my health is greatly influenced by accidental happenings	○	○	○	○	○	○

On a scale from 1 (strongly disagree) to 6 (strongly agree), please state the degree to which you agree or disagree with the following statement:

"Your diet and eating habits significantly affect your health."

1 (Strongly disagree)	2	3	4	5	6 (Strongly agree)
○	○	○	○	○	○

Please rate how disgusting the following statements are for you:

	Not disgusting	Somewhat disgusting	Very disgusting
Seeing someone eating monkey meat, under some circumstances	○	○	○
Seeing someone in a restaurant eating messy food with his fingers	○	○	○
You see someone put ketchup on vanilla ice cream, and eat it	○	○	○
You are about to drink a glass of milk when you smell that it is spoiled	○	○	○

You will now be asked several demographic questions. Please remember that you can skip any questions you do not feel comfortable providing a response for.

What is your age?

What is your gender?

- Male
- Female
- Other

What is your highest level of education?

- Less than high school
- High school graduate
- Some college
- Associate degree
- Bachelor's degree
- Completed some postgraduate
- Master's degree
- Ph.D., law or medical degree
- Other advanced degree beyond a Master's degree

Thinking about your total monthly income, how difficult or easy is it for you to make ends meet?

- Very difficult
- Difficult
- Neither easy nor difficult
- Easy
- Very easy
- Don’t know

How would you describe your current health status?

- Very good
- Good
- Fair
- Poor
- Very poor
- Don't know

What is your annual household income before tax?

- Less than $25,000
- $25,000 to $34,999
- $35,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $149,999
- $150,000 or more

What is your height? Please indicate your height *either* in feet *or* cm:

What is your height in feet?

Feet

Inch

What is your height in cm?

What is your weight? Please indicate your weight *either* in kgs *or* lbs:

What is your weight? (lbs)

What is your weight? (kg)

Thank you for participating in the "Health information" study! Your participation is extremely valuable.

Very broadly, this study investigates whether the persuasive impact of health messages on nutritional decisions depends on the emotional state of the recipient of the message. Understanding how people in various emotional states perceive a health message helps with developing better health communication methods. To examine this research question, we asked you to write about an emotional experience. It was done to elicit a particular emotion in you before answering the next questions.

The research team requires a few weeks to review the responses to the open ended questions before assigning the bonuses.
We recognize that participation in this research may have led you to have negative experiences. If you feel like you need additional mental health support, the following resources are available in the US free of charge:

· You can call Lifeline 1-800-273-TALK (8255) to reach a 24-hour crisis center, or text MHA to 741741 at the Crisis Text Line. The service is free, confidential and available to everyone.
o People who are deaf, hard of hearing, or have hearing loss can contact the Lifeline via TTY at 1-800-799-4889.

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Additional Information
If you would like a copy of the results when they are eventually published, please contact Mehrnaz Mostafapour at m3mostaf@uwaterloo.ca and a copy will be sent to you.

Your identity is considered confidential; indeed, your name will not be included or in any other way associated, with the data collected in the study. Furthermore, because the interest of this study is in the average responses of the entire group of participants, you will not be identified individually in any way in any written reports of this research. The data, with identifying information removed, will be retained for a minimum of 10 years, and then will completely be destroyed. The data, with identifying information removed, will be retained for a minimum of 10 years, and then will completely be destroyed. The data will be securely stored on a password protected server at the University of Waterloo.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#41330). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca. For all other questions contact Mehrnaz Mostafapour at m3mostaf@uwaterloo.ca.

This consent is also a record that the full purpose of the study was explained to you.

We really appreciate your participation and hope that this has been an interesting experience for you.

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