DISGUST, CONSERVATISM AND INFLUENZA PREVENTION: AN EMBODIED COGNITION APPROACH TO HEALTH ATTITUDES AND INTENTIONS

by

Luis G. Duran

B.S., University of Pittsburgh, 2001

M.P.H., M.P.I.A., University of Pittsburgh, 2004, 2004

Submitted to the Graduate Faculty of

Graduate School of Public Health in partial fulfillment

of the requirements for the degree of

Doctor of Public Health

University of Pittsburgh

2016

UNIVERSITY OF PITTSBURGH

GRADUATE SCHOOL OF PUBLIC HEALTH

This dissertation was presented

by

Luis G. Duran

It was defended on

February 12, 2016

and approved by

Jeanette Trauth, PhD, Associate Professor, Behavioral and Community Health Sciences, Graduate School of Public Health, University of Pittsburgh

Martha Ann Terry, PhD, Assistant Professor, Behavioral and Community Health Sciences, Graduate School of Public Health, University of Pittsburgh

Tristen Inagaki, PhD, Assistant Professor, Psychology, Dietrich School of Arts and Sciences, University of Pittsburgh

Dissertation Advisor: Christopher Keane, ScD, Assistant Professor, Behavioral and Community Health Sciences, Graduate School of Public Health, University of Pittsburgh

DISGUST, CONSERVATISM AND INFLUENZA PREVENTION: AN EMBODIED COGNITION APPROACH TO HEALTH ATTITUDES AND INTENTIONS

Luis G. Duran, DrPH

University of Pittsburgh, 2016

ABSTRACT

Background: Recent studies demonstrated that a disgust reaction, which evolved as an instinctive response to protect one's body from potential contaminants, affects judgments about morality and sexuality through embodied linkages between the concepts of cleanliness, physical purity, and moral purity. Therefore, disgust sensitivity and sexual and social conservatism, favoring traditional social norms in the face of external forces for change, might affect attitudes towards protective health behaviors and political support for health protection efforts. However, no studies have looked at these linkages in a public health context like infectious disease prevention.

Statement of public health relevance: Intentionally triggering a disgust reaction might prove an effective communication strategy for health behavior change interventions. Future research might focus on testing the fit between different disgust triggers and specific public health issues.

Methods: Forty-three literate English-speaking adults were randomized (1:1) to cleanliness prime – exposure to hand sanitizer – or control and shown publicly available influenza statistics illustrated with graphs and figures. The hypotheses were: (1) disgust sensitivity and sexual and social conservatism are positively associated with disgust, perceptions of influenza risk/severity/costs and likelihood of taking preventive measures against influenza, but negatively associated with trust of influenza-related information and likelihood of supporting taxes for influenza prevention; (2) disgust is similarly associated with the other four variables; and (3) hand sanitizer exposure is similarly associated with disgust and the other four variables.

Results: Statistically significant results at $\alpha = 0.05$ were observed for the first two of the three study hypotheses with the pilot sample size (N = 43). *Post hoc* analyses showed significant results for: (1) correlations between indexes for disgust sensitivity with disgust, perceptions of influenza risk/severity/costs and likelihood of taking preventive action against influenza; and (2) correlations between indexes for sexual and social conservatism with disgust and likelihood of supporting taxes for influenza prevention.

Conclusions: Disgust sensitivity and sexual and social conservatism were both correlated with disgust, while disgust sensitivity was correlated with perceptions of influenza risk/severity/costs and likelihood of taking preventive action against influenza, and sexual and social conservatism was correlated with likelihood of supporting influenza prevention taxes. However, exposure to hand sanitizer did not produce the hypothesized responses.

TABLE OF CONTENTS

PREFACE ..... **XVII**

1.0 INTRODUCTION **1**

1.1 WHAT IS EMBODIED COGNITION? **2**

1.2 ASSUMPTIONS AND IMPLICATIONS OF THE THEORY OF EMBODIED COGNITION **7**

1.3 THE THEORY OF EC IS COMPATIBLE WITH AND CAN ENHANCE EXISTING HEALTH BEHAVIOR CHANGE MODELS **11**

1.4 WHAT IS PRIMING? **15**

1.5 PRIMING APPLIED TO HEALTH BEHAVIORS **17**

1.6 ETHICAL AND PRACTICAL CONSIDERATIONS FOR USING EMOTIONAL MANIPULATIONS IN PUBLIC HEALTH EDUCATION AND ADVOCACY EFFORTS **20**

1.6.1 Observations from behavioral economics **22**

1.6.2 Observations from marketing **24**

1.7 ADAPTING DISGUST TRIGGERS FOR INFLUENZA PREVENTION EDUCATION AND ADVOCACY EFFORTS **26**

1.8 STATEMENT OF THE PROBLEM **28**

1.9 RESEARCH OBJECTIVES **30**

1.9.1 Research Objective #1 31

1.9.2 Research Objective #2 32

1.9.3 Research Objective #3 33

2.0 METHODOLOGY 34

2.1 STUDY POPULATION AND RECRUITMENT 34

2.2 DATA COLLECTION 35

2.2.1 Prior to research activities – Pre-screening and consent process 35

2.2.2 Research activities – Intervention and emotional response assessments.. 37

2.2.3 Research activities – Administration of questionnaires 41

2.3 DATA ANALYSIS 44

2.3.1 Hypothesized relationships tested 44

2.3.2 Variable and value labels 45

2.3.3 Statistical analysis strategy and rationale 47

2.3.4 Sample size calculations 52

2.3.5 Sample size considerations 54

3.0 RESULTS 56

3.1 DEMOGRAPHICS 56

3.2 RESULTS DESCRIPTION 58

3.2.1 Emotional response variable index scores 58

3.2.2 Emotional response variable scores for individual slides 60

3.2.3 Outcome variable index scores 62

3.2.4 Outcome variable scores for individual survey items 63

3.2.5 Moderating variable index scores 65

3.2.6 Moderating variable scores for individual survey items 67

3.3 HYPOTHESIS TESTS – EMOTIONAL RESPONSE VARIABLES VS. OUTCOME AND MODERATING VARIABLES 69

3.3.1 Emotional response effects on index scores for outcome and moderating variables 69

3.3.2 Emotional response effects on individual outcome variable items 73

3.3.3 Emotional response effects on individual moderating variable items 75

3.4 HYPOTHESIS TESTS – MODERATING VARIABLES VS. EMOTIONAL RESPONSE AND OUTCOME VARIABLES 77

3.4.1 Moderating variable effects on index scores for emotional response and outcome variables 77

3.4.2 Moderating variable effects on valence, arousal and disgust scores for individual slides 78

3.4.3 Moderating variable effects on individual outcome variable items 81

3.5 HYPOTHESIS TESTS – INTERVENTION/CONTROL VS. EMOTIONAL RESPONSE, OUTCOME AND MODERATING VARIABLES 84

3.5.1 Intervention effects on index scores for all variables 84

3.5.2 Intervention effects on valence scores for individual slides 86

3.5.3 Intervention effects on arousal and disgust scores for individual slides .. 87

3.5.4 Intervention effects on individual outcome variable items 89

3.5.5 Intervention effects on individual moderating variable items 91

3.6 DEMOGRAPHIC EFFECTS ON INDEX SCORES FOR ALL VARIABLES AND INDIVIDUAL SCORES FOR VALENCE 94

3.7 BIVARIATE CORRELATION TESTS 98

3.7.1 Emotional response and outcome variables 98

3.7.2 Emotional response and moderating variables 101

3.7.3 Outcome and moderating variables 104

3.7.4 Demographics and all variables 106

4.0 DISCUSSION 111

4.1 INTERPRETATION OF RESULTS 111

4.1.1 Emotional response effects on outcome and moderating variables 111

4.1.2 DS and SSC effects on emotional response and outcome variables 115

4.1.3 Intervention effects on emotional response, outcome and moderating variables 118

4.1.4 Demographic effects on emotional response, outcome and moderating variables 121

4.2 STUDY LIMITATIONS AND PROPOSED SOLUTIONS 127

4.3 THEORETICAL IMPLICATIONS & PRACTICAL APPLICATIONS .. 131

4.3.1 Significance of results and congruence with existing literature 131

4.3.2 Lessons learned and recommendations for future research 138

5.0 CONCLUSIONS 141

APPENDIX A: HEALTH BEHAVIOR THEORY CONSTRUCT DEFINITIONS 145

APPENDIX B:Q1: PARTICIPANT PERCEPTIONS OF INFLUENZA 149

APPENDIX C: Q2: PARTICIPANT INFLUENZA-RELATED TRUST 151

APPENDIX D: Q3: PARTICIPANT INTENTION TO TAKE PREVENTIVE MEASURES AGAINST INFLUENZA 153

APPENDIX E: Q4: PARTICIPANT INTENTION TO SUPPORT TAXES FOR INFLUENZA PREVENTION 155

APPENDIX F: Q5: PARTICIPANT GENERAL DISGUST SENSITIVITY 157

APPENDIX G: Q6: POLITICAL CONSERVATISM 162

APPENDIX H: PARTICIPANT PRE-SCREENING FORM 165

APPENDIX I: DEMOGRAPHIC QUESTIONNAIRE 166

BIBLIOGRAPHY 173

LIST OF TABLES

Table 1. Is a behavioral model incorporating the concepts of EC compatible with the core components of health-related behavior change? Is our understanding of those core components enhanced by incorporating a behavioral model based on EC? 12

Table 2. Core components of health-related behavior and decision making – Supporting theories 13

Table 3: Hypothesized relationships tested..... 45

Table 4: Emotional response variables vs. outcome and moderating variables 48

Table 5: Moderating variables vs. outcome and emotional response variables..... 49

Table 6: General statistical framework for Kruskal-Wallis H test for each dependent variable .. 50

Table 7: Intervention/control vs. Emotional response, outcome and moderating variables..... 50

Table 8: General statistical framework for Wilcoxon-Mann-Whitney test for each dependent variable..... 51

Table 9: Sample sizes needed by expected effect size for one-tailed Wilcoxon-Mann-Whitney test..... 53

Table 10: Demographics..... 57

Table 11: Results description – Arousal and disgust index scores 59

Table 12: Results description – Valence scores..... 60

Table 13: Results description – Individual arousal scores 61
Table 14: Results description – Individual disgust scores 61
Table 15: Results description – Outcome variable (Q1-Q4) index scores 62
Table 16: Results description – Individual outcome variable (Q1-Q4) item scores 64
Table 17: Results description – Moderating variable (Q5-Q6) index scores 66
Table 18: Results description – Individual moderating variable (Q5-Q6) item scores 67
Table 19: Kruskal-Wallis H test statistics – Arousal and disgust vs. outcome and moderating variable indexes 70
Table 20: Kruskal-Wallis H test statistics – Valence vs. outcome and moderating variable indexes 71
Table 21: Kruskal-Wallis H test statistics – Arousal and disgust vs. outcome variable item scores 73
Table 22: Kruskal-Wallis H test statistics – Arousal and disgust vs. moderating variable item scores 75
Table 23: Kruskal-Wallis H test statistics – DS and PSSC vs. Emotional response and outcome variable indexes 78
Table 24: Kruskal-Wallis H test statistics – DS and PSSC vs. Emotional response scores for individual slides 79
Table 25: Kruskal-Wallis H test statistics – DS and PSSC vs. outcome variable item scores 82
Table 26: One-tailed Wilcoxon-Mann-Whitney test statistics – Intervention/control vs. emotional response, outcome and moderating variable indexes 85
Table 27: Chi-square test statistics – Intervention/control vs. valence scores for individual slides 86

Table 28: One-tailed Wilcoxon-Mann-Whitney test statistics – Intervention/control vs. arousal and disgust scores for individual slides 87

Table 29: One-tailed Wilcoxon-Mann-Whitney test statistics – Intervention/control vs. outcome variable item scores..... 89

Table 30: One-tailed Wilcoxon-Mann-Whitney test statistics – Intervention/control vs. moderating variable item scores 92

Table 31: Kruskal-Wallis H test statistics – SES vs. indexes for all variables and individual valence scores 95

Table 32: Kruskal-Wallis H test statistics – Other demographics vs. indexes for all variables and individual valence scores..... 97

Table 33: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between arousal and disgust indexes vs. outcome variable indexes..... 99

Table 34: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between individual valence scores vs. outcome variable indexes 100

Table 35: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between arousal and disgust indexes vs. outcome and moderating variable indexes..... 103

Table 36: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between individual valence scores vs. moderating variable indexes..... 103

Table 37: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between general DS and PSSC indexes vs. outcome variable indexes..... 106

Table 38: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between general DS sub-indexes vs. outcome variable indexes..... 106

Table 39: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics between age, gender and race vs. all study variable indexes 108
Table 40: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics between income, education and religious service attendance vs. all study variable indexes 109
Table 41: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics for political affiliation, number and preferred types of health information sources vs. all study variable indexes 110
Table 42: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between arousal and disgust indexes vs. outcome and moderating variable indexes 112
Table 43: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between general DS and PSSC indexes vs. outcome variable indexes..... 116
Table 44: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between general DS sub-indexes vs. outcome variable indexes 117
Table 45: Mean rank differences between study variable indexes for intervention vs. control . 119
Table 46: Chi-square Phi coefficient test statistics – Individual valence scores for intervention vs. control 120
Table 47: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics between age, gender and race vs. all study variable indexes 123
Table 48: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics between income, education and religious service attendance vs. all study variable indexes 124
Table 49: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics for political affiliation, number and preferred types of health information sources vs. all study variable indexes 125

Table 50: Summary of content, formatting, and observed intervention, emotional response and demographic effects per presentation slide 134

LIST OF FIGURES

Figure 1. General EC model of human perception, decision making and behavior 4

Figure 2. General EC behavioral change model 6

Figure 3. Modified 9-point Self-Assessment Manikin scales 39

Figure 4. Modified 9-point Self-Assessment Manikin scale customized for disgust 40

PREFACE

As the years go by, I remember less and less of my early years growing up in Puerto Rico, and what I do remember keeps getting foggier with time. One of the things I do remember vividly from my early childhood – one of the few things I can still picture clearly with its details more or less intact – is an anti-dengue ad campaign that ran in the mid-1980s. The campaign included your usual informational posters, flyers and radio spots urging people to reduce mosquito breeding sites by covering or upending potential household containers for stagnant water such as tires, buckets, wheelbarrows, etc. What made this particular ad campaign so memorable to me was one television public service announcement which I still find chilling to this day. What follows is my recollection of that ad.

With carnival playground music playing in the background, a famous soap opera actor of the time called Braulio Castillo Jr. strolls through an empty house, describing the "typical" happy family that lives there: mom and dad, two boys, and a little girl who was excited about starting school because she wanted to be a teacher just like her mom. Once the actor reaches her room, the camera focuses on the little girl's dolls lying forgotten next to her book bag, while the background music turns to a much more somber tone. It is at this point that the camera shot changes to a shot of a large family dressed in black crying at a funeral, and the audience learns through Mr. Castillo's disembodied voice that this promising young life was cut tragically short by a preventable disease: dengue fever. The rest of the ad consists of the actor back at the

family's home, strolling out of the girl's room while pointing out all the potential breeding places in and around the house from where the mosquitos that killed her most likely came. It ended with the actor's trustworthy face – he usually played the leading man in the *telenovelas* – saying right into the camera that it was everyone's duty to keep our children safe, because no one should have to go through the pain of losing a child so young.

I have not been able to find footage of this ad so I cannot say if my recollection is accurate or not, and I cannot say whether this ad campaign was actually successful in preventing or even reducing dengue fever rates. What I do know is that from that moment on I have had an almost obsessive compulsive need to overturn any outdoor container with standing water I see. I also cannot say with certainty whether this need is the quirky result of a neurotic personality or of a natural if somewhat idiosyncratic manifestation of embodied cognition (EC), one of the fundamental mechanisms by which human beings make sense of the world and respond to it. I firmly believe it is the latter, and this paper discusses the evidence base for that belief and presents the results of a pilot study to test a number of EC-predicted effects in the context of public health and infectious disease prevention.

I would like to acknowledge the following University of Pittsburgh faculty members who have so generously contributed to my academic, professional and personal development over the years: Dr. Christopher Keane, Dr. Martha Terry, Dr. Jeanette Trauth, Dr. Tristen Inagaki, Dr. Patricia Documét, Dr. John Marx, Dr. Ronald Stall, Dr. Ravi Sharma, Dr. Russell Shuh, Dr. Mary Nowalk, Dr. Andrea Kriska, and many others. Thank you all.

I would also like to acknowledge the Clinical and Translational Science Institute's Research Participant Registry as this study's sole recruitment source. The project described was supported by the National Institutes of Health through Grant Number UL1TR000005.

1.0 INTRODUCTION

The theory of embodied cognition (EC) has received much attention in a number of academic and applied fields. However, its potential public health applications have been mostly ignored. This is unfortunate given that the theory of EC is compatible with existing health behavior theories and grounds them in a conceptual framework that is itself grounded in our growing understanding of the physiology of behavior. The studies discussed in Chapter 1 argue that EC is a fundamental mechanism of human perception, decision making and behavior, and public health educators and advocates would likely benefit from adoption of EC approaches to promoting disease prevention. But first, EC-derived concepts and tools need to be tested in the context of a real public health issue. The extent to which these concepts and tools can be translated to real-world settings will help set boundary limits to how widely they can be usefully implemented in public health education and advocacy.

The chapters that follow describe a pilot study testing the applicability of an EC-derived mechanism in the context of influenza prevention, by evaluating whether a disgust reaction and subsequent disease and moral contagion effects influence people's attitudes and behavioral intentions related to influenza. The primary investigator (PI) hypothesized that persons who experience a disgust reaction when presented with influenza prevention information would have their natural tendency to protect themselves from influenza infection magnified, and would also

have their natural tendency to oppose (or support) such advertisements magnified (or temporarily overridden).

1.1 WHAT IS EMBODIED COGNITION?

EC is not a new concept in the behavioral sciences. For many decades there have been proponents for some form of theory of human cognition explaining perception, decision making and behavior as grounded in our physiological interactions with the world [1-8]. With advances in statistics and computers during the twentieth century, these were essentially relegated to the fringe, giving way to cognitive theories explaining learning, decision making and behavior as the accumulation of abstract symbolic knowledge and logic rules which are algorithmically applied according to probability theory [1, 2, 4, 9, 10]. However, studies in linguistics and cognitive and developmental psychology in the last forty years have renewed the argument for more physiologically-grounded behavioral theories, and recent advances in the neurosciences and artificial intelligence have shifted the paradigm firmly towards embodied theories of human cognition [1, 7-13].

The theory of EC postulates that people evolved neural structures allowing them to ground their mental models of the world in readily understood processes derived from their sensory perceptions of and physical interactions with that world [5, 7, 12, 14-17]. It further postulates that, by virtue of the interconnected nature of the regions of the brain and nervous system dedicated to the sensorimotor, emotional, memory and language functions, people are able to apply information and behaviors learned through one functional domain across multiple domains [11, 13, 17-19]. Repeated observation and imitation of contextually situated responses

to specific stimuli conditions people to adopt or avoid some emotional, cognitive and behavioral responses over others, especially early in life [5, 14, 17, 18, 20-22]. Over time, these conditioned preferences form the perceptual filters, decision making biases and default behaviors which people apply, both consciously and unconsciously, to facilitate their responses to the specific life experiences afforded by the particular environmental niche(s) in which they live [5, 20-24]. Therefore, the theory of EC essentially states that people learn about their environment and how to cope in it instinctively by extrapolating necessary life lessons from observations of their own and others' bodily interactions with the world around them. Figure 1 (see next page) distills the above assertions into a general EC conceptual model of how information/stimuli become beliefs and behaviors.

People accumulate information about and experience feelings towards their environment throughout their lives, which first form and then reinforce certain beliefs, attitudes and behavioral responses in favor of other alternatives [20-23, 25]. This is probably a result of mechanisms that evolved to help early humans speed up their decision making and reaction time in the face of an uncertain and ever-changing environment, making them very adaptable to a large range of ecosystems and variation within ecosystems [14, 24, 26, 27]. In the wild, when even everyday situations could be matters of life or death and knowledge was often incomplete, being able to quickly infer what to do in a given situation according to one's experiences and/or those of trusted sources allowed people to avoid environmental threats and exploit environmental opportunities [20, 24, 25, 28].

The accumulation of information about negative or harmful experiences, such as insect bites lead to painful swelling or worse, instills a sense of fear and avoidance of known threats, and the accumulation of information about positive or beneficial experiences, such as bonfires

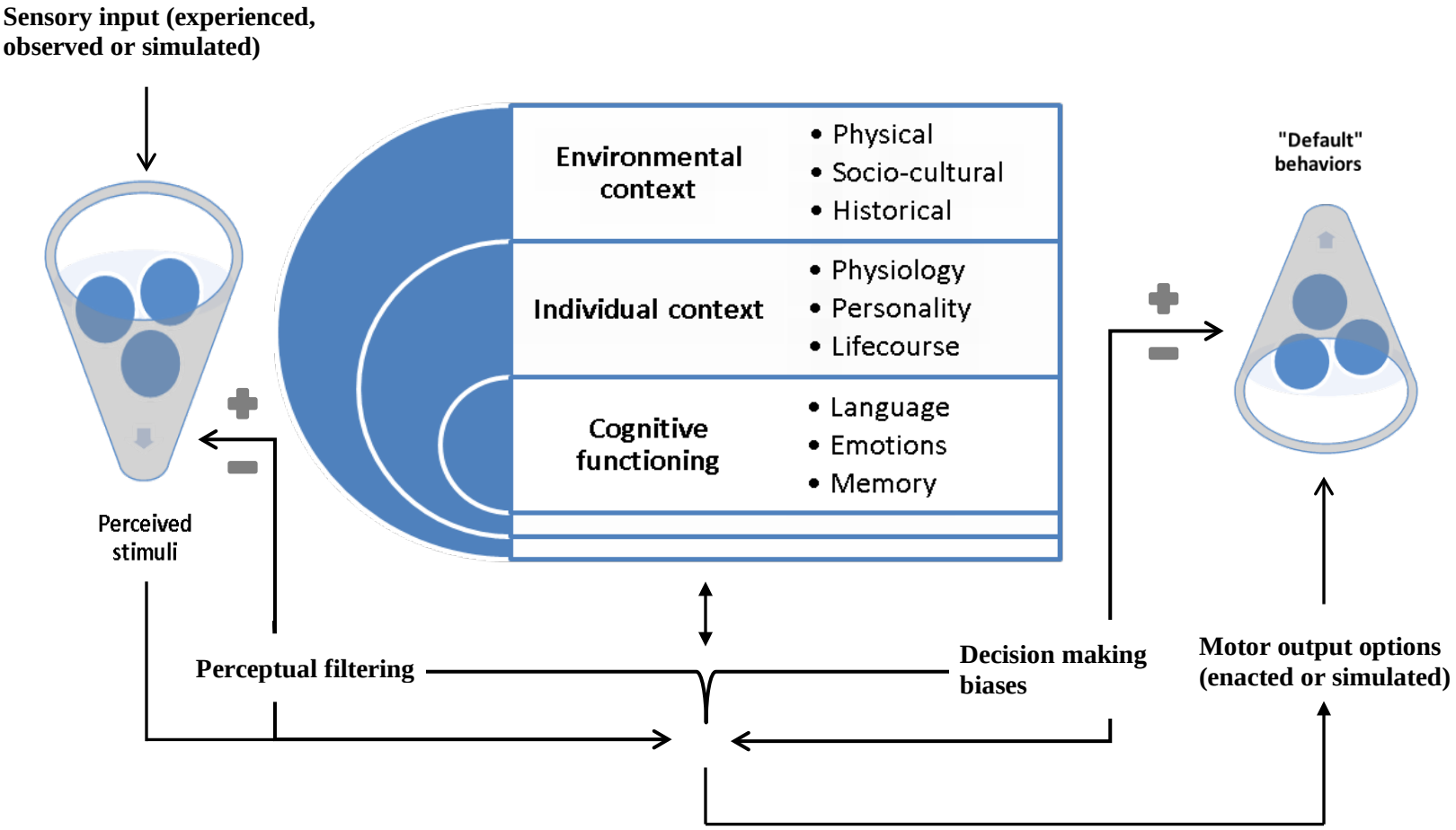

Figure 1. General EC model of human perception, decision making and behavior

bring safety and warmth in the night, instills a sense of wellbeing and a desire for those experiences [29]. It is this ability to abstract meaning from and assign meaning to actions and events across cognitive domains, meaning which is fundamentally grounded in our sensory perceptions of and motor interactions with the world, which has profound implications for our understanding of human perception, decision making and behavior, and therefore, for public health education and advocacy efforts.

A general behavioral change model based on EC (see Figure 2 in next page for an example derived from the discussion so far) revolves around three rules: (1) people's cognitive and emotional preferences are developed early in life and reinforced or modified throughout the life course according to (a) their own lived experiences and (b) observation of others' lived experiences; (2) these preferences form the rules by which people (a) filter information, (b) make decisions and (c) act; and (3) people selectively utilize these rules according to their current situational context. Such rules speed up decision making and reduce reaction time, but because they may not necessarily be evidence-based, or at least based on scientific evidence, they may not be based on accurate information. If people's early learning comes from lived experiences or the observed experiences of others, then it is possible that the rules people live by would be influenced by anecdotal evidence, which could lead to the creation and perpetuation of erroneous assumptions and maladaptive behaviors.

During humanity's early history the benefits of this knowledge processing system must have always outweighed the drawbacks. For example, humans inherited the disgust reaction that their mammal ancestors devised to protect themselves from ingesting potentially contaminated foods. Living in close-knit groups, early humans extended this autonomic reaction to encompass other types of environmental contaminants as a means to protect themselves from infectious

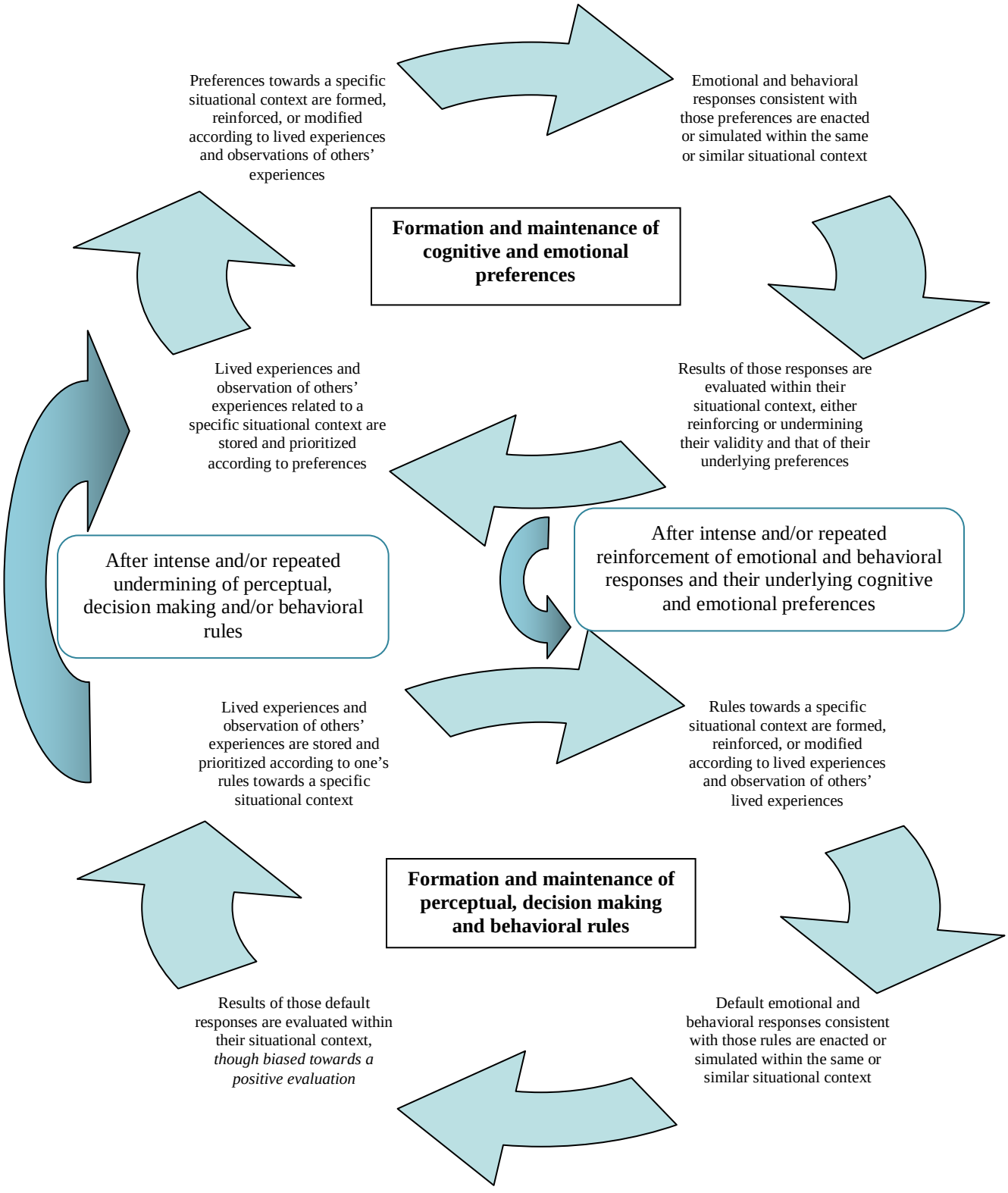

Figure 2. General EC behavioral change model

diseases, and even to social contaminants as a means of enforcing societal norms as well as protecting the group from potentially hostile outsiders [30, 31]. But, in modern societies, so different from the harsh environments that shaped our species, the benefits of these evolved behavioral strategies may not always outweigh the drawbacks, with potentially detrimental public health consequences [31, 32]. For example, hypersensitivity to disgust has been linked to a number of personality disorders, diminishing the quality of life of those who suffer conditions ranging from obsessive-compulsive behaviors to agoraphobia [31].

1.2 ASSUMPTIONS AND IMPLICATIONS OF THE THEORY OF EMBODIED COGNITION

EC assumes that sensory perception, motor activation and cognitive functions are physiologically interconnected [1, 18, 20, 33]. EC also assumes that after repeated exposure to the same contextual stimuli, these interconnected functions become conditioned to respond together so that it requires less stimulation to activate them over time, and even thinking about or anticipating the stimuli will lead to activation of the whole network [1, 18, 20, 33]. It is these physiological processes which allow people to learn how to behave in their environment instinctively, by grounding our mental models of the world in universally understood processes derived from the stimuli we receive and feel through our own physical interactions with that world [1, 5, 20, 22, 33, 34].

Imagine the most memorable events in your life. They are usually accompanied by a variety of sensations and emotions that become associated with those memories, and these sensations and emotions then become evocative of the information processed during those

events. It can be a pleasant memory, such as the crispy texture of fried pork and the spicy smell of beans simmering away on a stovetop reminding me of Christmas meals at my grandmother's house surrounded by family. Or, it can be an unpleasant memory, such as the whooping sound of helicopter blades overhead bringing memories of harrowing days spent in combat, like some Vietnam veterans suffering from post-traumatic stress disorder. In both instances, the cognitive and emotional information processed during the event was stored along with a context specific set of sensorimotor cues that help in later retrieval of that cognitive and emotional information, if triggered by similar sensorimotor cues.

Essentially, EC assumes that cognitive function follows from physiological form, similar to the way that an airplane's flying capabilities are a direct result of its engineered aerodynamic features. People instinctively utilize information processing shortcuts allowing them to store, prioritize, and retrieve only that information deemed relevant to their current situational context, relative to their pre-established priorities and preferences given their previous experience with similar situational contexts. Thus, as people live their lives and interact with others, they develop perceptual filters, decision making biases and default behaviors that have been reinforced by previous lived experience or by mental simulation of observed experiences. Following these shortcuts liberates people from second-guessing themselves through the adoption of hard and fast rules which guide their responses to specific scenarios, leading to a set of default behaviors to respond to those scenarios. Such rules liberate people from sorting through and accumulating information that goes against what they already believe and know to be true, reducing reaction time and speeding up decision making through streamlined cognitive processes.

These assumptions are consistent with the theory that disgust evolved to protect us from disease and from other potential contaminants, both physical and social. Another assumption

of EC is the seemingly situational nature of learning and behavior. The “situative perspective” ([27], page 5) states that learning always takes place in a specific context, and this context influences how people understand and apply their experiences [4, 27, 35, 36]. The degree to which knowledge is acquired and subsequently applied is as dependent on the actual information presented during the learning experience as on the actions and feelings, the physical and emotional processes, evoked during the learning experience. In other words, thinking is largely on the fly and in the moment, where people make choices and decisions in a given situation almost automatically based on their experiences related to the same or similar situations, or with the perceived experiences of others in the same or similar situations.

Such quick wits would be a definite asset to early humans trying to survive in the wild, as it would provide the ability to make complex inferences about a variety of environmental stimuli instantaneously, and quickly respond to avoid threats or take advantage of opportunities. But in the modern world, with its exponentially greater number and variety of life situations and information, most decisions are not as clear cut, fight-or-flight, or obviously life and death as they were in the wild. Therefore, the same mechanism that allowed early humans to distinguish facial patterns in the brush and avoid predators is the same mechanism that now not only allows modern humans to see constellations in the night sky, but also to reduce whole groups of people to stereotypes. This kind of quick, almost automatic information processing is a double-edged sword, as it can potentially lead to the propagation of sub-optimal behaviors through the naive adoption of erroneous beliefs and attitudes first learned early in life and uncritically applied later.

Although there are still many gaps in our understanding of the exact physiological processes through which EC works, the evidence suggests that perception, decision making and behavior rely on this naturally occurring cognitive shorthand to facilitate people’s conceptual

understanding of and reduce their response time to all manner of life situations. There likely is much untapped potential for the incorporation of EC concepts and tools in the implementation of behavioral change interventions to address individual-level causes of disease as well as in the utilization of advocacy campaigns to mobilize populations to address systemic causes of disease. For example, coupling information related to infectious disease prevention with a disgust trigger could be used to consistently and predictably elicit a disgust reaction in persons exposed to that information, potentially leading to improved receptivity to the prevention messages via the conceptual connections between disgust and protection from disease contagion.

Therefore, behavioral change interventions incorporating EC concepts and tools may be natural ways to impart information as long as the embodied mechanisms used to disseminate the information are conceptually compatible with the information content. A discussion of ways to adapt these tools for public health education and advocacy efforts is included in Section 1.7. To contextualize that discussion, a number of issues require further exploration beforehand. Section 1.3 analyzes the compatibility of an EC behavioral change model with established health behavior change theories to see how well it integrates with existing health behavior change approaches. Section 1.4 discusses various examples of EC-driven behavioral mechanisms in general, and Section 1.5 discusses various examples relevant to health behaviors in particular. Section 1.6 explores a number of ethical and practical considerations for incorporating EC-driven behavioral mechanisms in public health interventions, as this study's potential contribution to the field would be to provide proof of concept evidence for their scaling up, both to influence individuals' health-related behaviors and communities' willingness to materially support the elimination or mitigation of systemic causes of disease.

1.3 THE THEORY OF EC IS COMPATIBLE WITH AND CAN ENHANCE EXISTING HEALTH BEHAVIOR CHANGE MODELS

EC concepts described so far have important implications for public health educators and advocates seeking to influence people's behaviors. The theory of EC has received much attention in fields such as cognitive psychology and neuroscience, educational psychology, anthropology, sociology, and marketing research. Despite the pervasive role EC plays in human perception, decision making and behavior, its explicit application in health promotion, education and advocacy efforts has been largely neglected. This seeming neglect is especially puzzling given the similarities between an EC model of human behavior and many of the most widely used health behavior theories.

The following is a comparative analysis of selected health behavior theories to determine whether a model of human behavior based on EC is compatible with already agreed upon core concepts of health related behavior change and therefore can be integrated into tried-and-true health behavior change interventions (see Tables 1 and 2 in the next two pages for details of this compatibility analysis). These core concepts of human health behavior are material incentive structure, social-cultural incentive structure, cost-benefit analysis, perceived self-efficacy, and behavior context. These concepts were consolidated from the constructs of some of the most widely used theories in health promotion and education: health belief model, theory of planned behavior, social cognitive theory, and others (see Table 2 for relation between health behavior theory constructs and core concepts; see Appendix A for full theory construct and core concept definitions). Health behavior theories were chosen to contextualize the analysis so that it would be more relevant to public health promoters and advocates seeking to change people's behaviors.

Table 1. Is a behavioral model incorporating the concepts of EC compatible with the core components of health-related behavior change? Is our understanding of those core components enhanced by incorporating a behavioral model based on EC?

'Universal' health behavior component	Theory of EC perspective on core components of health-related behaviors
Material incentive structure – will this behavior be rewarded with material incentives, or will it be penalized? Do I need or want those material incentives?	**Incentive structures include visceral satisfaction and/or emotional vindication** – a given behavior will probably be adopted if the material gains associated with it are perceived to reinforce an individual's or community's set of values, attitudes, and/or beliefs by temporarily producing pleasurable thoughts and feelings, whatever the definition of 'pleasurable' is to the individual or community. Conversely, behaviors that result in material losses will probably be avoided by an individual or community because they temporarily produce unpleasant thoughts or feelings. Receiving material goods feels good and rewards/reinforces uncritical adoption of norms and 'default' behaviors.
Social-cultural incentive structure – will this behavior be rewarded with peer/societal approval/status, or with disapproval/loss of status? Do I need or want that peer/societal approval/status?	**Incentive structures include visceral satisfaction and/or emotional vindication** – a given behavior will probably be adopted if the gains in status associated with it are perceived to reinforce an individual's or community's set of values, attitudes, and/or beliefs by temporarily producing pleasurable thoughts and feelings, whatever the definition of 'pleasurable' is to the individual or community. Conversely, behaviors that result in loss of status will probably be avoided by individuals and communities because they temporarily produce unpleasant thoughts or feelings. Societal status and/or peer approval feels good and rewards/reinforces uncritical adoption of norms and 'default' behaviors.
Cost-benefit analysis – is it worth my time/energy to invest in this behavior, given what I know about it? Are the costs and benefits evident in the short term? Are the costs and benefits evident in the long term?	**Cost-benefit analysis leading to adaptive response** – potential costs and benefits of a given behavior, however 'costs' and 'benefits' are defined by the individual or community, are perceived to enhance adaptability to the environment, i.e. to ensure one's continued existence and/or chances for success in life, however 'success in life' is defined by the individual or community. If yes, behavior will probably be adopted. If not, it probably will not. **Cost-benefit analysis influenced by embodied responses to stimuli** – potential costs and benefits of a given behavior, however 'costs' and 'benefits' are defined by the individual or community, are apparent to individuals and communities, and preferences influencing the value placed on those costs and benefits are ingrained in a person early in life through their lived experiences and reinforcement of environmental norms and 'default' behaviors. If costs and benefits are apparent, and benefits outweigh costs, behavior will probably be adopted. If they are apparent, and costs outweigh benefits, it probably will not. If costs and benefits are not apparent, the behavior probably will not be adopted, given people's aversion to the unknown. If a given behavior produces short-term benefits but long-term net losses, the behavior may still be adopted if the individual or community has a projection bias, where short-term effects are weighed more heavily than long-term effects. **Cost-benefit analysis influenced by a tendency to follow 'path of least resistance'** – individuals or communities will usually adopt a given behavior if they perceive it to be the easiest and least energy-consuming alternative given their current norms and 'default' behaviors. If a given behavior involves a major change from their 'default', individuals or communities will probably not adopt it even if it provides a net benefit. If it involves relatively little change from their 'default', it has better chances of being adopted.
Perceived self-efficacy – if I was willing to perform this behavior, would I be able to, given the material resources and cognitive/emotional capacity at my disposal?	**Perceived self-efficacy and the role of embodied cognition and priming** – individuals or communities will be more likely to adopt behaviors that they feel confident they would be able to perform, and they may be more likely to feel confident about a particular behavior if it can be easily assimilated by persons into their already established behavioral repertoires through demonstrations illustrating the feasibility of adopting the behavior in question, and repeated practice of that behavior in its proper context. Norms and behaviors are best learned in their proper context for appropriate future application, and role-play and other simulation training techniques enhance capacity/skill level associated with the behavior in question.
Behavior context – if I was willing and able to perform this behavior, do I know when to perform this behavior? Are the appropriate times and places to do so environmentally and/or structurally evident, and if so, to what extent?	**Behavior context and the role of embodied cognition and priming** – individuals or communities will be more likely to adopt behaviors that are readily elicited by environmental stimuli that are congruent with the particular lived experiences and long-held values that have conditioned persons to respond to sets of stimuli in relatively consistent manner. These behavioral responses can be predictably elicited by manipulation of the relevant environmental stimuli, if the link between stimuli and response is known for a particular individual or community in a specific context, and if it can be accurately depicted and disseminated. To ensure appropriate application of behaviors, it is best if they are learned in their proper context, and training enhances persons' ability to recognize sensorimotor cues found in the environment.

Table 2. Core components of health-related behavior and decision making – Supporting theories

'Universal' health behavior component	Relevant behavior change theory constructs to justify 'universality' of health behavior core components [37]
Material incentive structure – will this behavior be rewarded with material incentives, or will it be penalized? Do I need or want those material incentives?	Health Belief Model – perceived benefits/barriers Theory of Planned Behavior – attitude toward behavior Social Cognitive Theory – reciprocal determinism; reinforcements Diffusion of Innovations Theory – compatibility Agenda Setting – problem definition; framing Social Marketing – product; price
Social-cultural incentive structure – will this behavior be rewarded with peer/societal approval/status, or with disapproval/loss of status? Do I need or want that peer/societal approval/status?	Health Belief Model – perceived benefits/barriers Theory of Planned Behavior – subjective norm Social Cognitive Theory – reciprocal determinism; reinforcements Diffusion of Innovations Theory – compatibility Agenda Setting – problem definition; framing Social Marketing – product; price
Cost-benefit analysis – is it worth my time/energy to invest in this behavior, given what I know about it? Are the costs and benefits evident in the short term? Are the costs and benefits evident in the long term?	Health Belief Model – perceived susceptibility/severity/benefits/barriers Theory of Planned Behavior – attitude toward behavior; subjective norm Social Cognitive Theory – expectations; behavioral capability Diffusion of Innovations Theory – relative advantage; observability Agenda Setting – media/public/policy agenda setting Social Marketing – product; price; place
Perceived self-efficacy – if I were to want to choose to perform this behavior, would I be able to, given the material resources and cognitive/emotional capacity at my disposal?	Health Belief Model – self-efficacy Theory of Planned Behavior – perceived behavioral control Social Cognitive Theory – behavioral capability; self-efficacy Diffusion of Innovations Theory – complexity; trialability Social Marketing – place
Behavior context – if I was willing and able to perform this behavior, do I know when to perform this behavior? Are the appropriate times and places to do so environmentally and/or structurally evident, and if so, to what extent?	Health Belief Model – cues to action Theory of Planned Behavior – behavioral intention Social Cognitive Theory – observational modeling; reinforcements Diffusion of Innovations Theory – trialability; observability Agenda Setting – framing Social Marketing – promotion

Table 1 summarizes the position that adoption of an EC behavioral model into health promotion and advocacy would not conflict with any of the most commonly utilized and agreed upon theories and models of health-related behavior change. It illustrates that such a model is at least consistent with existing constructs of explanatory and descriptive frameworks for human health behavior. Table 1 shows a number of core components of human decision making related to health behaviors side by side with related characteristics of EC, and brief explanations of how an EC model can enhance our understanding of those core components of health behaviors. Table 2 shows which specific theory constructs are relevant to the core concept categories described in Table 1.

Although the stages of change/transtheoretical model (SOC-TTM) was not included in the tables, this theory is also compatible with the analysis presented therein. The sub-constructs inherent within the theory's stages of change constructs (see Appendix A for definitions of SOC-TTM stages of change) heavily borrow from the constructs of most of the other included health behavior theories, and thus can also be categorized as costs, benefits, perceived self-efficacy and behavioral context. Furthermore, the SOC-TTM emphasizes tailoring health promotion interventions to accommodate a person's familiarity with and receptivity to behavior change at a particular point in his or her life course. SOC-TTM implicitly recognizes that people's motivation to adopt new behaviors depends on their internalization of the implications of adopting those behaviors and that this internalization is a function of time and intensity of exposure to information about the implications of those behaviors. Given that those two assumptions are compatible with the central assumptions of EC described earlier, it would be uncontroversial to assert that the theory of EC is also consistent with the SOC-TTM.

1.4 WHAT IS PRIMING?

Many researchers conduct priming experiments to test EC-derived hypotheses. Priming refers to the influence that a stimulus experienced at one time has on a person's response to another stimulus experienced at a later time, usually immediately after [38-41]. A number of sources in the psychology and neuroscience literature describe many instances of EC-predicted priming effects. Nodding while listening to persuasive messages leads to higher acceptance of the validity of those messages while shaking one's head while listening to the same messages leads to lesser acceptance of their validity [42, 43]. Posture (i.e., leaning forward vs. leaning back) influences whether persons behave in an honest or dishonest manner in a variety of situations [44]. Making a fist while reading passages related to the concept of power differentially influences men and women's judgments of the content of those passages [45]. Making a fist enhances self-assessments related to assertiveness, esteem and power for men but not for women [46]. People are better at detecting changes in both arm and leg position of others when moving their own arms or legs [47]. fMRI scans show that the brain circuits associated with grasping are activated when people are shown objects that can be manipulated with their hands [48]. Two independent fMRI studies showed significant and widespread reductions in overall neural activity when people process visual images of repeated objects as compared to new objects [49, 50]. People are slower to describe spatial elements of cartoons when deprived of their ability to gesture [51]. Providing an intuitively understood spatial coordinating system such as the body to abstract shapes allows persons to better manipulate the abstract shapes in their heads and complete various tasks [52]. Athletes are faster than average persons at matching sports-specific text to related sports-specific pictures even though there was no difference when matching non-sports-specific text to related non-sports-specific pictures [53]. Holding heavy vs. light clipboards

makes job candidates appear more important, solving rough vs. smooth puzzles makes social interactions appear more difficult, and touching hard vs. soft objects increases rigidity in negotiations [54]. The cross-race effect (i.e., the tendency to remember same-race faces better than cross-race faces) is reduced when target faces' perceived importance is explicitly manipulated by telling participants they were outcome-dependent on the faces' race, and eliminated entirely when implicitly manipulated by simply enlarging the pictures of the target faces [55]. Engaging in movements simulating approach behaviors, such as pulling towards the self, leads to more positive ratings of unfamiliar and neutral ideographs than engaging in movements simulating avoidance behaviors, such as pushing away from self [56]. Reading socially warm vs. neutral messages from friends and family makes people feel warmer, holding warm vs. neutral-temperature objects makes people feel more connected to friends and family, and fMRI results during social warmth overlapped with fMRI results during physical warmth [57]. Feeling socially excluded makes people judge their surroundings as colder and makes people prefer warmer products [58]. Touching warm vs. cold objects makes people perceive less distance between themselves and others, perceive more interpersonal warmth in others, behave more altruistically towards others, use more concrete language, and focus more on object interdependence [59, 60].Given that the priming effect is largely dependent on the assumptions that information processing is influenced by the sensorimotor stimuli associated with the information at the time of acquisition, and that quick information retrieval is influenced by the sensorimotor stimuli present at the time of retrieval, priming is regarded as a natural, expected manifestation of EC [19, 61, 62].

Priming effects illustrate the intimate physiological connection between sensory perception, motor activation, and information processing and retrieval that have evolved to allow

humans to better exploit environmental opportunities and avoid environmental threats. The ubiquity and variety of priming effects supports a robust link between somatosensory stimuli and the acquisition, assimilation, and application of both cognitive and emotional information for a variety of tasks. For example, in the case of persons who respond more positively to persuasive messages when nodding their heads, sensorimotor stimuli that evokes a particular concept – in this case, nodding one's head evokes the concept of agreement – seem to prime individuals to respond to stimuli more predictably – in this case, to agree with the information provided. If harnessed, such strategies can be powerful tools for behavioral change. When the behaviors in question are situated within deeply personal contexts like health, wellbeing and social interactions, as with infectious disease prevention, such strategies could in fact be superior to purely intellectual or informational approaches given that deliberate decision making is likely constrained or even impaired due to the behaviors' emotional and thus reactive nature.

1.5 PRIMING APPLIED TO HEALTH BEHAVIORS

It is not controversial to state that early life experiences significantly shape people's conscious and unconscious understanding of and reactions to the world around them over the life course. Williams, Huang and Bargh [22] review a number of studies focusing on "concepts and goal structures specialized for interacting with the physical environment (e.g., distance cues, temperature, cleanliness, and self-protection), which emerge early and automatically as a natural part of human development and evolution" (p. 1257). They argue that distance, temperature, cleanliness and self-protection cues serve to ground people's understanding of the more abstract

related concepts of relationships, personalities, morality and psychological pain, and therefore their manipulation influences how people perceive and react to the world around them.

The production of reliable behavior effects through the manipulation of cues related to simple concepts like size, distance, temperature, texture, cleanliness and self-protection has profound implications for public health. One recent study [63] illustrates a heaviness priming effect on people's perceptions of disease severity, medication effectiveness, and perceived severity of medication side effects, factors thought to contribute to medication adherence. The author found that experiencing heaviness via bulkier medication packaging made participants perceive: (1) diseases as more severe, (2) medications as more effective, and (3) medication side effects as more serious *but only when not also asked about medication effectiveness*. The author argues result #3 was due to participants conceptually prioritizing medication effectiveness over medication side effects, with side effects being a sub-concept within effectiveness. Understanding the conceptual underpinnings of health related beliefs and behaviors, then, is crucial to effectively apply embodied mechanisms like a weight manipulation for health behavior change.

One of the studies described earlier found that leaning forward vs. leaning back influences whether people behave in an honest or dishonest manner to a variety of situations [44]. In their experiments, the authors' manipulation of whether persons took an approach or avoidance posture seems to have engaged the physical concept of distance, related to the abstract concepts of social proximity and trust, and nudged people to be more or less honest in their answers accordingly. Another study described earlier found that sensations of touch (heavy vs. light, rough vs. smooth, hard vs. soft) influenced people's perceptions of social interactions [54]. In their experiments, the authors' manipulation of objects' weight and feel engaged the physical

concepts of size and texture related to the abstract concepts of social status and relationship dynamics, and nudged people to perceive others as more or less important, social interactions as more or less difficult, and negotiations as more or less rigid accordingly.

Manipulations such as these that unconsciously tap into abstract concepts like social proximity, trust, social status and relationship dynamics would likely also influence people's willingness to engage in protective behaviors for themselves. However, such manipulations could have contradictory effects in the context of public health. For example, inducing less trust could lead to more protective individual behaviors, but also to more resistance to materially supporting societal action to engage in those protective behaviors. Therefore, careful evaluation of potential emotional manipulations on target individuals as well as the general population is crucial to effectively apply such strategies in public health.

Liljenquist and Zhong [64] argue that virtuous/moral behaviors are elicited by reminders of physical cleanliness because virtuous/moral behaviors are conceptually related to cleanliness, evidenced by the ubiquity of cleansing practices in religious ceremonies throughout history. In a series of experiments, they show that threats to people's perceived moral purity elicited by recalling past ethical or unethical behaviors or transcribing written passages of ethical or unethical behaviors made them feel the need to cleanse themselves as determined by increased mental accessibility of cleansing-related concepts over others, greater desire for cleansing products over others, and a preference for antiseptic wipes over pencils as post-study free gifts. Physical cleansing, they argue, alleviates the unpleasant feelings elicited by unethical behavior and reduces threats to moral self-image. Zhong, Strejcek and Sivanathan [65] argue that the conceptual linkages between cleanliness and moral purity can have unintended consequences: if people's self-perceptions of cleanliness are linked to their self-perceptions of virtuosity, then

enhancing their self-perceptions of virtuosity through cleanliness reminders may make them judge others' behaviors more harshly. In a series of experiments, they show that cleaning hands with an antiseptic wipe or visualizing themselves in clean or dirty rooms made people more likely to rate contested issues such as abortion and pornography as immoral, and also to rate themselves higher relative to their peers in moral character but not in any other characteristic.

Results like those suggest caution when applying emotional manipulations like cleanliness reminders to health behaviors, as there may be unforeseen discrimination and prejudice effects towards others, particularly those seen as outsiders. However, this does not always need to be the case. Liljenquist, Zhong and Galinsky [66] found that clean scents unconsciously promote reciprocity of trust in anonymous trust games and promote intention to volunteer in and donate to charitable organizations. In these experiments, manipulating environmental olfactory cues seems to have engaged the physical concept of cleanliness, related to the abstract concepts of purity, virtue and morality, and nudged people to be more reciprocal and even charitable in their answers. As alluded to earlier, to effectively apply embodied mechanisms like the cleanliness-physical purity-moral purity linkage to health behaviors and public health, it is crucial that there is an appropriate fit between the mechanism(s) and the conceptual underpinnings of the target behavior(s).

1.6 ETHICAL AND PRACTICAL CONSIDERATIONS FOR USING EMOTIONAL MANIPULATIONS IN PUBLIC HEALTH EDUCATION AND ADVOCACY EFFORTS

One way that EC manifests in human health behavior is when instinctive reaction or gut feeling overwhelms the more deliberate aspects of cognition. Decisions are then made based mostly on

anecdotes and personal experience and not necessarily on empirical research or sound theory due to the affective/emotional appeal and cognitive immediacy of anecdotal information. The current decline in vaccination uptake due to the debate over the safety of vaccines is an example of the power of emotional appeals in public health, with the highly-publicized experiences of relatively few victims of alleged vaccine side effects distorting the general public's perception of the safety of vaccines, even though at a population level vaccines have a very high benefit to cost ratio [67, 68]. The uncritical adoption of claims that reinforce already-held beliefs and attitudes, regardless of their factual veracity, is a cornerstone of EC. Although this is one example where emphasizing an emotional response led to a detrimental public health result, such an emphasis on emotionally persuasive anecdotal data need not necessarily have negative consequences if the message being disseminated is not in opposition to empirical data.

Prejudice and stereotyping against persons, things or ideas regarded as "other" is another negative example of people's steadfast trust in hard and fast rules, and our own country's troubled racial history speaks volumes to this unfortunate evolutionary byproduct. Even when consciously rejecting such prejudices, individuals may still express them unconsciously [69]. As mentioned before, in the wild, when unquestioned adherence to hard and fast rules meant the difference between life and death for the individual and group, prejudice and stereotyping likely had evolutionary advantage; that is hardly the case in modern societies where the harsh life-or-death struggle to survive is not so ubiquitous. The strong link between socioeconomic status (SES), minority status and health throughout history [70-73] demonstrates how devastating the consequences can be for groups regarded as "other", such as racial, ethnic, religious and sexual preference minorities who are marginalized and deprived of the necessary affordances to thrive

within mainstream society because they are deemed outside that society and therefore less worthy of its membership benefits.

Therefore, health education and advocacy strategies incorporating embodied mechanisms like the cleanliness-physical purity-moral purity linkage must be carefully tailored to each specific audience and context. Furthermore, caution must be exercised when actively inducing feelings of disgust in an audience to avoid associating the disgust reaction with any given group. Examples from behavioral economics and marketing are now presented to illustrate the potential pitfalls of scaling up EC concepts and tools for population-level behavioral change.

1.6.1 Observations from behavioral economics

In their discussion of human behavior, Camerer and colleagues describe a model from behavioral economics called asymmetrical paternalism [74]. This model proposes the adoption of regulatory structures that "are relatively harmless to those who reliably make decisions in their best interest, while at the same time advantageous to those making suboptimal choices" ([74], page 1212). Such regulations would take advantage of a number of decision making biases highly prevalent among persons making suboptimal choices while not affecting the decision making processes of persons acting in their best interests, with the intent of producing reliably positive net social benefits. Some of these prevalent biases include the following: projection bias, when individuals "overweigh the short-term benefits of indulging their current state of mind" ([74], page 1238), even if the long-term consequences entail a net loss, as is the case with gamblers and drug and alcohol abusers; loss aversion, defined as "the tendency to place a greater negative value on losses than the positive value one places on equivalent gains" ([74], page 1224); and aversion to ambiguity and to incomplete knowledge.

These last two, loss aversion and aversion to ambiguity, contribute to status quo bias. The authors argue that people tend to adhere to the status quo when responding to their environments, regardless of how economically (*ir*)*rational*[1] the response may be. They state that people routinely follow the path of least resistance and choose the "default setting" in many transactional situations ([74], page 1227). The authors also state that the tendency for people to follow the path of least resistance and/or to act against their best interests is particularly strong when *rational* decision making is impaired and conscious inhibition of *irrational* impulses is weakened. Any withholding of information, or any framing of information in such a way that it can lead to the potential distortion of its meaning limits a person's understanding of a given situation and can lead to ill-informed or *irrational* choices ([74]).

Persons who are physically, mentally, and/or emotionally agitated or stressed are as susceptible to making hastily considered choices as those with limited information, responding to life situations in a manner that is readily accessible and/or spontaneously elicited given their particular life course. In summary, when people are unable to exercise full *rationality* in making decisions, they tend to fall back on those default responses that come from the gut and make sense to them given the visceral sensations elicited by satisfying their biases, regardless of the responses' (*ir*)*rationality*[2]. And, these biases are themselves a result of people's past lived

---

[1] Throughout this section, rational/irrational refers to economic rationality, i.e., when "people have well-defined preferences (or goals) and make decisions to maximize those preferences… those preferences accurately reflect (to the best of the person's knowledge) the true costs and benefits of the available options… [and] in situations that involve uncertainty, people have well-informed beliefs about how uncertainty will resolve itself, and when new information becomes available, they update their beliefs using Bayes' law – the presumed ability to update probabilistic assessments in light of new information." (as cited in Camerer, Issacharoff, et al. 2003, pages 1214-15).

[2] Although in this section I have referred to decisions based on hard and fast rules and biases as irrational, I would like to *emphatically* state that I make no value judgments regarding bias or irrationality, as such decisions are not inherently sub-optimal in nature. If that were the case, evolution would not have selected for these neural processing mechanisms in the first place!

experiences and value systems, mirroring the assumption behind an EC behavioral model. Putting aside how one may feel about adopting behavioral change strategies which may be deemed paternalistic, the above discussion illustrates the potential of adopting asymmetrically paternalistic strategies and policies for addressing a variety of public health issues. These could be particularly effective with issues like infectious disease prevention where targeted interventions are more cost-effective than those aimed at the general public and groups at high risk may be ill-prepared to protect themselves for a variety of reasons including lack of resources or misinformation.

1.6.2 Observations from marketing

In their study of marketing applications for public health, Niederdeppe and colleagues propose a number of strategies to increase the impact of public health messages by eliciting emotional responses from listeners [75]. The authors argue that public health advocacy and research would benefit from adoption of message marketing strategies, including message framing, use of narratives and use of visual imagery, to raise awareness of social determinants of health and health disparities [75].

In the example described by the authors, message framing involves acknowledging the role of individual behavior in the creation, maintenance, and solution to health disparities, so that individuals may feel empowered to actually do something about their situation and not just passively accept environmental conditions. Narratives provide examples of individuals facing structural barriers to overcome poverty, unemployment and discrimination, so that individuals may identify with and feel sympathy towards people experiencing those conditions and would feel compelled to do something about it. Visual images evoke generalizations and causal

interpretations, highlight contrasts and create analogies, useful when trying to get complex messages and relationships across in a short amount of time. Visual images are also useful because they can help increase the relatability of subject matter to the intended audience, if the imagery is compatible with imagery that resonates with the intended audience. The authors caution that these strategies should not distract attention from the disparities, reinforce negative stereotypes, or provoke unintended emotional responses in the target audience [75]. In their example, adverse consequences could occur if the importance of individuals' behavior in the creation, maintenance, and solution to health disparities is overstated, as this might engender a sense of blame towards the disadvantaged that could prove counter-productive.

Such strategies from marketing can be quite useful when crafting health education messages, such as adherence to infection prevention practices for high-risk groups, given the limited exposure most people have to them in everyday life. Such strategies from marketing also illustrate the necessity of a two-tiered approach to addressing the socio-cultural issues associated with many public health problems: (1) strategies engendering trust among the groups affected; and (2) strategies engendering empathy towards the groups affected. Therefore, public health education and advocacy efforts utilizing emotional manipulations like disgust triggers should include conceptually relevant message strategies for both the affected group(s) and the general population, take care not to overpromise results or undermine individuals and/or communities, and strictly adhere to scientifically accurate information.

1.7 ADAPTING DISGUST TRIGGERS FOR INFLUENZA PREVENTION EDUCATION AND ADVOCACY EFFORTS

This chapter has argued that the theory of EC is compatible with established health behavior theories and that EC-derived health education and advocacy interventions incorporating emotional manipulations would integrate well with existing health behavior change approaches. This chapter has also discussed some ethical and practical considerations for using emotional manipulations in public health interventions, particularly for the scaling up of such tools to influence individuals' health-related behaviors and peoples' willingness to materially support the elimination or mitigation of systemic causes of disease. The review will now finish by discussing a number of considerations specific to the adaptation of disgust triggers for health education and advocacy efforts aimed at influenza prevention.

Effective application of emotional manipulations to health behavior change and public health advocacy requires that the emotional triggers be conceptually linked to the target belief(s) and behavior(s). One simple, embodied conceptual connection applicable to the context of infectious disease and influenza prevention is that of physical cleanliness. As discussed earlier in this paper, physical cleanliness taps into an embodied conceptual connection between cleanliness, bodily purity and moral purity. As was also discussed earlier, moral purity is further conceptually linked to perceptions of moral authority relative to others and to perceptions of moral obligations towards the self and others.

Haidt, Rozin, McCauley and Imada have argued the cleanliness-morality connection can be thought to act through an embodied conceptual connection between cleanliness, physical contamination and moral contamination through the emotion of disgust [76, 77]. The physiological mechanism of disgust is thought to have evolved in mammals as a way to

instinctively reject potentially harmful foods or other types of contaminating exposures through the elicitation of unpleasant visceral reactions such as vomiting or spitting to certain stimuli such as bitter tastes or smells of decay, and thus avoid malnutrition and disease. The authors argue that humans learn to adapt the visceral disgust reaction from an early age to guide their appraisals of other types of environmental contamination or impurity, such as things outside the norm, as potential sources of contagion and therefore as things to be avoided. This includes appraisals of impurity and contamination in the moral and interpersonal domains to help avoid behaviors detrimental to socialization into the group. Humans seem to instinctively apply this purely biological function, the disgust reaction, to form their beliefs and guide their behavior on more abstract social and cultural situations also related to contamination and contagion [78-80].

The Zhong and Liljenquist [64] study cited earlier found that threats to a person's morality led them to seek cleansing. Helzer and Pizarro [81] found that using a reminder of bodily purity made people self-identify as more politically conservative and judge others' sexually "deviant" behaviors more harshly, arguing for the conceptual linking of physical purity, moral judgement and political attitudes. In related studies, Inbar and colleagues [82, 83] found that disgust sensitivity (DS), or how easily or readily people are disgusted by particular stimuli, was positively associated with sexual and social conservatism (SSC), or how likely people are to disapprove of behaviors they perceive as outside the prevalent cultural norm, even after controlling for demographic variables and personality traits. They also found that "contamination disgust", a heightened concern with person-to-person disease transmission and infectious pathogens, was strongly associated with SSC [82]. Other studies have shown similar associations between feelings of disgust/cleanliness, moral judgment and SSC [79, 80, 84-88].

Therefore, in the context of a disease like influenza, which is mainly transmitted through physical proximity and social interactions and is therefore associated with physical purity and disease contagion, studying disgust reactions might yield valuable insights into the underlying behavioral processes of both individuals and communities in relation to influenza prevention. These insights can then inform future infectious disease prevention interventions about incorporating emotion manipulations like the disgust reaction into their communication strategies.

It is clear that disgust reactions can have unforeseen and even detrimental effects if not done in a thoughtful and ethical manner. However, these possible consequences can be remedied through critical analysis of existing literature to determine the conceptual "fit" between the chosen mechanism and the target beliefs and behaviors, and careful evaluation of possible receptiveness issues with representative members of the intended audiences. Given the potential of EC concepts and tools to advance disease prevention agendas, such issues should not prevent public health educators and advocates from adopting EC strategies.

1.8 STATEMENT OF THE PROBLEM

The utilization of an EC-based health education and advocacy strategy can facilitate at-risk individuals' adherence to individual-level disease prevention while also engendering sympathy or support from the rest of the general population, including HCPs and policy makers, to addressing system-level disease determinants. For example, embedding a disgust trigger to an influenza prevention advertisement can elicit an automatic disgust reaction and ensuing disease

contagion and moral contagion effects in their target audience, possibly magnifying their natural tendency to protect themselves and their loved ones from influenza infection.

The following chapters describe a pilot study testing the application of the conceptual linkage between disgust, physical purity and moral purity in the context of influenza prevention. Influenza was chosen as the target disease for this test because its two most efficacious prevention practices, vaccination and hand hygiene [89], involve the elicitation of a disgust reaction and its disease contagion and moral contagion effects, referred to as the disgust-contagion mechanism. Vaccination involves introducing a foreign substance into the body by piercing the skin, and hand hygiene involves cleansing the body from contaminants. Although influenza is a significant public health problem in the United States, with 7.8-40.4 million estimated annual cases leading to 120,000-975,000 estimated annual hospitalizations between 2010 and 2015 [90], and 3000-49,000 estimated annual deaths between 1976 and 2007 [91], it is not perceived as such by much of the general population. This is evidenced by perennially low vaccine uptake rates among persons aged 13-64 years old, even among some of the more high-risk groups like pregnant women, health care workers, and those who are medically compromised [92, 93]. Furthermore, there is much distrust and a perceived lack of reliable information related to infectious disease transmission, prevention and treatment in the United States in general [94-97] and related to influenza in particular [98-101]. Therefore, there is a great need for influenza prevention strategies that can overcome the apparent limitations of current efforts, and studying the potential for incorporating emotional appeals to disgust into those strategies could help messages break through to unresponsive and/or distrusting audiences.

Because of its links to physical purity and disease contagion, influenza is a good candidate for testing whether a disgust reaction, the behavioral manifestation of the concept of

physical purity, is associated with any disease contagion and moral contagion effects. If it is found that promoting certain influenza prevention practices like hand hygiene could in fact influence people to avoid or not support other practices like vaccination, the results of such a test could change the way we think about infectious disease prevention and control. Chapter 1 now closes with a listing of research objectives to test the above assumptions. Chapter 2 describes the methods used to pilot test those objectives and Chapter 3 describes the ensuing results. Chapter 4 discusses those results, focusing on their theoretical implications, practical applications and next steps for the research agenda proposed herein. Lastly, Chapter 5 provides a series of conclusions based on that discussion, focusing on its overall implications for the field of public health.

1.9 RESEARCH OBJECTIVES

A number of assumptions need to be tested before implementing EC concepts like the disgust-disease contagion-moral contagion mechanism for influenza prevention education and advocacy. First, people's felt disgust towards influenza-related information will influence how they subsequently perceive influenza and how they would likely behave towards it. Second, people's felt disgust and their perceptions of and likely behaviors towards influenza will be moderated by their sensitivity to having a disgust reaction (disgust sensitivity [DS]) and to the related moral contagion effects (sexual and social conservatism [SSC]). And third, embedding a disgust trigger in influenza-related information will generate a disgust reaction, and its subsequent disease and moral contagion effects, in people exposed to it.

Influenza can be categorized according to characteristics that allow for studying how variations in emotional response are associated with perceptions of the following: (1) severity of

influenza; (2) susceptibility to influenza; (3) costs of influenza prevention; (4) trustworthiness of influenza prevention information; and (5) trustworthiness of sources of influenza information. It is predicted that a disgust reaction will be associated with people's perceptions of the above five disease characteristics. Second, it is predicted that a disgust reaction will be associated with people's likelihood of taking preventive measures against influenza and their likelihood of materially supporting its systematic prevention or eradication. Third, it is predicted that the disgust reaction and its associated moral contagion effects on perceptions of influenza and likely behaviors towards it will be moderated by DS and SSC.

1.9.1 Research Objective #1

Question #1: Does a disgust reaction during exposure to influenza-related information influence

a. perceptions of influenza?

b. influenza-related trust?

c. likelihood of taking preventive measures towards influenza?

d. likelihood of supporting taxes for the systemic prevention or eradication of influenza?

Hypothesis #1: Persons exhibiting a disgust reaction during exposure to influenza-related information will be more likely to

a. Perceive certain influenza characteristics as more severe, more high-risk, and more costly to prevent than those who do not. Perceptions of influenza will be measured by a questionnaire (see Appendix B) assessing: (i) perceived severity of influenza – 4 item scale; (ii) perceived susceptibility to influenza – 3 item scale; and (iii) perceived costs of influenza prevention – 3 item scale.

b. Have less influenza-related trust (i.e. be less trusting of influenza prevention information and information sources) than those who do not. Influenza-related trust will be measured by a questionnaire (see Appendix C) assessing: (i) trustworthiness of influenza prevention information – 3 item scale; and (ii) trustworthiness of sources of influenza information – 3 item scale.

c. Take preventive measures against influenza contact exposures but be less likely to vaccinate against influenza than those who do not. Likelihood of taking preventive measures towards influenza will be measured by a 6-item scale assessing likely behavior under various risk scenarios (see Appendix D).

d. Oppose tax support for the systematic prevention or eradication of influenza (e.g., free vaccinations, distribution of masks/gloves/hand sanitizer, access to primary care) than those who do not. Likelihood of supporting taxes for the systematic prevention or eradication of influenza will be measured by a 6-item scale assessing support for a small tax to fund various influenza prevention interventions (see Appendix E).

1.9.2 Research Objective #2

Question #2: Is the disgust reaction felt during exposure to influenza-related information moderated by disgust sensitivity (DS) and/or sexual and social conservatism (SSC)?

Hypothesis #2: Persons exhibiting a disgust reaction during exposure to influenza-related information will be more likely to exhibit greater general DS and SSC than those who do not. General DS will be measured by the 25-item Revised Disgust Sensitivity scale (see Appendix F). SSC will be measured by a 10-item Political Conservatism scale (see Appendix G).

1.9.3 Research Objective #3

Question #3: Will a disgust trigger in the form of a hand sanitizer elicit a disgust reaction towards influenza-related information when exposure to the disgust trigger occurs concurrently with exposure to that information?

Hypothesis #3: Persons exposed to a disgust trigger in the form of a hand sanitizer at the same time they watch an informational presentation on influenza will be more likely to exhibit an induced disgust reaction to that information than those shown the same presentation without the trigger. Participants' disgust reaction will be measured by modified Self-Assessment Manikin (SAM) scales depicting felt disgust, emotional response valence and arousal (see Section 2.2.2).

2.0 METHODOLOGY

2.1 STUDY POPULATION AND RECRUITMENT

The study population consists of English-literate adults 18 years or older who are able to provide informed consent and travel to the study visit location. Participants were recruited into the study through the University of Pittsburgh's Clinical and Translational Science Institute (CTSI) Research Participant Registry. The Registry (https://www.researchregistry.pitt.edu/Index.shtml) is a database created by the University of Pittsburgh and UPMC and made up of people who have volunteered to consider participation in research studies for themselves or their children. Study eligibility criteria were included in the Registry's recruitment text and potential participants were pre-screened for age, language and travel eligibility during their initial contact with the Registry office.

During this initial contact, participants were given a brief description of the research activities, told that participation entailed meeting for a two-hour session at a Graduate School of Public Health private office located in the Oakland neighborhood of Pittsburgh, and that they would be compensated for their time, effort and transportation/parking costs. Interested persons then gave permission to the Registry to forward their information to the PI so they could be contacted for further screening and scheduling procedures. These potential participants were then contacted via phone and/or email by the PI. At this time, the research activities, visit location and

duration, and compensation amount were reiterated. Participants were also told that the research involved minimal risk, no direct benefit, that participation was entirely voluntary and that all responses would be kept confidential. They were then told the purpose of the study was to see if presenting information related to influenza and its prevention options in different ways could influence how people perceived that information and reacted to it. Lastly, persons still interested in participating were asked for permission to answer a few eligibility questions (see Section 2.2.1 for details) and scheduled for a study visit afterwards.

2.2 DATA COLLECTION

2.2.1 Prior to research activities – Pre-screening and consent process

Participants' verbal informed consent for pre-screening was documented in the prescreening form (see Appendix H). This form was also used to document whether they were over 18 years of age, whether their primary language was English, whether they could read and write in English, and whether they were able to come to the study visit location. If they answered yes to all questions, they were scheduled for a study visit. After being scheduled, participants were assigned to either active or control group according to a previously generated randomization schedule generated using the RANDOM.ORG True Random Number Service operated by Randomness and Integrity Services Ltd. (www.random.org), an open-access online application.

Pre-printed labels with study identification numbers were used to identify participants on all printed study materials: participant contact list, informed consent forms, randomization schedule, emotional response scales, and all questionnaires. All printed study materials were pre-

labeled except for the informed consent forms, which were labeled only after potential eligible participants agreed to participate and signed the form. To ensure participant confidentiality, the participant contact list and signed informed consent forms will be stored in a locked filing cabinet, and all other printed study materials will be stored in another locked filing cabinet in a separate location. The PI will be the only person with a key to either cabinet. Meeting at a private office location ensured participant privacy and comfort with responding to study questions, as well as mitigated potential confounding of results from incidental exposure to extraneous environmental cues pertaining to cleanliness or contagion.

At the beginning of their scheduled session, participants were given a consent form to read and sign. The form contained a limited explanation of the study purpose and a full description of all study activities, their duration, and the compensation amount. The form also told participants the research involved minimal risk, no direct benefit, that participation was entirely voluntary and that all responses would be kept confidential. Taking into account the time between initial contact and the study visit, participants had enough time to reflect on whether they wanted to take part in the study or not prior to signing the consent form.

Participants were blinded to their group assignment until after their responses were recorded. Participants also were not given full disclosure as to the true purpose of the study – to evaluate disgust effects on perceptions of influenza and its prevention options – until after their responses were recorded. If participants were to know the true purpose of the study, it would likely influence their responses to the study questionnaires, distorting any potential disgust effects that might be observed. These additional disclosures were given at the end of their study visit and prior to compensation in the form of a one-page summary of the study's purpose, which they were offered to take along with a copy of their initial consent form.

2.2.2 Research activities – Intervention and emotional response assessments

After being consented, participants were asked to look at the open laptop computer on the desk in front of them. The laptop had the PowerPoint program open on a slide presentation consisting of twelve (12) slides with publicly available informational influenza content extracted from the CDC Web site, including pictures and figures with evidence-based information about morbidity, mortality, risk behaviors, at-risk groups, available prevention practices, and costs of prevention. Both active and control groups were exposed to the same influenza informational presentations, given the same instructions and asked to complete the same assessments.

However, active group participants were primed to have a disgust reaction to the presentation via exposure to a disgust trigger. The trigger consisted of the PI using a hand sanitizer before handing them the laptop and emotional response assessments and showing them how to complete them as well as how to go through the presentation slides. The disgust trigger was reinforced during the presentation and completion of questionnaires by keeping the hand sanitizer in the participants' view. The hand sanitizer used was an unscented generic brand in a pump-action bottle, and was the same for all active group participants.

The PI hypothesized that using the hand sanitizer in their view would remind participants of physical cleanliness and thus promote a sense of protection from disease contagion and from moral contagion through the visceral reaction of disgust as moderated by DS and SSC, respectively. Furthermore, the PI hypothesized that exposure to a trigger eliciting the cleanliness-disease contagion-moral contagion reactions (disgust, sense of self-protection from disease and harsher moral judgments of others) concurrent with exposure to information related to infectious diseases such as influenza would lead to the transference of those reactions to the subject of the information presented (influenza).

Given the small sample size for this pilot study, it was imperative that any observable emotional response effects were captured as accurately and precisely as possible to discern any differences there might be between active and control groups. For most people, the reliability of emotional response measurements seems to diminish with time due to cognitive up or down regulation of emotions [102-105], so it is crucial these assessments take place as close to exposure as possible to avoid potential dilution of measured effects. Therefore, participants' felt disgust, emotional valence and response magnitude – also called arousal – towards the influenza informational presentation needed to be captured during exposure to it. To achieve this, participants completed modified 9-point Self-Assessment Manikin (SAM) scales immediately after each presentation slide.

SAM scales consist of rows of graphic characters depicting gradients of expression or size for three widely accepted emotional response dimensions: valence, arousal and dominance [106-109]. The first row assesses valence along a 9-point scale of pleasant-unpleasant, the second row assesses arousal along a 9-point scale of excited-relaxed, and the third row assesses dominance along a 9-point scale of submissive-powerful. Printouts with the first two of these scales (arousal and valence) were handed to the participants prior to beginning the presentation (see Figure 3 in next page for SAM scales), with instructions to select which of the figures from each row best represented how they felt about each slide before moving to the next slide, and to choose only one circle for each of the rows.

Although physiological measurements such as heart rate, skin conductance, respiratory rate, and eye movement tend to be regarded as more objective than non-physiological emotional response metrics like the one described above [110-113], time and resource constraints did not allow for their use at this time. Therefore, the SAM scale was chosen for this study because it is

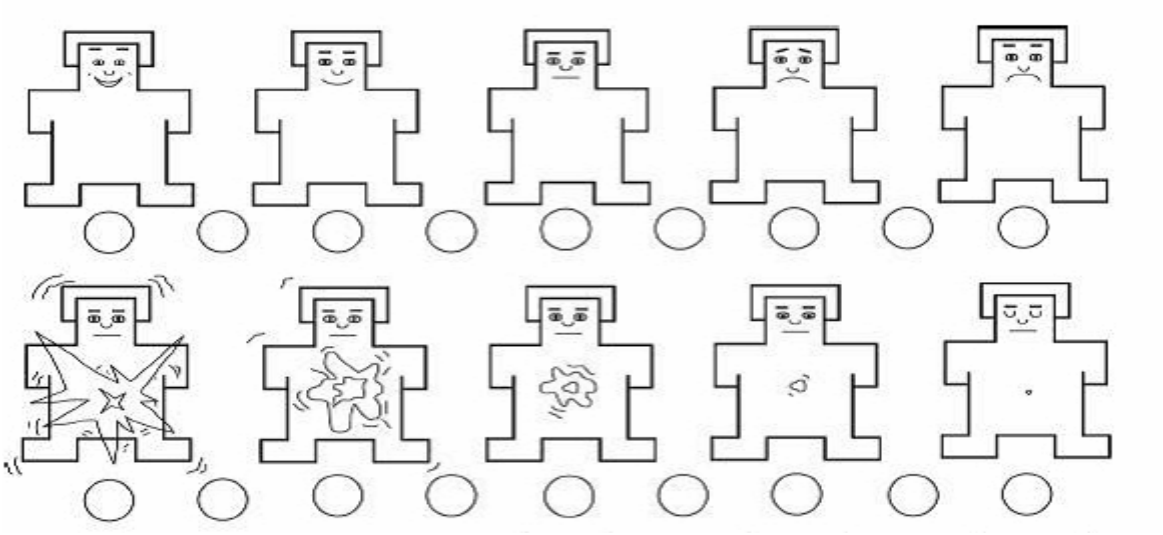

Figure 3. Modified 9-point Self-Assessment Manikin scales

a widely used and validated measure of emotional response that is very easy to implement in most settings due to its simplicity [106, 108, 109]. The SAM scale was especially appropriate for this study because the assessments can be integrated seamlessly into the pacing of a slide presentation. As will be described more fully in Section 2.3, the SAM scale can also be seamlessly integrated into the analysis as the other study variable measurements also consist of ordinal scales.

Given that disgust is a visceral reaction similar to other emotional responses, it also needed to be measured as close to exposure as possible. Therefore, the measurement of felt disgust was incorporated to the emotional response valence and arousal measurements. The modified SAM scales described earlier were customized to denote felt disgust (see Figure 4 in next page for disgust-specific SAM scale). Doing this allowed for consistency with the other study variable measurements, avoided disrupting the flow of the session, and reaped the benefits of the SAM scales as described earlier: ease of implementation and applicability across populations.

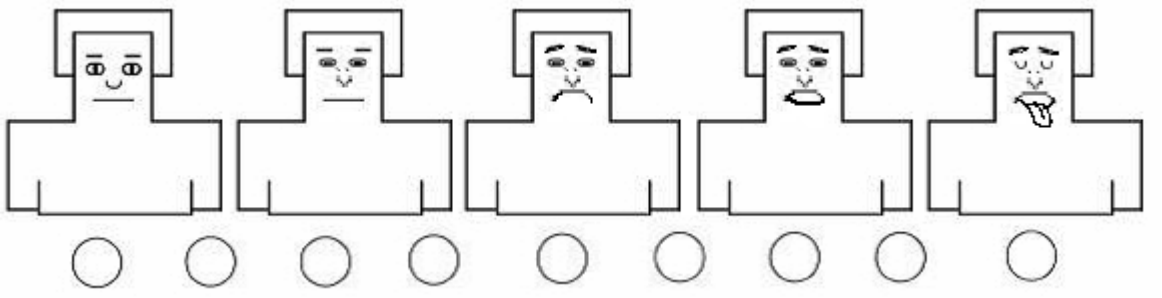

Figure 4. Modified 9-point Self-Assessment Manikin scale customized for disgust

Rozin, Lowery and Ebert demonstrated that certain facial expressions (wrinkled nose, raised upper lip, gaping mouth and tongue extrusion) are associated with a variety of disgust elicitors encompassing accepted dimensions of the disgust reaction (core, contamination, and animal reminder disgust) [114]. Core disgust refers to disgust related to "food, animals, and body products"; contamination disgust refers to disgust related to "concerns about interpersonal transmission of essences"; and animal reminder disgust refers to disgust related to "death and envelope violations" [115, 116], where "envelope violations" refers to "situations in which the normal exterior envelope of the body is breached or altered" (p. 702, [116]). The four facial expressions associated with the three disgust dimensions were progressively super-imposed on the standard SAM scale figure to create a graded representation of felt disgust, assessing it along a 9-point scale of "neutral" to "very disgusting". The disgust SAM scale was included in the printouts with the two SAM scales for arousal and valence, so that the two emotional response variables and the felt disgust variable were measured at the same time.

As alluded to earlier, the presentations were created using PowerPoint software. Once participants finished watching the twelve slides and completed all emotional response measures, the PI took the laptop and completed SAM scales from participants, closed the computer and put it away. The PI then handed participants the remaining study questionnaires and instructed them how to complete them.

2.2.3 Research activities – Administration of questionnaires

All things being equal, all participants would exhibit similar levels of felt disgust, emotional valence and arousal towards the influenza information. But, the theory of EC predicts that there would be differences in felt disgust between participants depending on whether they were in the active group or the control group. More importantly, it predicts that differences in participant felt disgust would be associated with differences in participant perceptions of the following: (1) influenza severity; (2) susceptibility to influenza; and (3) costs of influenza prevention and treatment. After completing the presentation and emotional response SAM scales, participants then completed a "perceptions of influenza" questionnaire (Q1) addressing those three items. Q1 consists of 10 questions with 7-point Likert-scale answer choices (see Appendix B for Q1). The theory of EC also predicts that differences in participant emotional response would be associated with differences in the following: (1) trust of influenza information sources; and (2) trust of influenza prevention information. After completing Q1, participants completed an "influenza-related trust" questionnaire (Q2) addressing those two items. Q2 consists of 6 questions with 7-point Likert-scale answer choices (see Appendix C for Q2).

The theory of EC also predicts that differences in participant emotional response would be associated with differences in participant likelihood of the following: (1) taking preventive measures against influenza (e.g. vaccination, consistent hand hygiene); and (2) supporting taxes for the systemic prevention or eradication of influenza (e.g. free vaccine clinics). After completing Q2, participants completed two questionnaires (Q3 and Q4) addressing those two items, respectively. Q3 and Q4 each consist of six questions with 7-point Likert-scale answer choices (see Appendices D and E for Q3 and Q4).

To empirically link any observed effects to the disgust-contagion mechanism, it was necessary to also measure participants' DS and SSC, the intermediary mechanisms thought to physiologically ground and behaviorally drive the disgust-contagion conceptual connection [82, 86, 114, 116, 117]. Olatunji and colleagues define DS as "a predisposition to experiencing disgust in response to a wide array of aversive stimuli" (p. 281, [117]). DS scales are widely used in studies of certain personality disorders because they essentially measure people's preoccupation with physical contamination and disease contagion, which are thought to be important in anxiety and obsessive-compulsive disorders [117]. Their utility in this study was to assess the intermediary embodied mechanism driving the disgust reaction and the linkage between the concepts of cleanliness and physical contamination, thus allowing for the attribution of any observed effects on the outcome variables to the disgust reaction.

The DS measurement chosen was the revised general DS scale (see Appendix F for Q5; DS-R scale developed by Haidt, McCauley & Rozin, 1994 [116], and modified by Olatunji et al., 2007 [117]) assessing sensitivity to the three accepted dimensions of disgust (core, contamination, and animal reminder). This scale was chosen because it has been validated by a number of studies and contains Likert scale response choices with values ranging from "Strongly disagree" to "Strongly agree" and from "Not disgusting at all" to "Extremely disgusting". These values are consistent with all other study measurements. For further consistency, response choices for the DS-R scale were modified into 7-point scales. After completing Q3 and Q4, participants completed Q5 assessing general DS.

SSC can be defined as a predisposition to make moral judgments of ideas and behaviors in absolute terms and based on traditional group norms, as opposed to moral judgments in relative or situational terms, or based on pluralism [80-83]. SSC is thought to act as the

intermediary mechanism between the concepts of physical and moral contamination in the disgust-contagion connection, by making it more or less likely that someone will disapprove of behaviors outside the norm [80-83]. Therefore, SSC was measured to assess this second intermediary mechanism linking disgust to moral contagion, an important step as one of the study objectives is to assess participants' willingness to invest in protecting others as well as themselves from disease. Inbar, Pizarro and Bloom's [83] PC index was chosen to measure SSC (see Appendix G for Q6) because it is a validated instrument for measuring conservatism in the sexual and social domains. It also uses 7-point Likert scales ranging from "Completely disagree" to "Completely agree" and thus is consistent with all other study measurements. After completing Q5, participants completed Q6 assessing SSC.

Finally, participants completed a series of basic demographic questions (see Appendix I for demographic questionnaire). This data was used to assess the representativeness of the sample, help contextualize any observed associations between the above described study measurements, and explore whether said variables were associated with broad categorizations like gender, race, ethnicity, education, income, religious affiliation, or health literacy. After participants completed this last questionnaire, they were debriefed as to the true purpose of the study and their group assignment. They were then compensated and offered copies of the additional disclosure summary page and consent form to take with them. Questionnaire data for all study variables were entered into and analyzed with the SPSS statistical analysis software package. To ensure participant confidentiality, all data files were stored in a password-protected hard drive folder, and the PI will be the only person to know the password.

2.3 DATA ANALYSIS

2.3.1 Hypothesized relationships tested

The PI predicted that higher values in participant felt disgust and arousal SAM scales and non-neutral values in participant emotional valence SAM scales would be associated with: (a) higher values in scales of participant perceptions of influenza severity, risk of infection and costs of prevention (Q1); (b) lower values in scales of participant trust of influenza information sources and of influenza prevention information (Q2); (c) higher values in scales of participant likelihood of taking preventive measures against influenza (Q3); and (d) lower values in scales of participant likelihood of supporting taxes for the systemic prevention or eradication of influenza (Q4). Second, the PI predicted that higher values in participant general DS (Q5) and SSC (Q6) would be associated with: (a) higher values in participant felt disgust and arousal SAM scales and non-neutral values in participant valence SAM scales; (b) higher values in scales of participant perceptions of influenza severity, risk of infection and costs of prevention (Q1); (c) lower values in scales of participant trust of influenza information sources and of influenza prevention information (Q2); (d) higher values in scales of participant likelihood of taking preventive measures against influenza (Q3); and (e) lower values in scales of participant likelihood of supporting taxes for the systemic prevention or eradication of influenza (Q4). And third, the PI predicted that participants exposed to hand sanitizer would be more likely to have higher values in felt disgust and arousal SAM scales and non-neutral values in emotional valence SAM scales than control group participants. Table 3 below provides a summary representation of the associations that will be tested in the present analysis.

Table 3: Hypothesized relationships tested

Variables	*Valence scores*	*Arousal index*	*Disgust index*	*Q1*	*Q2*	*Q3*	*Q4*	*Q5*	*Q6*
Active vs. control	↕	↑	↑	↑	↓	↑	↓	↑	↑
↕ ***Valence scores***				↑	↓	↑	↓	↑	↑
↑ ***Arousal index***				↑	↓	↑	↓	↑	↑
↑ ***Disgust index***				↑	↓	↑	↓	↑	↑
↑ ***Q1***								↑	↑
↓ ***Q2***								↑	↑
↑ ***Q3***								↑	↑
↓ ***Q4***								↑	↑

2.3.2 Variable and value labels

Emotional valence SAM scale values are on a 9-point ordinal scale but have a central point of reference, i.e. negative and positive values are at the ends of the 9-point spectrum with neutral values in the middle. Therefore, emotional valence was treated as a dichotomous variable, and valence SAM scale scores categorized as neutral or non-neutral in the following way: scores of 3-5 are considered neutral, and scores of 0-2 (positive) and 6-8 (negative) are considered non-neutral. SAM scores for the emotional valence variable were then turned to 0's (neutral) or 1's (non-neutral).

Felt disgust and arousal SAM scale values are also on a 9-point ordinal scale but their reference points are at the lower end of the 9-point spectrum. Therefore, felt disgust and arousal were treated as continuous variables, and felt disgust and arousal SAM scale values for each individual presentation slide ranged from 0 to 8. Disgust SAM scale values for low disgust = 0

and for high disgust = 8. Arousal SAM scale values were reverse coded to accommodate for the SAM scale convention of having the agitated end of the arousal spectrum to the left of the relaxed end, so that low arousal = 0 and high arousal = 8 after reverse coding. To calculate overall scores for the felt disgust and arousal variables, SAM scale values for each of the twelve presentation slides were added to give two index scores for felt disgust and arousal, each ranging from 0 (low) to 96 (high).

The values for the outcome variable measures are also on ordinal scales with their reference point at the lower end of the spectrum, though categorized using a 7-point spectrum rather than a 9-point spectrum. Therefore, the following were treated as continuous variables: (a) participant perceptions of influenza (severity, risk of infection, and costs of prevention); (b) influenza-related trust (trust of influenza information sources and trust of influenza prevention information); (c) participant likelihood of taking preventive measures against influenza; and (d) participant likelihood of supporting taxes for the systemic prevention or eradication of influenza. Individual Q1, Q2, Q3, and Q4 item values ranged from 0 (low) to 6 (high). To calculate overall scores for participant perceptions of influenza, values for the ten Q1 items were added to give a Q1 index score ranging from 0 (low risk/severity and high cost-benefit) to 60 (high risk/severity and low cost-benefit). All ten Q1 items were reverse coded to accommodate the wording of the questions. To calculate overall scores for influenza-related trust, values for the six Q2 items were added to give a Q2 index score ranging from 0 (low trust) to 36 (high trust). To calculate overall scores for participant likelihood of taking preventive measures against influenza, values for the six Q3 items were added to give a Q3 index score ranging from 0 (low likelihood) to 36 (high likelihood). And, to calculate overall scores for participant likelihood of supporting taxes for the

systemic prevention or eradication of influenza, values for the six Q4 items were added to give a Q4 index score ranging from 0 (low likelihood) to 36 (high likelihood).

The values for the moderating variable measures are also on ordinal scales with their reference point at the lower end of the spectrum, and are also categorized using a 7-point spectrum. Therefore, general DS and SSC were also treated as continuous variables, and individual DS and SSC values ranged from 0 (low) to 6 (high). To calculate overall scores for general DS, overall scores for its three component dimensions (core DS, contamination DS and animal reminder DS) were first calculated. Values for the twelve core DS items (Q5 items 1-5, 12, 14-18, and 23) were added to give a Q5 sub-index score ranging from 0 (low core DS) to 72 (high core DS). Values for the five contamination DS items (Q5 items 10-11, 22, and 24-25) were added to give a Q5 sub-index score ranging from 0 (low contamination DS) to 30 (high contamination DS). And values for the eight animal reminder DS items (Q5 items 6-9, 13, and 19-21) were added to give a Q5 sub-index score ranging from 0 (low animal reminder DS) to 48 (high animal reminder DS). Q5 items 1, 3 and 7 were reverse coded. These three DS dimension sub-index scores were then added to produce a general DS index score ranging from 0 (low general DS) to 150 (high general DS). Finally, to calculate overall scores for SSC, values for the ten Q6 items were added to give a Q6 index score ranging from 0 (low SSC) to 60 (high SSC). Q6 items 1, 2, and 7-9 were reverse coded.

2.3.3 Statistical analysis strategy and rationale

A 3x6 design was used to test whether there was an association between the emotional response study variables (felt disgust, emotional valence and arousal) and either the outcome variables (perceptions of influenza, influenza-related trust, likelihood of taking preventive measures

against influenza, and likelihood of supporting taxes for the systemic prevention or eradication of influenza) or the moderating variables (general DS and SSC). Table 4 below shows a visual display of this design.

Table 4: Emotional response variables vs. outcome and moderating variables

STUDY VARIABLES		**Emotional Response**		
		Valence (SAM)	***Arousal (SAM)***	***Disgust (SAM)***
Outcome	***Perceptions of influenza (Q1)***			
	Influenza-related trust (Q2)			
	Likelihood of taking preventive measures against influenza (Q3)			
	Likelihood of supporting taxes for the systemic prevention of influenza (Q4)			
Moderating	***General DS (Q5)***			
	SSC (Q6)			

A 2x6 design was used to test whether there was an association between the moderating study variables (general DS and SSC) and either the emotional response variables (felt disgust, emotional valence and arousal) or the outcome variables (perceptions of influenza, influenza-related trust, likelihood of taking preventive measures against influenza, and likelihood of supporting taxes for the systemic prevention or eradication of influenza). Table 5 below shows a visual display of this design.

Table 5: Moderating variables vs. outcome and emotional response variables

STUDY VARIABLES		Moderating	
		General DS (Q5)	***SSC (Q6)***
Outcome	***Perceptions of influenza (Q1)***		
	Influenza-related trust (Q2)		
	Likelihood of taking preventive measures against influenza (Q3)		
	Likelihood of supporting taxes for the systemic prevention of influenza (Q4)		
Emotional Response	***Valence (SAM)***		
	Arousal (SAM)		
	Disgust (SAM)		

The Kruskal-Wallis H test was used to analyze the above associations, as this test is optimal for testing associations between a multi-level categorical independent variable (felt disgust, emotional valence and arousal SAM scale scores; general DS and SSC scores) and an ordinal dependent variable with non-normal distribution (SAM and Q1-Q6 scores). The test statistic is denoted as $H = \frac{12}{n(n+1)} \sum_{i=1}^{k} \frac{R_i^2}{} - 3(n+1)$, where: (a) n_i (i = 1, 2, …, k) = the sample size for each of the groups k; and (b) R_i = the sum of the ranks for group i (see Table 6 below). The null hypothesis is expressed as H_0: average R_1 = average R_2 = … = average R_9 (9 = number of values in emotional response SAM scales).

Table 6: General statistical framework for Kruskal-Wallis H test for each dependent variable

Rating on individual dependent variable measurements				
	Independent variable category 1	**Independent variable category 2**	**…**	**Independent variable category *k***
Dependent variable observation 1				
Dependent variable observation 2				
…				
Mean rank				
Sum of ranks (R_i)				

Participants were randomly assigned to either an active or a control group. A 2x8 design was used to test whether there was an association between the dichotomous independent variable (exposure to the disgust trigger) and each of the ordinal dependent variables: emotional response (felt disgust and emotional arousal); outcome (perceptions of influenza, influenza-related trust, likelihood of taking preventive measures against influenza, and likelihood of supporting taxes for the systemic prevention or eradication of influenza); and moderating (general DS and SSC). Table 7 below shows a visual display of this design.

Table 7: Intervention/control vs. Emotional response, outcome and moderating variables

STUDY VARIABLES		***Disgust trigger***	***No disgust trigger***
Emotional Response	***Arousal (SAM)***		
	Disgust (SAM)		
Outcome	***Perceptions of influenza (Q1)***		
	Influenza-related trust (Q2)		

(Table 7 continued)

STUDY VARIABLES		*Disgust trigger*	*No disgust trigger*
	Likelihood of taking preventive measures against influenza (Q3)		
	Likelihood of supporting taxes for the systemic prevention of influenza (Q4)		
Moderating	***General DS (Q5)***		
	SSC (Q6)		

The Wilcoxon-Mann-Whitney test was used to analyze the above associations, as it is optimal for testing associations between a dichotomous independent variable (disgust trigger or no disgust trigger) and an ordinal dependent variable with non-normal distribution (felt disgust and emotional arousal SAM scale scores, and Q1-Q6 index scores). The test statistic is denoted as $U_1 = R_1 - \frac{n_1(n_1+1)}{2}$, where: (a) n_1 refers to the sample size for group 1; and (b) R_1 refers to the sum of the ranks in group 1 (see Table 8 below). The null hypothesis is expressed as: H_0: *Pr (X > Y) = Pr (Y > X)*, where *X* = observation from active and *Y* = observation from control groups.

Table 8: General statistical framework for Wilcoxon-Mann-Whitney test for each dependent variable

Dependent variable observation ranking	**Dependent variable observation values**	
	Group 1 *(n_1)*	**Group 2 *(n_2)***
1	*X1*	*Y1*
2	*X2*	*Y2*
…	…	…
n	*Xn*	*Yn*
R	R_1	R_2

Lastly, a 2x2 design was used to test whether there was an association between the dichotomous independent variable (exposure to the disgust trigger) and the one nominal variable

(emotional valence) categorized in binary form as neutral or non-neutral. The Chi-square test was used to analyze this association, as it is appropriate for testing associations between a dichotomous independent variable (disgust trigger or no disgust trigger) and a dichotomous dependent variable (emotional valence SAM scale scores). The test statistic is denoted as $X^2 = \Sigma [(O_{rc} - E_{rc})^2 / E_{rc}]$, where: (a) *r* is the number of levels for the independent variable and *c* is the number of levels for the dependent variable; (b) O_{rc} is the observed frequency count at level *r* of the independent variable and level *c* of the dependent variable; (c) E_{rc} is the expected frequency count at level *r* of the independent variable and level *c* of the dependent variable, and is equal to (*nr* * *nc*) / *n*; and (d) *nr* is the total number of sample observations at level *r* of the independent variable, *nc* is the total number of sample observations at level *c* of the dependent variable, and *n* is the total sample size. The null hypothesis is expressed as H_0: *Pr* (exposure to the disgust trigger) ≠ *Pr* (non-neutral emotional valence).

2.3.4 Sample size calculations

The research objectives were initially implemented as a pilot study to evaluate the feasibility of the research design and research setting to test the study hypotheses, and the feasibility of embedding a disgust trigger to influenza-related information. Potential receptiveness issues and other implementation process measures were also evaluated in this initial stage of the study, including visit duration times and participant understanding of SAM scales, among others. The PI initially assumed that only 85% of surveyed participants would respond to all the survey questions and that there would be a no-show rate of 10%. Therefore, 40 participants were targeted for recruitment into the pilot study phase to assure a full data set for at least 30 participants, with 15 in each study group. If the research design, setting and disgust trigger are

deemed feasible after preliminary evaluation of pilot results, then the research objectives will be implemented as a full significance testing study, and a larger sample size will then be pursued. The following sample size calculations denote the number of participants needed for a full significance testing study.

Sample size calculations were performed using the G*Power 3.1.9.2 [118, 119] power analysis software package's Wilcoxon signed-rank test a priori power analysis tool for one-tailed test. There are two value categories for participant exposure to the disgust trigger and all but one of the dependent variable measurements (emotional valence) are ordinal variables. Assuming a desired $\alpha = 0.05$, desired power $(1 - \beta) = 0.80$, and unknown standard deviations for all variables, then the following table (see Table 9 below) denotes the number of participants needed to adequately test for significant intervention effects in this study. Sample sizes were calculated for observed effect size *dz* ranging from 0.2 to 0.8 for the primary independent variable: active vs. control.

Table 9: Sample sizes needed by expected effect size for one-tailed Wilcoxon-Mann-Whitney test

Sample size calculation parameter	Total Sample Size N
Observed effect size *dz* = 0.2 (small)	325 x 2 = 650
Observed effect size *dz* = 0.5 (medium)	**53 x 2 = 106**
Observed effect size *dz* = 0.8 (large)	21 x 2 = 42

A sample size of 106 will be targeted to allow the detection of a minimum effect size of 0.5 for the primary independent variable (exposure to active vs. control presentation) on each of the emotional response, outcome and moderating variables. A minimum effect size of 0.5 was chosen because less than a moderate effect size would not be worth pursuing. To adequately test for effect significance, it is likely that more than 106 people will need to be recruited to achieve the desired sample size goal. Conservatively assuming that only 85% of participants respond to

all the survey questions, data need to be collected from at least 126 persons. Further assuming a no-show rate of 10%, at least 140 people need to be recruited into the study to assure a full data set for a total of 106 participants.

2.3.5 Sample size considerations

Recruitment goals for the pilot study phase of the study far surpassed expectations, thanks in large part to the CTSI Research Participant Registry's facilitation. Sixty-six persons were contacted to participate in the study over the course of four weeks. Fifteen persons never responded or responded after the recruitment timeline had expired, and another two persons screened ineligible. Although the goal was to recruit forty participants into the study, a total of forty-nine were enrolled (74.2% of all contacts). Furthermore, although the expectation of a 10% no-show rate held true, with five enrolled participants not showing for their visit and unable to be rescheduled in time, the expectation of only 85% having complete data sets was a great underestimation, with only one participant having an incomplete data set.

Recruitment therefore yielded a total of forty-three complete data sets (N = 43 = 65.2% of all contacts), thirteen more than previously expected. This sample size made the planned data analysis somewhat more meaningful for the pilot study phase for two reasons. First, it is large enough to allow the use of *post hoc* non-parametric bivariate correlation coefficient tests to detect whether index scores for the emotional response, outcome and moderating variables were associated with each other in a manner consistent with the study hypotheses. And second, it is large enough to at least determine with confidence whether there is a significant large effect size of 0.8 for intervention effects on index and on individual scores for each of the emotional response (arousal and disgust), outcome (Q1-Q4) and moderating (Q5-Q6) variables.

However, the pilot sample size is not large enough to justify assumptions of normally distributed data for any of the index scores, limiting the pilot study analyses to non-parametric tests of simple effects as described in the Section 2.3.3. As mentioned before, the PI expects to resume the study after evaluation of preliminary pilot results. With a larger sample size, it would be justifiable to assume normality in the distribution of participant responses, and therefore it would be justifiable to utilize more sophisticated parametric analyses like logistic regression. This would allow the PI to evaluate any possible confounding or contributing influences to any disgust-contagion effects that may or may not be observed, which the limited analyses planned for the pilot phase would not be able to tease out.

3.0 RESULTS

3.1 DEMOGRAPHICS

As described in Section 2.3.5, a total of 49 participants were enrolled into the study, yielding a total of 43 participants with evaluable data. 19 participants were randomly assigned to the control group (44.2%) and 24 were assigned to the active group (55.8%). Most of the 43 participants were White (72.1%), female (69.8%), young (65.1% between the ages of 18 and 30), and college educated (53.5% had a Bachelor's degree or higher, with an additional 27.9% having attended some college). Many were college students, with 37.2% of participants currently attending school at least part-time. Many participants were either currently unemployed (30.2%) or working part-time (23.3%). Income followed a mostly normal distribution around $25,000/year, with 32.6% of participants earning between $20,000-$30,000/year, 32.6% earning less than $20,000/year, 25.6% earning more than $30,000/year, and 9.3% preferring not to answer. 37.2% of participants identified themselves as having no religious affiliation, while 32.5% of participants identified themselves as Catholic and another 14% identified as Other. Most participants (65.1%) rarely or never attended religious services. Most participants identified themselves politically as either liberal (41.9%) or moderate (23.3%). Lastly, most participants utilized a variety of health information sources, with 69.8% reporting 5-12 information sources and 74.5% reporting 2 or more preferred types of health information

sources. Table 10 below describes in greater detail the demographic characteristics of the study sample.

Table 10: Demographics

Participant characteristics	Group assignment		Total (%) N=43
	Control n=19	*Intervention n=24*	
Gender			
Male	6	7	13 (30.2)
Female	13	17	30 (69.8)
Race			
White	16	15	31 (72.1)
Black	2	6	8 (18.6)
Multiracial	0	3	3 (7.0)
Other	1	0	1 (2.3)
Age			
18-21yo	2	5	7 (16.3)
22-25yo	7	4	11 (25.6)
26-30yo	3	7	10 (23.3)
31-35yo	2	1	3 (7.0)
36-45yo	3	1	4 (9.3)
46-55yo	0	3	3 (7.0)
56-65yo	1	2	3 (7.0)
65+yo	1	1	2 (4.7)
Education			
High school	0	5	5 (11.6)
Associates	1	2	3 (7.0)
Some college	6	6	12 (27.9)
Bachelors	8	5	13 (30.2)
Some graduate	2	2	4 (9.3)
Masters or higher	2	4	6 (14.0)
Currently attending school			
Not attending	14	13	27 (62.8)
Part-time (1-2 classes)	0	2	2 (4.7)
Part-time (3-4 classes)	1	2	3 (7.0)
Full-time (5+ classes)	4	7	11 (25.6)
Current employment status			
Not employed	4	9	13 (30.2)
Part-time (<20hrs)	1	3	4 (9.3)
Part-time (20-35hrs)	5	1	6 (14.0)
Full-time (>35hrs)	9	11	20 (46.5)
Personal income ($/year)			
<10,000	3	7	10 (23.3)
10,000-20,000	2	2	4 (9.3)
20,000-30,000	7	7	14 (32.6)
30,000-45,000	4	2	6 (14.0)
45,000-75,000	2	3	5 (11.6)
Prefer not to answer	1	3	4 (9.3)

(Table 10 continued)

Religious affiliation			
Protestant	2	1	3 (7.0)
Catholic	7	7	14 (32.6)
Jewish	1	0	1 (2.3)
Buddhist	1	0	1 (2.3)
No affiliation	7	9	16 (37.2)
Other	1	5	6 (14.0)
Prefer not to answer	0	2	2 (4.7)
Religious service attendance			
Never	3	7	10 (23.3)
Rarely (once/year or less)	7	11	18 (41.9)
Occasionally (once/month or less)	6	4	10 23.3)
Regularly (once/week)	2	2	4 (9.3)
Prefer not to answer	1	0	1 (2.3)
Political affiliation			
Liberal	9	9	18 (41.9)
Moderate	4	6	10 (23.3)
Conservative	4	4	8 (18.6)
Other	1	2	3 (7.0)
Not political	1	3	4 (9.3)
# of health information sources			
4 or less	5	4	9 (20.9)
5 to 8	6	13	19 (44.2)
9 to 12	5	6	11 (25.6)
13 or more	3	1	4 (9.3)
Preferred health information sources			
Print only	0	1	1 (2.3)
Television only	1	1	2 (4.7)
Online only	1	2	3 (7.0)
People only	2	3	5 (11.6)
2 different types	4	11	15 (34.9)
3 different types	5	5	10 (23.3)
4+ different types	6	1	7 (16.3)

3.2 RESULTS DESCRIPTION

3.2.1 Emotional response variable index scores

As described in Section 2.2.2, participant emotional responses to each of the twelve influenza informational slides were measured using SAM scales for the following: valence, arousal and disgust. Valence measurements for each of the twelve slides ranged from 0 (positive) to 4

(neutral) to 8 (negative). Arousal and disgust measurements for each slide ranged from 0 (no arousal or disgust) to 8 (high arousal or disgust). Individual measurements for two of these variables – arousal and disgust – were aggregated to produce index scores ranging from 0 (very low arousal or disgust) to 96 (very high arousal or disgust).

Arousal index scores were generally low, with an average = 22.19 (σ = 21.963) and a median = 15. Over three quarters of all arousal index scores were less than or equal to 33, and over 90% were less than or equal to 59. There was a potential outlier in that one participant had the maximum arousal index score of 96, which may have lessened the positive skewness of the data. Disgust index scores were also generally low, with an average = 18.67 (σ = 19.398) and a median = 13. Over three quarters of all disgust index scores were less than or equal to 28, and over 90% were less than or equal to 43. Unlike with the arousal index scores, there were no apparent outliers, and thus the disgust index scores appear even more positively skewed relative to the arousal scores. Table 11 below describes in more detail the distribution of the arousal and disgust index scores.

Table 11: Results description – Arousal and disgust index scores

Statistics	Arousal index score	Disgust index score
Minimum	0	0
Maximum	96	76
25th percentile	8	4
50th percentile/Median	15	13
75th percentile	33	28
90th percentile	59	43
Mean	22.19	18.67
Standard deviation (σ)	21.963	19.398

3.2.2 Emotional response variable scores for individual slides

Valence measurements for each of the twelve slides ranged from 0 (positive) to 4 (neutral) to 8 (negative). As described in Section 2.3.2, these individual measurements were recoded into a dichotomous variable, producing measurements for neutral and non-neutral valence. Participants generally exhibited neutral valence towards the information presented. Over half of all participants responded neutrally to ten out of the twelve slides; for seven of those slides, between 58% and 70% of participants responded neutrally. Of the remaining two slides, one elicited a non-neutral response from 53.5% of participants, and the other from 62.8% of participants. Table 12 below describes in more detail the distribution of the valence scores.

Table 12: Results description – Valence scores

Informational slide	Neutral valence score (% of total)	Non-neutral valence score (% of total)
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	29 (67.4)	14 (32.6)
#2: Text with caricatures – Flu symptoms	25 (58.1)	18 (41.9)
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	23 (53.5)	20 (46.5)
#4: Text with caricatures – Everyday health habits	25 (58.1)	18 (41.9)
#5: Text with caricatures – Cleaning to prevent the flu	22 (51.2)	21 (48.8)
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	16 (37.2)	27 (62.8)
#7: Bullet points with pictures – Persons at high risk for flu complications	27 (62.8)	16 (37.2)
#8: Bullet points with pictures – Persons at high risk for flu complications	30 (69.8)	13 (30.2)
#9: Bullet points with pictures – Flu vaccine recommendations	27 (62.8)	16 (37.2)
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	29 (67.4)	14 (32.6)
#11: Bullet points – Costs related to influenza	22 (51.2)	21 (48.8)
#12: Bullet points – Benefits of prevention/ treatment	20 (46.5)	23 (53.5)

Similar to their respective index scores, individual arousal and disgust measurements for the twelve slides were generally low. Average arousal measurements ranged between 1.42 (σ = 2.332) and 2.79 (σ = 2.077). Average disgust measurements ranged between 0.93 (σ = 1.668) and 2.26 (σ = 2.508). At least two thirds of participants scored between 0 and 2 on all but two of the individual arousal measurements, as well as on all but two of the individual disgust measurements. Tables 13 and 14 below describe in more detail the distribution of the individual arousal and disgust scores, respectively.

Table 13: Results description – Individual arousal scores

Statistics	Arousal scores for informational slides											
	#1	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**	**#10**	**#11**	**#12**
Minimum	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	8	8	8	8	8	8	8	8	8	8	8	8
25th percentile	0	0	0	0	0	1	0	0	0	0	1	0
50th percentile/Median	0	1	1	0	1	2	1	1	2	1	2	1
75th percentile	2	2	3	2	2	4	2	2	3	3	4	3
90th percentile	6	6	5	4	4	6	4	5	5	4	4	5
Mean	1.53	1.67	1.93	1.42	1.58	2.79	1.63	1.70	2.12	1.79	2.40	1.63
Standard deviation (σ)	2.35	2.50	2.50	2.33	2.25	2.08	1.95	2.23	2.05	2.11	2.07	2.09

Table 14: Results description – Individual disgust scores

Statistics	Disgust scores for informational slides											
	#1	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**	**#10**	**#11**	**#12**
Minimum	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	8	8	8	8	6	8	8	8	8	8	8	8
25th percentile	0	0	0	0	0	0	0	0	0	0	0	0
50th percentile/Median	2	2	0	0	1	1	1	0	1	0	1	0
75th percentile	4	4	1	1	2	4	2	2	3	3	3	2
90th percentile	6	8	4	3	4	6	4	5	5	4	6	4
Mean	2.26	2.26	1.14	0.93	1.33	2.14	1.30	1.40	1.49	1.58	1.79	1.07
Standard deviation (σ)	2.30	2.51	2.02	1.67	1.80	2.50	1.95	2.23	1.99	2.27	2.26	1.86

3.2.3 Outcome variable index scores

As described in Section 2.2.3, participants responded to four questionnaires (Q1-Q4) measuring the following outcome variables: perceptions of influenza (Q1), influenza-related trust (Q2), likelihood of taking preventive action against influenza (Q3), and likelihood of supporting taxes for influenza prevention (Q4). Individual questionnaire item measurements ranged from 0 (low) to 6 (high). Individual Q1 measurements were aggregated to produce index scores ranging from 0 (very low severity/susceptibility/cost) to 60 (very high severity/susceptibility/cost). Individual Q2-Q4 measurements were aggregated to produce index scores ranging from 0 (very low trust or likelihood) to 36 (very high trust or likelihood).

Index scores for perceptions of influenza were moderately high, with an average = 39.35 (σ = 5.451) and a median = 40. Half of all Q1 index scores were between 36 and 43. Index scores for influenza-related trust were also moderately high, with an average = 21.63 (σ = 6.705) and a median = 23. Half of all Q2 index scores were between 17 and 26. Index scores for likelihood of taking preventive action against influenza were in the medium range, with an average = 19.51 (σ = 7.453) and a median = 20. Half of all Q3 index scores were between 14 and 25. Index scores for likelihood of supporting taxes for influenza prevention were also moderately high, with an average = 22.72 (σ = 8.843) and a median = 24. Half of all Q4 index scores were between 19 and 28. Table 15 below describes in more detail the distribution of the Q1-Q4 index scores.

Table 15: Results description – Outcome variable (Q1-Q4) index scores

Statistics	Q1 index score	Q2 index score	Q3 index score	Q4 index score
Minimum	26	7	2	0
Maximum	51	36	36	36
25th percentile	36	17	14	19
50th percentile/Median	40	23	20	24

(Table 15 continued)

Statistics	Q1 index score	Q2 index score	Q3 index score	Q4 index score
75th percentile	43	26	25	28
90th percentile	46	30	30	32
Mean	39.35	21.63	19.51	22.72
Standard deviation (σ)	5.451	6.705	7.453	8.843

3.2.4 Outcome variable scores for individual survey items

Individual measurements for Q1 items 1-7 were generally high, while those for Q1 items 8-10 were generally low. Average Q1 measurements for items 1-7 ranged between 3.40 (σ = 1.498) and 5.72 (σ = 0.797), with median scores ranging between 4 and 6. Average Q1 measurements for items 8-10 ranged between 1.47 (σ = 1.351) and 1.98 (σ = 1.520), with median scores ranging between 1 and 2. Individual measurements for Q2 items 1-3 were generally high, while those for Q2 items 4-6 were in the medium range. Average Q2 measurements for items 1-3 ranged between 3.86 (σ = 1.355) and 4.26 (σ = 1.329), with median scores of 4. Average Q2 measurements for items 4-6 ranged between 3.00 (σ = 1.363) and 3.26 (σ = 1.416), with median scores of 3. Individual Q3 item measurements were generally in the medium range. Average Q3 measurements ranged between 2.40 (σ = 2.205) and 3.98 (σ = 1.946), with median scores ranging between 2 and 4. Individual measurements for Q4 items 1-3 were in the medium range, while those for Q4 items 4-6 were generally high. Average Q4 measurements for items 1-3 ranged between 2.44 (σ = 2.039) and 3.37 (σ = 1.676), with median scores ranging between 3 and 4. Average Q4 measurements for items 4-6 ranged between 4.44 (σ = 1.593) and 4.93 (σ = 1.653), with median scores ranging between 5 and 6. Table 16 below describes in more detail the distribution of the individual Q1-Q4 item scores.

Table 16: Results description – Individual outcome variable (Q1-Q4) item scores

Survey items	Statistics							
	Min	Max	Mean	Std. dev. (σ)	Percentiles			
					25th	50th/ Median	75th	90th
Q1 – Perceptions of influenza								
#1: Influenza has little to no impact on how long people can live.	0	6	4.35	1.446	4	4	6	6
#2: Influenza has little to no impact on how healthy people can be.	1	6	4.86	1.146	4	5	6	6
#3: Influenza has little to no impact on how good of a life a person can have.	0	6	3.40	1.498	2	4	4	5
#4: It takes a long time before people who get infected with influenza begin to look sick.	1	6	4.74	1.364	4	5	6	6
#5: It takes a long time before people who get infected with influenza can begin to infect other people.	1	6	5.58	0.932	5	6	6	6
#6: It would be nearly impossible for me to get an infectious disease.	3	6	5.72	0.797	6	6	6	6
#7: It would be nearly impossible for me to get influenza.	3	6	5.63	0.787	6	6	6	6
#8: The benefits of infection prevention education are worth any cost.	0	5	1.63	1.363	1	1	2	4
#9: The benefits of providing free influenza vaccines are worth any cost.	0	5	1.47	1.351	0	1	2	3
#10: The benefits of hand sanitizer distribution programs are worth any cost.	0	5	1.98	1.520	1	2	3	4
Q2 – Influenza-related trust								
#1: I always trust the information I normally hear or see about how to avoid getting sick.	1	6	3.86	1.355	3	4	5	5
#2: I always trust the information I normally hear or see about how to avoid getting an infectious disease.	1	6	4.09	1.250	3	4	5	5
#3: I always trust the information I normally hear or see about how to avoid getting influenza.	1	6	4.26	1.329	4	4	5	6
#4: I always trust the people I normally hear or see talking about health in general.	0	6	3.00	1.363	2	3	4	5
#5: I always trust the people I normally hear or see talking about infectious diseases.	0	6	3.16	1.446	2	3	4	5
#6: I always trust the people I normally hear or see talking about influenza.	0	6	3.26	1.416	2	3	4	5
Q3 – Likelihood of taking preventive action against influenza								
#1: I am always careful to cover my mouth and nose when I see other people cough, especially during flu season.	0	6	3.86	2.100	2	4	6	6
#2: I always tell people I know to cover their mouths when they cough, especially during flu season.	0	6	3.98	1.946	2	4	6	6
#3: After opening a door or using a public appliance like an ATM, I am always careful not to touch my face until I wash my hands or use hand sanitizer.	0	6	3.07	2.028	1	3	5	6
#4: I am careful to avoid touching surfaces as much as possible when I am in public	0	6	3.35	2.114	2	3	5	6

(Table 16 continued)

Survey items	Statistics							
	Min	Max	Mean	Std. dev. (σ)	Percentiles			
					25th	50th/ Median	75th	90th
#5: I always get a flu vaccine every year.	0	6	2.86	2.624	0	2	6	6
#6: I always tell people I know to get a flu vaccine every year.	0	6	2.40	2.205	0	2	4	6
Q4 – Likelihood of supporting taxes for influenza prevention								
#1: If a $10/person/year tax were proposed by the state of Pennsylvania to give away free hand sanitizers to all adults who want them, I would definitely vote for that tax.	0	6	2.98	2.110	1	3	5	6
#2: If a $10/person/year tax were proposed by the state of Pennsylvania to give away free masks and gloves to all adults who want them, I would definitely vote for that tax.	0	6	2.44	2.039	1	3	4	6
#3: If a $10/person/year tax were proposed by the state of Pennsylvania for a network of influenza prevention education programs for adults, I would definitely vote for that tax.	0	6	3.37	1.676	2	4	5	5
#4: If a $10/person/year tax were proposed by the state of Pennsylvania for a network of influenza prevention education programs in schools, I would definitely vote for that tax.	0	6	4.44	1.593	4	5	6	6
#5: If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all adults who want them, I would definitely vote for that tax.	0	6	4.56	1.709	4	5	6	6
#6: If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all school-age children, I would definitely vote for that tax.	0	6	4.93	1.653	4	6	6	6

3.2.5 Moderating variable index scores

As described in Section 2.2.3, participants responded to two questionnaires (Q5 and Q6) measuring the following moderating variables: general disgust sensitivity (Q5), and sexual and social conservatism (Q6). Individual questionnaire item measurements ranged from 0 (low) to 6 (high). The Q5 index score was itself produced from three separate sub-indexes for the following components of general DS: core DS, contamination DS, and animal reminder DS. Core DS sub-index scores range from 0 (very low core DS) to 72 (very high core DS), contamination DS scores range from 0 (very low contamination DS) to 30 (very high contamination DS), and

animal reminder DS scores range from 0 (very low animal reminder DS) to 48 (very high animal reminder DS). These three sub-indexes were aggregated to produce Q5 index scores ranging from 0 (very low general DS) to 150 (very high general DS). Individual Q6 measurements were aggregated to produce index scores ranging from 0 (very low SSC) to 60 (very high SSC).

Index scores for core DS were moderately high, with an average = 48.16 (σ = 13.522) and a median = 50. Half of all core DS sub-index scores were between 41 and 59. Index scores for contamination DS were somewhat low, with an average = 13.44 (σ = 7.839) and a median = 14. Half of all contamination DS sub-index scores were between 7 and 19. Index scores for animal reminder DS were in the medium range, with an average = 25.19 (σ = 11.746) and a median = 24. Half of all animal reminder DS sub-index scores were between 15 and 35. Index scores for general DS were moderately high, with an average = 86.79 (σ = 28.758) and a median = 89. Half of all Q5 index scores were between 68 and 108. Index scores for SSC were generally low, with an average = 20.09 (σ = 11.514) and a median = 19. Half of all Q6 index scores were between 13 and 26. Table 17 below describes in more detail the distribution of the Q5 and Q6 index scores.

Table 17: Results description – Moderating variable (Q5-Q6) index scores

Statistics	Core DS sub index	Contamination DS sub index	Animal reminder DS sub index	Q5 index score	Q6 index score
Minimum	15	0	5	32	3
Maximum	70	30	48	141	53
25^{th} percentile	41	7	15	68	13
50^{th} percentile/Median	50	14	24	89	19
75^{th} percentile	59	19	35	108	26
90^{th} percentile	63	23	42	119	34
Mean	48.16	13.44	25.19	86.79	20.09
Standard deviation (σ)	13.522	7.839	11.746	28.758	11.514

3.2.6 Moderating variable scores for individual survey items

Individual core DS sub-index item measurements were generally high. Average core DS measurements ranged between 3.21 (σ = 2.144) and 4.91 (σ = 1.645), with median scores ranging between 3 and 6. Individual contamination DS sub-index item measurements were mostly low. Average contamination DS measurements ranged between 1.58 (σ = 2.003) and 4.16 (σ = 1.902), with median scores ranging between 1 and 4. Individual animal reminder DS sub-index item measurements were generally in the medium range. Average animal reminder DS measurements ranged between 1.86 (σ = 2.274) and 4.70 (σ = 1.489), with median scores ranging between 0 and 5. Individual Q6 item measurements were generally low. Average Q6 measurements ranged between 0.67 (σ = 1.614) and 3.23 (σ = 1.586), with median scores ranging between 0 and 3. Table 18 below describes in more detail the distribution of the individual Q5 and Q6 item scores.

Table 18: Results description – Individual moderating variable (Q5-Q6) item scores

Survey items	Statistics							
	Min	Max	Mean	Std. dev. (σ)	Percentiles			
					25th	50th/ Median	75th	90th
Q5 – Core DS								
#1: I might be willing to try eating monkey meat, under some circumstances.	0	6	4.14	2.199	2	5	6	6
#2: It would bother me to see a rat run across my path in a park.	0	6	3.65	2.069	2	4	6	6
#3: Seeing a cockroach in someone else's house doesn't bother me.	0	6	4.47	1.804	4	5	6	6
#4: It bothers me to hear someone clear a throat full of mucus.	0	6	3.53	1.667	3	4	5	6
#5: If I see someone vomit, it makes me sick to my stomach.	0	6	3.88	2.206	2	5	6	6
#12: Even if I was hungry, I would not drink a bowl of my favorite soup it if had been stirred with a used but thoroughly washed flyswatter.	0	6	4.49	1.919	3	5	6	6
#14: If you see someone put ketchup on vanilla ice cream and eat it, would you find it disgusting?	0	6	3.23	1.900	2	3	5	6

(Table 18 continued)

Survey items	Statistics							
	Min	Max	Mean	Std. dev. (σ)	Percentiles			
					25th	50th/ Median	75th	90th
#15: You are about to drink a glass of milk when you smell that it is spoiled. Would you find that disgusting?	1	6	4.40	1.576	3	5	6	6
#16: You see maggots on a piece of meat in an outdoor garbage pail. Would you find that disgusting?	0	6	4.91	1.645	4	6	6	6
#17: You are walking barefoot on concrete and step on an earthworm. Would you find that disgusting?	0	6	3.21	2.144	1	4	5	6
#18: While you are walking through a tunnel under a railroad track, you smell urine. Would you find that disgusting?	0	6	3.44	1.623	2	4	5	5
#23: You discover that a friend of yours changes underwear only once a week. Would you find that disgusting?	0	6	4.81	1.532	4	5	6	6
Q5 – Contamination DS								
#10: I never let any part of my body touch the toilet seat in a public washroom.	0	6	3.19	2.363	1	4	5	6
#11: I probably would not go to my favorite restaurant if I found out that the cook had a cold.	0	6	4.16	1.902	3	4	6	6
#22: You take a sip of soda and realize that you drank from the glass that an acquaintance of yours had been drinking from. Would you find that disgusting?	0	6	1.58	2.003	0	1	3	5
#24: A friend offers you a piece of chocolate shaped like dog-doo. Would you find that disgusting?	0	6	2.19	1.967	0	2	4	5
#25: As part of a sex education class, you are required to inflate a new lubricated condom, using your mouth. Would you find that disgusting?	0	6	2.33	2.113	0	2	4	6
Q5 – Animal reminder DS								
#6: It would bother me to be in a science class, and see a human hand preserved in a jar.	0	6	2.12	2.163	0	1	4	6
#7: It would not upset me at all to watch a person with a glass eye take the eye out of the socket.	0	6	3.56	2.250	2	4	6	6
#8: It would bother me tremendously to touch a dead body.	0	6	2.88	2.301	1	3	5	6
#9: I would go out of my way to avoid walking through a graveyard.	0	6	1.86	2.274	0	0	6	6
#13: It would bother me to sleep in a nice hotel room if I knew that a man had died of a heart attack in that room the night before.	0	6	3.63	2.215	1	4	6	6
#19: You see a man with his intestines exposed after an accident. Would you find that disgusting?	1	6	4.70	1.489	4	5	6	6
#20: Your friend's pet cat dies and you have to pick up the dead body with your bare hands. Would you find that disgusting?	0	6	3.77	1.913	2	4	6	6
#21: You accidentally touch the ashes of a person who has been cremated. Would you find that disgusting?	0	6	2.67	2.254	1	2	5	6

(Table 18 continued)

Survey items	Statistics							
	Min	Max	Mean	Std. dev. (σ)	Percentiles			
					25th	50th/ Median	75th	90th
Q6 – Sexual and social conservatism								
#1: A woman should have the right to choose what to do with her body, even if that means getting an abortion.	0	6	1.26	1.928	0	0	2	5
#2: Homosexuals should have the same right to marriage as anyone else.	0	6	0.67	1.614	0	0	0	3
#3: The welfare system is too easy to abuse, and does not give people enough incentive to find work.	0	6	3.23	2.091	1	3	5	6
#4: To try to prevent Iran from developing nuclear technology, the United States should consider bombing Iran's nuclear development sites.	0	6	1.21	1.424	0	1	2	3
#5: Overall, labor unions tend to hurt the US economy.	0	6	1.93	1.724	0	2	3	4
#6: It is important for our legal system to use the death penalty as punishment for heinous crimes.	0	6	2.72	2.027	1	3	4	6
#7: Affirmative action gives those groups with a history of oppression a chance to get ahead.	0	5	1.88	1.562	0	2	3	4
#8: The United States should not have invaded Iraq.	0	5	1.98	1.640	0	2	3	4
#9: Gun control laws are not nearly strict enough.	0	6	1.98	2.231	0	1	3	6
#10: Federal tax cuts have been worth it, because they have helped strengthen the economy by allowing Americans to keep more of their own money.	0	6	3.23	1.586	2	3	5	5

3.3 HYPOTHESIS TESTS – EMOTIONAL RESPONSE VARIABLES VS. OUTCOME AND MODERATING VARIABLES

3.3.1 Emotional response effects on index scores for outcome and moderating variables

As described in Section 2.3.3, Kruskal-Wallis H tests were performed to test for valence, arousal and disgust effects on the aggregated outcome (Q1-Q4) and moderating (Q5-Q6) variable measurements. The null hypotheses for each of the above tests state that the distribution of Q1-Q6 index score values will be the same for participants across all valence, arousal index, and

disgust index categories. None of the tests performed for arousal and disgust index effects on the Q1-Q6 index scores yielded statistically significant results at $\alpha = 0.05$. Table 19 below lists the test statistics and significance values for each of the above Kruskal-Wallis H tests performed.

Table 19: Kruskal-Wallis H test statistics – Arousal and disgust vs. outcome and moderating variable indexes

STUDY VARIABLES		Arousal index score		Disgust index score	
		$X^2(df=27)$	p value	$X^2(df=25)$	p value
Outcome	*Perceptions of influenza (Q1)*	26.674	0.482	26.622	0.375
	Influenza-related trust (Q2)	33.780	0.173	26.707	0.371
	Likelihood of taking preventive measures against influenza (Q3)	25.362	0.554	22.653	0.598
	Likelihood of supporting taxes for the systemic prevention of influenza (Q4)	24.591	0.597	22.810	0.589
Moderating	*Core DS (Q5 sub index)*	30.954	0.273	26.593	0.377
	Contamination DS (Q5 sub index)	33.512	0.181	29.544	0.242
	Animal reminder DS (Q5 sub index)	29.584	0.333	26.994	0.356
	General DS (Q5)	30.929	0.274	27.735	0.320
	SSC (Q6)	32.052	0.230	28.258	0.296

However, Kruskal-Wallis H tests on valence scores for five of the twelve presentation slides yielded several statistically significant results at $\alpha = 0.05$, mostly for the general DS and Q5 sub-index scores. These were: (a) slide #1 – general DS (X^2 = 4.973, df = 1, p = 0.026), contamination DS (X^2 = 5.099, df = 1, p = 0.024) and animal reminder DS (X^2 = 4.860, df = 1, p = 0.027); (b) slide #2 – general DS (X^2 = 9.939, df = 1, p = 0.002), core DS (X^2 = 8.893, df = 1, p = 0.003), contamination DS (X^2 = 5.485, df = 1, p = 0.019), and animal reminder DS (X^2 = 7.888, df = 1, p = 0.005); (c) slide #5 – contamination DS (X^2 = 4.849, df = 1, p = 0.028); (d) slide #8 –

influenza-related trust (X^2 = 6.958, df = 1, p = 0.0.008), general DS (X^2 = 6.251, df = 1, p = 0.012), core DS (X^2 = 6.259, df = 1, p = 0.012), contamination DS (X^2 = 3.892, df = 1, p = 0.049), and animal reminder DS (X^2 = 4.709, df = 1, p = 0.030); and (e) slide #10 – contamination DS (X^2 = 6.470, df = 1, p = 0.011). Table 20 below lists the test statistics and significance values for each of the above Kruskal-Wallis H tests performed; p values ≤ 0.05 are marked with an asterisk (*).

Table 20: Kruskal-Wallis H test statistics – Valence vs. outcome and moderating variable indexes

STUDY VARIABLES		Valence score by slide			
		X^2(df=1)		p value	
Outcome	*Perceptions of influenza (Q1)*	#1 = 1.825 #2 = 3.290 #3 = 0.329 #4 = 3.290 #5 = 1.860 #6 = 0.822	#7 = 0.107 #8 = 1.239 #9 = 0.183 #10 = 0.055 #11 = 0.879 #12 = 1.835	#1 = 0.177 #2 = 0.070 #3 = 0.566 #4 = 0.070 #5 = 0.173 #6 = 0.365	#7 = 0.743 #8 = 0.266 #9 = 0.669 #10 = 0.815 #11 = 0.348 #12 = 0.176
	Influenza-related trust (Q2)	#1 = 0.017 #2 = 1.615 #3 = 0.358 #4 = 0.478 #5 = 0.001 #6 = 0.217	#7 = 0.010 #8 = 6.958 #9 = 1.402 #10 = 0.357 #11 = 0.085 #12 = 1.128	#1 = 0.897 #2 = 0.204 #3 = 0.550 #4 = 0.490 #5 = 0.971 #6 = 0.641	#7 = 0.920 #8 = 0.008* #9 = 0.236 #10 = 0.550 #11 = 0.770 #12 = 0.288
	Likelihood of taking preventive measures against influenza (Q3)	#1 = 1.894 #2 = 0.119 #3 = 0.117 #4 = 0.186 #5 = 0.665 #6 = 1.283	#7 = 0.041 #8 = 0.014 #9 = 0.008 #10 = 1.189 #11 = 0.007 #12 = 0.466	#1 = 0.169 #2 = 0.730 #3 = 0.733 #4 = 0.666 #5 = 0.415 #6 = 0.257	#7 = 0.840 #8 = 0.905 #9 = 0.930 #10 = 0.276 #11 = 0.932 #12 = 0.495
	Likelihood of supporting taxes for the systemic prevention of influenza (Q4)	#1 = 0.455 #2 = 1.581 #3 = 1.342 #4 = 1.906 #5 = 1.726 #6 = 1.038	#7 = 0.229 #8 = 0.355 #9 = 0.217 #10 = 3.639 #11 = 0.000 #12 = 0.315	#1 = 0.500 #2 = 0.209 #3 = 0.247 #4 = 0.167 #5 = 0.189 #6 = 0.308	#7 = 0.633 #8 = 0.551 #9 = 0.642 #10 = 0.056 #11 = 1.000 #12 = 0.575
Moderating	*Core DS (Q5 sub index)*	#1 = 2.304 #2 = 8.893 #3 = 0.500 #4 = 0.702 #5 = 1.956 #6 = 0.710	#7 = 3.280 #8 = 6.259 #9 = 0.013 #10 = 0.897 #11 = 1.019 #12 = 0.999	#1 = 0.129 #2 = 0.003* #3 = 0.480 #4 = 0.402 #5 = 0.162 #6 = 0.399	#7 = 0.070 #8 = 0.012* #9 = 0.910 #10 = 0.344 #11 = 0.313 #12 = 0.318
	Contamination DS (Q5 sub index)	#1 = 5.099 #2 = 5.485 #3 = 1.258 #4 = 3.745 #5 = 4.849 #6 = 0.010	#7 = 1.712 #8 = 3.892 #9 = 0.867 #10 = 6.470 #11 = 0.385 #12 = 1.486	#1 = 0.024* #2 = 0.019* #3 = 0.262 #4 = 0.053 #5 = 0.028* #6 = 0.920	#7 = 0.191 #8 = 0.049* #9 = 0.352 #10 = 0.011* #11 = 0.535 #12 = 0.223

(Table 20 continued)

STUDY VARIABLES		Valence score by slide			
		$X^2(df=1)$		p value	
	Animal reminder DS (Q5 sub index)	#1 = 4.860 #2 = 7.888 #3 = 0.226 #4 = 1.284 #5 = 0.568 #6 = 0.588	#7 = 2.314 #8 = 4.709 #9 = 0.194 #10 = 1.455 #11 = 0.225 #12 = 0.125	#1 = 0.027* #2 = 0.005* #3 = 0.635 #4 = 0.257 #5 = 0.451 #6 = 0.443	#7 = 0.128 #8 = 0.030* #9 = 0.660 #10 = 0.228 #11 = 0.635 #12 = 0.724
	General DS (Q5)	#1 = 4.973 #2 = 9.939 #3 = 0.499 #4 = 1.736 #5 = 1.787 #6 = 0.912	#7 = 2.965 #8 = 6.251 #9 = 0.003 #10 = 3.295 #11 = 0.313 #12 = 0.386	#1 = 0.026* #2 = 0.002* #3 = 0.480 #4 = 0.188 #5 = 0.181 #6 = 0.339	#7 = 0.085 #8 = 0.012* #9 = 0.960 #10 = 0.070 #11 = 0.576 #12 = 0.534
	SSC (Q6)	#1 = 1.104 #2 = 0.039 #3 = 0.192 #4 = 0.018 #5 = 0.142 #6 = 0.668	#7 = 0.962 #8 = 0.652 #9 = 1.063 #10 = 0.183 #11 = 0.431 #12 = 0.162	#1 = 0.293 #2 = 0.844 #3 = 0.661 #4 = 0.892 #5 = 0.706 #6 = 0.414	#7 = 0.327 #8 = 0.420 #9 = 0.303 #10 = 0.669 #11 = 0.511 #12 = 0.688

Furthermore, Kruskal-Wallis H tests on arousal scores for two of the twelve presentation slides yielded statistically significant results at $\alpha = 0.05$ for the influenza-related trust (Q2) index score. These were slide #4 ($X^2 = 13.238$, df = 6, p = 0.039) and slide #8 ($X^2 = 17.547$, df = 8, p = 0.025). Kruskal-Wallis H tests on arousal scores for two additional presentation slides yielded statistically significant results at $\alpha = 0.05$ for the general DS and Q5 sub-index scores. These were: (a) slide #1 – animal reminder DS ($X^2 = 14.737$, df = 7, p = 0.040); and (b) slide #12 – general DS ($X^2 = 18.117$, df = 7, p = 0.011), contamination DS ($X^2 = 14.053$, df = 7, p = 0.050), and animal reminder DS ($X^2 = 19.194$, df = 7, p = 0.008). No other individual arousal scores yielded statistically significant results at $\alpha = 0.05$.

Lastly, Kruskal-Wallis H tests on disgust scores for two of the twelve presentation slides yielded statistically significant results at $\alpha = 0.05$ for the likelihood of taking preventive action against influenza (Q3) index score. These were slide #6 ($X^2 = 18.388$, df = 8, p = 0.019) and slide #10 ($X^2 = 13.492$, df = 6, p = 0.036). Kruskal-Wallis H tests on disgust scores for four of the twelve presentation slides, including the two in the previous sentence, yielded statistically

significant results at α = 0.05 for the general DS, Q5 sub-index and/or SSC scores. These were: (a) slide #6 – general DS (X^2 = 16.142, df = 8, p = 0.040) and contamination DS (X^2 = 16.450, df = 8, p = 0.036); (b) slide #8 – core DS (X^2 = 14.525, df = 7, p = 0.043); (c) slide #10 – contamination DS (X^2 = 12.995, df = 6, p = 0.043); and (d) slide #11 – SSC (X^2 = 14.983, df = 7, p = 0.036).

3.3.2 Emotional response effects on individual outcome variable items

Kruskal-Wallis H tests were also performed to test for arousal and disgust effects on the individual survey item measurements for each of the four outcome variables (Q1-Q4). The null hypotheses for each of the above tests state that the distribution of Q1-Q4 item scores will be the same for participants across all arousal index and disgust index categories. None of the tests performed for arousal and disgust index effects on the individual Q1-Q4 item scores yielded statistically significant results at α = 0.05. Table 21 below lists the test statistics and significance values for each of the above Kruskal-Wallis H tests performed.

Table 21: Kruskal-Wallis H test statistics – Arousal and disgust vs. outcome variable item scores

STUDY VARIABLES	Arousal index score		Disgust index score	
	$X^2(df=27)$	p value	$X^2(df=25)$	p value
Perceptions of influenza (Q1)				
#1: Influenza has little to no impact on how long people can live.	18.864	0.881	27.181	0.347
#2: Influenza has little to no impact on how healthy people can be.	23.177	0.675	26.039	0.406
#3: Influenza has little to no impact on how good of a life a person can have.	22.355	0.719	26.425	0.385
#4: It takes a long time before people who get infected with influenza begin to look sick.	23.322	0.668	25.024	0.461
#5: It takes a long time before people who get infected with influenza can begin to infect other people.	26.184	0.508	34.169	0.104
#6: It would be nearly impossible for me to	29.138	0.354	28.271	0.296

(Table 21 continued)

STUDY VARIABLES	Arousal index score		Disgust index score	
	$X^2(df=27)$	p value	$X^2(df=25)$	p value
get an infectious disease.				
#7: It would be nearly impossible for me to get influenza.	32.580	0.211	27.618	0.326
#8: The benefits of infection prevention education are worth any cost.	29.773	0.324	22.672	0.597
#9: The benefits of providing free influenza vaccines are worth any cost.	29.977	0.315	26.640	0.374
#10: The benefits of hand sanitizer distribution programs are worth any cost.	26.290	0.503	22.119	0.629
Influenza-related trust (Q2)				
#1: I always trust the information I normally hear or see about how to avoid getting sick.	32.780	0.204	23.506	0.548
#2: I always trust the information I normally hear or see about how to avoid getting an infectious disease.	32.411	0.217	28.914	0.268
#3: I always trust the information I normally hear or see about how to avoid getting influenza.	30.567	0.289	31.476	0.174
#4: I always trust the people I normally hear or see talking about health in general.	29.502	0.337	28.028	0.307
#5: I always trust the people I normally hear or see talking about infectious diseases.	27.952	0.413	26.090	0.403
#6: I always trust the people I normally hear or see talking about influenza.	29.878	0.320	27.207	0.346
Likelihood of taking preventive action against influenza (Q3)				
#1: I am always careful to cover my mouth and nose when I see other people cough, especially during flu season.	24.468	0.604	25.835	0.416
#2: I always tell people I know to cover their mouths when they cough, especially during flu season.	25.395	0.552	25.932	0.411
#3: After opening a door or using a public appliance like an ATM, I am always careful not to touch my face until I wash my hands or use hand sanitizer.	28.734	0.374	27.998	0.308
#4: I am careful to avoid touching surfaces as much as possible when I am in public spaces.	24.600	0.597	29.699	0.236
#5: I always get a flu vaccine every year.	21.581	0.758	18.625	0.815
#6: I always tell people I know to get a flu vaccine every year.	19.828	0.838	21.088	0.688
Likelihood of supporting taxes for influenza prevention (Q4)				
#1: If a $10/person/year tax were proposed by the state of Pennsylvania to give away free hand sanitizers to all adults who want them, I would definitely vote for that tax.	27.384	0.443	23.164	0.568
#2: If a $10/person/year tax were proposed by the state of Pennsylvania to give away free masks and gloves to all adults who want them, I would definitely vote for that tax.	27.508	0.437	26.458	0.383
#3: If a $10/person/year tax were proposed by the state of Pennsylvania for a network of influenza prevention education programs for adults, I would definitely vote for that tax.	27.477	0.438	27.804	0.317
#4: If a $10/person/year tax were proposed	25.943	0.522	20.094	0.742

(Table 21 continued)

STUDY VARIABLES	Arousal index score		Disgust index score	
	$X^2(df=27)$	p value	$X^2(df=25)$	p value
by the state of Pennsylvania for a network of influenza prevention education programs in schools, I would definitely vote for that tax.				
#5: If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all adults who want them, I would definitely vote for that tax.	28.529	0.384	25.962	0.410
#6: If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all school-age children, I would definitely vote for that tax.	31.496	0.251	26.155	0.399

3.3.3 Emotional response effects on individual moderating variable items

Kruskal-Wallis H tests were also performed to test for arousal and disgust effects on the individual survey item measurements for both of the moderating variables (Q5-Q6). The null hypotheses for each of the above tests state that the distribution of Q5 and Q6 item scores will be the same for participants across all arousal index and disgust index categories. None of the tests performed for arousal and disgust effects on the individual Q5-Q6 item scores yielded statistically significant results at $\alpha = 0.05$. Table 22 below lists the test statistics and significance values for each of the above Kruskal-Wallis H tests performed.

Table 22: Kruskal-Wallis H test statistics – Arousal and disgust vs. moderating variable item scores

STUDY VARIABLES	Arousal index score		Disgust index score	
	$X^2(df=27)$	p value	$X^2(df=25)$	p value
General DS (Q5)				
#1: I might be willing to try eating monkey meat, under some circumstances.	32.747	0.206	28.001	0.308
#2: It would bother me to see a rat run across my path in a park.	26.423	0.495	24.128	0.512
#3: Seeing a cockroach in someone else's house doesn't bother me.	24.055	0.627	28.970	0.265
#4: It bothers me to hear someone clear a throat full of mucus.	27.966	0.413	25.142	0.454
#5: If I see someone vomit, it makes me sick to my stomach.	33.722	0.174	21.971	0.637
#6: It would bother me to be in a science class, and see a human hand preserved in a jar.	28.928	0.364	27.218	0.345

(Table 22 continued)

STUDY VARIABLES	Arousal index score		Disgust index score	
	$X^2(df=27)$	p value	$X^2(df=25)$	p value
#7: It would not upset me at all to watch a person with a glass eye take the eye out of the socket.	28.982	0.362	26.549	0.379
#8: It would bother me tremendously to touch a dead body.	26.038	0.517	30.888	0.193
#9: I would go out of my way to avoid walking through a graveyard.	29.366	0.343	24.120	0.512
#10: I never let any part of my body touch the toilet seat in a public washroom.	36.479	0.105	26.362	0.388
#11: I probably would not go to my favorite restaurant if I found out that the cook had a cold.	26.188	0.508	31.252	0.181
#12: Even if I was hungry, I would not drink a bowl of my favorite soup it if had been stirred with a used but thoroughly washed flyswatter.	30.387	0.297	25.076	0.458
#13: It would bother me to sleep in a nice hotel room if I knew that a man had died of a heart attack in that room the night before.	27.564	0.434	24.299	0.502
#14: If you see someone put ketchup on vanilla ice cream and eat it, would you find it disgusting?	30.550	0.290	30.415	0.209
#15: You are about to drink a glass of milk when you smell that it is spoiled. Would you find that disgusting?	34.933	0.141	19.450	0.775
#16: You see maggots on a piece of meat in an outdoor garbage pail. Would you find that disgusting?	24.571	0.598	22.715	0.594
#17: You are walking barefoot on concrete and step on an earthworm. Would you find that disgusting?	29.993	0.314	19.715	0.762
#18: While you are walking through a tunnel under a railroad track, you smell urine. Would you find that disgusting?	30.396	0.297	31.175	0.183
#19: You see a man with his intestines exposed after an accident. Would you find that disgusting?	27.882	0.417	23.861	0.527
#20: Your friend's pet cat dies and you have to pick up the dead body with your bare hands. Would you find that disgusting?	26.921	0.468	22.862	0.586
#21: You accidentally touch the ashes of a person who has been cremated. Would you find that disgusting?	31.105	0.267	26.236	0.395
#22: You take a sip of soda and realize that you drank from the glass that an acquaintance of yours had been drinking from. Would you find that disgusting?	31.537	0.250	25.443	0.438
#23: You discover that a friend of yours changes underwear only once a week. Would you find that disgusting?	23.374	0.665	26.703	0.371
#24: A friend offers you a piece of chocolate shaped like dog-doo. Would you find that disgusting?	34.039	0.165	23.525	0.547
#25: As part of a sex education class, you are required to inflate a new lubricated condom, using your mouth. Would you find that disgusting?	22.987	0.686	27.259	0.343
SSC (Q6)				
#1: A woman should have the right to choose	25.928	0.523	22.577	0.602

(Table 22 continued)

STUDY VARIABLES	Arousal index score		Disgust index score	
	$X^2(df=27)$	p value	$X^2(df=25)$	p value
what to do with her body, even if that means getting an abortion.				
#2: Homosexuals should have the same right to marriage as anyone else.	27.448	0.440	23.915	0.524
#3: The welfare system is too easy to abuse, and does not give people enough incentive to find work.	33.725	0.174	23.983	0.520
#4: To try to prevent Iran from developing nuclear technology, the United States should consider bombing Iran's nuclear development sites.	30.658	0.285	30.031	0.223
#5: Overall, labor unions tend to hurt the US economy.	33.486	0.182	28.159	0.301
#6: It is important for our legal system to use the death penalty as punishment for heinous crimes.	29.275	0.348	32.190	0.153
#7: Affirmative action gives those groups with a history of oppression a chance to get ahead.	35.285	0.132	23.973	0.521
#8: The United States should not have invaded Iraq.	21.788	0.748	29.040	0.262
#9: Gun control laws are not nearly strict enough.	24.218	0.618	17.022	0.881
#10: Federal tax cuts have been worth it, because they have helped strengthen the economy by allowing Americans to keep more of their own money.	29.787	0.324	25.582	0.430

3.4 HYPOTHESIS TESTS – MODERATING VARIABLES VS. EMOTIONAL RESPONSE AND OUTCOME VARIABLES

3.4.1 Moderating variable effects on index scores for emotional response and outcome variables

Kruskal-Wallis H tests were performed to test for DS (general, core, contamination and animal reminder) and SSC effects on the aggregated emotional response (arousal and disgust) and outcome (Q1-Q4) variable measurements. The null hypotheses for each of the above tests state that the distribution of arousal, disgust and Q1-Q4 index score values will be the same for participants across all DS and SSC categories. None of the tests performed for DS and SSC

effects on the arousal, disgust or Q1-Q4 index scores yielded statistically significant results at α = 0.05. Table 23 below lists the test statistics and significance values for each of the above Kruskal-Wallis H tests performed.

Table 23: Kruskal-Wallis H test statistics – DS and PSSC vs. Emotional response and outcome variable indexes

STUDY VARIABLES		Core DS *(df=26)*		Cont. DS *(df=21)*		Ani. Rem. DS *(df=29)*		Q5 index *(df=32)*		Q6 index *(df=26)*	
		X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
Emotional response	***Arousal index***	23.239	0.619	24.709	0.260	23.573	0.750	29.345	0.602	21.635	0.709
	Disgust index	22.464	0.663	23.504	0.318	29.503	0.439	29.697	0.584	20.198	0.782
Outcome	***Q1 index***	23.644	0.596	22.394	0.377	30.493	0.390	36.883	0.253	32.012	0.193
	Q2 index	25.750	0.477	22.167	0.390	24.067	0.726	25.014	0.805	32.250	0.185
	Q3 index	23.611	0.598	22.190	0.389	29.423	0.443	33.919	0.375	31.110	0.224
	Q4 index	29.551	0.287	20.348	0.499	24.289	0.715	35.357	0.313	20.916	0.746

3.4.2 Moderating variable effects on valence, arousal and disgust scores for individual slides

Kruskal-Wallis H tests were also performed to test for DS and SSC effects on the valence, arousal and disgust measurements for each of the twelve presentation slides. The null hypotheses for the above tests state that the distribution of individual valence, arousal and disgust scores will be the same for participants across all DS and SSC categories. None of the tests performed for DS and SSC effects on the valence, arousal or disgust measurements for any of the twelve presentation slides yielded statistically significant results at α = 0.05. Table 24 below lists the test statistics and significance values for each of the above Kruskal-Wallis H tests performed.

Table 24: Kruskal-Wallis H test statistics – DS and PSSC vs. Emotional response scores for individual slides

STUDY VARIABLES	Core DS *(df=26)*		Cont. DS *(df=21)*		Ani. Rem. DS *(df=29)*		Q5 index *(df=32)*		Q6 index *(df=26)*	
	X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
Valence score by slide										
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	19.388	0.820	21.241	0.444	30.138	0.407	25.690	0.777	27.914	0.363
#2: Text with caricatures – Flu symptoms	23.606	0.599	27.619	0.151	32.636	0.293	27.284	0.704	21.933	0.692
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	21.388	0.722	18.771	0.600	34.802	0.211	27.604	0.689	24.987	0.520
#4: Text with caricatures – Everyday health habits	23.606	0.599	22.937	0.347	32.636	0.293	29.291	0.604	22.602	0.655
#5: Text with caricatures – Cleaning to prevent the flu	26.038	0.461	20.500	0.490	32.879	0.283	31.576	0.488	27.015	0.409
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	25.975	0.465	15.523	0.796	30.155	0.406	30.852	0.525	14.826	0.960
#7: Bullet points with pictures – Persons at high risk for flu complications	25.278	0.503	29.458	0.103	25.975	0.627	28.762	0.631	26.671	0.427
#8: Bullet points with pictures – Persons at high risk for flu complications	25.792	0.475	30.809	0.077	26.564	0.595	36.597	0.264	21.162	0.734
#9: Bullet points with pictures – Flu vaccine recommendations	25.975	0.465	20.052	0.518	27.368	0.552	30.852	0.525	21.097	0.737
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	21.983	0.690	23.095	0.339	24.948	0.681	25.690	0.777	24.948	0.522
#11: Bullet points – Costs related to influenza	27.015	0.409	18.220	0.635	28.318	0.501	27.667	0.686	22.455	0.664
#12: Bullet points – Benefits of prevention/ treatment	25.314	0.501	31.858	0.061	24.333	0.712	29.567	0.590	24.333	0.557
Arousal score by slide										
#1: Text with caricatures – What is the flu? Do people in the US get the	22.617	0.654	18.883	0.593	25.093	0.673	25.262	0.795	30.444	0.250

(Table 24 continued)

STUDY VARIABLES	Core DS (df=26)		Cont. DS (df=21)		Ani. Rem. DS (df=29)		Q5 index (df=32)		Q6 index (df=26)	
	X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
flu? How does it spread?										
#2: Text with caricatures – Flu symptoms	24.399	0.553	18.023	0.648	26.010	0.625	32.095	0.462	22.282	0.673
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	26.462	0.438	22.206	0.388	22.780	0.787	30.116	0.562	25.173	0.509
#4: Text with caricatures – Everyday health habits	25.656	0.482	22.743	0.358	29.247	0.452	32.467	0.444	28.948	0.313
#5: Text with caricatures – Cleaning to prevent the flu	24.685	0.537	22.842	0.352	26.386	0.605	29.150	0.612	29.737	0.279
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	27.557	0.381	17.590	0.675	27.272	0.557	32.803	0.427	27.003	0.409
#7: Bullet points with pictures – Persons at high risk for flu complications	19.338	0.822	21.414	0.434	21.915	0.824	32.419	0.446	25.867	0.470
#8: Bullet points with pictures – Persons at high risk for flu complications	25.594	0.486	20.805	0.471	22.150	0.814	34.785	0.337	24.951	0.522
#9: Bullet points with pictures – Flu vaccine recommendations	26.617	0.430	22.464	0.373	28.230	0.506	32.675	0.434	25.965	0.465
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	27.359	0.391	17.724	0.666	28.245	0.505	27.076	0.714	21.126	0.735
#11: Bullet points – Costs related to influenza	22.307	0.672	23.393	0.323	29.181	0.456	29.037	0.617	19.656	0.808
#12: Bullet points – Benefits of prevention/ treatment	26.033	0.461	19.559	0.549	27.543	0.542	30.945	0.520	25.017	0.518
Disgust score by slide										
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	25.301	0.502	24.709	0.260	35.468	0.190	35.099	0.323	22.022	0.687
#2: Text with caricatures – Flu symptoms	25.682	0.481	20.515	0.489	35.280	0.195	34.090	0.367	19.445	0.817
#3: Text with caricatures – How sick can you get from the flu? How long	18.094	0.872	23.550	0.315	31.608	0.337	33.431	0.398	23.010	0.632

(Table 24 continued)

STUDY VARIABLES	Core DS *(df=26)*		Cont. DS *(df=21)*		Ani. Rem. DS *(df=29)*		Q5 index *(df=32)*		Q6 index *(df=26)*	
	X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
does it last? How can I protect myself from it?										
#4: Text with caricatures – Everyday health habits	25.565	0.487	27.865	0.144	29.998	0.414	33.994	0.372	30.544	0.246
#5: Text with caricatures – Cleaning to prevent the flu	23.032	0.631	26.210	0.199	30.341	0.397	31.720	0.481	26.342	0.444
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	26.100	0.458	21.892	0.406	32.865	0.283	29.054	0.616	20.506	0.767
#7: Bullet points with pictures – Persons at high risk for flu complications	18.921	0.840	22.451	0.374	27.923	0.522	27.996	0.670	19.014	0.836
#8: Bullet points with pictures – Persons at high risk for flu complications	22.543	0.659	25.643	0.220	27.326	0.554	34.883	0.333	23.509	0.604
#9: Bullet points with pictures – Flu vaccine recommendations	27.707	0.373	20.732	0.475	27.656	0.536	31.114	0.511	22.163	0.680
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	21.723	0.704	21.399	0.435	29.994	0.414	29.410	0.598	21.165	0.733
#11: Bullet points – Costs related to influenza	23.815	0.587	15.870	0.777	28.556	0.488	28.984	0.620	26.190	0.453
#12: Bullet points – Benefits of prevention/ treatment	21.812	0.699	21.700	0.417	25.448	0.655	29.484	0.594	22.269	0.674

3.4.3 Moderating variable effects on individual outcome variable items

Kruskal-Wallis H tests were also performed to test for DS and SSC effects on the individual survey item measurements for the outcome variables (Q1-Q4). The null hypotheses for the above tests state that the distribution of individual Q1-Q4 scores will be the same for participants across all DS and SSC categories. None of the tests performed for DS and SSC effects on the individual

Q1-Q4 survey items yielded statistically significant results at $\alpha = 0.05$. Table 25 below lists the test statistics and significance values for each of the above Kruskal-Wallis H tests performed.

Table 25: Kruskal-Wallis H test statistics – DS and PSSC vs. outcome variable item scores

STUDY VARIABLES	Core DS *(df=26)*		Cont. DS *(df=21)*		Ani. Rem. DS *(df=29)*		Q5 index *(df=32)*		Q6 index *(df=26)*	
	X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
Perceptions of influenza (Q1)										
#1: Influenza has little to no impact on how long people can live.	25.160	0.510	18.485	0.618	34.787	0.212	36.295	0.275	26.193	0.453
#2: Influenza has little to no impact on how healthy people can be.	23.632	0.597	23.605	0.313	25.929	0.629	35.818	0.294	30.457	0.249
#3: Influenza has little to no impact on how good of a life a person can have.	21.692	0.705	23.203	0.333	32.931	0.281	33.288	0.404	19.902	0.796
#4: It takes a long time before people who get infected with influenza begin to look sick.	26.566	0.432	21.780	0.412	32.120	0.315	35.760	0.296	27.820	0.367
#5: It takes a long time before people who get infected with influenza can begin to infect other people.	26.184	0.453	28.075	0.138	32.818	0.285	35.478	0.308	29.533	0.287
#6: It would be nearly impossible for me to get an infectious disease.	27.493	0.384	13.154	0.903	28.828	0.474	37.371	0.236	25.742	0.477
#7: It would be nearly impossible for me to get influenza.	22.821	0.643	11.968	0.940	32.443	0.301	33.797	0.381	19.434	0.818
#8: The benefits of infection prevention education are worth any cost.	27.705	0.373	25.299	0.234	27.774	0.530	31.291	0.502	20.220	0.781
#9: The benefits of providing free influenza vaccines are worth any cost.	22.394	0.667	18.692	0.605	26.601	0.593	32.535	0.440	29.578	0.285
#10: The benefits of hand sanitizer distribution programs are worth any cost.	26.885	0.415	26.570	0.186	31.902	0.324	37.700	0.225	28.617	0.329
Influenza-related trust (Q2)										
#1: I always trust the information I normally hear or see about how to avoid getting sick.	21.363	0.723	24.720	0.259	26.359	0.606	27.440	0.697	28.414	0.338
#2: I always trust the information I normally hear or see about how to	25.353	0.499	24.370	0.275	28.513	0.491	28.536	0.643	29.976	0.269

(Table 25 continued)

STUDY VARIABLES	Core DS (df=26)		Cont. DS (df=21)		Ani. Rem. DS (df=29)		Q5 index (df=32)		Q6 index (df=26)	
	X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
avoid getting an infectious disease.										
#3: I always trust the information I normally hear or see about how to avoid getting influenza.	27.624	0.377	25.129	0.242	27.781	0.530	30.438	0.546	25.439	0.494
#4: I always trust the people I normally hear or see talking about health in general.	27.807	0.368	20.740	0.475	27.183	0.562	26.546	0.739	28.130	0.352
#5: I always trust the people I normally hear or see talking about infectious diseases.	29.602	0.284	18.202	0.636	26.092	0.621	28.131	0.663	32.482	0.178
#6: I always trust the people I normally hear or see talking about influenza.	29.552	0.287	19.826	0.532	26.542	0.596	25.678	0.778	31.228	0.220
Likelihood of taking preventive action against influenza (Q3)										
#1: I am always careful to cover my mouth and nose when I see other people cough, especially during flu season.	22.808	0.644	16.543	0.738	28.358	0.499	34.519	0.348	25.750	0.477
#2: I always tell people I know to cover their mouths when they cough, especially during flu season.	24.336	0.557	20.774	0.473	31.969	0.321	33.345	0.402	28.920	0.315
#3: After opening a door or using a public appliance like an ATM, I am always careful not to touch my face until I wash my hands or use hand sanitizer.	28.840	0.318	32.492	0.052	28.049	0.515	31.089	0.512	29.166	0.304
#4: I am careful to avoid touching surfaces as much as possible when I am in public spaces.	22.945	0.636	30.704	0.079	24.510	0.703	31.964	0.469	30.507	0.247
#5: I always get a flu vaccine every year.	27.919	0.362	24.226	0.282	24.559	0.701	29.355	0.601	23.157	0.624
#6: I always tell people I know to get a flu vaccine every year.	26.689	0.325	20.804	0.471	26.963	0.574	33.351	0.401	23.724	0.592
Likelihood of supporting taxes for influenza prevention (Q4)										
#1: If a $10/person/year tax were proposed by the state of Pennsylvania to give away free hand sanitizers to all adults who want them, I would definitely vote for that tax.	29.768	0.277	19.792	0.534	28.446	0.494	37.166	0.243	24.504	0.547
#2: If a $10/person/year tax were proposed by the	27.127	0.403	19.750	0.537	25.550	0.649	32.729	0.431	26.297	0.447

(Table 25 continued)

STUDY VARIABLES	Core DS *(df=26)*		Cont. DS *(df=21)*		Ani. Rem. DS *(df=29)*		Q5 index *(df=32)*		Q6 index *(df=26)*	
	X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
state of Pennsylvania to give away free masks and gloves to all adults who want them, I would definitely vote for that tax.										
#3: If a $10/person/year tax were proposed by the state of Pennsylvania for a network of influenza prevention education programs for adults, I would definitely vote for that tax.	26.604	0.430	27.046	0.169	30.990	0.366	35.423	0.310	23.836	0.585
#4: If a $10/person/year tax were proposed by the state of Pennsylvania for a network of influenza prevention education programs in schools, I would definitely vote for that tax.	25.920	0.468	22.323	0.381	25.338	0.661	28.867	0.626	27.090	0.405
#5: If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all adults who want them, I would definitely vote for that tax.	23.873	0.583	21.371	0.437	26.078	0.621	30.090	0.563	24.387	0.554
#6: If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all school-age children, I would definitely vote for that tax.	24.621	0.540	22.105	0.393	31.028	0.364	32.619	0.436	26.735	0.423

3.5 HYPOTHESIS TESTS – INTERVENTION/CONTROL VS. EMOTIONAL RESPONSE, OUTCOME AND MODERATING VARIABLES

3.5.1 Intervention effects on index scores for all variables

As described in Section 2.3.3, one-tailed Wilcoxon-Mann-Whitney tests were performed to test for intervention effects on the aggregated emotional response (arousal and disgust), outcome

(Q1-Q4) and moderating (Q5-Q6) variable measurements. The null hypotheses for each of the above tests state that the distribution of index score values will be the same for participants exposed to the hand sanitizer prime and for participants in the control group. None of the tests performed for intervention effects on the arousal, disgust or Q1-Q6 index scores yielded statistically significant results at $\alpha = 0.05$. Table 26 below lists the test statistics and significance values for each of the above tests.

Table 26: One-tailed Wilcoxon-Mann-Whitney test statistics – Intervention/control vs. emotional response, outcome and moderating variable indexes

STUDY VARIABLES		Intervention/control			
		Mean rank (control)	**Mean rank (intervention)**	**Z**	**p value**
Emotional Response	***Arousal index score***	22.45	21.65	-0.208	0.418
	Disgust index score	20.21	23.42	-0.833	0.203
Outcome	***Perceptions of influenza (Q1)***	21.11	22.71	-0.417	0.338
	Influenza-related trust (Q2)	23.21	21.04	-0.564	0.287
	Likelihood of taking preventive measures against influenza (Q3)	21.95	22.04	-0.024	0.490
	Likelihood of supporting taxes for influenza prevention (Q4)	22.82	21.35	-0.380	0.352
Moderating	***Core DS (Q5 sub index)***	19.16	24.25	-1.322	0.093
	Contamination DS (Q5 sub index)	19.05	24.33	-1.371	0.085
	Animal reminder DS (Q5 sub index)	20.58	23.13	-0.661	0.255
	General DS (Q5)	19.37	24.08	-1.223	0.111
	SSC (Q6)	20.63	23.08	-0.636	0.263

3.5.2 Intervention effects on valence scores for individual slides

As described in Section 2.3.3, Chi-square tests were performed to test for intervention effects on the valence measurements for each of the twelve presentation slides. The null hypotheses for the above tests state that the distribution of individual valence scores will be the same for participants exposed to the hand sanitizer prime and for participants in the control group. None of the tests performed for intervention effects on the individual valence scores yielded statistically significant results at $\alpha = 0.05$. Table 27 below lists the test statistics and significance values for each of the above tests.

Table 27: Chi-square test statistics – Intervention/control vs. valence scores for individual slides

STUDY VARIABLES	Intervention/control		
Valence score by slide	$X^2(df=1)$	**Phi (ϕ)**	**p value**
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	0.285	-0.081	0.594
#2: Text with caricatures – Flu symptoms	0.001	-0.004	0.977
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	0.010	-0.015	0.920
#4: Text with caricatures – Everyday health habits	0.424	-0.099	0.515
#5: Text with caricatures – Cleaning to prevent the flu	0.196	-0.068	0.658
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	0.002	-0.007	0.965
#7: Bullet points with pictures – Persons at high risk for flu complications	0.349	-0.090	0.555
#8: Bullet points with pictures – Persons at high risk for flu complications	0.705	-0.128	0.401
#9: Bullet points with pictures – Flu vaccine recommendations	0.002	0.007	0.965
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	1.413	-0.181	0.235
#11: Bullet points – Costs related to influenza	0.196	-0.068	0.658
#12: Bullet points – Benefits of prevention/ treatment	0.010	0.015	0.920

3.5.3 Intervention effects on arousal and disgust scores for individual slides

One-tailed Wilcoxon-Mann-Whitney tests were also performed to test for intervention effects on the arousal and disgust measurements for each of the twelve presentation slides. The null hypotheses for each of the above tests state that the distribution of individual arousal and disgust scores will be the same for participants exposed to the hand sanitizer prime and for participants in the control group. None of the tests performed for intervention effects on the individual arousal and disgust scores yielded statistically significant results at $\alpha = 0.05$. Table 28 below lists the test statistics and significance values for each of the above tests.

Table 28: One-tailed Wilcoxon-Mann-Whitney test statistics – Intervention/control vs. arousal and disgust scores for individual slides

STUDY VARIABLES	Intervention/control			
	Mean rank (control)	Mean rank (intervention)	Z	p value
Arousal score by slide				
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	21.50	22.40	-0.251	0.401
#2: Text with caricatures – Flu symptoms	23.00	21.21	-0.497	0.310
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	22.16	21.88	-0.077	0.470
#4: Text with caricatures – Everyday health habits	21.74	22.21	-0.133	0.447
#5: Text with caricatures – Cleaning to prevent the flu	20.53	23.17	-0.727	0.234
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	19.29	24.15	-1.293	0.098
#7: Bullet points with pictures – Persons at high risk for flu complications	21.21	22.63	-0.379	0.352
#8: Bullet points with pictures – Persons at high risk for flu complications	21.84	22.13	-0.076	0.470

(Table 28 continued)

STUDY VARIABLES	Intervention/control			
	Mean rank (control)	Mean rank (intervention)	Z	p value
#9: Bullet points with pictures – Flu vaccine recommendations	22.08	21.94	-0.038	0.485
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	25.32	19.38	-1.592	0.056
#11: Bullet points – Costs related to influenza	24.61	19.94	-1.234	0.109
#12: Bullet points – Benefits of prevention/ treatment	21.53	22.38	-0.233	0.408
Disgust score by slide				
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	19.39	24.06	-1.240	0.108
#2: Text with caricatures – Flu symptoms	20.82	22.94	-0.563	0.287
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	22.45	21.65	-0.233	0.408
#4: Text with caricatures – Everyday health habits	20.87	22.90	-0.586	0.279
#5: Text with caricatures – Cleaning to prevent the flu	20.47	23.21	-0.758	0.224
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	20.47	23.21	-0.736	0.231
#7: Bullet points with pictures – Persons at high risk for flu complications	22.55	21.56	-0.275	0.392
#8: Bullet points with pictures – Persons at high risk for flu complications	21.95	22.04	-0.027	0.490
#9: Bullet points with pictures – Flu vaccine recommendations	20.79	22.96	-0.601	0.274
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	22.74	21.42	-0.373	0.355
#11: Bullet points – Costs related to influenza	22.63	21.50	-0.311	0.378
#12: Bullet points – Benefits of prevention/ treatment	22.82	21.35	-0.448	0.327

3.5.4 Intervention effects on individual outcome variable items

One-tailed Wilcoxon-Mann-Whitney tests were also performed to test for intervention effects on the individual survey item measurements for each of the four outcome variables (Q1-Q4). The null hypotheses for each of the above tests state that the distribution of Q1-Q4 item scores will be the same for participants exposed to the hand sanitizer prime and for participants in the control group. Only three of the twenty-eight tests performed for intervention effects on the individual Q1-Q4 item scores yielded statistically significant results at $\alpha = 0.05$. These were: Q1 question #10 (mean control rank = 18.08, mean intervention rank = 25.10, Z = -1.858, p = 0.032); Q2 question #1 (mean control rank = 25.82, mean intervention rank = 18.98, Z = -1.832, p = 0.034); and Q4 question #1 (mean control rank = 25.97, mean intervention rank = 18.85, Z = -1.871, p = 0.031). Table 29 below lists the test statistics and significance values for each of the above tests; p values ≤ 0.05 are marked with an asterisk (*).

Table 29: One-tailed Wilcoxon-Mann-Whitney test statistics – Intervention/control vs. outcome variable item scores

STUDY VARIABLES	Intervention/control			
	Mean rank (control)	Mean rank (intervention)	Z	p value
Perceptions of influenza (Q1)				
#1: Influenza has little to no impact on how long people can live.	22.13	21.90	-0.063	0.475
#2: Influenza has little to no impact on how healthy people can be.	22.47	21.63	-0.231	0.409
#3: Influenza has little to no impact on how good of a life a person can have.	22.08	21.94	-0.038	0.485
#4: It takes a long time before people who get infected with influenza begin to look sick.	23.39	20.90	-0.679	0.249
#5: It takes a long time before people who get infected with influenza can begin to infect other people.	24.76	19.81	-1.640	0.051
#6: It would be nearly impossible for me to get an infectious disease.	22.74	21.42	-0.569	0.285

(Table 29 continued)

STUDY VARIABLES	Intervention/control			
	Mean rank (control)	Mean rank (intervention)	Z	p value
#7: It would be nearly impossible for me to get influenza.	21.55	22.35	-0.281	0.389
#8: The benefits of infection prevention education are worth any cost.	20.61	23.10	-0.669	0.252
#9: The benefits of providing free influenza vaccines are worth any cost.	22.76	21.40	-0.368	0.357
#10: The benefits of hand sanitizer distribution programs are worth any cost.	18.08	25.10	-1.858	0.032*
Influenza-related trust (Q2)				
#1: I always trust the information I normally hear or see about how to avoid getting sick.	25.82	18.98	-1.832	0.034*
#2: I always trust the information I normally hear or see about how to avoid getting an infectious disease.	24.68	19.88	-1.293	0.098
#3: I always trust the information I normally hear or see about how to avoid getting influenza.	23.24	21.02	-0.593	0.277
#4: I always trust the people I normally hear or see talking about health in general.	21.39	22.48	-0.290	0.386
#5: I always trust the people I normally hear or see talking about infectious diseases.	21.87	22.10	-0.063	0.475
#6: I always trust the people I normally hear or see talking about influenza.	21.61	22.31	-0.188	0.426
Likelihood of taking preventive action against influenza (Q3)				
#1: I am always careful to cover my mouth and nose when I see other people cough, especially during flu season.	22.95	21.25	-0.454	0.325
#2: I always tell people I know to cover their mouths when they cough, especially during flu season.	22.26	21.79	-0.125	0.450
#3: After opening a door or using a public appliance like an ATM, I am always careful not to touch my face until I wash my hands or use hand sanitizer.	20.55	23.15	-0.680	0.249
#4: I am careful to avoid touching surfaces as much as possible when I am in public spaces.	20.42	23.25	-0.744	0.229
#5: I always get a flu vaccine every year.	21.79	22.17	-0.102	0.460
#6: I always tell people I know to get a flu vaccine every year.	22.26	21.79	-0.125	0.451
Likelihood of supporting taxes for influenza prevention (Q4)				
#1: If a $10/person/year tax were proposed by the state of Pennsylvania to give away free hand sanitizers to all adults who want them, I would definitely vote for that tax.	25.97	18.85	-1.871	0.031*
#2: If a $10/person/year tax were proposed by the state of Pennsylvania to give away free masks and gloves to all adults who want them, I would definitely vote for that tax.	22.82	21.35	-0.386	0.350
#3: If a $10/person/year tax were proposed by the state of Pennsylvania for a network of influenza prevention education programs for adults, I would definitely vote for that tax.	22.84	21.33	-0.399	0.345
#4: If a $10/person/year tax were proposed by the state of Pennsylvania for a network of influenza	20.00	23.58	-0.963	0.168

(Table 29 continued)

STUDY VARIABLES	Intervention/control			
	Mean rank (control)	Mean rank (intervention)	Z	p value
prevention education programs in schools, I would definitely vote for that tax.				
#5: If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all adults who want them, I would definitely vote for that tax.	20.24	23.40	-0.854	0.197
#6: If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all school-age children, I would definitely vote for that tax.	20.21	23.42	-0.910	0.182

3.5.5 Intervention effects on individual moderating variable items

One-tailed Wilcoxon-Mann-Whitney tests were also performed to test for intervention effects on the individual survey item measurements for both of the moderating variables (Q5-Q6). The null hypotheses for each of the above tests state that the distribution of Q5-Q6 item scores will be the same for participants exposed to the hand sanitizer prime and for participants in the control group. Only two of the thirty-five tests performed for intervention effects on the individual Q5-Q6 item scores yielded statistically significant results at $\alpha = 0.05$, both core DS sub-index items. These were: Q5 question #3 (mean control rank = 17.87, mean intervention rank = 25.27, $Z = -1.992$, $p = 0.023$); and Q5 question #18 (mean control rank = 17.82, mean intervention rank = 25.31, $Z = -1.978$, $p = 0.024$). Table 30 below lists the test statistics and significance values for each of the above tests; p values ≤ 0.05 are marked with an asterisk (*).

Table 30: One-tailed Wilcoxon-Mann-Whitney test statistics – Intervention/control vs. moderating variable item scores

STUDY VARIABLES	Intervention/control			
	Mean rank (control)	Mean rank (intervention)	Z	p value
General DS (Q5)				
#1: I might be willing to try eating monkey meat, under some circumstances.	19.84	23.71	-1.054	0.146
#2: It would bother me to see a rat run across my path in a park.	18.66	24.65	-1.577	0.058
#3: Seeing a cockroach in someone else's house doesn't bother me.	17.87	25.27	-1.992	0.023*
#4: It bothers me to hear someone clear a throat full of mucus.	19.08	24.31	-1.395	0.082
#5: If I see someone vomit, it makes me sick to my stomach.	19.84	23.71	-1.030	0.152
#6: It would bother me to be in a science class, and see a human hand preserved in a jar.	22.74	21.42	-0.351	0.363
#7: It would not upset me at all to watch a person with a glass eye take the eye out of the socket.	21.00	22.79	-0.476	0.317
#8: It would bother me tremendously to touch a dead body.	22.95	21.25	-0.447	0.328
#9: I would go out of my way to avoid walking through a graveyard.	20.18	23.44	-0.908	0.182
#10: I never let any part of my body touch the toilet seat in a public washroom.	20.79	22.96	-0.572	0.284
#11: I probably would not go to my favorite restaurant if I found out that the cook had a cold.	19.47	24.00	-1.209	0.114
#12: Even if I was hungry, I would not drink a bowl of my favorite soup it if had been stirred with a used but thoroughly washed flyswatter.	20.47	23.21	-0.752	0.226
#13: It would bother me to sleep in a nice hotel room if I knew that a man had died of a heart attack in that room the night before.	18.89	24.46	-1.472	0.071
#14: If you see someone put ketchup on vanilla ice cream and eat it, would you find it disgusting?	19.21	24.21	-1.312	0.085
#15: You are about to drink a glass of milk when you smell that it is spoiled. Would you find that disgusting?	22.97	21.23	-0.468	0.320
#16: You see maggots on a piece of meat in an outdoor garbage pail. Would you find that disgusting?	21.68	22.25	-0.162	0.436
#17: You are walking barefoot on concrete and step on an earthworm. Would you find that disgusting?	23.37	20.92	-0.647	0.258
#18: While you are walking through a tunnel under a railroad track, you smell urine. Would you find that disgusting?	17.82	25.31	-1.978	0.024*
#19: You see a man with his intestines exposed after an accident. Would you find that disgusting?	20.34	23.31	-0.811	0.209
#20: Your friend's pet cat dies and you have to pick up the dead body with your bare hands. Would you find that disgusting?	22.16	21.88	-0.075	0.470
#21: You accidentally touch the ashes of a person	20.05	23.54	-0.918	0.180

(Table 30 continued)

STUDY VARIABLES	Intervention/control			
	Mean rank (control)	Mean rank (intervention)	Z	p value
who has been cremated. Would you find that disgusting?				
#22: You take a sip of soda and realize that you drank from the glass that an acquaintance of yours had been drinking from. Would you find that disgusting?	19.61	23.90	-1.178	0.120
#23: You discover that a friend of yours changes underwear only once a week. Would you find that disgusting?	20.82	22.94	-0.585	0.280
#24: A friend offers you a piece of chocolate shaped like dog-doo. Would you find that disgusting?	19.61	23.90	-1.137	0.128
#25: As part of a sex education class, you are required to inflate a new lubricated condom, using your mouth. Would you find that disgusting?	20.95	22.83	-0.497	0.310
SSC (Q6)				
#1: A woman should have the right to choose what to do with her body, even if that means getting an abortion.	19.11	24.29	-1.470	0.071
#2: Homosexuals should have the same right to marriage as anyone else.	21.24	22.60	-0.499	0.309
#3: The welfare system is too easy to abuse, and does not give people enough incentive to find work.	22.68	21.46	-0.322	0.374
#4: To try to prevent Iran from developing nuclear technology, the United States should consider bombing Iran's nuclear development sites.	20.03	23.56	-0.968	0.167
#5: Overall, labor unions tend to hurt the US economy.	23.00	21.21	-0.477	0.317
#6: It is important for our legal system to use the death penalty as punishment for heinous crimes.	19.84	23.71	-1.021	0.154
#7: Affirmative action gives those groups with a history of oppression a chance to get ahead.	20.42	23.25	-0.751	0.226
#8: The United States should not have invaded Iraq.	20.89	22.88	-0.530	0.298
#9: Gun control laws are not nearly strict enough.	19.45	24.02	-1.229	0.110
#10: Federal tax cuts have been worth it, because they have helped strengthen the economy by allowing Americans to keep more of their own money.	22.42	21.67	-0.202	0.420

3.6 DEMOGRAPHIC EFFECTS ON INDEX SCORES FOR ALL VARIABLES AND INDIVIDUAL SCORES FOR VALENCE

Kruskal-Wallis H tests were performed to test for SES (age, gender, race, income, education) and other demographic (political affiliation, religious service attendance, number and preferred types of health information sources) effects on all the aggregated emotional response (arousal and disgust), outcome (Q1-Q4) and moderating (Q5-Q6) variable measurements. The null hypotheses for each of the above tests state that the distribution of index score values will be the same for participants across all SES and demographic categories. Non-parametric statistical tests were used to test for the above effects because demographic questionnaire items for all SES and demographic variables were operationalized as either nominal measures for gender and race or ordinal measures for the seven other SES and demographic variables (see Appendix I for demographic questionnaire survey questions).

Kruskal-Wallis H tests for age yielded statistically significant results at $\alpha = 0.05$ for the arousal index score ($X^2 = 18.580$, df = 7, p = 0.010) and one of the individual valence scores, for slide #9 ($X^2 = 16.265$, df = 7, p = 0.023). Kruskal-Wallis H tests for gender yielded statistically significant results at $\alpha = 0.05$ for the general DS index score ($X^2 = 7.498$, df = 1, p = 0.006), core DS ($X^2 = 8.791$, df = 1, p = 0.003), animal reminder DS ($X^2 = 5.119$, df = 1, p = 0.024), and two of the individual valence scores, for slide #9 ($X^2 = 4.611$, df = 1, p = 0.032) and slide #11 ($X^2 = 5.746$, df = 1, p = 0.017). Kruskal-Wallis H tests for race yielded statistically significant results at $\alpha = 0.05$ for the arousal index score ($X^2 = 7.815$, df = 3, p = 0.050), the general DS index score ($X^2 = 7.946$, df = 3, p = 0.047), contamination DS ($X^2 = 10.512$, df = 3, p = 0.015), and five of the individual valence scores, for slide #1 ($X^2 = 8.925$, df = 3, p = 0.030), slide #2 ($X^2 = 10.179$, df = 3, p = 0.017), slide #3 ($X^2 = 9.351$, df = 3, p = 0.025), slide #4 ($X^2 = 11.992$, df = 3, p =

0.007), and slide #5 (X^2 = 8.232, df = 3, p = 0.041). Kruskal-Wallis H tests for income yielded statistically significant results at α = 0.05 for the influenza-related index (Q2) score (X^2 = 14.590, df = 5, p = 0.012).

Kruskal-Wallis H tests for political affiliation yielded statistically significant results at α = 0.05 for the SSC index (Q6) score (X^2 = 20.269, df = 4, p < 0.001) and one of the individual valence scores, for slide #12 (X^2 = 10.711, df = 4, p = 0.030). Kruskal-Wallis H tests for religious service attendance yielded statistically significant results at α = 0.05 for the perceptions of influenza index (Q1) score (X^2 = 10.090, df = 4, p = 0.039). Kruskal-Wallis H tests for number of health information sources yielded statistically significant results at α = 0.05 for one of the individual valence scores, for slide #6 (X^2 = 23.188, df = 13, p = 0.039). No other tests performed for SES or demographic effects on the arousal, disgust, or Q1-6 index scores yielded statistically significant results at α = 0.05. Tables 31 and 32 below list the test statistics and significance values for each of the above Kruskal-Wallis H tests performed; p values ≤ 0.05 are marked with an asterisk (*).

Table 31: Kruskal-Wallis H test statistics – SES vs. indexes for all variables and individual valence scores

STUDY VARIABLES	Age *(df=7)*		Gender *(df=1)*		Race *(df=3)*		Income *(df=5)*		Education *(df=5)*	
	X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
Arousal index score	18.580	0.010*	0.191	0.662	7.815	0.050*	7.905	0.162	1.898	0.863
Disgust index score	12.023	0.100	0.030	0.863	4.699	0.195	6.007	0.306	7.153	0.210
Perceptions of influenza (Q1)	2.844	0.899	0.203	0.652	1.842	0.606	1.810	0.875	4.067	0.540
Influenza-related trust (Q2)	7.129	0.416	0.051	0.822	0.592	0.898	14.590	0.012*	3.635	0.603
Likelihood of taking preventive measures for influenza (Q3)	3.426	0.843	2.965	0.085	1.112	0.774	9.825	0.080	4.996	0.416

(Table 31 continued)

STUDY VARIABLES	Age (df=7)		Gender (df=1)		Race (df=3)		Income (df=5)		Education (df=5)	
	X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
Likelihood of supporting influenza prevention taxes (Q4)	9.113	0.245	0.110	0.741	4.352	0.226	4.853	0.434	8.415	0.135
Core DS (Q5 sub index)	7.274	0.401	8.791	0.003*	4.610	0.203	5.580	0.349	9.298	0.098
Contamination DS (Q5 sub index)	10.369	0.169	2.653	0.103	10.512	0.015*	8.007	0.156	5.482	0.360
Animal reminder DS (Q5 sub index)	11.413	0.122	5.119	0.024*	7.239	0.065	5.310	0.379	9.145	0.103
General DS (Q5)	11.199	0.130	7.498	0.006*	7.946	0.047*	7.245	0.203	8.050	0.153
SSC (Q6)	5.841	0.558	0.240	0.624	2.354	0.502	8.306	0.140	3.350	0.646
Valence score by slide										
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	6.792	0.451	0.289	0.591	8.925	0.030*	9.093	0.105	3.414	0.636
#2: Text with caricatures – Flu symptoms	8.152	0.319	0.138	0.710	10.179	0.017*	2.669	0.751	8.586	0.127
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	3.501	0.835	0.394	0.530	9.351	0.025*	2.543	0.770	5.326	0.377
#4: Text with caricatures – Everyday health habits	6.039	0.535	0.138	0.710	11.992	0.007*	3.959	0.555	7.856	0.164
#5: Text with caricatures – Cleaning to prevent the flu	4.293	0.746	0.052	0.819	8.232	0.041*	1.541	0.908	7.114	0.212
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	8.246	0.311	2.156	0.142	1.706	0.636	6.834	0.233	7.918	0.161
#7: Bullet points with pictures – Persons at high risk for flu complications	6.133	0.524	1.556	0.212	3.055	0.383	5.161	0.397	3.110	0.683
#8: Bullet points with pictures – Persons at high risk for flu complications	5.909	0.550	1.902	0.168	5.134	0.162	5.825	0.324	3.446	0.632
#9: Bullet points with pictures – Flu vaccine recommendations	16.265	0.023*	4.611	0.032*	6.241	0.100	9.481	0.091	7.543	0.183
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	9.185	0.240	0.027	0.871	2.282	0.516	2.008	0.848	1.846	0.870

(Table 31 continued)

STUDY VARIABLES	Age (df=7)		Gender (df=1)		Race (df=3)		Income (df=5)		Education (df=5)	
	X^2	p	X^2	p	X^2	p	X^2	p	X^2	p
#11: Bullet points – Costs related to influenza	13.003	0.072	5.746	0.017*	4.407	0.221	3.896	0.565	6.372	0.272
#12: Bullet points – Benefits of prevention/ treatment	6.484	0.484	0.474	0.491	3.098	0.377	3.141	0.678	7.113	0.212

Table 32: Kruskal-Wallis H test statistics – Other demographics vs. indexes for all variables and individual valence scores

STUDY VARIABLES	Political affiliation (df=4)		Religious service attendance (df=4)		# of health info sources (df=13)		Preferred health info sources (df=6)	
	X^2	p	X^2	p	X^2	p	X^2	p
Arousal index score	6.556	0.161	2.698	0.610	16.080	0.245	10.454	0.107
Disgust index score	5.232	0.264	6.302	0.178	7.077	0.898	3.859	0.696
Perceptions of influenza (Q1)	1.802	0.772	10.090	0.039	11.509	0.568	2.012	0.919
Influenza-related trust (Q2)	2.532	0.639	3.887	0.422	9.567	0.729	2.878	0.824
Likelihood of taking preventive measures against influenza (Q3)	2.135	0.711	5.805	0.214	14.202	0.360	4.461	0.614
Likelihood of supporting influenza prevention taxes (Q4)	6.810	0.146	3.847	0.427	13.988	0.375	1.609	0.952
Core DS (Q5 sub index)	3.671	0.452	2.877	0.579	6.086	0.943	9.939	0.127
Contamination DS (Q5 sub index)	1.892	0.756	2.036	0.729	10.012	0.693	6.005	0.423
Animal reminder DS (Q5 sub index)	5.162	0.271	8.800	0.066	8.004	0.843	4.138	0.658
General DS (Q5)	4.100	0.393	3.824	0.430	7.215	0.891	3.841	0.698
SSC (Q6)	20.269	0.000	3.287	0.511	12.667	0.474	2.635	0.835
Valence score by slide								
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	5.808	0.214	0.952	0.917	14.693	0.327	4.952	0.550
#2: Text with caricatures – Flu symptoms	1.599	0.809	4.966	0.291	12.680	0.473	8.900	0.179
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	5.586	0.232	4.135	0.388	9.392	0.743	5.039	0.539
#4: Text with caricatures – Everyday health habits	4.264	0.372	2.759	0.599	12.346	0.500	4.619	0.594

(Table 32 continued)

STUDY VARIABLES	Political affiliation *(df=4)*		Religious service attendance *(df=4)*		# of health info sources *(df=13)*		Preferred health info sources *(df=6)*	
	X^2	p	X^2	p	X^2	p	X^2	p
#5: Text with caricatures – Cleaning to prevent the flu	1.986	0.738	3.126	0.537	9.859	0.705	6.632	0.356
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	2.691	0.611	5.861	0.210	23.188	0.039	0.971	0.987
#7: Bullet points with pictures – Persons at high risk for flu complications	2.064	0.724	0.914	0.922	12.388	0.496	4.733	0.578
#8: Bullet points with pictures – Persons at high risk for flu complications	3.668	0.453	2.124	0.713	11.257	0.589	5.814	0.444
#9: Bullet points with pictures – Flu vaccine recommendations	4.619	0.329	3.492	0.479	9.601	0.726	7.182	0.304
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	6.179	0.186	3.251	0.517	15.434	0.281	10.735	0.097
#11: Bullet points – Costs related to influenza	0.911	0.923	2.909	0.573	16.265	0.235	5.590	0.471
#12: Bullet points – Benefits of prevention/ treatment	10.711	0.030	2.761	0.599	13.536	0.407	6.086	0.414

3.7 BIVARIATE CORRELATION TESTS

3.7.1 Emotional response and outcome variables

Two non-parametric bivariate correlation tests for ordinal data, the Kendall's *tau-b* and Spearman's *rho* correlation coefficient tests, were performed to test for associations between emotional response (valence, arousal and disgust) and outcome (Q1-Q4) variable index measurements. The PI hypothesized that higher scores on index measures for arousal and disgust and non-neutral valence scores for individual presentation slides would be associated with higher scores on index measures for two of the outcome variables (perceptions of influenza (Q1) and likelihood of taking preventive measures against influenza (Q3)), but lower scores on index

measures for the two other outcome variables (influenza-related trust (Q2) and likelihood of supporting taxes for influenza prevention (Q4)).

Given that effect directionality was hypothesized *a priori* for the above associations, one-tailed significance tests were performed on the correlation coefficient statistics. None of the tests performed for arousal or disgust index correlations with the Q1-Q4 indexes yielded statistically significant results at $\alpha = 0.05$, although the p-values for correlations between the arousal index score with perceptions of influenza and influenza-related trust came close to being significant (Kendall's *tau-b* = -0.164, p = 0.066 and Kendall's *tau-b* = 0.155, p = 0.076, respectively; Spearman's *rho* = -0.231, p = 0.068 and Spearman's *rho* = 0.248, p = 0.054, respectively). Valence scores for four separate presentation slides were significantly correlated with one of the outcome variable indexes as follows: slides #2 and #4 with perceptions of influenza (Kendall's *tau-b* = -0.236, p = 0.035 and Kendall's *tau-b* = -0.236, p 0.035, respectively; Spearman's *rho* = -0.280, p = 0.035 and Spearman's *rho* = -0.280, p = 0.035, respectively); slide #8 with influenza-related trust (Kendall's *tau-b* = 0.343, p = 0.004; Spearman's *rho* = 0.407, p = 0.003); and slide #10 with likelihood of supporting influenza prevention taxes (Kendall's *tau-b* = 0.246, p = 0.028; Spearman's *rho* = 0.294, p = 0.028). Tables 33 and 34 below list the Kendall's *tau-b* and Spearman's *rho* correlation coefficient test statistics for arousal, disgust and valence versus each of the outcome variable indexes.

Table 33: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between arousal and disgust indexes vs. outcome variable indexes

STUDY VARIABLES	Arousal index score		Disgust index score	
	***tau-b* (p-value)**	***rho* (p-value)**	***tau-b* (p-value)**	***rho* (p-value)**
Perceptions of influenza (Q1)	-0.164 (0.066)	-0.231 (0.068)	-0.046 (0.337)	-0.107 (0.247)
Influenza-related trust (Q2)	0.155 (0.076)	0.248 (0.054)	-0.087 (0.212)	-0.131 (0.202)

(Table 33 continued)

Likelihood of taking preventive measures against influenza (Q3)	0.104 (0.170)	0.142 (0.182)	0.142 (0.096)	0.198 (0.102)
Likelihood of supporting taxes for influenza prevention (Q4)	-0.083 (0.222)	-0.126 (0.211)	0.062 (0.285)	0.091 (0.282)

Table 34: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between individual valence scores vs. outcome variable indexes

STUDY VARIABLES	**Perceptions of influenza (Q1)**		**Influenza-related trust (Q2)**		**Likelihood of taking preventive measures against influenza (Q3)**		**Likelihood of supporting taxes for influenza prevention (Q4)**	
Valence scores by slide	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	-0.176 (0.088)	-0.208 (0.090)	0.017 (0.448)	0.020 (0.449)	0.178 (0.084)	0.212 (0.086)	0.087 (0.250)	0.104 (0.253)
#2: Text with caricatures – Flu symptoms	-0.236 (0.035)*	-0.280 (0.035)*	0.165 (0.102)	0.196 (0.104)	0.045 (0.365)	0.053 (0.367)	0.162 (0.104)	0.194 (0.106)
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	-0.075 (0.283)	-0.089 (0.286)	0.078 (0.275)	0.092 (0.278)	-0.044 (0.366)	-0.053 (0.369)	0.150 (0.123)	0.179 (0.126)
#4: Text with caricatures – Everyday health habits	-0.236 (0.035)*	-0.280 (0.035)*	-0.090 (0.245)	-0.107 (0.248)	0.056 (0.333)	0.067 (0.336)	0.178 (0.084)	0.213 (0.085)
#5: Text with caricatures – Cleaning to prevent flu	-0.177 (0.086)	-0.210 (0.088)	0.005 (0.485)	0.006 (0.486)	0.106 (0.207)	0.126 (0.211)	0.170 (0.094)	0.203 (0.096)
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	-0.118 (0.182)	-0.140 (0.185)	0.061 (0.321)	0.072 (0.323)	-0.147 (0.129)	-0.175 (0.131)	-0.132 (0.154)	-0.157 (0.157)
#7: Bullet points with pictures – Persons at high risk for flu complications	0.043 (0.372)	0.051 (0.374)	0.013 (0.460)	0.016 (0.461)	0.026 (0.420)	0.031 (0.422)	0.062 (0.316)	0.074 (0.319)
#8: Bullet points with pictures – Persons at high risk for flu complications	-0.145 (0.133)	-0.172 (0.135)	0.343 (0.004)*	0.407 (0.003)*	0.015 (0.453)	0.018 (0.453)	-0.077 (0.276)	-0.092 (0.279)
#9: Bullet points with pictures – Flu vaccine recommendations	-0.056 (0.334)	-0.066 (0.337)	0.154 (0.118)	0.183 (0.121)	0.011 (0.465)	0.014 (0.466)	0.060 (0.321)	0.072 (0.324)

(Table 34 continued)

STUDY VARIABLES	Perceptions of influenza (Q1)		Influenza-related trust (Q2)		Likelihood of taking preventive measures against influenza (Q3)		Likelihood of supporting taxes for influenza prevention (Q4)	
Valence scores by slide	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	-0.030 (0.408)	-0.036 (0.409)	0.078 (0.275)	0.092 (0.278)	0.141 (0.138)	0.168 (0.140)	0.246 (0.028)*	0.294 (0.028)*
#11: Bullet points – Costs related to influenza	-0.122 (0.174)	-0.145 (0.177)	-0.038 (0.385)	-0.045 (0.387)	0.011 (0.466)	0.013 (0.467)	0.000 (0.500)	0.000 (0.500)
#12: Bullet points – Benefits of prevention/ treatment	-0.176 (0.088)	-0.209 (0.089)	-0.138 (0.144)	-0.164 (0.147)	0.088 (0.247)	0.105 (0.251)	0.072 (0.287)	0.087 (0.291)

3.7.2 Emotional response and moderating variables

Two non-parametric bivariate correlation tests for ordinal data, the Kendall's *tau-b* and Spearman's *rho* correlation coefficient tests, were performed to test for associations between emotional response (valence, arousal and disgust) and moderating (Q5-Q6) variable index measurements. The PI hypothesized that higher scores on index measures for arousal and disgust and non-neutral valence scores for individual presentation slides would be associated with higher scores on index measures for the moderating variables (DS, core DS, contamination DS, animal reminder DS (Q5 and Q5 sub-indexes) and SSC (Q6)). Given that effect directionality was hypothesized *a priori* for the above associations, one-tailed significance tests were performed on the correlation coefficient statistics.

There were statistically significant correlations between the arousal index and all of the moderating variables: general DS (Kendall's *tau-b* = 0.299, p = 0.003; Spearman's *rho* = 0.391, p = 0.005); core DS (Kendall's *tau-b* = 0.200, p = 0.032; Spearman's *rho* = 0.286, p = 0.032); contamination DS (Kendall's *tau-b* = 0.288, p = 0.004; Spearman's *rho* = 0.382, p = 0.006);

animal reminder DS (Kendall's *tau-b* = 0.270, p = 0.006; Spearman's *rho* = 0.374, p = 0.007); and SSC (Kendall's *tau-b* = 0.219, p = 0.021; Spearman's *rho* = 0.339, p = 0.013). There were also statistically significant correlations between the disgust index and three of the moderating variables: general DS (Kendall's *tau-b* = 0.201, p = 0.031; Spearman's *rho* = 0.270, p = 0.040); contamination DS (Kendall's *tau-b* = 0.212, p = 0.025; Spearman's *rho* = 0.325, p = 0.017); and SSC (Kendall's *tau-b* = 0.216, p = 0.023; Spearman's *rho* = 0.289, p = 0.030).

Valence scores for seven separate presentation slides were each significantly correlated with one or more of the DS indexes as follows: slide #1 with contamination DS (Kendall's *tau-b* = 0.292, p = 0.012; Spearman's *rho* = 0.348, p = 0.011), animal reminder DS (Kendall's *tau-b* = 0.283, p = 0.014; Spearman's *rho* = 0.340, p = 0.013), and general DS (Kendall's *tau-b* = 0.286, p = 0.013; Spearman's *rho* = 0.344, p = 0.012); slide #2 with core DS (Kendall's *tau-b* = 0.384, p = 0.001; Spearman's *rho* = 0.460, p < 0.001), contamination DS (Kendall's *tau-b* = 0.303, p = 0.010; Spearman's *rho* = 0.361, p = 0.009), animal reminder DS (Kendall's *tau-b* = 0.361, p = 0.002; Spearman's *rho* = 0.433, p = 0.002), and general DS (Kendall's *tau-b* = 0.404, p < 0.001; Spearman's *rho* = 0.486, p < 0.001); slide #4 with contamination DS (Kendall's *tau-b* = 0.250, p = 0.026; Spearman's *rho* = 0.299, p = 0.026); slide #5 with contamination DS (Kendall's *tau-b* = 0.285, p = 0.014; Spearman's *rho* = 0.340, p = 0.013); slide #7 with core DS (Kendall's *tau-b* = 0.233, p = 0.035; Spearman's *rho* = 0.279, p = 0.035), and general DS (Kendall's *tau-b* = 0.221, p = 0.043; Spearman's *rho* = 0.266, p = 0.043); slide #8 with core DS (Kendall's *tau-b* = 0.322, p = 0.006; Spearman's *rho* = 0.386, p = 0.005), contamination DS (Kendall's *tau-b* = 0.255, p = 0.024; Spearman's *rho* = 0.304, p = 0.024), animal reminder DS (Kendall's *tau-b* = 0.279, p = 0.015; Spearman's *rho* = 0.335, p = 0.014), and general DS (Kendall's *tau-b* = 0.320, p = 0.006; Spearman's *rho* = 0.386, p = 0.005); and slide #10 with contamination DS (Kendall's *tau-b* =

0.329, p = 0.005; Spearman's *rho* = 0.392, p = 0.005), and general DS (Kendall's *tau-b* = 0.233, p = 0.035; Spearman's *rho* = 0.280, p = 0.034). Tables 35 and 36 below list the Kendall's *tau-b* and Spearman's *rho* correlation coefficient test statistics for arousal, disgust and valence versus each of the moderating variable indexes; p values ≤ 0.05 are marked with an asterisk (*).

Table 35: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between arousal and disgust indexes vs. outcome and moderating variable indexes

STUDY VARIABLES	Arousal index score		Disgust index score	
	***tau-b* (p-value)**	***rho* (p-value)**	***tau-b* (p-value)**	***rho* (p-value)**
Core DS (Q5 sub index)	0.200 (0.032)*	0.286 (0.032)*	0.166 (0.063)	0.245 (0.057)
Contamination DS (Q5 sub index)	0.288 (0.004)*	0.382 (0.006)*	0.212 (0.025)*	0.325 (0.017)*
Animal reminder DS (Q5 sub index)	0.270 (0.006)*	0.374 (0.007)*	0.126 (0.122)	0.183 (0.120)
General DS (Q5)	0.299 (0.003)*	0.391 (0.005)*	0.201 (0.031)*	0.270 (0.040)*
SSC (Q6)	0.219 (0.021)*	0.339 (0.013)*	0.216 (0.023)*	0.289 (0.030)*

Table 36: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between individual valence scores vs. moderating variable indexes

STUDY VARIABLES	Core DS		Contamination DS		Animal reminder DS		General DS (Q5)		SSC (Q6)	
Valence scores by slide	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**
#1: Text w/ caricatures – What is the flu? Do people in the US get the flu? How does it spread?	0.196 (0.065)	0.234 (0.065)	0.292 (0.012)*	0.348 (0.011)*	0.283 (0.014)*	0.340 (0.013)*	0.286 (0.013)*	0.344 (0.012)*	0.135 (0.147)	0.162 (0.150)
#2: Text w/ caricatures – Flu symptoms	0.384 (0.001)*	0.460 (0.001)*	0.303 (0.010)*	0.361 (0.009)*	0.361 (0.002)*	0.433 (0.002)*	0.404 (0.001)*	0.486 (<.001)*	-0.025 (0.422)	-0.030 (0.423)
#3: Text w/ caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	0.091 (0.240)	0.109 (0.243)	0.145 (0.131)	0.173 (0.134)	0.061 (0.317)	0.073 (0.320)	0.091 (0.240)	0.109 (0.243)	-0.056 (0.330)	-0.068 (0.333)

(Table 36 continued)

STUDY VARIABLES	Core DS		Contamination DS		Animal reminder DS		General DS (Q5)		SSC (Q6)	
Valence scores by slide	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**	***tau-b* (p-val)**	***rho* (p-val)**
#4: Text w/ caricatures – Everyday health habits	0.108 (0.201)	0.129 (0.204)	0.250 (0.026)*	0.299 (0.026)*	0.146 (0.129)	0.175 (0.131)	0.169 (0.094)	0.203 (0.095)	-0.017 (0.446)	-0.021 (0.447)
#5: Text w/ caricatures – Cleaning to prevent the flu	0.180 (0.081)	0.216 (0.082)	0.285 (0.014)*	0.340 (0.013)*	0.097 (0.226)	0.116 (0.229)	0.171 (0.091)	0.206 (0.092)	-0.049 (0.353)	-0.058 (0.356)
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	0.109 (0.200)	0.130 (0.203)	0.013 (0.460)	0.016 (0.461)	0.099 (0.222)	0.118 (0.225)	0.122 (0.170)	0.147 (0.173)	-0.105 (0.207)	-0.126 (0.210)
#7: Bullet points with pictures – Persons at high risk for flu complications	0.233 (0.035)*	0.279 (0.035)*	0.169 (0.095)	0.202 (0.097)	0.195 (0.064)	0.235 (0.065)	0.221 (0.043)*	0.266 (0.043)*	-0.126 (0.163)	-0.151 (0.166)
#8: Bullet points with pictures – Persons at high risk for flu complications	0.322 (0.006)*	0.386 (0.005)*	0.255 (0.024)*	0.304 (0.024)*	0.279 (0.015)*	0.335 (0.014)*	0.320 (0.006)*	0.386 (0.005)*	-0.104 (0.210)	-0.125 (0.213)
#9: Bullet points with pictures – Flu vaccine recommendations	-0.015 (0.455)	-0.017 (0.456)	0.120 (0.176)	0.144 (0.179)	-0.057 (0.330)	-0.068 (0.333)	-0.006 (0.480)	-0.008 (0.480)	-0.133 (0.151)	-0.159 (0.154)
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	0.122 (0.172)	0.146 (0.175)	0.329 (0.005)*	0.392 (0.005)*	0.155 (0.114)	0.186 (0.116)	0.233 (0.035)*	0.280 (0.034)*	-0.055 (0.334)	-0.066 (0.337)
#11: Bullet points – Costs related to influenza	-0.130 (0.156)	-0.156 (0.159)	0.080 (0.267)	0.096 (0.271)	-0.061 (0.318)	-0.073 (0.321)	-0.072 (0.288)	-0.086 (0.291)	0.084 (0.256)	0.101 (0.259)
#12: Bullet points – Benefits of prevention/ treatment	0.129 (0.159)	0.154 (0.162)	0.158 (0.111)	0.188 (0.114)	0.045 (0.362)	0.055 (0.364)	0.080 (0.267)	0.096 (0.270)	0.052 (0.344)	0.062 (0.346)

3.7.3 Outcome and moderating variables

Two non-parametric bivariate correlation tests for ordinal data, the Kendall's *tau-b* and Spearman's *rho* correlation coefficient tests, were performed to test for associations between outcome (Q1-Q4) and moderating (Q5-Q6) variable index measurements. The PI hypothesized

that higher scores on index measures for the moderating variables (DS (Q5 and Q5 sub-indexes) and SSC (Q6)) would be associated with higher scores on index measures for two of the outcome variables (perceptions of influenza (Q1) and likelihood of taking preventive measures against influenza (Q3)), but lower scores on index measures for the two other outcome variables (influenza-related trust (Q2) and likelihood of supporting taxes for influenza prevention (Q4)). Given that effect directionality was hypothesized *a priori* for the above associations, one-tailed significance tests were performed on the correlation coefficient statistics.

There were statistically significant correlations between the likelihood of taking preventive action against influenza index and all of the DS variables: general DS (Kendall's *tau-b* = 0.323, p = 0.001; Spearman's *rho* = 0.448, p = 0.001); core DS (Kendall's *tau-b* = 0.209, p = 0.027; Spearman's *rho* = 0.286, p = 0.032); contamination DS (Kendall's *tau-b* = 0.386, p < 0.001; Spearman's *rho* = 0.537, p < 0.001); and animal reminder DS (Kendall's *tau-b* = 0.285, p = 0.004; Spearman's *rho* = 0.388, p = 0.005). There were also statistically significant correlations between the perceptions of influenza index and both general DS (Kendall's *tau-b* = -0.182, p = 0.046; Spearman's *rho* = -0.252, p = 0.052) and animal reminder DS (Kendall's *tau-b* = -0.211, p = 0.026; Spearman's *rho* = -0.284, p = 0.032), and between the likelihood of supporting taxes for influenza prevention index and SSC (Kendall's *tau-b* = -0.207, p = 0.028; Spearman's *rho* = -0.280, p = 0.035). Tables 37 and 38 below list the Kendall's *tau-b* and Spearman's *rho* correlation coefficient test statistics for DS and SSC versus each of the outcome variable indexes; p values ≤ 0.05 are marked with an asterisk (*).

Table 37: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between general DS and PSSC indexes vs. outcome variable indexes

STUDY VARIABLES	General DS (Q5)		SSC (Q6)	
	***tau-b* (p-value)**	***rho* (p-value)**	***tau-b* (p-value)**	***rho* (p-value)**
Perceptions of influenza (Q1)	-0.182 (0.046)*	-0.252 (0.052)	0.076 (0.244)	0.115 (0.231)
Influenza-related trust (Q2)	0.087 (0.212)	0.120 (0.221)	-0.079 (0.234)	-0.096 (0.271)
Likelihood of taking preventive measures against influenza (Q3)	0.323 (0.001)*	0.448 (0.001)*	0.133 (0.110)	0.189 (0.113)
Likelihood of supporting taxes for influenza prevention (Q4)	0.054 (0.307)	0.095 (0.272)	-0.207 (0.028)*	-0.280 (0.035)*

Table 38: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between general DS sub-indexes vs. outcome variable indexes

STUDY VARIABLES	Core DS		Contamination DS		Animal reminder DS	
	***tau-b* (p-value)**	***rho* (p-value)**	***tau-b* (p-value)**	***rho* (p-value)**	***tau-b* (p-value)**	***rho* (p-value)**
Perceptions of influenza (Q1)	-0.135 (0.107)	-0.182 (0.121)	-0.113 (0.151)	-0.147 (0.173)	-0.211 (0.026)*	-0.284 (0.032)*
Influenza-related trust (Q2)	0.069 (0.264)	0.102 (0.257)	-0.051 (0.322)	-0.059 (0.354)	0.118 (0.140)	0.153 (0.164)
Likelihood of taking preventive measures against influenza (Q3)	0.209 (0.027)*	0.286 (0.032)*	0.386 (<.001)*	0.537 (<.001)*	0.285 (0.004)*	0.388 (0.005)*
Likelihood of supporting taxes for influenza prevention (Q4)	0.061 (0.285)	0.092 (0.278)	0.069 (0.264)	0.106 (0.248)	0.083 (0.222)	0.096 (0.270)

3.7.4 Demographics and all variables

Two non-parametric bivariate correlation tests for ordinal data, the Kendall's *tau-b* and Spearman's *rho* correlation coefficient tests, were performed to test for associations between SES/demographic and all study variable (arousal, disgust, Q1-Q6) index measurements. Given that no *a priori* hypotheses were considered regarding effect directionality for SES and other

demographic effects on any of the study variable index measures, two-tailed significance tests were performed on the correlation coefficient statistics. Several of the SES/demographic variables were significantly correlated with multiple study variables.

There were statistically significant correlations between age and arousal (Kendall's *tau-b* = 0.446, p < 0.001; Spearman's *rho* = 0.574, p < 0.001) as well as contamination DS (Kendall's *tau-b* = 0.263, p = 0.021; Spearman's *rho* = 0.357, p = 0.019). There were statistically significant correlations between gender and all but one of the DS indexes: general DS (Kendall's *tau-b* = 0.351, p = 0.006; Spearman's *rho* = 0.423, p = 0.005); core DS (Kendall's *tau-b* = 0.382, p = 0.003; Spearman's *rho* = 0.458, p = 0.002); and animal reminder DS (Kendall's *tau-b* = 0.291, p = 0.024; Spearman's *rho* = 0.349, p = 0.022). And, there were statistically significant correlations between race and all but one of the emotional response and moderating variable indexes: arousal (Kendall's *tau-b* = -0.333, p = 0.007; Spearman's *rho* = -0.398, p = 0.008); disgust (Kendall's *tau-b* = -0.244, p = 0.051; Spearman's *rho* = -0.308, p = 0.044); general DS (Kendall's *tau-b* = -0.217, p = 0.017; Spearman's *rho* = -0.366, p = 0.016); contamination DS (Kendall's *tau-b* = -0.332, p = 0.008; Spearman's *rho* = -0.409, p = 0.006); and animal reminder DS (Kendall's *tau-b* = -0.303, p = 0.015; Spearman's *rho* = -0.368, p = 0.016).

There were also statistically significant correlations between political affiliation and arousal (Kendall's *tau-b* = 0.269, p = 0.022; Spearman's *rho* = 0.359, p = 0.018) as well as SSC (Kendall's *tau-b* = 0.517, p < 0.001; Spearman's *rho* = 0.642, p < 0.001). There were statistically significant correlations between income and three of the emotional response and moderating variable indexes: arousal (Kendall's *tau-b* = 0.290, p = 0.012; Spearman's *rho* = 0.395, p = 0.009); general DS (Kendall's *tau-b* = 0.244, p = 0.034; Spearman's *rho* = 0.330, p = 0.031); and contamination DS (Kendall's *tau-b* = 0.233, p = 0.045; Spearman's *rho* = 0.308, p = 0.045).

Finally, religious service attendance was significantly correlated with perceptions of influenza (Kendall's *tau-b* = -0.254, p = 0.034; Spearman's *rho* = -0.318, p = 0.038), and preferred health information sources was significantly correlated with arousal (Kendall's *tau-b* = 0.242, p = 0.036; Spearman's *rho* = 0.325, p = 0.034). Tables 39-41 below list the Kendall's *tau-b* and Spearman's *rho* correlation coefficient test statistics for SES and other demographics versus each of the study variable indexes; p values ≤ 0.05 are marked with an asterisk (*).

Table 39: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics between age, gender and race vs. all study variable indexes

STUDY VARIABLES	Age		Gender		Race	
	tau-b **(p-value)**	***rho*** **(p-value)**	***tau-b*** **(p-value)**	***rho*** **(p-value)**	***tau-b*** **(p-value)**	***rho*** **(p-value)**
Arousal index	0.446* (<0.001)	0.574* (<0.001)	-0.056 (0.662)	-0.067 (0.668)	-.333* (0.007)	-.398* (0.008)
Disgust index	0.218 (0.056)	0.282 (0.067)	0.022 (0.863)	0.027 (0.866)	-0.244 (0.051)	-.308* (0.044)
Perceptions of influenza (Q1)	-0.069 (0.549)	-0.099 (0.529)	-0.059 (0.652)	-0.070 (0.658)	-0.047 (0.708)	-0.058 (0.712)
Influenza-related trust (Q2)	0.060 (0.600)	0.094 (0.548)	0.029 (0.822)	0.035 (0.825)	-0.039 (0.758)	-0.054 (0.732)
Likelihood of taking preventive measures against influenza (Q3)	-0.039 (0.732)	-0.038 (0.808)	0.223 (0.085)	0.266 (0.085)	-0.034 (0.789)	-0.038 (0.810)
Likelihood of supporting influenza prevention taxes (Q4)	-0.203 (0.076)	-0.277 (0.072)	0.043 (0.741)	0.051 (0.745)	0.075 (0.547)	0.095 (0.545)
Core DS (Q5 sub index)	0.112 (0.325)	0.170 (0.275)	0.382* (0.003)	0.458* (0.002)	-0.202 (0.105)	-0.242 (0.118)
Contamination DS (Q5 sub index)	0.263* (0.021)	0.357* (0.019)	0.211 (0.103)	0.251 (0.104)	-.332* (0.008)	-.409* (0.006)
Animal reminder DS (Q5 sub index)	0.049 (0.669)	0.065 (0.677)	0.291* (0.024)	0.349* (0.022)	-.303* (0.015)	-.368* (0.016)
General DS (Q5)	0.138 (0.223)	0.206 (0.184)	0.351* (0.006)	0.423* (0.005)	-.297* (0.017)	-.366* (0.016)

(Table 39 continued)

STUDY VARIABLES	Age		Gender		Race	
	tau-b **(p-value)**	***rho*** **(p-value)**	***tau-b*** **(p-value)**	***rho*** **(p-value)**	***tau-b*** **(p-value)**	***rho*** **(p-value)**
SSC (Q6)	0.137 (0.227)	0.185 (0.235)	-0.063 (0.624)	-0.076 (0.630)	-0.098 (0.430)	-0.142 (0.365)

Table 40: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics between income, education and religious service attendance vs. all study variable indexes

STUDY VARIABLES	Income		Education		Religious service attendance	
	tau-b **(p-value)**	***rho*** **(p-value)**	***tau-b*** **(p-value)**	***rho*** **(p-value)**	***tau-b*** **(p-value)**	***rho*** **(p-value)**
Arousal index	0.290* (0.012)	0.395* (0.009)	0.006 (0.957)	0.016 (0.921)	0.117 (0.324)	0.152 (0.329)
Disgust index	0.200 (0.084)	0.278 (0.071)	-0.046 (0.689)	-0.072 (0.645)	-0.011 (0.929)	-0.018 (0.910)
Perceptions of influenza (Q1)	-0.076 (0.517)	-0.095 (0.543)	0.049 (0.673)	0.062 (0.692)	-.254* (0.034)	-.318* (0.038)
Influenza-related trust (Q2)	-0.016 (0.888)	-0.046 (0.771)	0.053 (0.650)	0.076 (0.626)	0.058 (0.626)	0.074 (0.638)
Likelihood of taking preventive measures against influenza (Q3)	0.056 (0.627)	0.070 (0.656)	-0.136 (0.243)	-0.175 (0.261)	0.062 (0.602)	0.069 (0.660)
Likelihood of supporting influenza prevention taxes (Q4)	-0.140 (0.227)	-0.180 (0.248)	-0.142 (0.222)	-0.189 (0.225)	-0.123 (0.303)	-0.161 (0.302)
Core DS (Q5 sub index)	0.180 (0.120)	0.246 (0.113)	-0.090 (0.437)	-0.127 (0.418)	0.025 (0.833)	0.027 (0.862)
Contamination DS (Q5 sub index)	0.233* (0.045)	0.308* (0.045)	-0.192 (0.098)	-0.268 (0.082)	-0.119 (0.319)	-0.156 (0.317)
Animal reminder DS (Q5 sub index)	0.149 (0.196)	0.218 (0.161)	-0.201 (0.082)	-0.287 (0.062)	0.214 (0.071)	0.263 (0.088)
General DS (Q5)	0.244* (0.034)	0.330* (0.031)	-0.155 (0.177)	-0.244 (0.115)	0.081 (0.493)	0.090 (0.565)
SSC (Q6)	0.162 (0.161)	0.218 (0.160)	-0.159 (0.170)	-0.210 (0.176)	0.103 (0.388)	0.127 (0.416)

Table 41: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics for political affiliation, number and preferred types of health information sources vs. all study variable indexes

STUDY VARIABLES	Political affiliation		# of health info sources		Preferred health info sources	
	tau-b **(p-value)**	***rho*** **(p-value)**	***tau-b*** **(p-value)**	***rho*** **(p-value)**	***tau-b*** **(p-value)**	***rho*** **(p-value)**
Arousal index	0.269* (0.022)	0.359* (0.018)	0.098 (0.375)	0.135 (0.387)	0.242* (0.036)	0.325* (0.034)
Disgust index	0.018 (0.877)	0.016 (0.918)	-0.019 (0.866)	-0.025 (0.874)	0.025 (0.828)	0.024 (0.877)
Perceptions of influenza (Q1)	-0.013 (0.912)	-0.016 (0.917)	-0.033 (0.767)	-0.039 (0.803)	-0.090 (0.441)	-0.114 (0.465)
Influenza-related trust (Q2)	-0.008 (0.947)	-0.021 (0.892)	0.056 (0.619)	0.060 (0.702)	0.029 (0.803)	0.026 (0.867)
Likelihood of taking preventive measures against influenza (Q3)	0.144 (0.224)	0.200 (0.200)	0.151 (0.176)	0.200 (0.199)	-0.016 (0.888)	-0.008 (0.958)
Likelihood of supporting influenza prevention taxes (Q4)	-0.135 (0.255)	-0.181 (0.246)	0.040 (0.719)	0.068 (0.664)	-0.034 (0.770)	-0.034 (0.829)
Core DS (Q5 sub index)	0.211 (0.074)	0.259 (0.093)	0.090 (0.416)	0.120 (0.442)	-0.106 (0.363)	-0.149 (0.340)
Contamination DS (Q5 sub index)	0.143 (0.229)	0.180 (0.248)	0.123 (0.271)	0.173 (0.269)	0.018 (0.879)	0.031 (0.845)
Animal reminder DS (Q5 sub index)	0.201 (0.087)	0.265 (0.086)	0.042 (0.704)	0.047 (0.763)	0.140 (0.225)	0.188 (0.227)
General DS (Q5)	0.215 (0.067)	0.267 (0.084)	0.078 (0.479)	0.090 (0.564)	0.031 (0.787)	0.031 (0.842)
SSC (Q6)	0.517* (<0.001)	0.642* (<0.001)	0.150 (0.176)	0.212 (0.171)	-0.014 (0.905)	-0.020 (0.901)

4.0 DISCUSSION

4.1 INTERPRETATION OF RESULTS

4.1.1 Emotional response effects on outcome and moderating variables

Given the small sample size, the lack of statistically significant results for emotional response effects on the index measures for the outcome and moderating variables was expected. Unlike the Wilcoxon-Mann-Whitney or Chi-square test statistics discussed in Section 3, Kruskal-Wallis H test statistics do not allow for effect directionality inferences to be made. The Kendall's *tau-b* and Spearman's *rho* correlation coefficient tests, however, allow for inferences to be made regarding the directionality of valence, arousal and disgust effects on the outcome and moderating variable indexes. For example, if the Kendall's *tau-b* and Spearman's *rho* correlation coefficients for the arousal and influenza-related trust index scores have positive signs, then it can be inferred that arousal is positively correlated with influenza-related trust, even if the effect magnitude cannot be determined with confidence. Therefore, any arousal index effects on influenza-related trust could then be inferred to have positive directionality.

The PI hypothesized that higher scores on index measures for emotional response (arousal and disgust) would be associated with higher scores on index measures for two of the outcome variables (perceptions of influenza (Q1) and likelihood of taking preventive measures

against influenza (Q3)), and for the moderating variables (DS (Q5 and Q5 sub-indexes) and SSC (Q6)), but lower scores on index measures for the two other outcome variables (influenza-related trust (Q2) and likelihood of supporting taxes for influenza prevention (Q4)). Table 42 below compares observed vs. hypothesized effect directionality for all of the hypothesized associations. It illustrates the effect directionality was correct for all of the hypothesized associations except for: arousal and disgust with perceptions of influenza (negative rather than positive); arousal with influenza-related trust (positive rather than negative); and disgust with likelihood of supporting influenza prevention taxes (positive rather than negative). Table 42 also reiterates the observed large effect size for associations between both disgust and arousal and DS and SSC index scores.

Table 42: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between arousal and disgust indexes vs. outcome and moderating variable indexes

STUDY VARIABLES	Arousal index score			Disgust index score		
	tau-b **(p-value)**	***rho*** **(p-value)**	**Expected: Observed direction**	***tau-b*** **(p-value)**	***rho*** **(p-value)**	**Expected: Observed direction**
Perceptions of influenza (Q1)	-0.164 (0.066)	-0.231 (0.068)	↑ : ↓	-0.046 (0.337)	-0.107 (0.247)	↑ : ↓
Influenza-related trust (Q2)	0.155 (0.076)	0.248 (0.054)	↓ : ↑	-0.087 (0.212)	-0.131 (0.202)	↓ : ↓
Likelihood of taking preventive measures against influenza (Q3)	0.104 (0.170)	0.142 (0.182)	↑ : ↑	0.142 (0.096)	0.198 (0.102)	↑ : ↑
Likelihood of supporting influenza prevention taxes (Q4)	-0.083 (0.222)	-0.126 (0.211)	↓ : ↓	0.062 (0.285)	0.091 (0.282)	↓ : ↑
Core DS (Q5 sub index)	0.200 (0.032)*	0.286 (0.032)*	↑ : ↑	0.166 (0.063)	0.245 (0.057)	↑ : ↑
Contamination DS (Q5 sub index)	0.288 (0.004)*	0.382 (0.006)*	↑ : ↑	0.212 (0.025)*	0.325 (0.017)*	↑ : ↑
Animal reminder DS (Q5 sub index)	0.270 (0.006)*	0.374 (0.007)*	↑ : ↑	0.126 (0.122)	0.183 (0.120)	↑ : ↑

(Table 42 continued)

STUDY VARIABLES	Arousal index score			Disgust index score		
	tau-b **(p-value)**	***rho*** **(p-value)**	**Expected: Observed direction**	***tau-b*** **(p-value)**	***rho*** **(p-value)**	**Expected: Observed direction**
General DS (Q5)	0.299 (0.003)*	0.391 (0.005)*	↑ : ↑	0.201 (0.031)*	0.270 (0.040)*	↑ : ↑
SSC (Q6)	0.219 (0.021)*	0.339 (0.013)*	↑ : ↑	0.216 (0.023)*	0.289 (0.030)*	↑ : ↑

Furthermore, as described in Section 3.3.1, there were statistically significant results for many of the individual valence, arousal and disgust scores on several of the outcome and moderating variable indexes, particularly on the general DS index and its component sub-indexes. Valence scores for five of the twelve presentation slides yielded a total of 14 statistically significant results, all but one of them for valence effects on the general DS index and its three sub-indexes. Arousal scores for two of the twelve presentation slides yielded statistically significant results for arousal effects on the influenza-related trust index, and arousal scores for two additional presentation slides yielded statistically significant results for arousal effects on the general DS index and two of its sub-index measures. Disgust scores for two of the twelve presentation slides yielded statistically significant results for disgust effects on the likelihood of taking preventive action against influenza index and contamination DS sub-index, disgust scores for another presentation slide yielded statistically significant results for disgust effects on the general DS index, and disgust scores for two additional presentation slides yielded statistically significant results for disgust effects on the core DS sub-index and SSC index.

Finally, as described in Sections 3.7.1 and 3.7.2, there were statistically significant correlations between several of the individual valence scores on a number of the outcome variable and DS indexes. Valence scores for two presentation slides were significantly correlated with the perceptions of influenza index, while valence scores for two other presentation slides

were significantly correlated to the influenza-related trust and likelihood of supporting influenza prevention taxes indexes. And, valence scores for seven separate slides were significantly correlated with one or more of the DS indexes.

Even though no statistically significant results were observed for emotional response index effects on the outcome and moderating variable indexes, the pilot study results would suggest that a larger sample size could yield statistically significant results for the hypothesized effects using the Kruskal-Wallis H test. Those results are: (1) statistically significant correlations between arousal index and all of the moderating variable indexes (general DS, core DS, contamination DS, animal reminder DS, and SSC); (2) statistically significant correlations between disgust index and most of the moderating variable indexes (general DS, contamination DS, and SSC); (3) congruence between hypothesized and observed arousal index effect directionality for all but two of the outcome and moderating variable indexes (perceptions of influenza and influenza-related trust); (4) congruence between hypothesized and observed disgust index effect directionality for all but two of the outcome and moderating variable indexes (perceptions of influenza and likelihood of supporting influenza prevention taxes); (5) statistically significant results for many of the individual valence, arousal and disgust scores on several of the outcome and moderating variable indexes; and (6) statistically significant correlations between many of the individual valence scores and many of the outcome and DS indexes.

However, it may be necessary to achieve a sample size powered to detect moderate to small effect sizes (N > 106) for variables exhibiting smaller Kendall's *tau-b* and Spearman's *rho* correlation coefficients, such as the likelihood of supporting taxes for influenza prevention (Q4) index. Arousal effects could also be in the opposite direction than what were originally

hypothesized for the perceptions of influenza (Q1) and influenza-related trust (Q2) indexes, while disgust effects could be in the opposite direction than what were originally hypothesized for the Q1 and Q4 measures. Possible confounding or contributing factors, such as demographics or content and format of the informational presentation slides, will also need to be accounted for. With the planned sample size (N = 106) and incorporation of logistic regression and multivariate analyses for the full significance testing phase of this study, it is hypothesized that a disgust reaction would influence the outcome and moderating variables regardless of hand sanitizer exposure.

4.1.2 DS and SSC effects on emotional response and outcome variables

Given the small sample size, the lack of statistically significant results for moderating variable effects on the index measures for the emotional response and outcome variables was also expected. As mentioned earlier, Kruskal-Wallis H test statistics do not allow for effect directionality inferences to be made. The Kendall's *tau-b* and Spearman's *rho* correlation coefficient tests, however, allow for inferences to be made regarding the directionality of DS and SSC effects on the arousal, disgust and outcome (Q1-Q4) variable indexes.

The PI hypothesized that higher scores on index measures for the moderating variables (DS and SSC) would be associated with higher scores on index measures for the emotional response variables (arousal and disgust) and two of the outcome variables (perceptions of influenza (Q1) and likelihood of taking preventive measures against influenza (Q3)), but lower scores on index measures for the two other outcome variables (influenza-related trust (Q2) and likelihood of supporting taxes for influenza prevention (Q4)). Given that effect directionality was hypothesized *a priori* for the above associations, one-tailed significance tests were performed on

the correlation coefficient statistics. Effect directionality for associations between the moderating and emotional response variables was already discussed in Section 4.1.1. Tables 43 and 44 below illustrate the hypothesized effect directionality was correct for all of the above associations with the SSC index, but half of the hypothesized associations (Q1, Q2 and Q4) with the general DS index and its three sub-indexes (core DS, contamination DS and animal reminder DS) were in the opposite direction than had been hypothesized. Tables 43 and 44 also reiterate the observed large effect size for associations between DS and both perceptions of influenza and likelihood of taking preventive measures against influenza index scores, and between SSC and likelihood of supporting taxes for influenza prevention index scores.

Table 43: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between general DS and PSSC indexes vs. outcome variable indexes

STUDY VARIABLES	General DS (Q5)			SSC (Q6)		
	tau-b **(p-value)**	***rho*** **(p-value)**	**Expected: Observed direction**	***tau-b*** **(p-value)**	***rho*** **(p-value)**	**Expected: Observed direction**
Perceptions of influenza (Q1)	-0.182 (0.046)*	-0.252 (0.052)	↑ : ↓	0.076 (0.244)	0.115 (0.231)	↑ : ↑
Influenza-related trust (Q2)	0.087 (0.212)	0.120 (0.221)	↓ : ↑	-0.079 (0.234)	-0.096 (0.271)	↓ : ↓
Likelihood of taking preventive measures against influenza (Q3)	0.323 (0.001)*	0.448 (0.001)*	↑ : ↑	0.133 (0.110)	0.189 (0.113)	↑ : ↑
Likelihood of supporting taxes for influenza prevention (Q4)	0.054 (0.307)	0.095 (0.272)	↓ : ↑	-0.207 (0.028)*	-0.280 (0.035)*	↓ : ↓

Table 44: Kendall's *tau-b and* Spearman's *rho* correlation coefficient one-tailed test statistics between general DS sub-indexes vs. outcome variable indexes

STUDY VARIABLES	Core DS			Contamination DS			Animal reminder DS		
	tau-b **(p-val)**	***rho*** **(p-val)**	**Expected: Observed direction**	***tau-b*** **(p-val)**	***rho*** **(p-val)**	**Expected: Observed direction**	***tau-b*** **(p-val)**	***rho*** **(p-val)**	**Expected: Observed direction**
Perceptions of influenza (Q1)	-0.135 (0.107)	-0.182 (0.121)	↑ : ↓	-0.113 (0.151)	-0.147 (0.173)	↑ : ↓	-0.211 (0.026)*	-0.284 (0.032)*	↑ : ↓
Influenza-related trust (Q2)	0.069 (0.264)	0.102 (0.257)	↓ : ↑	-0.051 (0.322)	-0.059 (0.354)	↓ : ↓	0.118 (0.140)	0.153 (0.164)	↓ : ↑
Likelihood of taking preventive measures against influenza (Q3)	0.209 (0.027)*	0.286 (0.032)*	↑ : ↑	0.386 (<.001)*	0.537 (<.001)*	↑ : ↑	0.285 (0.004)*	0.388 (0.005)*	↑ : ↑
Likelihood of supporting taxes for influenza prevention (Q4)	0.061 (0.285)	0.092 (0.278)	↓ : ↑	0.069 (0.264)	0.106 (0.248)	↓ : ↑	0.083 (0.222)	0.096 (0.270)	↓ : ↑

As mentioned in Section 4.1.1, all of the DS and SSC indexes were significantly correlated with the arousal index, the SSC and two DS indexes were significantly correlated with the disgust index, and one or more of the DS indexes were significantly correlated with valence scores for seven separate slides. Finally, as described in Sections 3.4.2 and 3.4.3, none of the tests performed for DS and SSC effects on the individual emotional response (valence, arousal, and disgust) and outcome variable (Q1-Q4) measurements yielded statistically significant results.

The lack of DS and SSC effects on emotional response or outcome variable measures when analyzed using Kruskal-Wallis H tests, combined with the observed effect directionality between all of the DS measures and most of the outcome variable measures being different than hypothesized, makes it unclear whether the planned sample size (N = 106) for the full significance testing phase of this study would yield statistically significant results for DS and SSC effects using the Kruskal-Wallis H test. However, the observation of several statistically

significant correlations between DS and SSC with various emotional response and outcome variables would suggest that DS and SSC could exert a moderating influence on either emotional response effects, intervention effects, or both. Possible confounding or contributing factors, such as demographics or content and format of the informational presentation slides, will also need to be accounted for. A large enough sample should allow the adoption of normality assumptions on the distribution of index score measurements. This would allow for the use of logistic regression and multivariate analyses to more confidently determine whether DS and SSC indexes have a moderating influence on either emotional response effects on the outcome variable indexes or on intervention effects for the emotional response and outcome variable indexes.

4.1.3 Intervention effects on emotional response, outcome and moderating variables

Given the small sample size (N = 43), this pilot study was only powered to detect large intervention effect sizes (see Section 2.3.4 for sample size calculations). Therefore, the lack of statistically significant results for intervention effects on the index measures for the emotional response, outcome and moderating variables was expected. However, the observed differences in index score mean ranks between control and intervention groups for the Wilcoxon-Mann-Whitney tests performed can still allow for inferences to be made regarding the directionality of intervention effects on the study variable indexes, even if the size of the effect cannot be determined with confidence. For example, if the mean rank for control group arousal index scores is lower than the mean rank for intervention group arousal index scores, then it can be inferred that the intervention has a positive effect on the arousal index scores because intervention group scores are on the whole higher than control group scores.

The PI hypothesized that the intervention group would exhibit higher scores than controls on index measures for emotional response (arousal and disgust), for two of the outcome variables (perceptions of influenza (Q1) and likelihood of taking preventive measures against influenza (Q3)), and for the moderating variables (DS (Q5 and Q5 sub-indexes) and SSC (Q6)), but lower scores than controls for the two other outcome variables (influenza-related trust (Q2) and likelihood of supporting taxes for influenza prevention (Q4)). The hypothesized effect directionality was correct for all of the hypothesized associations except the arousal measure. Table 45 below lists the mean rank differences between the two groups for each of the study variable indexes, and compares observed vs. hypothesized effect directionality.

Table 45: Mean rank differences between study variable indexes for intervention vs. control

STUDY VARIABLES		Intervention/control		
		Mean rank (control)	**Mean rank (intervention)**	**Expected:Observed direction**
Emotional Response	***Arousal index score***	22.45	21.65	↑ : ↓
	Disgust index score	20.21	23.42	↑ : ↑
Outcome	***Perceptions of influenza (Q1)***	21.11	22.71	↑ : ↑
	Influenza-related trust (Q2)	23.21	21.04	↓ : ↓
	Likelihood of taking preventive measures against influenza (Q3)	21.95	22.04	↑ : ↑
	Likelihood of supporting taxes for influenza prevention (Q4)	22.82	21.35	↓ : ↓
Moderating	***Core DS (Q5 sub index)***	19.16	24.25	↑ : ↑
	Contamination DS (Q5 sub index)	19.05	24.33	↑ : ↑
	Animal reminder DS (Q5 sub index)	20.58	23.13	↑ : ↑
	General DS (Q5)	19.37	24.08	↑ : ↑
	SSC (Q6)	20.63	23.08	↑ : ↑

The PI also hypothesized that the intervention group would exhibit a higher proportion of non-neutral scores than controls on nominal measures for emotional response (valence). The hypothesized effect directionality was only correct for two of the twelve individual valence scores, slides #9 and #12. Table 46 below lists the valence Chi-square Phi coefficient test statistics for each presentation slide, and compares observed vs. hypothesized effect directionality.

Table 46: Chi-square Phi coefficient test statistics – Individual valence scores for intervention vs. control

STUDY VARIABLES	Intervention/control		
Valence score by slide	**Phi (ϕ)**	**p value**	**Expected:Observed direction**
#1: Text with caricatures – What is the flu? Do people in the US get the flu? How does it spread?	-0.081	0.594	↑ : ↓
#2: Text with caricatures – Flu symptoms	-0.004	0.977	↑ : ↓
#3: Text with caricatures – How sick can you get from the flu? How long does it last? How can I protect myself from it?	-0.015	0.920	↑ : ↓
#4: Text with caricatures – Everyday health habits	-0.099	0.515	↑ : ↓
#5: Text with caricatures – Cleaning to prevent the flu	-0.068	0.658	↑ : ↓
#6: Image of submerged glacier with captions – Estimated annual burden of seasonal flu	-0.007	0.965	↑ : ↓
#7: Bullet points with pictures – Persons at high risk for flu complications	-0.090	0.555	↑ : ↓
#8: Bullet points with pictures – Persons at high risk for flu complications	-0.128	0.401	↑ : ↓
#9: Bullet points with pictures – Flu vaccine recommendations	0.007	0.965	↑ : ↑
#10: Chart – Seasonal flu coverage in US by age group, 2009-2014	-0.181	0.235	↑ : ↓
#11: Bullet points – Costs related to influenza	-0.068	0.658	↑ : ↓
#12: Bullet points – Benefits of prevention/ treatment	0.015	0.920	↑ : ↑

Even though no statistically significant results were observed for intervention effects on the study variable indexes, the pilot study results would suggest that a larger sample size could yield statistically significant results for intervention effects using the Wilcoxon-Mann-Whitney test. Those results are: (1) congruence between hypothesized and observed intervention effect directionality for all but two study variables (valence and arousal); and (2) at least one individual survey item for four out of nine indexes (perceptions of influenza, influenza-related trust, likelihood of supporting influenza prevention taxes, and core DS) achieved statistical significance and therefore exhibited a large effect size. However, it may be necessary to achieve a sample size powered to detect moderate to small effect sizes (N > 106) for study variable measures with smaller observed differences in mean rank scores (arousal and Q3 index) and for the valence measures. Intervention effects could also be in the opposite direction than what were originally hypothesized for the valence and arousal measures (i.e., negative rather than positive). Possible confounding or contributing factors, such as demographics or content and format of the informational presentation slides, will also need to be accounted for. Given the unpredictable nature of hand sanitizer exposure as a disgust trigger, even with the planned sample size (N = 106) for the full significance testing phase of this study, it is hypothesized that utilizing a disgust trigger in the form of hand sanitizer exposure would not influence the emotional response, outcome or moderating variables.

4.1.4 Demographic effects on emotional response, outcome and moderating variables

Given the small sample size, the PI did not expect to observe statistically significant results for SES and other demographic effects on the emotional response, outcome and moderating variable index measures. As described in Section 3.6, however, several SES and other demographic

variable measures exhibited statistically significant results on one or more of the study variable indexes using two-tailed Kruskal-Wallis H tests. Age yielded statistically significant results for the arousal index and one individual valence score. Gender yielded statistically significant results for the general DS index and two of its sub-indexes (core DS and animal reminder DS), and also for two individual valence scores. Race yielded statistically significant results for the arousal index, general DS index and one of its sub-indexes (contamination DS), and for five individual valence scores. Income yielded statistically significant results for the influenza-related trust index (Q2). Religious service attendance yielded statistically significant results for the perceptions of influenza index (Q1). Political affiliation yielded statistically significant results for the SSC index (Q6) and one individual valence score. Lastly, number of health information sources used yielded statistically significant results for one individual valence score.

The observation of significant political affiliation effects on the SSC index is not surprising because the Q6 survey is a validated instrument for measuring the extent to which someone's views can be categorized on the political spectrum from liberal to conservative. The observation of gender effects on disgust and DS is also not surprising, given that gender has been previously linked to disgust and DS [116, 120]. The other results are less straightforward to explain: age and race significantly influenced the emotional response and DS indexes; income significantly influenced the influenza-related trust index; and religious service attendance significantly influenced the perceptions of influenza index. As mentioned earlier, Kruskal-Wallis H test statistics do not allow for effect directionality inferences to be made. The Kendall's *tau-b* and Spearman's *rho* correlation coefficient tests, however, allow for inferences to be made regarding the directionality of SES and other demographic effects on the emotional response (arousal and disgust), outcome (Q1-Q4) and moderating (Q5-Q6) variable indexes. Tables 47-49

below illustrate the observed effect directionality for the SES and demographic variables versus each of the study variable indexes.

Table 47: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics between age, gender and race vs. all study variable indexes

STUDY VARIABLES	Age			Gender			Race		
	tau-b **(p-value)**	***rho*** **(p-value)**	**Observed direction**	***tau-b*** **(p-value)**	***rho*** **(p-value)**	**Observed direction**	***tau-b*** **(p-value)**	***rho*** **(p-value)**	**Observed direction**
Arousal index	0.446* (<0.001)	0.574* (<0.001)	↑	-0.056 (0.662)	-0.067 (0.668)	↓	-.333* (0.007)	-.398* (0.008)	↓
Disgust index	0.218 (0.056)	0.282 (0.067)	↑	0.022 (0.863)	0.027 (0.866)	↑	-0.244 (0.051)	-.308* (0.044)	↓
Perceptions of influenza (Q1)	-0.069 (0.549)	-0.099 (0.529)	↓	-0.059 (0.652)	-0.070 (0.658)	↓	-0.047 (0.708)	-0.058 (0.712)	↓
Influenza-related trust (Q2)	0.060 (0.600)	0.094 (0.548)	↑	0.029 (0.822)	0.035 (0.825)	↑	-0.039 (0.758)	-0.054 (0.732)	↓
Likelihood of taking preventive measures against influenza (Q3)	-0.039 (0.732)	-0.038 (0.808)	↓	0.223 (0.085)	0.266 (0.085)	↑	-0.034 (0.789)	-0.038 (0.810)	↓
Likelihood of supporting taxes for influenza prevention (Q4)	-0.203 (0.076)	-0.277 (0.072)	↓	0.043 (0.741)	0.051 (0.745)	↑	0.075 (0.547)	0.095 (0.545)	↑
Core DS (Q5 sub index)	0.112 (0.325)	0.170 (0.275)	↑	0.382* (0.003)	0.458* (0.002)	↑	-0.202 (0.105)	-0.242 (0.118)	↓
Contamination DS (Q5 sub index)	0.263* (0.021)	0.357* (0.019)	↑	0.211 (0.103)	0.251 (0.104)	↑	-.332* (0.008)	-.409* (0.006)	↓
Animal reminder DS (Q5 sub index)	0.049 (0.669)	0.065 (0.677)	↑	0.291* (0.024)	0.349* (0.022)	↑	-.303* (0.015)	-.368* (0.016)	↓
General DS (Q5)	0.138 (0.223)	0.206 (0.184)	↑	0.351* (0.006)	0.423* (0.005)	↑	-.297* (0.017)	-.366* (0.016)	↓
SSC (Q6)	0.137 (0.227)	0.185 (0.235)	↑	-0.063 (0.624)	-0.076 (0.630)	↓	-0.098 (0.430)	-0.142 (0.365)	↓

Table 48: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics between income, education and religious service attendance vs. all study variable indexes

STUDY VARIABLES	Income			Education			Religious service attendance		
	***tau-b* (p-value)**	***rho* (p-value)**	**Observed direction**	***tau-b* (p-value)**	***rho* (p-value)**	**Observed direction**	***tau-b* (p-value)**	***rho* (p-value)**	**Observed direction**
Arousal index	0.290* (0.012)	0.395* (0.009)	↑	0.006 (0.957)	0.016 (0.921)	↑	0.117 (0.324)	0.152 (0.329)	↑
Disgust index	0.200 (0.084)	0.278 (0.071)	↑	-0.046 (0.689)	-0.072 (0.645)	↓	-0.011 (0.929)	-0.018 (0.910)	↑
Perceptions of influenza (Q1)	-0.076 (0.517)	-0.095 (0.543)	↓	0.049 (0.673)	0.062 (0.692)	↑	-.254* (0.034)	-.318* (0.038)	↓
Influenza-related trust (Q2)	-0.016 (0.888)	-0.046 (0.771)	↓	0.053 (0.650)	0.076 (0.626)	↑	0.058 (0.626)	0.074 (0.638)	↑
Likelihood of taking preventive measures against influenza (Q3)	0.056 (0.627)	0.070 (0.656)	↑	-0.136 (0.243)	-0.175 (0.261)	↓	0.062 (0.602)	0.069 (0.660)	↓
Likelihood of supporting taxes for influenza prevention (Q4)	-0.140 (0.227)	-0.180 (0.248)	↓	-0.142 (0.222)	-0.189 (0.225)	↓	-0.123 (0.303)	-0.161 (0.302)	↓
Core DS (Q5 sub index)	0.180 (0.120)	0.246 (0.113)	↑	-0.090 (0.437)	-0.127 (0.418)	↓	0.025 (0.833)	0.027 (0.862)	↑
Contamination DS (Q5 sub index)	0.233* (0.045)	0.308* (0.045)	↑	-0.192 (0.098)	-0.268 (0.082)	↓	-0.119 (0.319)	-0.156 (0.317)	↑
Animal reminder DS (Q5 sub index)	0.149 (0.196)	0.218 (0.161)	↑	-0.201 (0.082)	-0.287 (0.062)	↓	0.214 (0.071)	0.263 (0.088)	↑
General DS (Q5)	0.244* (0.034)	0.330* (0.031)	↑	-0.155 (0.177)	-0.244 (0.115)	↓	0.081 (0.493)	0.090 (0.565)	↑
SSC (Q6)	0.162 (0.161)	0.218 (0.160)	↑	-0.159 (0.170)	-0.210 (0.176)	↓	0.103 (0.388)	0.127 (0.416)	↑

Table 49: Kendall's *tau-b and* Spearman's *rho* correlation coefficient two-tailed test statistics for political affiliation, number and preferred types of health information sources vs. all study variable indexes

STUDY VARIABLES	Political affiliation			# of health info sources			Preferred health info sources		
	tau-b (p-value)	*rho* (p-value)	Observed direction	*tau-b* (p-value)	*rho* (p-value)	Observed direction	*tau-b* (p-value)	*rho* (p-value)	Observed direction
Arousal index	0.269* (0.022)	0.359* (0.018)	↑	0.098 (0.375)	0.135 (0.387)	↑	0.242* (0.036)	0.325* (0.034)	↑
Disgust index	0.018 (0.877)	0.016 (0.918)	↑	-0.019 (0.866)	-0.025 (0.874)	↓	0.025 (0.828)	0.024 (0.877)	↑
Perceptions of influenza (Q1)	-0.013 (0.912)	-0.016 (0.917)	↓	-0.033 (0.767)	-0.039 (0.803)	↓	-0.090 (0.441)	-0.114 (0.465)	↓
Influenza-related trust (Q2)	-0.008 (0.947)	-0.021 (0.892)	↓	0.056 (0.619)	0.060 (0.702)	↑	0.029 (0.803)	0.026 (0.867)	↑
Likelihood of taking preventive measures against influenza (Q3)	0.144 (0.224)	0.200 (0.200)	↑	0.151 (0.176)	0.200 (0.199)	↑	-0.016 (0.888)	-0.008 (0.958)	↓
Likelihood of supporting taxes for influenza prevention (Q4)	-0.135 (0.255)	-0.181 (0.246)	↓	0.040 (0.719)	0.068 (0.664)	↑	-0.034 (0.770)	-0.034 (0.829)	↓
Core DS (Q5 sub index)	0.211 (0.074)	0.259 (0.093)	↑	0.090 (0.416)	0.120 (0.442)	↑	-0.106 (0.363)	-0.149 (0.340)	↓
Contamination DS (Q5 sub index)	0.143 (0.229)	0.180 (0.248)	↑	0.123 (0.271)	0.173 (0.269)	↑	0.018 (0.879)	0.031 (0.845)	↑
Animal reminder DS (Q5 sub index)	0.201 (0.087)	0.265 (0.086)	↑	0.042 (0.704)	0.047 (0.763)	↑	0.140 (0.225)	0.188 (0.227)	↑
General DS (Q5)	0.215 (0.067)	0.267 (0.084)	↑	0.078 (0.479)	0.090 (0.564)	↑	0.031 (0.787)	0.031 (0.842)	↑
SSC (Q6)	0.517* (<0.001)	0.642* (<0.001)	↑	0.150 (0.176)	0.212 (0.171)	↑	-0.014 (0.905)	-0.020 (0.901)	↓

The political affiliation effect on the SSC index was positive and significantly correlated. Age effects on the arousal and contamination DS indexes were positive and significantly correlated. Gender effects on the general DS, core DS and animal reminder DS indexes were

positive and significantly correlated. Positive gender effects in the context of this study means that index scores were higher for females than for males. Race effects on the arousal, general DS and contamination DS indexes were negative and significantly correlated. Negative race effects in the context of this study means that index scores were lower for persons who identified themselves as White or multiracial than for those who identified themselves as Black/African American. The income effect on the influenza-related trust (Q2) index was negative but not significantly correlated. And, the religious service attendance effect on the perceptions of influenza (Q1) index was negative and significantly correlated.

As described in Section 3.7.4, there were additional statistically significant correlations between SES/demographics and other study variable indexes than those for the above effects. Age and contamination DS were significantly and positively correlated. Race was significantly and negatively correlated with disgust and animal reminder DS. Negative race correlation in the context of this study means that index scores were lower for persons who identified themselves as White or multiracial than for those who identified themselves as Black/African American. Income was significantly and positively correlated with arousal, contamination DS, and general DS. Political affiliation and preferred health information sources were both significantly and positively correlated with arousal. In the context of this study, positive preferred health information source correlation means that index scores were higher for persons with multiple media format preferences than for those with only one preferred type.

The small pilot sample size makes it difficult to interpret what these observed associations could mean. It may be that demographic characteristics, like DS and SSC, act as moderating or mediating variables for the associations hypothesized in this study. For example, the hand sanitizer intervention might lead to higher emotional response scores for older

participants than for younger participants, as suggested by the positive and significant correlation between age and arousal. Or perhaps higher arousal index scores lead to lower perceptions of influenza scores for participants who more frequently attend religious services, as suggested by the negative and significant correlation between religious service attendance and perceptions of influenza. Perhaps they may even exhibit unforeseen synergistic or counteracting influences with other possible confounding or contributing factors, such as content and format of the informational presentation slides. As with DS and SSC, a large enough sample should allow the adoption of normality assumptions on the distribution of SES and other demographic measurements. This would allow for the use of logistic regression and multivariate analyses to more confidently determine whether SES and other demographics have a moderating influence on either emotional response effects on the outcome and moderating variables, or on intervention effects for the emotional response, outcome and moderating variables.

4.2 STUDY LIMITATIONS AND PROPOSED SOLUTIONS

As discussed at some length in previous sections, the most important limitation in this study is the small sample size (N = 43), which was only powered to detect large intervention effect sizes using Wilcoxon-Mann-Whitney tests of significance. The results presented are for the pilot phase of the study, and it would have been unlikely that a modest intervention such as the one implemented would lead to large enough effect sizes to be detectable at this time. The small sample size also limited the data analysis options to non-parametric tests. Given that this was the first time that half of the index measures (disgust, Q1-Q4) were ever implemented in the field, it would have been inappropriate to assume normal distribution of responses to these measures

without first field-testing that assumption. For example, the potential for assumptions of normality in the distribution of variable index measures was not even considered for this pilot study because the PI did not expect to achieve a sample size greater than 30. A sample size of 30 is widely regarded as the minimum number of observations needed to perform hypothesis and correlational tests assuming normality. Therefore, no logistic regression or multivariate analyses were planned for or conducted during this pilot phase.

A resumption of this study is expected in the near future to achieve the planned sample size (N = 106) for the full significance testing phase of the study. The statistically significant correlations between many of the study variable measures, the congruence between hypothesized and observed effect directionality for most of the hypothesized associations between study variable measures, the statistically significant observed intervention effects on some of the individual items on the outcome and moderating variable measures, and the statistically significant observed emotional response effects on several of the individual items on the outcome and moderating variable measures, all would suggest that this larger sample size of 106 could yield statistically significant results during the next study phase. This would also be a large enough sample to allow the adoption of normality assumptions on the distribution of index score measurements for all study variables. With a larger sample size and assumptions of normality, the PI can justifiably perform logistic regression and multivariate analyses to more confidently infer whether the DS, SSC or SES/demographic variable measures have a moderating influence on either emotional response effects on the outcome variables or on intervention effects for the emotional response and outcome variables. Normality tests, bivariate correlation tests on selected variable dyads' individual item measures, and multi-variate analyses to control for DS, SSC and

SES/demographic effects will be incorporated in the analysis plan prior to resumption of the study.

Another important limitation in this study is that, because all study variable individual item measures, all of which were either 7- or 9-point Likert scales, were operationalized as ordinal data (except for valence), their index measures were also operationalized as ordinal data. This was not an issue when testing two of the premises of this study, that there are emotional response effects on the outcome and moderating variable measures and also intervention effects on all the study variable measures, because non-parametric tests like the Wilcoxon-Mann-Whitney and Kruskal-Wallis H test are perfectly capable of testing for simple effects. The most important premise of this study, however, states that DS and SSC act as moderating variables for those effects, and it is unclear how adequately one can infer moderating or mediating relationships using non-parametric statistical tests because there are no non-parametric multivariate analysis tests in the SPSS statistical analysis software package. Although analysis of DS and SSC simple effects on the emotional response and outcome variables can help determine whether it is possible or not that DS and SSC could exert a moderating influence on intervention and/or emotional response effects, such analysis falls short of providing a satisfying answer to whether they actually do, particularly with a small sample size like this one.

Similarly, several of the demographic variables (age, income, education, religious service attendance, and number of health information sources) could have been operationalized as scale data, not ordinal. As previously mentioned, a larger sample size that allows normality assumptions will be achieved for the next study phase. This will allow for the use of logistic regression and multivariate analysis tests to more confidently infer whether the demographic

variable measures have a moderating influence on either emotional response effects on the outcome variables or on intervention effects for the emotional response and outcome variables.

Finally, it remains unclear why, for some presentation slides but not others, there were significant emotional response effects and correlations between individual valence, arousal and disgust scores with the outcome and moderating variable indexes. It is possible that different information content (e.g., statistics, recommendations, and warnings) and/or presentation formats (e.g., cartoons, pictures of people, graphs, and bullet points) could have different confounding or contributing influences on participants' responses to the study variable measurements. It is also possible these influences could manifest differently in the presence or absence of disgust triggers like exposure to hand sanitizer. The PI did not conduct an in-depth comparative analysis of the content and format between presentation slides as it was not within the scope of the pilot study, but this analysis will be incorporated into the full significance testing phase of this study. A thorough categorization of the presentation slides' content and format would allow both to be operationalized as additional moderating variables. With the planned sample size (N = 106) and incorporation of logistic regression and multivariate analyses, the PI should be able to tease out any confounding or contributing influences that may exist between information content and presentation format with the emotional response, outcome and moderating variables.

4.3 THEORETICAL IMPLICATIONS & PRACTICAL APPLICATIONS

4.3.1 Significance of results and congruence with existing literature

Although the PI was unable to reject any of the three main hypotheses during the pilot phase of this study using Kruskal-Wallis H tests or Wilcoxon-Mann-Whitney tests, several pilot study results would suggest at least two of the three study hypotheses were on the right track: that a disgust reaction influences participants' perceptions of and likely behaviors towards influenza; and that DS and SSC influence both the disgust reaction and participants' perceptions of and likely behaviors towards influenza. Pilot study results would also support the study continuing into the full significance testing phase to more conclusively determine whether the above two hypotheses hold true, and to see whether the third hypothesis might also be on the right track. These pilot study results are: (1) statistically significant correlations between emotional response and moderating variable indexes; (2) statistically significant correlations between moderating and outcome variable indexes; (3) congruence between hypothesized and observed effect directionality for most of the hypothesized associations between study variable indexes; (4) statistically significant observed intervention effects on some of the individual outcome and moderating variable index items; and (5) statistically significant observed emotional response effects on several of the individual outcome and moderating variable index items.

The above pilot study results are consistent with the literature on hand sanitizer as a disgust trigger cited in Sections 1 and 2. Hand sanitizer exposure studies conducted by Helzer and Pizarro [81] found that using a cleanliness reminder made people self-identify as more politically conservative and judge others' sexually "deviant" behaviors more harshly, while Inbar and colleagues [82, 83] found that DS and contamination DS were positively associated

with SSC. Zhong, Strejcek and Sivanathan [65] showed that having participants clean their hands with an antiseptic wipe or visualize themselves in clean or dirty room made them more likely to rate contested issues such as abortion and pornography as immoral, and also to rate themselves higher relative to their peers in moral character but not in any other characteristic. Other studies using different disgust triggers have shown similar associations between feelings of disgust/cleanliness, moral judgment and SSC [79, 80, 84-88]. Those findings are consistent with the correlations observed between emotional response, outcome and moderating variable indexes.

Most of the hypothesized associations exhibited the expected effect directionality, even when non-significant. However, the observed correlations between DS and all outcome variables except likelihood of taking preventive action against influenza exhibited opposite effect directionality than hypothesized: negatively (and significantly) correlated with perceptions of influenza and positively (but not significantly) correlated with both influenza-related trust and likelihood of supporting influenza prevention taxes. Also, the observed correlations between emotional response and all outcome variables except likelihood of taking preventive action against influenza exhibited opposite effect directionality than hypothesized: negatively (but not significantly) correlated with perceptions of influenza and positively (but not significantly) correlated with both influenza-related trust and likelihood of supporting influenza prevention taxes. Those findings would suggest that the relationship between emotional response and DS with the outcome variables is more complex than originally hypothesized, and less predictable than suggested by the hand sanitizer exposure studies cited in this paper. The more rigorous analyses planned in the full significance testing study phase should help the PI tease out this

complexity, and add to the knowledge base on possible public health applications of the disgust reaction.

In addition, the disgust SAM measurement index created by the PI was significantly and positively correlated with the publicly available arousal SAM measurement index using non-parametric correlation coefficient tests (Kendall's *tau-b* = 0.346, p = 0.001; Spearman's *rho* = 0.448, p = 0.001). The disgust SAM scale was also significantly and positively correlated with three of the twelve valence scores for individual presentation slides using non-parametric correlation coefficient tests: slide #1 (Kendall's *tau-b* = 0.235, p = 0.035; Spearman's *rho* = 0.280, p = 0.034); slide #9 (Kendall's *tau-b* = 0.213, p = 0.050; Spearman's *rho* = 0.254, p = 0.050); and slide #12 (Kendall's *tau-b* = 0.228, p = 0.039; Spearman's *rho* = 0.273, p = 0.038). This suggests the newly created disgust SAM scale is internally consistent with the other two SAM scales for valence and arousal, both of which have been extensively validated as emotional response measurements. As mentioned earlier, the disgust SAM measurement index created by the PI was significantly and positively correlated with both DS and SSC as hypothesized, providing further evidence for the scale's validity in the context of this study.

Furthermore, it is likely the content and/or format of the individual information presentation slides had confounding or contributing influences on the hypothesized emotional response and moderating variable effects, and also on intervention effects. This is suggested by a number of pilot study observations. First, although not statistically significant, hand sanitizer exposure seemed to elicit stronger emotional response scores for some presentation slides but not others. Slides #8 and #10 showed Phi coefficients > 0.1 for intervention effects on individual valence SAM scores. Slides #6, #10, and #11 showed mean rank differences > 4 for intervention effects on individual arousal SAM scores. And, slide #1 showed a mean rank difference > 4 for

intervention effects on individual disgust SAM scores. Table 50 below summarizes the observed hand sanitizer effects on each presentation slide, the observed emotional response effects for each presentation slide, the observed demographic effects on each presentation slide, and all slides' content and formatting.

Table 50: Summary of content, formatting, and observed intervention, emotional response and demographic effects per presentation slide

Slide	Content	Format	Hand sanitizer effects	Emotional response effects on outcome	Emotional response effects on DS / SSC	Correlations with valence	Demographic effects on valence
#1	What is the flu? Do people in the US get the flu? How does it spread?	Text with caricatures	Disgust		Valence & Arousal on DS	Q1 & DS	Race
#2	Flu symptoms	Text with caricatures			Valence on DS	DS	Race
#3	How sick can you get from the flu? How long does it last? How can I protect myself from it?	Text with caricatures					Race
#4	Everyday health habits	Text with caricatures		Arousal on Q2		Q1 & DS	Race
#5	Cleaning to prevent the flu	Text with caricatures			Valence on DS	DS	Race
#6	Estimated annual burden of seasonal flu	Image of submerged glacier with captions	Arousal	Disgust on Q3	Disgust on DS		Number of health info sources
#7	Persons at high risk for flu complications	Bullet points with pictures				DS	
#8	Persons at high risk for flu complications	Bullet points with pictures	Valence	Valence & Arousal on Q2	Valence & Disgust on DS	Q2 & DS	
#9	Flu vaccine recommendations	Bullet points with pictures					Age & Gender
#10	Seasonal flu coverage in US by age group, 2009-2014	Chart	Valence & Arousal	Disgust on Q3	Valence & Disgust on DS	Q4 & DS	

(Table 50 continued)

Slide	Content	Format	Hand sanitizer effects	Emotional response effects on outcome	Emotional response effects on DS / SSC	Correlations with valence	Demographic effects on valence
#11	Costs related to influenza	Bullet points	Arousal		Disgust on SSC		Gender
#12	Benefits of influenza prevention/ treatment	Bullet points			Arousal on DS		Political affiliation

Second, individual valence, arousal and disgust SAM scores for some of the presentation slides but not others showed statistically significant emotional response effects on a number of the outcome and moderating variable indexes. Valence scores for five presentation slides (#1, 2, 5, 8 and 10) showed statistically significant effects on one or more of the DS indexes. Valence scores for presentation slide #8 showed statistically significant effects on the influenza-related trust (Q2) index. Arousal scores for two presentation slides (#4 and #8) showed statistically significant effects on the influenza-related trust (Q2) index. Arousal scores for two additional presentation slides (#1 and #12) showed statistically significant effects on one or more of the DS indexes. Disgust scores for two presentation slides (#6 and #10) showed statistically significant effects on the likelihood of taking preventive action against influenza (Q3) index. Disgust scores for three presentation slides (#6, 8 and 10) showed statistically significant effects on one or more DS indexes, and for presentation slide #11 showed statistically significant effects on SSC.

Third, individual valence SAM scores for some of the presentation slides but not others showed statistically significant correlations with a number of the outcome and moderating variable indexes. Valence scores for slides #2 and #4 were significantly correlated with the perceptions of influenza (Q1) index. Valence scores for slide #8 were significantly correlated with the influenza-related trust (Q2) index. Valence scores for slide #10 were significantly correlated with the likelihood of supporting influenza prevention taxes (Q4) index. And, valence

scores for seven presentation slides (#1, 2, 4, 5, 7, 8, and 10) were significantly correlated with one or more of the DS indexes.

And fourth, several SES and other demographic variables showed statistically significant effects on valence scores for some of the presentation slides but not others. Age showed statistically significant effects on valence for presentation slide #9. Gender showed statistically significant effects on valence for two presentation slides (#9 and 11). Race showed statistically significant effects on valence for five presentation slides (#1-5). Political affiliation showed statistically significant effects on valence for presentation slide #12. And, number of health information sources showed statistically significant effects on valence for presentation slide #6.

Variations in tone and visual imagery could have led to different participant interpretations of the same information, and thus to different responses to the same information. Although an in-depth analysis of the presentation slide content or formatting was beyond the scope of this pilot study, Table 50 suggests that content and formatting may have had unforeseen influences on participants' responses to the study variable measurements. For example, race seemed to influence valence scores for influenza-related information, but only when presented as text with caricatures. Also, content related to influenza risk/susceptibility (slides #1, 6 and 8) and protective measures (slides #4 and 10) seemed to influence emotional response scores more consistently than other content categories. These observed effect and correlation variations between the individual presentation slides, although unexpected, are consistent with the EC literature cited in this paper. The incorporation of more thorough information content and format categorization is planned for the full significance testing study phase, and should help the PI better understand these observed variations, adding to the knowledge base on potential

interactions between message framing and disgust triggers when applied in public health contexts.

Finally, the pilot study results are consistent with much of the EC literature cited in Section 1 that would suggest EC-based concepts, like the incorporation of emotionality and autonomic responses into education strategies, can be readily implemented in public health contexts, like promotion of infectious disease prevention. This could open a whole new avenue for both research and action in addressing all manner of public health issues and not just infectious disease prevention. For example, how might different types of emotional triggers, such as cleanliness, distance, size, and temperature cues, influence people's response to information about different diseases? How might different types of emotional reactions influence people's response to information about the same disease but presented in different ways? How might the influence of these different types of emotional reactions change over time, or with repeated exposure to emotional triggers? And what would be the best ways to implement different types of emotional triggers so as to lead to synergistic and not counteracting influences towards the desired attitudinal and behavioral responses?

Studies like the one presented here will help build the evidence base to answer the above questions. Observing the hypothesized effects at the conclusion of the full significance testing phase of the study will contribute proof-of-concept evidence for the real-world applicability of using EC-based concepts like the disgust-contagion mechanism to complement existing public health interventions like influenza prevention. Additional studies would be needed to more fully map out the relationships between different emotional triggers, target diseases, information presentation, and time. The study presented here, however, can also provide practical guidance on how to undertake this daunting task.

4.3.2 Lessons learned and recommendations for future research

This study was originally intended to evaluate the possible effects that eliciting a disgust reaction would have on people's attitudes of and likely behaviors towards information related to HIV/AIDS and its prevention options. Given its etiology and associations with morality and sexuality, the PI thought that HIV/AIDS would provide an appropriate target disease for testing the applicability of an intervention based on the cleanliness-disease contagion-moral contagion mechanism. During institutional review, however, the reviewers pointed out that it would be unethical to conduct the study with HIV/AIDS as the target disease because of the high vulnerability of HIV at-risk populations. Potentially eliciting a disgust reaction towards HIV at-risk groups, who are already marginalized for many reasons including their being perceived as being at high risk of contracting HIV/AIDS, was deemed too risky for the little direct benefit that those populations would receive from the study. It would be highly unlikely that a one-time exposure to a disgust trigger while being exposed to information related to HIV/AIDS would lead to persons developing a permanent feeling of disgust towards persons at risk for contracting HIV. But, since this is the first time such a test has been performed outside the laboratory and in a public health context, the PI decided to change the target disease. Therefore, the target disease for the intervention was changed to influenza, a less controversial subject whose at-risk groups are not marginalized because of their perceived associations with the disease. Given that it is also an infectious disease associated with physical purity and cleanliness, it was relatively easy to change the study's target disease without modifying its premise or the intervention itself.

Although it took a great deal of time and work to conceive of and then plan the study design and intervention described in this paper, it was relatively low-cost and easy to implement in the field once regulatory approval was granted. The PI only needed one bottle of generic,

unscented hand sanitizer and a large-screen laptop computer with PowerPoint software to show the presentations and apply the intervention. The PI printed all data collection materials in black and white on plain white paper, keeping printing costs to a minimum. Furthermore, participant recruitment involved no costs as the CTSI Research Participant Registry is available free of charge to all researchers with a University of Pittsburgh IRB-approved study. The Registry proved to be a valuable recruitment asset, greatly facilitating the recruitment of a larger than expected pilot study sample within a very constrained time window of one month.

To achieve the original pilot study sample size of forty by the projected data collection end date, the PI decided early on that participant compensation of $30 per participant would be needed. This compensation amount was deemed adequate based on a one-time study visit duration estimated at no more than 2 hours. However, participants rarely took more than 15-20 minutes to view the presentation and complete the emotional response measurements. Participants also rarely took more than 15-20 minutes to complete all of the questionnaires. Actual participant time investment was usually around 45 minutes and rarely more than an hour. When this study reopens for the full significance testing phase, it is planned that the estimated visit duration will be reduced to no more than an hour and the compensation amount will be reduced to $20 per participant given the overestimation of participants' time investment in the study. This should reduce the costs of implementation, and a shorter time window might attract more potential participants into the full significance testing phase of this study.

Besides being low-cost and easy to implement in the field, the present study design demonstrates a flexible, modular template for testing the incorporation of emotional manipulations into public health education and advocacy interventions. The same embodied mechanism, e.g., disgust-contagion, could be similarly evaluated when coupled with different

infectious disease types, e.g., water-borne or food-borne or vector-borne, and respective preventive behaviors, e.g., water sanitation or food handling or mosquito eradication practices, in both cross-sectional and cohort studies. This could help determine the disgust-contagion mechanism's fit across infectious disease types and preventive behaviors and over time. Furthermore, the effects of different embodied mechanisms, e.g., disgust-contagion vs. warmth-trust, could be evaluated when coupled with the same disease and respective preventive behaviors, e.g., influenza and hand hygiene or vaccination, in both cross-sectional and cohort studies. This could help determine the most fitting embodied mechanisms for different disease types and preventive behaviors. Information related to different diseases can be inserted into the presentation slides in different formats and in different order. Different types of triggers can be incorporated into the informational presentation, and the timing of exposure to the trigger can also be manipulated. The same participants could be exposed to different information content, information format, or emotional triggers over time, or to the same information content, information format, or emotional triggers over time.

The present study design's modular quality is evidenced by the following: (1) all study variable measurements were either created by the PI (disgust SAM scale, Q1-Q4 surveys, and demographic questionnaire) or adapted from publicly available sources (valence and arousal SAM scales, Q5 and Q6 surveys); (2) the relative ease with which the disgust SAM measurement was created, simply by adding the appropriate facial expressions to the SAM figure; and (3) the relative ease with which the target disease was changed from HIV/AIDS to influenza. By applying variations on the present study design, the PI plans to continue building the evidence base for the real-world applicability of utilizing EC-based concepts like the disgust-contagion mechanism to influence people's health attitudes and likely behaviors.

5.0 CONCLUSIONS

First, the PI hypothesized that DS and SSC would have positive effects on measures of felt disgust, perceptions of influenza, and likelihood of taking preventive measures against influenza, but negative effects on measures of influenza-related trust and likelihood of supporting taxes for influenza prevention. Second, measures of felt disgust would have positive effects on perceptions of influenza and likelihood of taking preventive measures against influenza, but negative effects on measures of influenza-related trust and likelihood of supporting taxes for influenza prevention. And third, hand sanitizer exposure would have positive effects on measures of felt disgust, perceptions of influenza, and likelihood of taking preventive measures against influenza, but negative effects on measures of influenza-related trust and likelihood of supporting taxes for influenza prevention.

Post hoc non-parametric bivariate correlation analyses of pilot study data showed several significant correlations between DS, SSC, felt disgust index measures and index measures for perceptions and likely behaviors towards influenza. Specifically, perceptions of influenza and likelihood of taking preventive action against influenza were significantly correlated with DS, SSC was significantly correlated with likelihood of supporting influenza prevention taxes, and both DS and SSC were significantly correlated with valence, arousal and disgust. Those findings would suggest that the first two of the three main study hypotheses were on the right track.

Those findings would also suggest it would be worthwhile to continue with the full significance testing phase of the study. A larger sample size, assumptions of normality, and an analysis strategy incorporating logistic regression and multivariate analyses would allow the PI to detect with confidence whether there are moderate disgust effects on perceptions of and likely behaviors towards influenza, and whether DS and SSC have moderating influences on these disgust effects. The larger sample size would also allow the PI to determine with confidence whether hand sanitizer exposure is a fitting trigger for the disgust-contagion mechanism in the context of influenza prevention.

The application of EC concepts and tools in public health education and advocacy campaigns is long overdue. However, before implementing concepts like the disgust-disease contagion-moral contagion linkage or tools like disgust triggers at the scale needed to achieve positive public health outcomes, EC-driven strategies need to be tested in real-world public health contexts and settings. Observing the effects hypothesized in this study would provide evidence for the real-world applicability of the disgust-disease contagion-moral contagion linkage and disgust triggers as low-cost, medium-impact complements to existing public health education and promotion programs targeting infectious disease prevention. It would also provide proof-of-concept evidence for the real-world applicability of utilizing EC-based concepts, including emotional manipulations, to influence people's health attitudes and likely behaviors, including their desire to protect themselves from various disease exposures, thus complementing existing education and promotion programs targeting public health issues, like reducing at-risk populations' susceptibility to disease and morbidity.

Lastly, and perhaps most importantly, it would provide much needed insight for both researchers and practitioners into the potentially significant yet largely unexplored influences

that emotional appeals can have in the context of disease prevention. Awareness of the various counteracting and synergistic influences that such appeals to emotion can have on people's perceptions of and likely behaviors towards disease prevention would allow for their identification in existing messages and environments to which target audiences are exposed, either currently or historically. Understanding how emotional appeals can influence people's perceptions of and likely behaviors towards disease would allow for the nullification of potentially detrimental effects while reinforcing potentially beneficial effects. For example, if people exposed to HIV prevention messages containing disgust-contagion triggers, such as images evoking intravenous drug use or risky sexual practices, are also made aware of the images' potential to trigger the disgust-disease contagion-moral contagion mechanism, it would be less likely that the images would produce either the disgust reaction or its disease and moral contagion effects.

If the pilot study findings are corroborated during the next study phase, the results could suggest a way forward in the translation of infectious disease prevention knowledge into real-world action. By using targeted emotional appeals that resonate with their audiences, public health educators and advocates may be able to more efficiently and effectively communicate their messages and recommendations to both the target groups and the general population, including HCPs and policy-makers, in ways that are easier for them to understand, internalize, and ultimately, incorporate into their own perceptual, decision making and behavioral rules. Such strategies can ground disease prevention messages in their audiences' sensorimotor and emotional experience, and thus more reliably produce the desired attitude(s) and behavior(s) among individuals as well as communities. Moreover, by raising awareness of these kinds of strategies, it may be possible for people to detect the hidden or unintended emotional appeals and

reaction triggers that may be embedded in health related information, including their associated conceptually linked attitude(s) and behavior(s). Therefore, this study's findings could have important implications for infectious disease prevention programs aimed at individual health behavior change and for advocacy efforts aimed at ensuring support for such programs, and thus for the health of our communities.

APPENDIX A

HEALTH BEHAVIOR THEORY CONSTRUCT DEFINITIONS (RIMER AND GLANZ, 2005)[37]

1) Health Belief Model

a) Perceived benefits – individual's beliefs about the potential benefits of taking action to reduce risk of an adverse event.

b) Perceived barriers – individual's beliefs about the potential costs of taking action to reduce risk of an adverse event.

c) Perceived susceptibility – individual's beliefs about the chances of an adverse event occurring.

d) Perceived severity – individual's beliefs about the severity of an adverse event should it occur.

e) Perceived self-efficacy – individual's confidence in his/her ability to take action to reduce risk of an adverse event.

f) Cues to action – environmental factors that activate individual's 'readiness to change' and lead to consistent action that reduces risk of an adverse event.

2) Theory of Planned Behavior

a) Attitude toward behavior – individual's overall evaluation of a behavior.

b) Subjective norm – individual's beliefs about whether a behavior will result in approval or disapproval from others, and whether individual is motivated to seek others' approval.

c) Perceived behavioral control – individual's beliefs about whether a behavior is under his/her control and ability to perform.

d) Behavioral intention – individual's perceptions about his/her chances of performing a behavior.

3) Social Cognitive Theory

a) Reciprocal determinism – behaviors are performed in dynamic environments where persons influence their social and physical environments through their behavior as much as the environment influences persons' behaviors, leading to constant evolution of norms and behaviors.

b) Expectations – expected outcomes of a behavior.

c) Behavioral capability – persons have the necessary knowledge and skill for a behavior.

d) Self-efficacy – persons are confident in their ability to overcome obstacles and perform a behavior.

e) Observational learning/modeling – behaviors that are acquired by observing how others behave and how they fare.

f) Reinforcements – responses to behaviors that increase or decrease the likelihood of persons performing that behavior again.

4) Diffusion of Innovations Theory

a) Compatibility – persons' perceptions of whether a new behavior will be compatible with their current values/preferences.

b) Relative advantage – persons' perceptions of whether a new behavior will be better than what is currently available.

c) Observability – persons' ability to readily observe and evaluate the results of a new behavior.

d) Complexity – persons' perceptions of whether a new behavior will be easy to adopt.

e) Trialability – persons' ability to try out a new behavior in a safe setting before committing to consistent adoption of the behavior.

5) Agenda Setting Theory

a) Problem definition – factors that influence whether an issue is identified as a problem or factors that influence whether a given course of action is identified as a solution to an identified problem.

b) Framing – selection of certain aspects of a given course of action for emphasis and selection of other aspects for exclusion when talking about a given course of action.

c) Media agenda setting – factors that influence how the media define, select, and prioritize issues.

d) Public agenda setting – whether the public's priorities are reflected in the media's coverage of issues.

e) Policy agenda setting – whether the policy-makers' legislative priorities are reflected in the media's coverage of issues.

6) Social Marketing Approach

a) Product – description of a given behavior and its benefits, including comparison to other alternative behaviors, to produce the perception that this is the right kind of behavior.

b) Price – description of the barriers and costs to adopting a given behavior, including comparison to other alternative behaviors, to produce the perception that this is a relatively less costly behavior.

c) Place – description of a given behavior as accessible, convenient, and easy to perform, and the reinforcement of this perception by facilitating the behavior and incentivizing its proper application.

d) Promotion – the media used to notify the intended audiences of the behavior, its benefits, costs, and ease of adoption.

7) Stages of Change/Transtheoretical Model

a) Precontemplation – at this time in the person's life course, they have no intention of adopting a particular behavior in the near future.

b) Contemplation – at this time in the person's life course, they intend to adopt a particular behavior in the near future.

c) Preparation – at this time in the person's life course, they not only intend to adopt a particular behavior in the very near future, but have also taken steps to prepare for making that behavioral change.

d) Action – at this time in the person's life course, they have just begun adopting a particular behavior.

e) Maintenance – at this time in the person's life course, they have been adopting a particular behavior for some time.

APPENDIX B

Q1: PARTICIPANT PERCEPTIONS OF INFLUENZA

Please read the following items closely and answer as truthfully as possible by rating how much you agree or disagree with each statement. Please answer the following items by selecting ONLY ONE of the choices indicated along the line for each statement:

1. Influenza has little to no impact on how long people can live.

Strongly disagree——————————————————————— Strongly agree

1 2 3 4 5 6 7

2. Influenza has little to no impact on how healthy people can be.

Strongly disagree——————————————————————— Strongly agree

1 2 3 4 5 6 7

3. Influenza has little to no impact on how good of a life a person can have.

Strongly disagree——————————————————————— Strongly agree

1 2 3 4 5 6 7

4. It takes a long time before people who get infected with influenza begin to look sick.

Strongly disagree——————————————————————— Strongly agree

1 2 3 4 5 6 7

5. It takes a long time before people who get infected with influenza can begin to infect other people.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

6. It would be nearly impossible for me to get an infectious disease.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

7. It would be nearly impossible for me to get influenza.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

8. The benefits of infection prevention education are worth any cost.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

9. The benefits of providing free influenza vaccines are worth any cost.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

10. The benefits of hand sanitizer distribution programs are worth any cost.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

APPENDIX C

Q2: PARTICIPANT INFLUENZA-RELATED TRUST

Please read the following items closely and answer as truthfully as possible by rating how much you agree or disagree with each statement. Please answer the following items by selecting ONLY ONE of the choices indicated along the line for each statement:

1. I always trust the information I normally hear or see about how to avoid getting sick.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

2. I always trust the information I normally hear or see about how to avoid getting an infectious disease.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

3. I always trust the information I normally hear or see about how to avoid getting influenza.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

4. I always trust the people I normally hear or see talking about health in general.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

5. I always trust the people I normally hear or see talking about infectious diseases.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

6. I always trust the people I normally hear or see talking about influenza.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

APPENDIX D

Q3: PARTICIPANT INTENTION TO TAKE PREVENTIVE MEASURES AGAINST INFLUENZA

Please read the following items closely and answer as truthfully as possible by rating how much you agree or disagree with each statement. Please answer the following items by selecting ONLY ONE of the choices indicated along the line for each statement:

1. I am always careful to cover my mouth and nose when I see other people cough, especially during flu season.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

2. I always tell people I know to cover their mouths when they cough, especially during flu season.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

3. After opening a door or using a public appliance like an ATM, I am always careful not to touch my face until I wash my hands or use hand sanitizer.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

4. I am careful to avoid touching surfaces as much as possible when I am in public spaces.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

5. I always get a flu vaccine every year.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

6. I always tell people I know to get a flu vaccine every year.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

APPENDIX E

Q4: PARTICIPANT INTENTION TO SUPPORT TAXES FOR INFLUENZA PREVENTION

Please read the following items closely and answer as truthfully as possible by rating how much you agree or disagree with each statement. Please answer the following items by selecting ONLY ONE of the choices indicated along the line for each statement:

1. If a $10/person/year tax were proposed by the state of Pennsylvania to give away free hand sanitizers to all adults who want them, I would definitely vote for that tax.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

2. If a $10/person/year tax were proposed by the state of Pennsylvania to give away free masks and gloves to all adults who want them, I would definitely vote for that tax.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

3. If a $10/person/year tax were proposed by the state of Pennsylvania for a network of influenza prevention education programs for adults, I would definitely vote for that tax.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

4. If a $10/person/year tax were proposed by the state of Pennsylvania for a network of influenza prevention education programs in schools, I would definitely vote for that tax.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

5. If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all adults who want them, I would definitely vote for that tax.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

6. If a $10/person/year tax were proposed by the state of Pennsylvania to subsidize influenza vaccines for all school-age children, I would definitely vote for that tax.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

APPENDIX F

Q5: PARTICIPANT GENERAL DISGUST SENSITIVITY (DS-R; DEVELOPED BY HAIDT, MCCAULEY AND ROZIN, 1994 [116], AND MODIFIED BY OLATUNJI ET AL, 2007 [117])

Please read the following items closely and answer as truthfully as possible by rating how much you agree or disagree with each statement. Please answer the following items by selecting ONLY ONE of the choices indicated along the line for each statement:

1. I might be willing to try eating monkey meat, under some circumstances.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

2. It would bother me to see a rat run across my path in a park.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

3. Seeing a cockroach in someone else's house doesn't bother me.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

4. It bothers me to hear someone clear a throat full of mucus.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

5. If I see someone vomit, it makes me sick to my stomach.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

6. It would bother me to be in a science class, and see a human hand preserved in a jar.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

7. It would not upset me at all to watch a person with a glass eye take the eye out of the socket.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

8. It would bother me tremendously to touch a dead body.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

9. I would go out of my way to avoid walking through a graveyard.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

10. I never let any part of my body touch the toilet seat in a public washroom.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

11. I probably would not go to my favorite restaurant if I found out that the cook had a cold.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

12. Even if I was hungry, I would not drink a bowl of my favorite soup it if had been stirred with a used but thoroughly washed flyswatter.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

13. It would bother me to sleep in a nice hotel room if I knew that a man had died of a heart attack in that room the night before.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

Please read the following items closely and answer as truthfully as possible by selecting ONLY ONE of the choices indicated along the line.

How disgusting would you find each of the following experiences?

14. If you see someone put ketchup on vanilla ice cream and eat it.

Not disgusting ——————————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

15. You are about to drink a glass of milk when you smell that it is spoiled.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

16. You see maggots on a piece of meat in an outdoor garbage pail.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

17. You are walking barefoot on concrete and step on an earthworm.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

18. While you are walking through a tunnel under a railroad track, you smell urine.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

19. You see a man with his intestines exposed after an accident.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

20. Your friend’s pet cat dies and you have to pick up the dead body with your bare hands.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

21. You accidentally touch the ashes of a person who has been cremated.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

22. You take a sip of soda and realize that you drank from the glass that an acquaintance of yours had been drinking from.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

23. You discover that a friend of yours changes underwear only once a week.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

24. A friend offers you a piece of chocolate shaped like dog-doo.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

25. As part of a sex education class, you are required to inflate a new lubricated condom, using your mouth.

Not disgusting ——————————————————————— Very disgusting

at all 1 2 3 4 5 6 7

APPENDIX G

Q6: POLITICAL CONSERVATISM (SSC SCALE; INBAR, PIZARRO AND BLOOM, 2009)[83]

Please read the following items closely and answer as truthfully as possible by rating how much you agree or disagree with each statement. Please answer the following items by selecting ONLY ONE of the choices indicated along the line for each statement:

1. A woman should have the right to choose what to do with her body, even if that means getting an abortion.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

2. Homosexuals should have the same right to marriage as anyone else.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

3. The welfare system is too easy to abuse, and does not give people enough incentive to find work.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

4. To try to prevent Iran from developing nuclear technology, the United States should consider bombing Iran's nuclear development sites.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

5. Overall, labor unions tend to hurt the US economy.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

6. It is important for our legal system to use the death penalty as punishment for heinous crimes.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

7. Affirmative action gives those groups with a history of oppression a chance to get ahead.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

8. The United States should not have invaded Iraq.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

9. Gun control laws are not nearly strict enough.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

10. Federal tax cuts have been worth it, because they have helped strengthen the economy by allowing Americans to keep more of their own money.

Strongly disagree——————————————————————————— Strongly agree

1 2 3 4 5 6 7

APPENDIX H

PARTICIPANT PRE-SCREENING FORM

1. Did potential participant express an interest in participating in the research study after the initial introduction?

_____Yes ____No ***[if checked, end Initial Contact]***

2. Did potential participant give permission to be asked eligibility questions?

_____Yes ____No ***[if checked, end Initial Contact]***

3. What is participant's age?

_____18+ years old ____Under 18 years old ***[if checked, not eligible]***

4. Is English participant's primary language?

_____Yes ____No ***[if checked, not eligible]***

5. Is participant able to read and write in English?

_____Yes ____No ***[if checked, not eligible]***

6. Is participant able to travel to the study visit location in Oakland?

_____Yes ____No ***[if checked, not eligible]***

APPENDIX I

DEMOGRAPHIC QUESTIONNAIRE

Please answer the following by selecting ONLY ONE of the choices indicated for each question:

1. How old are you?

- o 18-21 years
- o 22-25 years
- o 26-30 years
- o 31-35 years
- o 36-45 years
- o 46-55 years
- o 56-65 years
- o Over 65 years
- o Prefer not to answer

2. How would you self-identify your gender?

- o Male
- o Female
- o Both male and female
- o Transgender – male to female

- o Transgender – female to male
- o Prefer not to answer

3. How would you self-identify your race?

- o Alaska Native/American Indian (please specify if you feel inclined) _____
- o Asian (please specify if you feel inclined) _____
- o Black/African American (please specify if you feel inclined) _____
- o Pacific Islander (please specify if you feel inclined) _____
- o White/Caucasian (please specify if you feel inclined) _____
- o Multi-racial (please specify if you feel inclined) _____
- o Other (please describe) _____
- o Prefer not to answer

4. Do you self-identify as Hispanic or Latino(a)?

- o Yes
- o No
- o Prefer not to answer

5. How far have you gone/did you go in school?

- o No degree
- o High school degree or GED
- o Vocational/trade school/associate degree
- o Some college
- o Bachelor's degree
- o Some graduate school

- o Master's degree or higher
- o Prefer not to answer

6. Are you currently going to school or college?

- o Not going to school or college at this time
- o Yes, part-time (1-2 classes/semester)
- o Yes, part-time (3-4 classes/semester)
- o Yes, full-time (5 or more classes/semester)
- o Prefer not to answer

7. Are you currently employed?

- o Not employed at this time
- o Yes, part-time (less than 20 hours/week)
- o Yes, part-time (20-35 hours/week)
- o Yes, full-time (over 35 hours/week)
- o Prefer not to answer

8. How much would you say you earned/will earn this year?

- o Less than $10K
- o At least $10K but less than $20K
- o At least $20K but less than $30K
- o At least $30K but less than $45K
- o At least $45K but less than $75K
- o $75K or more
- o Prefer not to answer

9. Would you say that what you earned/will earn this year is typical for you?

- o No, it's less than what I have earned in the past
- o Yes, it's about the same as what I have earned in the past
- o No, it's more than what I have earned in the past
- o Prefer not to answer

10. What would you say is your religious affiliation?

- o Protestant
- o Catholic
- o Muslim
- o Jewish
- o Buddhist
- o Hindu
- o No affiliation
- o Other (please describe) _____
- o Prefer not to answer

11. How often would you say you attend religious services?

- o Never
- o Rarely (once a year or less)
- o Occasionally (once a month or less)
- o Regularly (once a week)
- o Often (more than once a week)
- o Prefer not to answer

12. When it comes to politics, do you usually think of yourself as liberal, moderate, conservative, or something else?

- o Liberal
- o Moderate
- o Conservative
- o Other (please describe) _____
- o Not political
- o Prefer not to answer

Please answer the following by selecting ALL APPLICABLE ANSWERS from the list of choices for each question:

13. Where do you usually get information about health in general?

- o Talk radio
- o Radio news
- o News magazines or newspapers
- o Other magazines
- o Scientific journals or books
- o Other books
- o Local television news (e.g. ABC, CBS, NBC)
- o Public broadcast television news (e.g. PBS, BBC)
- o Cable television news (e.g. CNN, FOX, MSNBC)
- o Television talk shows

- o Commercials (radio or television)
- o Government Web sites (.gov)
- o Academic Web sites (.edu)
- o Private, for-profit Web sites (.com)
- o Private, not-for-profit Web sites (.org)
- o Online blogs, chat rooms or message boards
- o Medical health professionals (e.g. doctors, nurses)
- o Health authorities (e.g. local or state health department officials)
- o Friends and/or family
- o Other media sources (please list)_____
- o Other persons (please list)_____
- o Never look for information about health in general

14. Where would you get information about influenza or other infectious diseases?

- o Talk radio
- o Radio news
- o News magazines or newspapers
- o Other magazines
- o Scientific journals or books
- o Other books
- o Local television news (e.g. ABC, CBS, NBC)
- o Public broadcast television news (e.g. PBS, BBC)
- o Cable television news (e.g. CNN, FOX, MSNBC)
- o Television talk shows

- o Commercials (radio or television)
- o Government Web sites (.gov)
- o Academic Web sites (.edu)
- o Private, for-profit Web sites (.com)
- o Private, not-for-profit Web sites (.org)
- o Online blogs, chat rooms or message boards
- o Medical health professionals (e.g. doctors, nurses)
- o Health authorities (e.g. local or state health department officials)
- o Friends and/or family
- o Other media sources (please list)_____
- o Other persons (please list)_____
- o Never look for information about influenza or other infectious diseases

BIBLIOGRAPHY

1. Barsalou, L.W., *Perceptual symbol systems.* Behavioral and Brain Sciences, 1999. **22**(4): p. 577-609; discussion 610-60.

2. Barsalou, L.W., *Grounded Cognition: Past, Present, and Future.* Topics in Cognitive Science, 2010. **2**(4): p. 716-724.

3. Gendron, M. and L. Feldman Barrett, *Reconstructing the Past: A Century of Ideas About Emotion in Psychology.* Emotion Review, 2009. **1**(4): p. 316-339.

4. Núñez, R., L. Edwards, and J. Filipe Matos, *Embodied cognition as grounding for situatedness and context in mathematics education.* Educational Studies in Mathematics, 1999. **39**(1-1): p. 45-65.

5. Thelen, E., *Time-scale dynamics and the development of an embodied cognition,* in *Mind as Motion: Explorations in the Dynamics of Cognition,* T. van Gelder and R. Port, Editors. 1995, Mit Press. p. 69--100.

6. Wilson, M., *Six views of embodied cognition.* Psychon Bull Rev, 2002. **9**(4): p. 625-36.

7. Wilson, R.A. and L. Foglia, *Embodied cognition.* Stanford Encyclopedia of Philosophy, 2011.

8. Ziemke, T., *What's that thing called embodiment?* 2003, Proceedings of the 25th Annual Conference of the Cognitive Science Society. p. 1305-1310.

9. Anderson, M.L., *Embodied Cognition: A field guide.* Artificial Intelligence, 2003. **149**(1): p. 91-130.

10. Lakoff, G., *Explaining Embodied Cognition Results.* Topics in Cognitive Science, 2012. **4**(4): p. 773-785.

11. Gallese, V. and G. Lakoff, *The Brain's concepts: the role of the Sensory-motor system in conceptual knowledge.* Cognitive Neuropsychology, 2005. **22**(3-4): p. 455-479.

12. Gibbs Jr, R.W., *Embodied experience and linguistic meaning.* Brain and Language, 2003. **84**(1): p. 1-15.

13. Smith, L. and M. Gasser, *The development of embodied cognition: six lessons from babies.* Artif Life, 2005. **11**(1-2): p. 13-29.

14. Adolphs, R., *The social brain: neural basis of social knowledge.* Annu Rev Psychol, 2009. **60**: p. 693-716.

15. Davis, J.I. and A.B. Markman, *Embodied cognition as a practical paradigm: introduction to the topic, the future of embodied cognition.* Top Cogn Sci, 2012. **4**(4): p. 685-91.

16. Johnson, M. and G. Lakoff, *Why cognitive linguistics requires embodied realism.* Cognitive linguistics, 2002. **13**(3): p. 245-264.

17. Svensson, H. and T. Ziemke. *Making sense of embodiment: Simulation theories and the sharing of neural circuitry between sensorimotor and cognitive processes*. in *Proceedings of the 26th Annual Meeting of the Cognitive Science Society, Chicago. Hillsdale, NJ: Lawrence Erlbaum*. 2004.

18. Doyon, J. and H. Benali, *Reorganization and plasticity in the adult brain during learning of motor skills.* Current Opinion in Neurobiology, 2005. **15**(2): p. 161-167.

19. Rueschemeyer, S.-A., et al., *Embodied cognition: The interplay between automatic resonance and selection-for-action mechanisms.* European Journal of Social Psychology, 2009. **39**(7): p. 1180-1187.

20. Ernst, M. and M.P. Paulus, *Neurobiology of Decision Making: A Selective Review from a Neurocognitive and Clinical Perspective.* Biological Psychiatry, 2005. **58**(8): p. 597-604.

21. Naqvi, N., B. Shiv, and A. Bechara, *The Role of Emotion in Decision Making: A Cognitive Neuroscience Perspective.* Current Directions in Psychological Science, 2006. **15**(5): p. 260-264.

22. Williams, L.E., J.Y. Huang, and J.A. Bargh, *The scaffolded mind: Higher mental processes are grounded in early experience of the physical world.* European Journal of Social Psychology, 2009. **39**(7): p. 1257-1267.

23. DeCaro, D.A., et al., *How do motoric realities shape, and become shaped by, the way people evaluate and select potential courses of action? Toward a unitary framework of embodied decision making,* in *Progress in Brain Research,* J.G.J. Markus Raab and R.H. Hauke, Editors. 2009, Elsevier. p. 189-203.

24. Gigerenzer, G. and W. Gaissmaier, *Heuristic Decision Making.* Annual Review of Psychology, 2011. **62**(1): p. 451-482.

25. Immordino-Yang, M.H. and A. Damasio, *We Feel, Therefore We Learn: The Relevance of Affective and Social Neuroscience to Education.* Mind, Brain, and Education, 2007. **1**(1): p. 3-10.

26. Gigerenzer, G. and R. Selten, *Bounded Rationality: The Adaptive Toolbox*. 2002: MIT Press.

27. Greeno, J.G., *The situativity of knowing, learning, and research.* American Psychologist, 1998. **53**(1): p. 5-26.

28. Loewenstein, G., S. Rick, and J.D. Cohen, *Neuroeconomics.* Annual Review of Psychology, 2008. **59**(1): p. 647-672.

29. Higgins, E.T., *Beyond pleasure and pain.* Am Psychol, 1997. **52**(12): p. 1280-300.

30. Curtis, V., R. Aunger, and T. Rabie, *Evidence that disgust evolved to protect from risk of disease.* Proceedings of the Royal Society B: Biological Sciences, 2004. **271**(Suppl 4): p. S131-S133.

31. Curtis, V., M. de Barra, and R. Aunger, *Disgust as an adaptive system for disease avoidance behaviour.* Philosophical Transactions of the Royal Society B: Biological Sciences, 2011. **366**(1568): p. 1320-1320.

32. Curtis, V., *Why disgust matters.* Philosophical Transactions of the Royal Society B: Biological Sciences, 2011. **366**(1583): p. 3478-3490.

33. Niedenthal, P.M., et al., *Embodiment in attitudes, social perception, and emotion.* Pers Soc Psychol Rev, 2005. **9**(3): p. 184-211.

34. Lakoff, G. and M. Johnson, *Philosophy in the flesh : the embodied mind and its challenge to western thought*. 1999, New York, NY: Basic Books.

35. Allal, L., *Situated cognition and learning: From conceptual frameworks to classroom investigations.* Revue suisse des sciences de l'éducation, 2001. **23**(3): p. 407-422.

36. Durning, S.J. and A.R. Artino, *Situativity theory: a perspective on how participants and the environment can interact: AMEE Guide no. 52.* Med Teach, 2011. **33**(3): p. 188-99.

37. Rimer, B.K. and K. Glanz, *Theory at a glance: a guide for health promotion practice*. 2nd ed. 2005, New York, NY: US Department of Health and Human Services, National Institutes of Health, National Cancer Institute.

38. Schacter, D.L., I.G. Dobbins, and D.M. Schnyer, *Specificity of priming: a cognitive neuroscience perspective.* Nat Rev Neurosci, 2004. **5**(11): p. 853-62.

39. Schacter, D.L. and R.L. Buckner, *Priming and the brain.* Neuron, 1998. **20**(2): p. 185-95.

40. Schunn, C.D. and K. Dunbar, *Priming, analogy, and awareness in complex reasoning.* Mem Cognit, 1996. **24**(3): p. 271-84.

41. Marsolek, C.J., *What is priming and why?*, in *Rethinking implicit memory*. 2003, Oxford University Press: New York, NY, US. p. 41-64.

42. Brinol, P. and R.E. Petty, *Overt head movements and persuasion: a self-validation analysis.* J Pers Soc Psychol, 2003. **84**(6): p. 1123-39.

43. Wells, G.L. and R.E. Petty, *The Effects of Overt Head Movements on Persuasion: Compatibility and Incompatibility of Responses.* Basic and Applied Social Psychology, 1980. **1**(3): p. 219-230.

44. Yap, A.J., et al., *The ergonomics of dishonesty: the effect of incidental posture on stealing, cheating, and traffic violations.* Psychol Sci, 2013. **24**(11): p. 2281-9.

45. Schubert, T.W., *The Power in Your Hand: Gender Differences in Bodily Feedback From Making a Fist.* Personality and Social Psychology Bulletin, 2004. **30**(6): p. 757-769.

46. Schubert, T.W. and S.L. Koole, *The embodied self: Making a fist enhances men's power-related self-conceptions.* Journal of Experimental Social Psychology, 2009. **45**(4): p. 828-834.

47. Reed, C.L. and M.J. Farah, *The psychological reality of the body schema: a test with normal participants.* J Exp Psychol Hum Percept Perform, 1995. **21**(2): p. 334-43.

48. Chao, L.L. and A. Martin, *Representation of Manipulable Man-Made Objects in the Dorsal Stream.* NeuroImage, 2000. **12**(4): p. 478-484.

49. Koutstaal, W., et al., *Perceptual specificity in visual object priming: functional magnetic resonance imaging evidence for a laterality difference in fusiform cortex.* Neuropsychologia, 2001. **39**(2): p. 184-99.

50. Dobbins, I.G., et al., *Cortical activity reductions during repetition priming can result from rapid response learning.* Nature, 2004. **428**(6980): p. 316-319.

51. Rauscher, F.H., R.M. Krauss, and Y. Chen, *Gesture, speech, and lexical access: The role of lexical movements in speech production.* Psychological Science, 1996. **7**(4): p. 226-231.

52. Amorim, M.A., B. Isableu, and M. Jarraya, *Embodied spatial transformations: "body analogy" for the mental rotation of objects.* J Exp Psychol Gen, 2006. **135**(3): p. 327-47.

53. Holt, L.E. and S.L. Beilock, *Expertise and its embodiment: examining the impact of sensorimotor skill expertise on the representation of action-related text.* Psychon Bull Rev, 2006. **13**(4): p. 694-701.

54. Ackerman, J.M., C.C. Nocera, and J.A. Bargh, *Incidental haptic sensations influence social judgments and decisions.* Science, 2010. **328**(5986): p. 1712-5.

55. Baldwin, M., et al., *Perceived importance of cross-race targets facilitates recall: Support for a motivated account of face memory.* Group Processes & Intergroup Relations, 2013. **16**(4): p. 505-515.

56. Cacioppo, J.T., J.R. Priester, and G.G. Berntson, *Rudimentary determinants of attitudes: II. Arm flexion and extension have differential effects on attitudes.* Journal of Personality and Social Psychology, 1993. **65**(1): p. 5-17.

57. Inagaki, T.K. and N.I. Eisenberger, *Shared Neural Mechanisms Underlying Social Warmth and Physical Warmth.* Psychological Science, 2013. **24**(11): p. 2272-2280.

58. Zhong, C.-B. and G.J. Leonardelli, *Cold and Lonely: Does Social Exclusion Literally Feel Cold?* Psychological Science, 2008. **19**(9): p. 838-842.

59. IJzerman, H. and G.R. Semin, *The Thermometer of Social Relations: Mapping Social Proximity on Temperature.* Psychological Science, 2009. **20**(10): p. 1214-1220.

60. Williams, L.E. and J.A. Bargh, *Experiencing Physical Warmth Promotes Interpersonal Warmth.* Science, 2008. **322**(5901): p. 606-607.

61. Ansorge, U., et al., *Testing the theory of embodied cognition with subliminal words.* Cognition, 2010. **116**(3): p. 303-320.

62. Busiello, M., et al., *Sensory-motor interference abolishes repetition priming for observed actions, but not for action-related verbs.* Neuroscience Letters, 2011. **492**(2): p. 89-93.

63. Kaspar, K., *A weighty matter: heaviness influences the evaluation of disease severity, drug effectiveness, and side effects.* PLoS One, 2013. **8**(11): p. e78307.

64. Zhong, C.-B. and K. Liljenquist, *Washing Away Your Sins: Threatened Morality and Physical Cleansing.* Science, 2006. **313**(5792): p. 1451-1452.

65. Zhong, C.-B., B. Strejcek, and N. Sivanathan, *A clean self can render harsh moral judgment.* Journal of Experimental Social Psychology, 2010. **46**(5): p. 859-862.

66. Liljenquist, K., C.-B. Zhong, and A.D. Galinsky, *The Smell of Virtue: Clean Scents Promote Reciprocity and Charity.* Psychological Science, 2010. **21**(3): p. 381-383.

67. Cooper, L.Z., H.J. Larson, and S.L. Katz, *Protecting public trust in immunization.* Pediatrics, 2008. **122**(1): p. 149-53.

68. Waterhouse, L., *Autism overflows: increasing prevalence and proliferating theories.* Neuropsychol Rev, 2008. **18**(4): p. 273-86.

69. Devine, P.G., *Stereotypes and prejudice: Their automatic and controlled components.* Journal of Personality and Social Psychology, 1989. **56**(1): p. 5.

70. Wilkinson, R.G. and K.E. Pickett, *Income inequality and population health: A review and explanation of the evidence.* Social Science & Medicine, 2006. **62**(7): p. 1768-1784.

71. Krieger, N., *Who and what is a "population"? Historical debates, current controversies, and implications for understanding "population health" and rectifying health inequities.* Milbank Q, 2012. **90**(4): p. 634-81.

72. Mayberry, R.M., F. Mili, and E. Ofili, *Racial and Ethnic Differences in Access to Medical Care.* Medical Care Research and Review, 2000. **57**(4 suppl): p. 108-145.

73. Nelson, A., *Unequal Treatment:: Confronting Racial and Ethnic Disparities in Health Care (with CD).* Journal of the National Medical Association, 2002. **94**(8): p. 666-668.

74. Camerer, C.F., et al., *Regulation for conservatives: Behavioral economics and the case for ``asymmetric paternalism''.* University of Pennsylvania Law Review, 2003. **151**(3): p. 1211-1254.

75. Niederdeppe, J., et al., *Message design strategies to raise public awareness of social determinants of health and population health disparities.* Milbank Q, 2008. **86**(3): p. 481-513.

76. Haidt, J., et al., *Body, Psyche, and Culture: The Relationship between Disgust and Morality.* Psychology & Developing Societies, 1997. **9**(1): p. 107-131.

77. Rozin, P., J. Haidt, and C.R. McCauley, *Disgust: The Body and Soul Emotion,* in *Handbook of Cognition and Emotion,* T. Dalgleish and M. Power, Editors. 1999, John Wiley & Sons, Ltd. p. 429-445.

78. Buckels, E.E. and P.D. Trapnell, *Disgust Facilitates Outgroup Dehumanization.* Group Processes & Intergroup Relations, 2013.

79. Dasgupta, N., et al., *Fanning the flames of prejudice: The influence of specific incidental emotions on implicit prejudice.* Emotion, 2009. **9**(4): p. 585-591.

80. Terrizzi Jr, J.A., N.J. Shook, and W.L. Ventis, *Disgust: A predictor of social conservatism and prejudicial attitudes toward homosexuals.* Personality and Individual Differences, 2010. **49**(6): p. 587-592.

81. Helzer, E.G. and D.A. Pizarro, *Dirty Liberals!: Reminders of Physical Cleanliness Influence Moral and Political Attitudes.* Psychological Science, 2011. **22**(4): p. 517-522.

82. Inbar, Y., et al., *Disgust Sensitivity, Political Conservatism, and Voting.* Social Psychological and Personality Science, 2012. **3**(5): p. 537-544.

83. Inbar, Y., D.A. Pizarro, and P. Bloom, *Conservatives are more easily disgusted than liberals.* Cognition and Emotion, 2009. **23**(4): p. 714-725.

84. Eskine, K.J., N.A. Kacinik, and J.J. Prinz, *A Bad Taste in the Mouth: Gustatory Disgust Influences Moral Judgment.* Psychological Science, 2011. **22**(3): p. 295-299.

85. Schnall, S., J. Benton, and S. Harvey, *With a Clean Conscience: Cleanliness Reduces the Severity of Moral Judgments.* Psychological Science, 2008. **19**(12): p. 1219-1222.

86. Schnall, S., et al., *Disgust as Embodied Moral Judgment.* Personality and Social Psychology Bulletin, 2008.

87. Horberg, E.J., et al., *Disgust and the moralization of purity.* Journal of Personality and Social Psychology, 2009. **97**(6): p. 963-976.

88. Olatunji, B.O., *Disgust, scrupulosity and conservative attitudes about sex: Evidence for a mediational model of homophobia.* Journal of Research in Personality, 2008. **42**(5): p. 1364-1369.

89. CDC, *Prevention and control of seasonal influenza with vaccines. Recommendations of the Advisory Committee on Immunization Practices--United States, 2013-2014.* MMWR Recomm Rep, 2013. **62**(RR-07): p. 1-43.

90. CDC *Estimated Influenza Illnesses and Hospitalizations Averted by Vaccination — United States, 2014–15 Influenza Season*. December 10, 2015; Accessed February 26, 2016.

91. CDC, *Estimates of deaths associated with seasonal influenza --- United States, 1976-2007.* MMWR Morb Mortal Wkly Rep, 2010. **59**(33): p. 1057-62.

92. Lu, P., et al., *Influenza vaccination of recommended adult populations, U.S., 1989–2005.* Vaccine, 2008. **26**(14): p. 1786-1793.

93. Lu, P.-J., et al., *Seasonal Influenza Vaccination Coverage Among Adult Populations in the United States, 2005–2011.* American Journal of Epidemiology, 2013. **178**(9): p. 1478-1487.

94. Baker, J.P., *Mercury, vaccines, and autism: one controversy, three histories.* Am J Public Health, 2008. **98**(2): p. 244-53.

95. Gullion, J.S., L. Henry, and G. Gullion, *Deciding to opt out of childhood vaccination mandates.* Public Health Nurs, 2008. **25**(5): p. 401-8.

96. Quinn, S.C., T. Thomas, and S. Kumar, *The anthrax vaccine and research: reactions from postal workers and public health professionals.* Biosecur Bioterror, 2008. **6**(4): p. 321-33.

97. Sturm, L.A., R.M. Mays, and G.D. Zimet, *Parental beliefs and decision making about child and adolescent immunization: from polio to sexually transmitted infections.* J Dev Behav Pediatr, 2005. **26**(6): p. 441-52.

98. Hebert, P.L., et al., *The Causes of Racial and Ethnic Differences in Influenza Vaccination Rates among Elderly Medicare Beneficiaries.* Health Services Research, 2005. **40**(2): p. 517-538.

99. Nowalk, M.P., et al., *Parental Perspectives on Influenza Immunization of Children Aged 6 to 23 Months.* American journal of preventive medicine, 2005. **29**(3): p. 210-214.

100. Rhudy, L.M., et al., *Personal Choice or Evidence-Based Nursing Intervention: Nurses' Decision making about Influenza Vaccination.* Worldviews on Evidence-Based Nursing, 2010. **7**(2): p. 111-120.

101. Willis, B.C. and P. Wortley, *Nurses' attitudes and beliefs about influenza and the influenza vaccine: A summary of focus groups in Alabama and Michigan.* American Journal of Infection Control, 2007. **35**(1): p. 20-24.

102. Siegle, G.J., et al., *Can't shake that feeling: event-related fMRI assessment of sustained amygdala activity in response to emotional information in depressed individuals.* Biological Psychiatry, 2002. **51**(9): p. 693-707.

103. Fustos, J., et al., *On the embodiment of emotion regulation: interoceptive awareness facilitates reappraisal.* Soc Cogn Affect Neurosci, 2013. **8**(8): p. 911-7.

104. Garrett, A.S. and R.J. Maddock, *Time course of the subjective emotional response to aversive pictures: relevance to fMRI studies.* Psychiatry Research: Neuroimaging, 2001. **108**(1): p. 39-48.

105. Garrett, A.S. and R.J. Maddock, *Separating subjective emotion from the perception of emotion-inducing stimuli: An fMRI study*. NeuroImage, 2006. **33**(1): p. 263-274.

106. Bradley, M.M. and P.J. Lang, *Measuring emotion: The self-assessment manikin and the semantic differential.* Journal of Behavior Therapy and Experimental Psychiatry, 1994. **25**(1): p. 49-59.

107. Russell, J.A. and A. Mehrabian, *Evidence for a three-factor theory of emotions.* Journal of Research in Personality, 1977. **11**(3): p. 273-294.

108. Geason, J.A., et al., *The power of affect: predicting intention*, in *Journal of Advertising Research* 2002. p. 7-17.

109. Morris, J.D., *Observations: SAM: the Self-Assessment Manikin; an efficient cross-cultural measurement of emotional response.* Journal of advertising research, 1995. **35**(6): p. 63-68.

110. Scherer, K.R., *What are emotions? And how can they be measured?* Social Science Information, 2005. **44**(4): p. 695-729.

111. Desmet, P., *Measuring Emotion: Development and Application of an Instrument to Measure Emotional Responses to Products*, in *Funology*, M. Blythe, et al., Editors. 2005, Springer Netherlands. p. 111-123.

112. Mandryk, R.L., M.S. Atkins, and K.M. Inkpen, *A continuous and objective evaluation of emotional experience with interactive play environments*, in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*2006, ACM: Montreal, Quebec, Canada. p. 1027-1036.

113. Mast, F.W. and G. Zaltman, *A behavioral window on the mind of the market: An application of the response time paradigm.* Brain Research Bulletin, 2005. **67**(5): p. 422-427.

114. Rozin, P., L. Lowery, and R. Ebert, *Varieties of disgust faces and the structure of disgust.* Journal of Personality and Social Psychology, 1994. **66**(5): p. 870-881.

115. Haidt, M.R., 1994, modified by Olatunji et al. 2007, *The DS-R (Haidt, McCauley & Rozin, 1994, modified by Olatunji et al. 2007).* Retrieved April 2015.

116. Haidt, J., C. McCauley, and P. Rozin, *Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors.* Personality and Individual Differences, 1994. **16**(5): p. 701-713.

117. Olatunji, B.O., et al., *The Disgust Scale: Item analysis, factor structure, and suggestions for refinement.* Psychological Assessment, 2007. **19**(3): p. 281-297.

118. Faul, F., et al., *Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses.* Behav Res Methods, 2009. **41**(4): p. 1149-60.

119. Faul, F., et al., *G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences.* Behav Res Methods, 2007. **39**(2): p. 175-91.

120. Fessler, D.M.T. and C.D. Navarrete, *Domain-specific variation in disgust sensitivity across the menstrual cycle.* Evolution and Human Behavior, 2003. **24**(6): p. 406-417.