Summer 8-23-2015

Incidental Affect, Facial Expressions, and Risk

Michael M. Shuster
DePaul University, mshuster@depaul.edu

Incidental Affect, Facial Expressions, and Risk

A Dissertation

Presented in

Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

By

Michael M. Shuster

August, 2015

Department of Psychology

College of Science and Health

DePaul University

Chicago, Illinois

Dissertation Committee

Joseph A. Mikels, Ph.D., Chairperson

Linda A. Camras, Ph.D.

Kimberly Quinn, Ph.D.

Joel Whalen, Ph.D.

James Alvarez Mourey, Ph.D.

Acknowledgments

With overwhelming gratitude, I extend my most sincere thanks to my Dissertation Chairperson Dr. Joseph A. Mikels for his concise feedback, constructive counseling, and his exceptional support throughout the development of my thesis. I would also like to acknowledge Dr. Linda Camras for molding me into a future emotion researcher during my first few years at DePaul and for working closely with Dr. Mikels and myself on the development of this research project. I am also grateful for Dr. Kimberly Quinn's willingness to serve on my committee. I would also like to thank my friends and fellow lab mates at the Emotion and Cognition lab for their support and encouragement. Last but not least, I would like to thank my family for their unconditional support throughout my work on this project.

Biography

Michael Shuster (formerly Mikhail Shusternyak) was born in the city of Minsk, which is now a part of the Republic of Belarus. He graduated from James E. Taylor high school in Katy Texas in 2003. Michael received his Bachelor of Arts in psychology form the University of Texas at Dallas in 2007. In 2011 he earned his Masters of Arts degree in Psychology from DePaul University.

Table of Contents

Dissertation Committee. i

Acknowledgments. ii

Biography. iii

List of Tables vi

List of Figures viii

Abstract 1

General Introduction 4

Incidental Affect and Risk. 7

Emotional Facial Expressions, Affect, and Subjective Evaluations 14

Facial electromyography (EMG) 17

Rationale For Study 1. 20

Statement of Hypotheses 24

Method 25

Research participants 25

Measures 25

Procedure 31

Analysis and results 31

Hypothesis I 33

Hypothesis II 33

Rationale For Study 2. 52

Statement of Hypotheses 57

Method 61

Research participants 61

Materials 61

Procedure 66

Analysis and results. 67

Hypothesis I 68

Hypothesis II 69

Hypothesis III. 73

Hypothesis IV 73

Hypothesis V 80

References. 116

Appendix A. Affect Grid. 132

Appendix B mDES State affect Measure. 133

Appendix C. Numeracy Questionnaire. 134

Appendix D. Pre-Flu Study. 135

Appendix E. Post-Flu Study Questionnaire. 137

Appendix F. Script for Flu Commercials. 138

List of Tables

Table 1. Risk-Seeking Mistakes as a Function of the Covariates, Facial Posing Condition, and Affective Responding Variables. 36

Table 2. Risk-Averse Mistakes as a Function of the Covariates, Facial Posing Condition, and Affective Responding Variables. 37

Table 3. Confusion Mistakes as a Function of the Covariates, Facial Posing Condition, and Affective Responding Variables. 38

Table 4. Average Percent of Sub-Optimal Decisions by Condition 40

Table 5. Means and Standard Deviations for Affective Responding Variables by Condition and Age Group. 68

Table 6. ANOVA Results for the Effects of Age Group and Condition on fEMG 69

Table 7. ANOVA Results for the Effects of Age Group and Condition on Valence and Arousal. 70

Table 8. ANOVA Results for the Effects of Age Group and Condition on mDES Measures. 72

Table 9. Descriptive Statistics for the Changes in Evaluations of the Flu and Flu Vaccine by Age Group and Condition. 74

Table 10. Multivariate Effects of Age Group, Condition, and Covariates. 76

Table 11. Univariate F-test Results of Each Factor on Each of the Outcome Measures 78

Table 12. Steps 1 and 2 of Hierarchical Regression Analyses Relating Covariates and Main Effects on Vaccine Feelings and Flu-Related Worry 81

Table 13. Steps 1 and 2 of Hierarchical Regression Analyses Relating Covariates and Main Effects on Risk/Benefits and Intentions Scores. 82

Table 14. Step 3 of Hierarchical Regression Analyses Examining Effects of fEMG on Vaccine Feelings and Flu-Related Worry. 84

Table 15. Step 3 of Hierarchical Regression Analyses Examining Effects of fEMG on Risk/Benefits and Intentions Scores. 85

Table 16. Step 3 of Hierarchical Regression Analyses Examining Effects of Valence and Arousal on Vaccine Feelings and Flu-Related Worry. 88

Table 17. Step 3 of Hierarchical Regression Analyses Examining Effects Of Valence and Arousal on Risk/Benefits and Intentions Scores. 89

Table 18. Step 3 of Hierarchical Regression Analyses Examining Effects of Valence and Arousal on Vaccine Feelings and Worry about Getting the Flu. . . .91

Table 19. Step 3 of Hierarchical Regression Analyses Examining Effects of mDES measures on Risk/Benefits and Intentions Scores. 96

List of Figures

No Figures provided.

Abstract

Emotional facial expressions are potent social signals that can change people's feeling states and shape judgments of targets that are unrelated to the expressions. Whether they originate from other individuals or advertisements in the environment, facial expressions are undoubtedly one of the most prominent emotional stimuli. Thus, there is a great need to examine how facial expressions can influence potentially consequential judgments and decisions that involve uncertain or risky prospects, as such decisions are greatly impacted by emotion.

The domains of finance and health could particularly benefit from such an examination. In the financial domain, expressions of other individuals could shape investment behavior. For instance, facial expressions may trigger emotional reactions that can focus an individual on either the unwanted consequences or benefits of a risky option. In the health domain, individuals' evaluations of the risks and benefits associated with a medical treatment could be guided by the emotionality depicted on the face of a doctor. This second domain has particular relevance to older individuals due to their greater preference for positively over negatively valenced stimuli and the importance of effectively promoting preventative health behaviors for older adults.

Thus, two studies were conducted in order to examine the role of emotional facial expressions in judgments and decisions involving risk in the financial and health domains. The first study examined whether the posing of positive (happiness), negative (fear), and neutral facial expressions could influence participants' affective responding and ultimately their sub-optimal risk-

taking and risk-avoidant behavior in a financial investment task. In Study 1, the facial posing manipulation did not have the intended effect on participants' changes in self-reported valence. Specifically, in the neutral-posing condition, participants reported the greatest increase in negative valence and demonstrated significantly greater sub-optimal risk aversion in comparison to the fear-posing condition. Furthermore, significant relations between participants' facial responding and sub-optimal risk seeking behavior were discovered in the neutral posing condition. Specifically, decreased *corrugator* and increased *zygomaticus* activity in response to affectively neutral expressions in the neutral-posing condition was related to increased risk seeking. This relationship between fEMG activity and risk seeking was consistent with previously described relations between positive and negative affective and risk seeking. Thus, fEMG may be a useful tool when attempting to evaluate how individuals' affective responses to stimuli relate to their risk seeking behavior in financial decision tasks.

The second study explored whether spontaneous facial responses to emotional facial expressions presented during an influenza vaccine commercial could change participants' evaluations (behavioral intentions, risk perceptions, and integral feelings) regarding the flu vaccine. Importantly, this study included older and younger adults to examine whether aging-related increases in the preference for positive over negative information could lead to differential influences of positive and negative facial expressions on the above-mentioned evaluations. Manipulating the facial expressions in the commercial had a significant, albeit unpredicted effect on participants' evaluations. Relative to those who watched the smiling doctors, older and younger adults who watched the concerned doctors felt better about the vaccine. Furthermore, older adults who watched the smiling doctors reported greater increases in worry about contracting the flu in comparison to those who watched the concerned doctors. Overall, findings of Study 2 suggest that concerned rather than happy facial expressions should accompany messages that are aimed at increasing vaccination behavior.

General Introduction

Until recent decades, decision-making theorists posited that decisions with uncertain outcomes were navigated solely by weighing the probabilities and severity of favorable and unfavorable outcomes (e.g., Savage 1954). Such accounts were modified through the realization that affective processes influence rational calculations of risk in numerous ways (for review see: Lerner, Li, Valdesolo, & Kassam, 2014). Importantly, two manifestations of affect can influence risk-related decisions and judgments (i.e., subjective assessments of a target's potential for harm or benefit). *Integral* affect arises in response to one or more components of a decision (see e.g., Bechara, Damasio, Tranel, & Damasio, 1996; Schwarz & Clore, 2007; Slovic, Peters, & Finucace, 2005). In contrast, *incidental* affect originates from a source that is unrelated to the current task yet can infiltrate the decision process (see e.g., Lerner & Keltner, 2000; Tiedens & Linton, 2001). Incidental affect can lead to unintended consequences for decision makers as it can operate under the radar of one's awareness to influence their perception of probabilistic information (e.g., Caruso & Shafir, 2006; Constans, & Mathews, 1993; Mayer, Gaschke, Braverman, & Evans, 1992). Given the influence of affect on perceived probabilities, judgments and decisions involving risk are particularly vulnerable to incidental affect (Chou, Lee, & Ho, 2007; Lerner & Keltner, 2001; Raghunathan & Pham, 1999; Wright & Bower, 1992).

Given the potential for incidental affect to bias some of our most consequential decisions, it is paramount to better understand how incidental affect can influence our responses to risks when managing our finances and physical health. For instance, an incidental negative state can motivate one to avoid future losses, thus promoting a risk-averse strategy. Moreover, in the treatment domain, incidental positive affect may divert attention away from information highlighting the potential for unwanted outcomes such as side effects.

Beyond examining how incidental affect guides judgments and decisions involving risk, it is also critical to study the most prominent sources of incidental affect. One of the most common and ecologically valid sources of incidental affect are emotional facial expressions. Few emotional stimuli are as evident in everyday circumstances as are emotional facial expressions (Dimberg, Thunberg, & Elmehed, 2000; Hatfield, Cacioppo, & Rapson, 1994). Given their ubiquity and prominence in our social environment, it is surprising that so few studies have examined the influence of facial expressions on risk-related evaluations or decisions. Converging evidence suggest that facial expressions can create an affective context that may be sufficient enough to impact risk-related decision making (e.g., Habib, Cassotti, Moutier, Houdé, & Borst, 2015). For instance, viewing facial expressions can elicit emotional experiences (Lishner, Cooter, & Zald, 2008; Schneider, Gur, Gur, & Muenz, 1994). There is also considerable evidence that people automatically mimic observed facial expressions (for discussion see: Hess, Philippot, & Blairy, 1999) and experience the corresponding affective state through an embodied process called facial feedback (e.g., Cannon Hayes & Tipper, 2009; Hess & Blairy, 2001; Moody & McIntosh, 2006). Furthermore, emotional facial stimuli can influence evaluations of targets unrelated to the expression (Murphy, & Zajonc, 1993; Ottati, Terkildsen, &

Hubbard, 1997) and can even influence consumption behavior (Winkielman, Berridge, & Wilbarger, 2005).

Based on the converging findings from the multiple research areas that are cited above, it is likely that both posed expressions and spontaneous reactions to facial stimuli will influence risk-related decision-making in the consequential domains of health and finance. To test this prediction, two experiments were conducted in order to examine the role of emotional facial expressions in risk-related judgments and decisions. The first study examined whether modeling positive (happiness) or negative (fear) versus neutral facial expressions could influence risk-taking and risk-avoidant behavior in a financial investment task. The second study examined whether spontaneous facial reactions to emotional expressions presented during an influenza vaccine commercial could change participants' evaluations (behavioral intentions, risk perceptions, and integral feelings) regarding the flu vaccine. Importantly, this study included older and younger adult samples to examine whether age-related preferences for positive over negative information would lead to differential influences of positive and negative facial expressions on the above-mentioned evaluations.

Prior to discussing the unique rationale for each study, the following sections will review literature that is only relevant to both of the present experiments. The review begins by explaining how incidental affect relates to risk-related judgments and decisions. Next, the review focuses on the influences and measurement of facial expressions in social, emotional, and evaluative contexts.

Incidental Affect and Risk

Incidental affect can take the form of mood states (affective states that have lingered over from recent experiences), influences from the immediate environment, and/or the dispositional affective characteristics of an individual (Tiedens & Linton, 2001). Although incidental affect is unrelated to the present choice, it can have consequences for judgments and evaluations. Previous theoretical perspectives and empirical studies have outlined several ways that moods and other forms of incidental affect can impact the perception and/or selection of risky options. Specifically, incidental affect can “color” our perceptions and memory, change the process by which decisions are made, and alter our goals in a decision environment (for reviews see Winkielman, Knutson, Paulus, & Trujillo, 2007). It should be noted that the following two paragraphs discuss the effects of incidental affective states on judgments and decisions even though such effects are applicable to integral and incidental affect.

Incidental affect can alter cognitive processes such as the attention to, encoding, or retrieval of information. Regarding attention, incidental affect may focus an individual on aspects of the environment that correspond with an affective state (Weber et al., 2005). According to the Affect Infusion Model (AIM), such selective attention is thought to be concordant with a current mood-state. For instance, positive moods tend to focus attention toward the potential benefits and away from the downsides of a risky option (Forgas, 1994, 1995). Incidental affect can also influence how memory for information is encoded and retrieved (e.g., Bower, 1981, Matthews, Pitcaithly, & Mann, 1995; Watkins, Vache, Verney, & Mathews, 1996), and thus can have consequences in risk taking tasks that involve learning or accessing previous knowledge that is necessary to ascertain the riskiness of an option. For example, negative incidental affective states can trigger affectively-similarly information in memory (Bower, 1981). Next, incidental affect can alter how deeply and deliberately decisions are processed. Several theorists have argued that the human thought processes are guided by the requirements that are demanded by a certain situation (King & Hicks, 2009; Schwarz, 2011). People tend to feel good in the absence of threat or after attaining a positive outcome. Thus, such positive affective states can signal that "all is well" and are not often associated with the need for greater deliberation. Alternately, people tend to feel bad in problematic situations that require deliberate actions and thus negative affect is often associated with more deliberate processing. In summary, incidental positive affect can trigger more intuitive processing, whereas incidental negative states may result in a "bottom-up" processing strategy that involves a systematic attention to detail (King, Burton, Hicks, & Drigotas, 2007, King & Hicks, 2009; Schwarz, 2011). Lastly, incidental affective states can lead to specific appraisals that inspire action tendencies or other motivations that may change one's goal in a decision scenario (Lerner & Keltner, 2001; Lerner, Small, Loewenstein, 2004; Schaller, & Cialdini, 1990).

Importantly, incidental affect can be mistaken as integral affect that has been elicited by task-relevant characteristics such as choice options or the anticipation of an outcome (Schwarz, 2002; Schwarz & Clore, 1983; Wilson &

Daly, 2004). Such a misattribution is likely, given that incidental affect has been shown to impact decision making regardless of one's conscious awareness of it during decision process (e.g., Caruso & Shafir, 2006). Once incidental affect is mistaken for integral affect, it can influence judgments and decisions in a manner that is usually unique to the integral affect.

Integral affect typically arises as affective evaluations of previous experiences with similar task characteristics are incorporated into the decision process in order to improve future choices (i.e., the *affect as information* perspective: Schwarz, 2002, 2011). Popular evidence from physiological research exemplifies this phenomenon and highlights the function of bodily responses during risky decision making. Bechara and colleagues (1996) demonstrated that optimal performance in gambling tasks resulted from “somatic markers”, as measured by skin conductance responses, elicited prior to the selection of an option that previously yielded unfavorable outcomes. Over time, these anticipatory integral responses guided individuals with normal brain functioning away from unfavorable choices. Furthermore, according to research supporting the *affect heuristic* (e.g., Alhakami & Slovic, 1994; Finucane, Alhakami, Slovic & Johnson, 2000), positive integral feelings toward decision targets are often associated with higher perceived benefits and lower perceived risk. In contrast, negative integral feelings toward decision targets result in lower perceived benefits and higher risk perceptions.

The above section summarizes the primary ways that incidental affect can bias our judgments of uncertain prospects and ultimately our decision strategy when faced with a risky choice. Historically, research on the specific effects of incidental affect in risk-related behaviors has examined either the affective dimensions of valence and arousal or discrete emotions (e.g., happiness, and fear). Thus, the following review of empirical findings on the role of incidental affect in risk-related decision making will be organized according to the distinction between affective dimensions (valence and arousal) and discrete emotions.

The role of incidental valence. Circumplex models of affect (Russell, 1980) conceptualize affect as consisting of two underlying components: valence (positive vs. negative) and arousal (degree of autonomic nervous system activation associated with an emotional response). Some researchers propose that such an unpacking of affect can lead to a more nuanced understanding of the role of affect in risk taking (e.g. Mano, 1992, 1994). Supporting this proposition, studies that operationally defined and measured affect in terms of positively and negatively valenced states have yielded significant findings. Contrasting the effects of negative affect, positive affect (either measured or manipulated) has been related to more optimistic expectations for obtaining favorable outcomes (e.g., Johnson & Tversky, 1983; Mayer et al., 1992). In an early example, Johnson and Tversky (1983) presented participants with either tragic or happy newspaper articles. Participants exposed to the tragic reports provided higher risk estimates for a series of undesirable events (e.g., fires, floods, and causes of death) in comparison to participants who saw happy news reports. In a later study, Wright and Bower (1992) reported that participants in a positive mood overestimated the probability of positive events and underestimated the probability of negative events. Participants reporting negative mood states overestimated the probability of negative events and underestimated the probability of positive events. Few, if any, studies have examined the role of incidental valence on *actual* risk-taking, yet some studies have examined how induced mood states influenced hypothetical risk-taking. Yuen & Lee (2003) found that participants induced to feel negative moods were more conservative in their willingness to take risks than those in a positive or neutral mood. Similarly, Chou et al. (2007), induced participants into either positive, negative, or neutral mood states and found that both older and younger adults were more likely to take hypothetical risks in positive compared to the negative moods.

In summary, the above findings generally support mood-congruent effects of incidental affect on risk-related judgments and decision. Generally speaking, incidental positive affect states increase the weight given to positive aspects of an uncertain situation and thus relate to lower perceptions of risk and an increased tendency toward risks. In contrast, negative affect leads to an increased consideration of the negative aspects of risky situations, which relates to higher perceptions of risk and lower tendencies toward risk taking.

The role of incidental arousal. The experience of the arousal dimension of affect reflects the degree of autonomic nervous system activity and is considered the degree of activation that is associated with an affective response. Arousal can be measured on a scale that ranges from extreme calm or sleepiness at one pole, to intense states such as excitement at the other (Lang et al., 1993; Russell, Weiss, & Mendelsohn,1989). In decision making research, incidental arousal has been associated with both risk perception and risk taking (e.g., Ariely & Loewenstein, 2006; Mano, 1994). Mano (1994) demonstrated that individuals who reported experiencing higher levels of arousal were more prone to risky behavior as measured by their increased willingness to pay for lottery tickets but lower willingness to pay for insurance. Similarly, Ariely and Loewenstein (2006) found that incidentally induced states of high arousal were related to an increased willingness to participate in risky hypothetical behaviors. Regarding more integral influences of arousal, considerable research has measured physiological markers of autonomic arousal (e.g. heart rate and galvanic skin response) during various gambling (Bechara et al., 1997) and investment activities (for review see Lo & Repin, 2002). These studies suggest that physiological measures of arousal predict adaptive decision strategies that reduce sub-optimal risk taking in order to prevent unwanted losses.

The role of incidental discrete emotions. Purely "dimensional" conceptualizations of affective valence have historically been criticized by discrete emotion theorists for their inability to discriminate among qualitatively different states that are both high in arousal and negative valence (for review see: Fontaine, Scherer, Roesch, & Ellsworth, 2007). Lerner & Keltner's appraisal-tendency theory (2000) posits that discrete emotions can be similar in valence and arousal yet can lead to different judgments and decisions due to the unique cognitive/behavioral predispositions or action tendencies that are associated with the specific appraisals of discrete emotions. For instance, fear stems from appraisals of uncertainty and lower situational control, whereas anger and happiness originate from appraisals of certainty (Smith & Ellsworth, 1985). The appraisals of uncertainty that are motivated by fearful states increase perceptions of risk and lead to risk avoidant behavior. In contrast, the appraisals of certainty associated with anger decrease risk perceptions and increase risk-seeking (Lerner & Keltner, 2001).

Across multiple studies, incidental fear and anxiety have been related to increased risk estimates and risk-avoidant preferences (Lerner & Keltner, 2001; Raghunathan & Pham, 1999). Raghunathan and Pham (1999) induced participants into states of anxiety and sadness and found that more anxious states predicted increased preferences for low-risk, low-reward options in work-related and gambling scenarios. Sad mood states had the opposite effect of anxious states. Demonstrating further differentiation between negative emotions and their influence on risk evaluations, Lerner and Keltner (2001) found that individuals induced to feel fear made less optimistic estimates regarding future events. Relative to fearful individuals those in angry states had reduced risk estimates and demonstrated increased risk seeking in unrelated domains. In a similar study, Lerner and colleagues (2003) found that participants who were made to experience fear (about terrorism) evaluated unrelated negative outcomes (e.g., getting the flu) as more probable in comparison to individuals who were made to feel angry. These findings were consistent for both experimentally induced and naturally occurring forms of the emotions (Lerner, Gonzalez, Small, & Fischoff, 2003).

In summary, both dimensional (valence and arousal) and discrete emotion conceptualizations of incidental affect can predict risk-related judgments and decisions. Future research should thus continue to examine how risk-related decision making is influenced by incidental discrete positive and negative emotions in addition to general positive and negative affective states. Although numerous cues in the environment (even those that are minimally perceptible) can influence incidental affective sates (e.g., Niedenthal & Kitayama, 1994; Niedenthal & Setterlund, 1994), the next section discusses an influential and prominent source of incidental affect that has been under examined in decision making research.

Emotional Facial Expressions, Affect, and Subjective Evaluations

Facial expressions have long been considered to be a potent source of affective information and influence. For instance, viewing facial expressions can elicit emotional experiences that correspond with the viewed expression (Lishner, Cooter, & Zald, 2008; Schneider, Gur, Gur, & Muenz, 1994). There is even some evidence to suggest that compared to other types of emotional stimuli, facial stimuli are more affectively impactful in terms of their ability to trigger a physiological responses associated with core affective systems (Larsen, Norris, & Cacioppo, 2003).

Beyond altering a perceiver's affective state, the viewing of emotional faces has been found to influence unrelated behaviors (Winkielman, Berridge, & Wilbarger, 2005), evaluations (Murphy & Zajonc, 1993), and processing styles (Ottati et al., 1997). Such influences are examined using affective priming paradigms. In such paradigms, facial expressions or other emotional stimuli are shown to participants who are then asked to evaluate a target or perform a behavior. Even the subliminal presentation of facial expressions has influenced various evaluations (Murphy & Zajonc, 1993; Niedenthal, 1990, Niedenthal & Setterlund, 1994) and approach-avoidance behaviors (Winkielman et al., 2005). For example, participants exposed to subliminally presented smiles poured and drank more of a new beverage, whereas subliminally presented frowns had the opposite effect (Winkielman et al., 2005). Importantly, facial expressions seem to be unique among affective stimuli in their ability to motivate approach-avoidance behaviors (Starr, Gogolushko, & Winkielman, 2008).

An important question remains as to how emotional facial expressions are able to change the way we feel and how we evaluate things in our environment. One possible process through which the facial expressions of other individuals can impact our own feelings is *emotion contagion* (Hatfield et al., 1994; Parkinson & Simons, 2009). This affective transference can occur when an observer automatically mimics the emotional facial expression of another individual (Dimberg, Thunberg, & Elmehed, 2000; Wallbott, 1991). The mimicked movements are then theorized to trigger corresponding feeling states via an embodied process outlined by the *facial feedback hypothesis* (Adelmann, & Zajonc, 1989). According to this hypothesis, subtle contractions of muscles in a perceivers face change emotional states as the brain receives afferent muscular feedback signals from the face.

Darwin is credited with formulating the first hypotheses regarding the differential influence of positive and negative facial expressions on evaluations (Darwin, 1872/2005). Fear and anger were suggested to signal unfavorable conditions, whereas expressions of happiness were proposed to signal favorable conditions. More recently, researchers have explored how posed facial expressions influence various cognitive and affective processes.

Consistent results support the *facial feedback hypothesis,* or in other words, the proposition that activation of certain facial muscles changes the experience of affect or other autonomic system activity (Larsen, Kasimatis, & Frey, 1992; Levenson, Ekman, & Friesen, 1990; McIntosh, 1996). When an individual's facial muscle activity is inhibited by cosmetic procedures (i.e., BOTOX), they are less influenced by emotional videos in comparison to those who received injections of a substance that had no effect on their facial muscles (Davis, Senghas, Brandt, & Ochsner, 2010). Furthermore, requiring participants to pose facial expressions influences their self-reported affective states in the direction corresponding with the posed expression (e.g., Duclos, Laird, Schneider, Sexter, Stern, & VanLighten, 1989). Other studies have demonstrated that posing or inhibiting emotional facial expressions can alter the perception of emotional stimuli as well as judgments of other targets (e.g., Havas, Glenberg, Gutowski, Lucarelli, & Davidson, 2010; Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001; Strack, Martin, & Stepper, 1988). For instance, Strack et al., (1988) found that participants rated cartoons more favorably when pressing a pencil between their teeth (in a manner that formed their mouth into a smile) as opposed to their lips (in a manner that inhibited smiling). These findings are supported by accounts of embodied cognition, which suggest that the activation of sensorimotor cortex in the brain is imperative for some emotional processes (Nicotra, Critchley, Mathias, & Dolan, 2006; Winkielman, Niedenthal, & Oberman, 2008) and can impact risk-related decision making as the brain reacts to signals sent by the body (Bechara, Damasio, Damasio, & Anderson, 1994).

These above-mentioned studies and theoretical perspectives suggest that self-posed and incidentally presented facial expressions should be as effective as the affective manipulations used in previous research examining the role of affect on risk-related decision making. The present investigation will thus attempt to bias risk-related judgments and decisions with the use of emotional facial expressions. To best examine how facial responses to emotional expressions are involved in such biases, it is imperative to have a precise and objective measure of facial responding. Therefore, facial electromyography will be used in the present research as the measure of facial responding during the affective manipulations used in the tasks. The next sections will highlight the utility of measuring facial activity in order to assess affective responding in the current project.

Facial electromyography (EMG). Facial EMG is a tool frequently used to assess affect via measuring facial muscle movements. Despite the limited use of facial EMG in decision making research, the following review will highlight the utility of such a measure. Emotion theorists have long posited that facial expressions of emotion are evoked spontaneously and automatically and that some facial expressions can be used to interpret internal feeling states (Dimberg & Öhman, 1996; Ekman & Rosenberg 1997; Tomkins, 1962). EMG is a valid and reliable indicator of both the observable and unseen movements of facial muscles (e.g., Tassinary, Cacioppo, & Geen, 1989). Activations of facial muscles have consistently been associated with affective and physiological states (Ekman, Davidson & Friesen, 1990; Ekman, Levenson & Friesen, 1983, Rosenberg & Ekman, 1994). For example, the *corrugator supercilii*, the muscle that pulls the brow downward and together, is reliably activated when individuals report experiencing negative affect. The *zygomaticus major* is the muscle that pulls the mouth corners back and up to form a smile and is commonly associated with positive affect (Bonanno & Keltner, 1997; Bradley, Codispoti, Cuthbert, & Lang, 2001; Brown & Schwartz, 1980; Frank, Ekman, & Friesen, 1993; Hess, Banse, & Kappas, 1995). These two muscles are also automatically and rapidly elicited by emotional stimuli (Dimberg et al., 2000). Furthermore, researchers have discovered reliable patterns of responses to the valence of multiple kinds of emotional stimuli (e.g., words and faces; Larsen, Norris, & Cacioppo, 2003). Studies using emotional images find that the *corrigator supercillii* muscle is activated in response to unpleasant pictures and inhibited by positive pictures (Cacioppo, Petty, Losch, & Kim, 1986; Lang, Greenwald, Bradley, & Hamm, 1993) whereas the reverse pattern was observed for the *zygomaticus* muscle. Larsen, Norris, and Cacioppo (2003) measured fEMG while female participants viewed and later provided self-reported affective responses to positively and negatively valenced pictures, sounds, and words. Self-reported positive affective responding was positively related to *zygomaticus* activation. Researchers have even used facial EMG as a measure of affective responses to positively and negatively framed radio messages (Bolls, Lang, & Potter, 2001). Importantly, there is evidence that *corrugator* activation might be a better measure of valence given the stronger effect of valence on *corrugator*, in comparison to *zygomaticus* activity (Larsen et al., 2003). This is further corroborated by some neurophysiological evidence which suggests that due to the *corrugator's* relatively sparse representation in the motor cortex (involved in the conscious control over display rules), the muscle may even be a more implicit measure of emotional valence than the *zygomaticus major* (Larsen et al., 2003).

The next sections will introduce specific rationale for examining the influence of facial expressions on risk-related behavior. The rationale for Study 1 justifies examining the influence of posed facial expressions on financial risk-taking. Subsequently, the rationale for Study 2 provides reasoning justifying the examination of how incidentally-presented facial expressions may influence risk-perceptions and other evaluations of medical treatments.

Study 1: The Role of Incidental Positive and Negative Affect on Risky Investment Behavior

Rationale for Study 1

Given the robust influence of incidental affect on people's evaluations of and responses to uncertain prospects (e.g., Lerner & Keltner, 2001), it is imperative to understand how facial expressions, a frequently occurring source of emotional influence, can bias our decisions in the consequential domain of financial decision making. Recent evidence suggests that the viewing of facial expressions can impact gambling behavior (e.g., Habib et al., 2015). Although this research suggests that viewing facial expressions is sufficient to create an affective context that can influence risk taking, more research is needed to examine how the expressions present on one's own face can influence complex decision making involving risk.

As stated above, multiple studies demonstrate that individuals in incidental positive (compared to negative) valenced states viewed their probability of obtaining gains more optimistically even when the feeling was unrelated to their decision. Alternately, individuals reporting higher levels of incidental negative affect overestimated the likelihood of negative outcomes and underestimated the likelihood of positive outcomes (e.g., Johnson & Tversky, 1983; Wright & Bower, 1992). Other work has investigated the role of specific discrete emotions and their impact on risky decisions (Lerner & Keltner, 2001; Raghunathan & Pham, 1999). For instance, incidental fearful (versus angry and happy) states resulted in less optimistic estimates regarding future events and greater degrees of risk-averse choices (Lerner & Keltner, 2001).

Although facial expressions are common sources of affective influence, researchers have only recently began to examine how facial expressions can impact risk-related decision making. Habib, Cassotti and colleagues (2015) found that individuals presented with fearful and angry faces responded differently to the choice between a sure gain and a risky gamble. When faced with such a choice, participants in the fear face condition were less risk taking than those in the angry condition. Such findings corroborate the predictions made by the appraisal tendency theory regarding the appraisal-driven behaviors associated with discrete negative emotions. This study demonstrates that facial expressions can serve as a source of incidental affect and bias risk-related decisions. Still, no published studies have examined how posing facial expressions on one's own face can influence risk-related evaluations or decisions.

Evidence supporting the *facial feedback hypothesis* suggests that posed facial expressions reliably induce affective states (Duclos et al., 1989; Larsen et al., 1992; Levenson et al., 1990; McIntosh, 1996). Furthermore, the effects of facial feedback have been found to be strongest when the facial configurations match expressions of basic emotions (Levenson et al., 1990; Soussignan, 2002). Moreover, other research has demonstrated that posing emotional facial expressions can alter evaluations of unrelated stimuli (e.g., Niedenthal et al., 2001; Strack et al., 1988). The question remains as to whether emotional facial expressions are capable of influencing more complex behavior such as risk taking in the consequential financial domain.

Present Study

The present study examined the effects of a within-subject affective manipulation on subsequent risky decision making in an investment task. The manipulation required participants to imitate positive (happiness), negative (fear), or neutral facial expressions prior to making choices among three options: two high-risk, high-payoff stocks and a safe, yet low-payoff bond. The Behavioral Investment Allocation Strategy (BIAS) task was chosen for the present experiment as the performance of individuals in the task has previously been related to real-life measures of assets and debt (Kuhnen & Knutson, 2005; Samanez-Larkin, Kuhnen, Yoo, & Knutson, 2010). The BIAS task requires participants to repeatedly choose among a good stock, a bad stock, and a bond without explicit knowledge of which stock is more optimal. Furthermore, just like in the real stock market, participants see how both stocks performed after every investment choice. This feedback adds to the ecological validity of the task. In addition, the feedback allows participants to adjust their investment strategy based on the expected value of each stock. Once the expected value of one stock is clearly higher than the other stock, the selection of the low-payoff bond would be considered a risk-averse error. Alternately, when the expected values of the stocks are equal, the selection of either stock would be considered a risk-taking error given that both stocks are equally likely to result in a loss. This task is advantageous for examining the role of positive and negative affect on risk seeking as it allows for the examination of both risk-taking and risk-averse behavior.

Importantly, in order to determine the effectiveness of the emotion induction manipulations, participants completed an Affect Grid prior to and after each emotion induction as a manipulation check. As an additional manipulation check, fEMG measures of *corrugator* and *zygomaticus* activity were examined during the facial imitation procedure to ensure that participants were following the directions.

Based on findings from Lerner and Keltner's (2000) experiments on the role of incidental emotion on risk perception, participants were predicted to be less risk-taking and more risk-averse in the fear condition (compared to the happy and neutral conditions) as fear is associated with an appraisal of uncertainty and desire to mitigate loss. In contrast, participants were predicted to be more risk-taking in the happy condition (compared to the neutral and negative conditions) as happy states are associated with certainty and a tendency to approach risks.

In addition to serving as manipulation checks, the self-reported and physiologically-measured affective variables were also examined in their capacity to moderate the effect of the facial posing condition on risky decision making. For instance, participants who responded to the positive emotion induction procedure with a greater (versus lesser) change in positive valence (either measured via the Affect Grid or *zygomaticus* activity) were expected to more closely behave in the manner corresponding to the affective state. Thus in this example, they were expected to be more risk taking.

Hypotheses

HI. It was predicted that there would be a main effect of the within-subject emotion manipulation on participants' investment behavior in the BIAS task. Specifically, relative to their performance in the negative (fear) and neutral conditions, participants were expected to make more risk-taking mistakes and fewer risk-averse mistakes in the positive affect (happy) condition. In contrast, relative to their performance in the positive (happy) and neutral conditions, participants were predicted to make more risk-averse,mistakes and less risk-taking mistakes in the negative (fear) condition.

HII. It was further predicted that the magnitude of participants' facial responses to the stimuli and/or their changes in self-reported affect from before to after the stimuli would interact with the facial posing condition in order to influence their investment behavior. Specifically, participants who responded to the positive emotion induction procedure with a greater (versus lesser) change in positive valence (either measured via the Affect Grid or *zygomaticus* activity) were expected to demonstrate more risk-taking mistakes and fewer risk-averse mistakes. Alternately, participants who responded to the negative emotion induction procedure with a greater (versus lesser) change in negative valence (measured via the Affect Grid and *corrugator* activity) were expected to demonstrate fewer risk-taking mistakes and more risk-averse mistakes

Methods

Sample

Forty younger adults were recruited from the DePaul University SONA system subject pool and were compensated for their time via course credit. Two participants did not complete the entire procedure and the physiological data from another two participants was unusable due to technical malfunctions. Data from those four participants was excluded from the analyses resulting in a final sample of 36 participants (27 female) with an average age of 21.38.

Measures

The Affect Grid (Appendix A). The Affect Grid (Russell, Weiss, & Mendelsohn, 1989) was developed based on the Circumplex Model of Affect, which aims to represent a person's current affective state on a two dimensional graph with valence on the x-axis (anchored with "unpleasant" on the left and "pleasant" on the right) and arousal on the y-axis (anchored with "sleepiness" on the bottom and "high arousal" on the top). The Affect Grid instructs participants to rate how they are feeling at that present moment by placing a single mark on the nine by nine grid, thus allowing them to quickly report their state affect and valence with a single response. The participant's valence score is taken as the number of the box that is marked, with the boxes numbered from 1 to 9 along the horizontal axis. The arousal score is taken as the number of the box that is marked, with the boxes numbered from 1 to 9 along the vertical axis. The Affect Grid was previously validated with other measures of state emotion such as the PANAS (Watson, Clark, & Tellegen, 1988).

Numeracy. Numeracy is the ability to comprehend and work with quantitative information (Peters et al., 2006). Previous research has stressed the importance of comprehending numeric information in risky decision-making (e.g., Peters, 2012). Individuals high in numeracy have demonstrated reduced susceptibility to emotionally-driven framing effects (De Martino, Kumaran, Seymour, & Dolan, 2006; Peters et al., 2006). It is therefore a concern that numeracy may modulate the effect of an emotion induction procedure. Specifically, highly numerate individuals may be resistant to the effects of the emotion induction. Numeracy was thus measured using an 11-item measure (Lipkus , Samsa, & Rimer, 2001) and included as a covariate in all analyses of decision making behavior in order to assess and control for individual differences in the ability to comprehend numeric information (see Appendix C).

Modified Behavioral Investment Allocation Strategy (BIAS) task. The present study utilized a modified version of the BIAS task (Kuhnen & Knutson, 2005; Samanez-Larkin et al., 2010). The task was modified to include a within-participant emotion manipulation in order to study the effects of emotion induction on risky financial decision-making. The BIAS task is an investment task in which participants try to earn as much money as possible. At the beginning of the task, participants were informed that the task involves choosing between two risky options with variable chances of gaining/losing large amounts of money (stocks) and a sure option for gaining small amounts of money (bond). They were then informed that over each block of ten trials, there is a clear good and bad stock and that they must determine which is which in order to maximize their winnings. After ten trials, the good and bad stocks would be randomly re-assigned. Participants were further instructed that, on average, the good stock had a 50% probability of gaining $10, a 25% probability of neither a gain nor a loss, and a 25% probability of losing $10, whereas the bad stock had a 25% probability of gaining $10, a 25% probability of neither a gain nor a loss, and a 50% probability of losing $10. The outcome of the bond was consistently set at a 100% chance of gaining $1. This payoff structure was consistent across all blocks.

For the purpose of this study, the task was modified to include two emotion induction conditions (happiness and fear) and a neutral control condition. Participants completed three blocks of 10 trials for each of the three conditions (total of 90 trials). The order of the conditions was counterbalanced across participants, yet all three blocks of the same condition occurred one after the other in order to maximize the effect of the emotion induction. The participants' earnings were reset after each facial posing condition. Prior to the beginning of each block, participants completed the emotion induction task (described below) that corresponded to the given condition.

After the emotion induction procedure, the 10 trials began. At the beginning of each trial, participants were first presented with a two-second-long anticipation screen displaying the following options from left to right: a stock, a bond, and another stock. The following screen presented the word "choose" above the three options, during which participants had four seconds to choose which asset they would prefer (by pressing the corresponding key on the keyboard). Once the participant made their decision, there was a brief 2-second wait period that was followed by a 4-second screen displaying their earnings (or losses) for that trial in addition to their total earnings for the task. Finally, participants were shown the outcomes of each of the three possible assets for that trial for 4 seconds. This feedback was designed to help participants assess which of the stocks was more optimal in the given block.

Facial-posing emotion induction task. The procedure used to induce changes in affective experience was developed for the purpose of this study. Each administration of this induction began with a pre-test Affect Grid (Russell et al., 1989) to establish the participants' baseline valence and arousal. Next, participants were informed that they were going to evaluate the intensity of facial expressions and that they should do their best to imitate the expression for the full duration that the face was presented. Prior to each face, participants were exposed to a blank screen for 10 seconds. This period was used to collect baseline physiological measures. After the blank screen, participants were presented with a facial expression for 10 seconds. During this period, fEMG measures were collected. Next, participants were asked to rate the intensity of the expression on a scale of 1 (not at all intense) to 7 (extremely intense) using the number pad on their keyboard. Participants then viewed, imitated, and evaluated 10 faces prior to completing a post-test Affect Grid measure and beginning a new block of BIAS trials. The emotion depicted by the 10 expressions corresponded with the facial posing condition that they were currently in. For the happy condition, participants were only presented with happy faces. For the fear condition, participants were only presented with fearful faces. For the neutral condition, participants were presented with neutral facial expressions. Each set of ten photographs consisted of five male and five female younger adult models presented in a random order. The same models were used to display each of the three facial expressions.

Stimuli. The facial stimuli were taken from the FACES database, which contains 2,052 photos of younger and older adult emotional facial expressions (Ebner et al., 2010). The photos were created by photographing models as they posed prototypic emotional expressions. The validity of the expressions was examined with the use of the Facial Action Coding System (FACS) in order to make sure that the modeled expressions matched the prototypic expression configurations (Ekman & Friesen, 1977).

Physiological measures and apparatus. Two relatively unobtrusive physiological measures, fEMG and electrodermal activity (EDA), were collected. These measures served as objective measures of affective responses during the emotion induction portion of the task. Both facial and electrodermal activity was recorded at a sampling rate of 1 kHz with an integrated wireless system and software package (Biopac MP150, AcqKnowledge; Biopac Systems, Goleta, CA).

Facial electromyography (fEMG). fEMG activity served as an objective measure of participants' facial responses (Larsen et al., 2003) during the ten seconds prior to and after the initial presentation of the emotional faces in the emotion induction task. EMG was measured on the *corrugator* and *zygomaticus* muscle sites. Pairs of 4 mm Ag/AgCl electrodes were attached to the *zygomaticus major* and *corrugator supercillii* muscles following the guidelines set forth by Fridlund and Cacioppo (1986). The raw fEMG waveforms were first high-pass (at

400hz), low-pass (at 28hz), and notch filtered (at 60hz to reduce electrical noise) and then rectified (transformed into positive numbers), and smoothed with a moving average window of 50ms.

Next, *corrugator* and *zygomaticus* muscle activity was processed into scores for the analyses. First, to correct outliers, the data was “winsorized” within each participant (Tukey, 1977). Each participant’s facial activity during the facial posing trial was then divided into twenty 1000ms windows (ten for the baseline period prior to the trial and ten during the trial itself). Windows with absolute values that were higher than three standard deviations from the mean of a participant’s collective muscle activity were replaced with values representing three standard deviations from the mean for that participants’ muscle activity. In order to calculate a score representing the change in muscle activity from the baseline, fEMG activity in each 1000ms window during the posing trial was converted into a *z*-score using the mean and standard deviation of the facial muscle activity during all of that subject’s baseline periods. Facial activity *z*-scores across the 1000ms windows were then averaged into one score for each of the blocks. A positive score indicated that there was more activity during the posing trial than the average activity across all of the baseline periods.

Electrodermal activity. EDA activity was indicative of autonomic nervous system activation during the entire task. Such activations are often viewed as correlates of affective arousal (Cacioppo, Berntson, Larsen, Poehlmann, & Ito, 2000; Bechara et al., 1994; Lo & Repin, 2002) and can occur in response to emotional stressors (e.g., fear stimuli; Stern, Ray, & Quigley, 2001). Although physiological arousal was not central to the goals or scope of this present study, measures of EDA responses while participants completed the bias task were collected for exploratory purposes.

Procedure

After participants' signing of the consent form, fEMG sensors were attached to the *zygomaticus major* and *corrugator supercilii* muscle sites. Next, EDA electrodes were attached to the anterior tips of the phalanges of the middle and ring fingers on participants' non-dominant hand. After sensor calibration, participants began a five-minute rest period during which they relaxed and acclimated to the sensors. Next, participants completed the modified BIAS task and were informed that they would keep a proportion of their winnings (in order to make the task more personally relevant). After the task, participants completed a measure of numeracy and a basic demographics questionnaire. The sensors were then removed and participants were paid $1 regardless of their performance.

Analyses and Results

A total of 36 participants were included in the analyses (see sample section above for exclusion criteria). A manipulation check was first conducted in order to examine the influence of the facial posing task on participants' facial activity and self-reported affect. Next, the hypotheses were examined using multi level regressions.

Manipulation Check

Prior to testing the main hypotheses, it was important to examine whether the facial posing manipulation had the intended effect on participants' fEMG activity and self-reported affect.

First, separate one-way analyses of variance (ANOVA's) were conducted in order to determine if there was a difference in *corrugator* and *zygomaticus* activity across the three facial posing conditions. A main effect of condition was found for both *corrugator* ($F(2, 321) = 123.37$, $p <.001$, $\eta_p^2 =.435$) and *zygomaticus* activity ($F(2, 321) = 400.85$, $p < .001$. $\eta_p^2 =.714$).

Follow-up pairwise comparisons indicated that participants had significantly higher *corrugator* activity in the fear ($M = 4.00$, $SD = 3.65$) relative to the happy ($M = -.34$, $SD = .60$, $t(215) = 14.64$, $p < .001$) and neutral ($M = .38$, $SD = .73$, $t(215) = 12.25$, $p < .001$) posing conditions. Furthermore, *corrugator* activity in the neutral condition ($M = .38$, $SD = .73$) was significantly higher relative to the happy condition ($M = -.34$, $SD = .60$, $t(215) = 2.39$, $p = .018$).

For *zygomaticus* activity, pairwise comparisons indicated that participants had significantly higher *zygomaticus* activity in the happy ($M = 2.02$, $SD = .91$) relative to the fear ($M = .34$, $SD = .45$, $t(215) = 20.76$, $p < .001$) and neutral posing conditions ($M = -.18$, $SD = .18$, $t(215) = 27.05$, $p < .001$). Furthermore, *zygomaticus* activity in the fear condition ($M = .34$, $SD = .45$) was significantly higher relative to the neutral condition ($M = -.18$, $SD = .18$, $t(215) = 6.29$, $p < .001$).

Next, a one-way ANOVA was conducted in order to assess whether the posing conditions successfully manipulated self-reported changes in valence. A main effect of condition was found for changes in valence ($F(2, 321) = 3.28$, $p = .039$, $\eta_p^2 = .020$). Follow-up pairwise comparisons indicated that participants had a significantly greater reduction in valence (i.e., greater negative valence) after the posing trials in the neutral condition (*M* = -.47, *SD* = 1.24) relative to those in both the fear (*M* = -.07, *SD* = 1.43, $t(215) = -2.06$, $p < .001$) and happy (*M* = -.02, *SD* =1.56, $t(215) = -2.35$, $p < .001$) conditions. Changes in valence were not significantly different between the happy (*M* = -.02, *SD* =1.56) and fearful conditions (*M* = -.07, *SD* = 1.43, $t(215) = .29$, $p = .774$).

Tests of Main Hypotheses

To determine the percentage of sub-optimal choices made, participants' choices were compared to a rational investment strategy model used in previous BIAS task research (Kuhnen & Knutson, 2005). The model uses the feedback from each stock's earnings and losses in previous trials (within the same block) to calculate the expected value of each stock and thus determine the optimal choice for every decision trial. Choices that deviated from the rational strategy model were counted as sub-optimal mistakes in one of three ways. Risk-taking mistakes were scored when participants selected a stock rather than a bond when it was still unclear which stock was optimal. Risk-averse mistakes were scored when participants selected a bond when it should have been clear that one of the stocks was optimal. Lastly, confusion mistakes were scored when participants selected one stock when it was clear that the other one was the optimal choice. Although no predictions regarding confusion mistakes were made, these mistakes are examined in the analyses for exploratory purposes. These scores were averaged across each block into scores representing the percentage of each type of mistake made in each block of 10 trials. These percentages served as the outcome variables in the following analyses.

To test Hypotheses I and II, multi-level regressions were conducted in order to examine whether participants made significantly different percentages of sub-optimal decisions across the three facial posing conditions. Additionally, the analyses tested whether the participants' self-reported affect and fEMG activity moderated the effect of the emotion expression condition on the percentage of each type of sub-optimal mistake. Multi-level regressions (fit using restricted maximum likelihood) were used because the data has a multi-level structure, i.e., the blocks were nested within subjects. Multi-level analyses such as these have notable advantages over repeated measures ANOVAs. Namely, the unit of analysis in these multi-level regressions is the block itself, rather than the individual (as it would be with a traditional ANOVA). Therefore, this analysis controls for the non-independence among the repeated observations across each block and each individual.

Three step regressions were run for each of the three sub-optimal decision scores, which served as dependent variables. The first step of each regression included the covariates of numeracy (in order to control for participants' ability to work with quantitative information) and a variable representing the order of the blocks (in order to control for improved decision making as the blocks progressed). The second step included the factor representing the main effect of the facial posing condition in order to test HI. The variable representing the posing condition was dummy coded so that the neutral condition would serve as the referent group. Lastly, the third step tested HII by including the factors representing the three continuous affect variables (self-reported valence, *corrugator* activity, or *zygomaticus* activity) and the interactions between the affect variables and condition. Follow-up post-hoc analyses were used to examine if the percentages of sub-optimal mistakes differed across each pair of conditions. Significant interactions in the third step were examined by computing simple slopes. See Tables 1, 2, and 3 for detailed effects of the predictors at each step of the regressions for risk-seeking, risk-averse, and confusion mistakes.

Table 1.

Risk-Seeking Mistakes as a Function of the Covariates, Facial Posing Condition, and Affective Responding Variables

	Step 1			Step 2			Step 3		
	b	*SE*	*t*	*b*	*SE*	*t*	*b*	*SE*	*t*
Intercept	20.24*	8.60	2.35	20.28*	8.66	2.34	25.21*	9.28	2.71
Block order	-0.64*	0.29	-2.18	-0.64	0.30	-2.17	-0.60*	0.30	-1.97
Numeracy	1.98	11.74	0.17	1.98	11.74	0.17	4.12	12.46	0.33
Fear vs. Neutral Condition				-0.02	1.79	-0.01	-8.44*	-8.44	3.34
Happy vs. Neutral Condition				-0.09	1.79	-0.05	-7.83	-7.83	4.38
Valence Ratings							1.26	1.21	1.04
Corrugator Activity							-3.92*	2.04	-1.92
Zygomaticus Activity							26.27**	8.55	3.07
Fear vs. Neutral * Valence							-0.79	1.56	-0.51
Happy vs. Neutral * Valence							-0.75	1.42	-0.53
Fear vs. Neutral * *Corr*							4.40*	2.08	2.12
Happy vs. Neutral * *Corr*							4.76	3.25	1.46
Fear vs. Neutral * Zyg							-26.67**	9.58	-2.78
Happy vs. Neutral * *Zyg*							-25.59**	8.76	-2.92
Wald χ^2	.900, p = .630			4.75, p = .314			19.82, p = .099		

Note. Values are the MLM unstandardized b coefficients (SE in parentheses). *p < .05; **p < .01; ***p < .001.

Table 2.

Risk-Averse Mistakes as a Function of the Covariates, Facial Posing Condition, and Affective Responding Variables

	Step 1			***Step 2***			***Step 3***		
	b	*SE*	*t*	*b*	*SE*	*t*	*b*	*SE*	*t*
Intercept	31.19*	9.78	3.19	32.80*	9.82	3.34	33.54*	10.30	3.26
Block order	0.23	0.29	0.81	0.26*	0.29	0.91	0.38	0.30	1.29
Numeracy	-6.58	13.40	-0.49	-6.58	13.40	-0.49	-8.71	13.91	-0.63
Fear vs. Neutral Condition				-3.86*	1.73	-2.23	-5.19	3.30	-1.57
Happy vs. Neutral Condition				-1.39	1.73	-0.80	5.88	4.33	1.36
Valence Ratings							-0.28	1.20	-0.23
Corrugator							-0.16	2.02	-0.08
Zygomaticus							-0.43	8.45	-0.05
Fear vs. Neutral *Valence							-1.98	1.54	-1.28
Happy vs. Neutral *Valence							-0.25	1.40	-0.18
Fear vs. Neutral **Corr*							0.64	2.05	0.31
Happy vs. Neutral * *Corr*							4.89	3.22	1.52
Fear vs. Neutral * *Zyg*							-1.49	9.50	-0.16
Happy vs. Neutral * *Zyg*							-2.30	8.67	-0.27
Wald χ^2	.900, p = .639			6.00, p = .199			17.45, p = .180		

Note. Values are the MLM unstandardized b coefficients (SE in parentheses). *p < .05; **p < .01; ***p < .001.

Table 3.

Confusion Mistakes as a Function of the Covariates, Facial Posing Condition, and Affective Responding Variables

	Step 1			Step 2			Step 3		
	b	*SE*	*t*	*b*	*SE*	*t*	*b*	*SE*	*t*
Intercept	8.15	5.27	1.55	6.98	5.32	1.31	6.70*	5.62	1.19
Block order	-0.74**	0.20	-3.62	-0.64*	0.30	-2.17	-0.64*	0.21	-3.09
Numeracy	2.98	7.16	0.42	1.98	11.74	0.17	4.13	7.47	0.55
Fear vs. Neutral				-0.02	1.79	-0.01	-8.44	3.34	-2.53
Happy vs. Neutral				-0.09	1.79	-0.05	-7.83	4.38	-1.79
Valence Ratings							-0.46	0.81	-0.57
Corrugator							2.02	1.38	1.47
Zygomaticus							11.65*	5.87	1.99
Fear vs. Neutral * Valence							0.21	1.06	0.20
Happy vs. Neutral * Valence							0.71	0.97	0.73
Fear vs. Neutral * Corr							-2.52	1.40	-1.80
Happy vs. Neutral * Corr							-5.43*	2.22	-2.45
Fear vs. Neutral * Zyg							-14.59*	6.55	-2.23
Happy vs. Neutral * Zyg							-12.91*	6.01	-2.15
Wald χ^2	13.25, p = .001			16.58, p = .002			31.90, p = .003		

Note. Values are the MLM unstandardized b coefficients (SE in parentheses). *p < .05; **p < .01; ***p < .001.

Step 1: Numeracy and block order on sub-optimal decision making. The first step of each regression examined the influence of the covariates, block order, and numeracy, on sub-optimal decision making (see step 1 statistics in tables 1, 2, and 3). Controlling for the order in which the blocks were presented, numeracy had no effect on any type of sub-optimal decision. Regarding the influence of the order variable, subjects made fewer risk-seeking mistakes (b = -.64, t(105) = -2.18, p = .03) and confusion mistakes (b = -.74, t(105) = -3.62, p < .001) as blocks progressed. No significant effects of block order or numeracy for risk-averse mistakes were found and are therefore not described.

Step 2: Main effects of facial posing condition on sub-optimal decision making. The second step in each regression included the main effect of facial posing condition with the neutral condition dummy coded as the referent. Thus, the unstandardized betas reported for the fear and happy conditions represent the changes in the slopes relative to the neutral condition. Table 4 reports the mean percentage of each sub-optimal mistake for each condition. As indicated in step 2 of Table 2,and confirmed using pair-wise comparisons, the percentage of risk averse mistakes was lower in the fear-posing condition relative to the neutral condition (b = -3.86, t(104) = -2.23, p = .03). The percentage of risk-seeking mistakes and confusion mistakes did not vary across conditions. As for the covariates, subjects made fewer risk-seeking mistakes (b = -.64, t(104) = -2.17, p = .03) and confusion mistakes (b = -.75, t(104) = -3.69, p < .001) as the order of the trials progressed. Numeracy had no effect on sub-optimal decision making (see step 2 of Tables 1, 2, and 3).

Table 4.

Average Percent of Sub-Optimal Decisions by Condition

	Risk-Seeking Mean (SD)	Risk-Averse Mean (SD)	Confusion Mean (SD)
Condition			
Fear	18.33 (20.07)	25.65 (22.72)	7.41 (13.42)
Happy	18.43 (21.62)	28.06 (23.30)	6.85 (11.97)
Neutral	18.52 (22.12)	29.44 (23.36)	5.37 (9.61)

Step 3: Main effects of affective responding (self-reported valence and fEMG) and interactions between affective responding and facial posing condition on sub-optimal decision making. The third step in each regression tested HII by assessing how sub-optimal decisions were influenced by the interactions among the fEMG variables and condition as well as by the interaction between the degree of self reported valence change and condition. The following sections detail the results of the regressions for risk-seeking and confusion mistakes. No significant main effects or interactions were observed for risk-averse mistakes and are therefore not described (see step 3 of Tables 1, 2, and 3).

Risk-seeking mistakes. As in previous steps of the regression for this outcome variable, the significant effect of the order variable indicates that there were lower percentages of risk-seeking mistakes as the blocks progressed (b = -.06, $t(100) = -1.97$, p = .05). Significant main effects for the fear vs. neutral condition and both of the fEMG variables were found in the third step of the risk-seeking regression; however these main effects were not interpretable given the presence of significant interactions between the fear vs. neutral condition and zygomatic EMG activity variables (see Table 1).

There was no significant interaction between valence-ratings change scores and facial posing condition. Significant interactions between the fear vs. neutral condition variable and both fEMG variables were found. In addition the results indicated a significant interaction between the happy vs. neutral condition and *zygomaticus* activity. Specifically, the slopes demonstrating the relationship between *corrugator* activity and risk-seeking mistakes were different between the fear and neutral conditions (b = 4.40, t(100) = 2.12, p = .034). The slopes demonstrating the relationship between *zygomaticus* activity and risk-seeking mistakes in the fear (b = -26.67, t(100) = -2.78, p = .005) and happy (b = -25.59, t(100) = -2.92, p = .003) conditions were both different from the slopes in the neutral condition.

Follow-up examinations of simple slopes were conducted to examine how the influence of both fEMG variables on risk-seeking mistakes differed across emotion induction conditions. No effects of EMG activity were found for either the fear or happy conditions. In the neutral condition blocks, the percentage of risk-seeking mistakes was negatively related to *corrugator* activity (b = -3.92, t(100) = 2.04, p = .050) and positively related to *zygomaticus* activity (b = 26.27, t(100) = 3.07, p = .002). Thus, decreased *corrugator* activation and increased *zygomaticus* activation related to increased percentages of risk-seeking mistakes in the neutral condition.

Confusion mistakes. A significant effect of the order variable was found, indicating that there were lower percentages of confusion mistakes as the blocks progressed (*b* = -.64, *t*(100) = -3.09, *p* = .002). A significant main effect of *zygomaticus* activity was found in the third step of this regression, yet this main effect was qualified by a significant interaction between condition and *zygomaticus* activity (thus rendering the main effect uninterpretable).

There was no significant interaction between valence-change and condition. Significant two-way interactions among the condition variable and both EMG variables were found. Specifically, the slopes representing the relationship between *corrugator* activity and confusion mistakes were different in the happy relative to the neutral condition (*b* = -5.43, *t*(100) = 2.22, *p* = .014). The slopes demonstrating the relationship between *zygomaticus* activity and confusion mistakes in the fear (*b* = -14.59, *t*(100) = -2.23, *p* = .026) and happy (*b* = -12.91, *t*(100) = -2.15, *p* = .032) conditions were both different from the slopes in the neutral condition.

Follow-up examinations of simple slopes were conducted to determine how the influence of both fEMG variables on confusion mistakes differed across emotion induction conditions. In the neutral condition blocks, the percentage of confusion mistakes was positively related to *zygomaticus* activity (*b* = 11.65, *t*(100) = 5.87, *p* = .047). Thus, increased *zygomaticus* activation (in response to the faces prior to decisions) in the neutral blocks related to increased percentages of confusion mistakes. For blocks within the happy condition, increased *corrugator* activity was related to decreased confusion mistakes ($b = -3.41$, $t(100) = -2.00$, $p = .046$).

Additional Analyses

Given the unexpected relationship between fEMG activity and risk-seeking behavior in the neutral and happy conditions, correlations were conducted in order to examine if facial responding was related to changes in valence (as measured by the Affect Grid) separately for each condition. In all conditions, self-reported changes in valence was not significantly correlated to either *corrugator* or *zygomaticus* activity (all p's $>.05$)

Discussion

The current investigation aimed to examine how a facial posing manipulation of incidental affect influenced the percentage of sub-optimal decision-making errors in an investment task. Furthermore, an additional aim was to examine if the extent to which participants were influenced by the manipulation (in terms of their facial muscle activity and self-reported affective valence) impacted their risk-related decisions differently across conditions.

Influence of facial posing condition on fEMG activity

On average, participants successfully followed the instructions in the facial posing task. Specifically, greater *corrugator* activity was present in the fear relative to the happy and neutral conditions and greater *zygomaticus* activity was present in the happy relative to the fearful and neutral conditions.

Influence of Facial Posing Condition on Changes in Self-Reported Valence

The manipulation check indicated that the facial posing manipulation did not have the intended effects on participants' changes in self-reported valence. Contrary to expectations, participants in all conditions reported some degree of increased negative valence from before to after the facial posing tasks. The greatest increase in negative valence was in the neutral condition. These findings indicate that the posing task was, to some extent, unpleasant overall and especially unpleasant in the neutral condition. Potentially, participants felt more negative valence after the neutral condition due to a lower level of engagement (or increased boredom from posing and evaluating the neutral stimuli).

Influence of Facial Posing Condition on Risk-Related Decision Making

Hypothesis 1 proposed that participants would be make more risk averse mistakes in the negative affect (fear-posing) condition relative to the neutral and positive affect (happy-posing) conditions. Participants were predicted to make more risk-seeking mistakes in the positive affect (happy-posing) relative to the negative affect (fear-posing) and neutral-posing conditions. The results do not support these predictions. The percentages of risk-seeking choices were not significantly different across the facial posing conditions. Further contrary to the predictions, participants demonstrated more sub-optimal risk aversion in the neutral condition relative to the negative affect (fear-posing) condition. These results are indeed inconsistent with previous findings regarding the influence of facial expressions on decision making. Importantly, though, the manipulation check analyses revealed that relative to the other conditions, participants experienced significantly greater increases in negative affect in the neutral condition. Given that negative affect is related to increased risk aversion mistakes, it is not surprising that participants made greater percentages of risk-averse mistakes in the neutral condition.

Moderating Influence of Facial Muscle Activity and Valence Change on Risk-related Decision Making Across Facial Posing Conditions

The second hypothesis proposed that the degree to which participants were influenced by the facial posing manipulation would moderate the influence of condition on decision making. The influence of the manipulation was measured in two different ways: (1) by assessing the degree to which participants activated their *corrugator* and *zygomaticus* muscles during the facial posing task, and (2) by assessing the degree to which their self-reported valence changed from before to after the task. It was specifically predicted that participants who responded to the positive emotion induction procedure with a greater (versus lesser) change in positive valence (either measured via the Affect Grid or *zygomaticus* activity) would make more risk-taking mistakes and fewer risk-averse mistakes. Furthermore, participants who responded to the negative emotion induction procedure with a greater (versus lesser) change in negative valence (measured via the Affect Grid and *corrugator* activity) were predicted to make fewer risk-taking mistakes and more risk-averse mistakes.

Overall, there was no support for the predictions regarding the moderating influence of the affective responding variables on the relationship between the posing condition and sub-optimal decision making. First, no interactions between the facial posing condition and self-reported changes in valence were found. This indicated that the extent to which participants' self reported affect predicted sub-optimal decision making did not differ across conditions. The significant interactions between the posing condition variable and fEMG variables indicate that the influence of facial activity on risk-seeking mistakes and confusion mistakes did differ across conditions. Unfortunately, the pattern of results did not support the hypotheses. It is possible that this lack of support for the predictions was due to the unsuccessful manipulation of incidental affect. The following sections discuss the interactions among condition and facial activity on risk-seeking and confusion mistakes in detail.

Risk-seeking mistakes. As stated above, risk-seeking mistakes occurred when participants selected a risky option when it was not yet clear if a stock had a greater expected value than the bond. No relations among EMG activity and risk-seeking mistakes were found for either the fear or happy conditions. Although participants in the neutral condition were instructed to pose neutral facial expressions, variability in *corrugator* and *zygomaticus* responding to the neutral expressions was related to the percentage of risk-seeking mistakes. Specifically, in the neutral condition blocks, decreased *corrugator* activation and increased *zygomaticus* activation (in response to the faces in the neutral blocks) resulted in increased percentages of risk-seeking mistakes. Indeed, this pattern of results was not predicted. Nonetheless, previous research suggests that if the pattern of facial responding to the neutral stimuli was a manifestation or correlate of affective experience, then the associations between facial responding and risk seeking in the neutral condition should have been expected.

Based on previous research, corrugator responding is related with higher levels of experienced negative affect (Larsen, et al., 2003), and negative affect is related to less risk-seeking behavior (e.g., Habib et al., 2015; Yuen & Lee, 2003). Conversely, *zygomaticus* responding is known to relate to increased experience of positive affect (Larsen, et al., 2003), which other research has found to predict increased risk-seeking behavior (e.g., Chou et al., 2007). Unfortunately, such an explanation cannot be supported by the current data given that neither *corrugator* nor *zygomaticus* activity were correlated with self-reported changes in valence in the neutral condition. On the other hand, it is possible that the variability in *corrugator* and *zygomaticus* activity in response to neutral stimuli reflected unconscious affective experiences that participants were not aware of and thus unable to report on the Affect Grid. If this were the case, then the general relationship between facial responding and risk seeking in the neutral condition is in line with the research mentioned above.

An alternate explanation is that participants' facial responses to the neutral stimuli reflected an interpretive or evaluative bias that carried over to the decision task. Previous work has linked *corrugator* responding to a negativity bias in the evaluation of affectively ambiguous facial stimuli (Neta, Norris, & Whalen, 2009). The neutral expressions in the present study were also ambiguous in valence, thus the pattern of facial responses during the neutral posing task may have reflected a similar interpretive bias. For instance, increased *corrugator* activity in the neutral posing condition could have indicated that a participant was evaluating the neutral face more negatively.

If this were the case, then it is possible that such interpretive biases could have also extended to evaluations of the stocks and bonds. For instance, if a participant evaluated the neutral faces more negatively, it is possible that they also evaluated the ambiguous stocks more negatively and thus avoided them. Alternately, if a participant evaluated the neutral faces more positively (as could be indicated by increased *zygomaticus* activity) then they could have also evaluated the subsequent ambiguous stocks to be more positive and thus were more sub-optimally risk seeking.

The presence of interactions for risk-seeking mistakes and not for risk-averse mistakes indicates that facial responses in the neutral condition were related to a propensity to incorrectly select risky options over optimal safe options and not the propensity to incorrectly choose safe options over more optimal risky options. Again following the reason above, which suggests that facial responses can represent evaluations of ambiguous stimuli, it can be suggested that facial responding would not predict the selection of a non-ambiguous bond. The bond was unambiguous in that it had the same rate of return for every trial ($1).

Confusion mistakes. These types of mistakes occurred when participants selected a sub-optimal stock rather than an optimal one. Although no specific predictions regarding the interaction of condition and facial activity were made for confusion mistakes, an interesting pattern of results emerged. Specifically, increased *zygomaticus* activation in the neutral blocks was related to an increased percentage of confusion mistakes. This suggests that positive affect (as suggested by increased *zygomaticus* activity) may be related to more haphazard and less optimal risk-taking in the current investment paradigm. As mentioned above in the previous section, the current data cannot support this explanation, as valence change was not correlated to fEMG activity in any condition. Alternately, a similar explanation can be made for this finding as was provided earlier for the relation between *zygomaticus* activity and risk-seeking mistakes in the neutral condition. That is, increased *zygomaticus* activity in response to the neutral stimuli can reflect an overall interpretive bias that would relate to more positive evaluations of ambiguous risky stock options.

Furthermore, in the happy condition, increased *corrugator* activity was related to decreased confusion mistakes. These results can be taken to suggest that negative affective facial responding in the happy condition was related to a lower likelihood of selecting sub-optimal risky stocks. Although as previously mentioned in this discussion, such an explanation is not supported by the current data given the lack of correlation between valence change and fEMG activity in the happy condition.

Limitations and Future Directions

It is possible that the lack of support for the predictions regarding the influence of the facial posing condition on decision making was due to the unsuccessful manipulation of incidental affect across all conditions. Future research may opt for a task requiring participants to passively view facial expression rather than pose them as such a task has been successful in altering risk-seeking behavior in previous research (Habib et al., 2015).

Furthermore, the facial posing task may have been too explicit of a manipulation and lacked some degree of ecological validity. For instance, individuals are never required to imitate facial expressions prior to making risky decisions in real-world settings. Future research examining the role of (incidental) affective stimuli on risk-related behavior should strive to integrate the affective stimuli with the decision targets in a more cohesive manner. For example, this could be achieved by manipulating the facial expressions of individuals in commercials then asking viewers to evaluate the risks of the product being advertised. Lastly, future research may consider utilizing an independent groups design rather than a repeated measures design as such a design would control for carry-over effects of the emotion conditions to a better extent than by merely counterbalancing the order of conditions in a repeated measures design.

Conclusion

Although the main predictions regarding the influence of the facial posing manipulation on risk-related decision making were not supported, significant relations between risk-seeking mistakes and fEMG activity were found in the neutral condition. These findings suggest that increased *corrugator* responses to neutral facial expressions may predict reduced risk seeking, whereas increased *zygomaticus* activity in response to the same stimuli may predict increased risk seeking. These findings begin to shed light on how one’s fEMG responses to facial stimuli can predict risk-related decision making. More research is still needed to determine whether the pattern of results in the present study can be explained by changes in affective experiences or by interpretive biases that carry over onto the decision scenario.

Rationale for Study 2:

The Role of Incidental Affect in Risk Perception, Feelings, and Behavioral Intentions toward the Flu Vaccine in Older and Younger Adults

Extending from the previous study's examination of the influence that incidental affect has on financial risk taking, Study 2 will examine how incidental affect can change risk perceptions, affective judgments, and behavioral intentions toward flu vaccinations for younger and older adults. Given that the flu is preventable with the use of vaccines (Nichol et al., 1995), it is important to address barriers to vaccination that may contribute to the less than ideal rates of vaccination for younger and older adults (Nichol, Margolis, Wuorenma, Von Sternberg, 1994). One common barrier to vaccination practices for older and younger adults is the perceived risk related to vaccines (Bartels, Kelly, & Rothman, 2007; Betsch, Ulshöfer, Renkewitz & Betsch, 2011; Ferguson & Gallagher, 2007; Zimmerman et al., 2003).

Although previous research has effectively changed treatment-related feelings and risk perceptions through the use of message-frame manipulations (e.g., McCaul, Johnson, & Rothman, 2002; Rothman, Salovey, Antone, Keough, & Martin, 1993), researchers have largely ignored more social media through which consumers and patients receive much of their health information. The present study attempted to change risk perceptions, feelings, and intentions regarding the flu vaccine by inducing incidental affect through the use of an *affective framing* manipulation. The manipulation required participants to watch an informational commercial about the flu vaccine. Based on the previously discussed influences of positive and negative valence on judgments and decisions involving risk, the commercial depicted doctors who were either displaying facial expressions representing positive affect (smiling) or negative affect (furrowing their brow in concern). Brow furrowing was achieved by activating the *corrugator* muscle. The *corrugator* was the only muscle that is activated in the display of all negative emotional facial expressions and is not a component of any emotionally positive expression (Ekman & Friesen, 1975).

Based on the research described above, emotional facial expressions accompanying medical information in commercials were predicted to modulate the influence of the health messages. Specifically, affect elicited from emotional expressions accompanying health massages was expected to influence risk and benefit perceptions, and shape intentions to vaccinate. Additionally, given the age-related shift toward a preference for positive over negative information, the positive and negative emotional stimuli were predicted to have differential effects for older and younger adults (Carstensen & Mikels, 2005; Chou et al., 2007).

As previously described, early research conducted outside of the medical domain supports the association between induced incidental affect and risk perception. Specifically, incidental positive affect leads to higher subjective probabilities of positive outcomes and negative affect leads to higher subjective probabilities of negative outcomes (e.g., Johnson & Tversky, 1983; Wright & Bower, 1992). In the domain of vaccines, a positive outcome would involve the vaccine working and resulting in no undesired side effects, whereas a negative outcome would involve the vaccine not working and/or causing unwanted side effects. Examining the influence of incidental affect on treatment evaluations for older and younger adults requires a consideration of age differences in health-related risk perception, vaccine utilization, and most importantly, emotional processes that are relevant for risk-related decision making.

Research examining age-differences in risk perception across multiple domains found that compared to the young, older adults were less likely to take risks that could aversely affect their health (Rolison, Hanoch, Wood, & Liu, 2013). Thus, it may be no surprise that older adults receive influenza vaccinations at higher rates than their younger counterparts in order to reduce their risk of contracting the flu (Bish, Yardley, Nicoll, & Michie, 2001; Galvani, Reluga, & Chapman, 2007). Unfortunately, few psychological studies have examined risk perceptions related to the flu or the flu vaccine among older and younger adults. Given the higher rates of vaccine utilization among older adults, it is unclear whether they perceive the flu to be riskier or whether they perceive the flu vaccine to be less risky than it is beneficial. Either way, the findings regarding age differences in vaccine utilization stress the importance of controlling for previous vaccine usage in any analyses comparing the effects of affective manipulations on risk perceptions.

Moving onto age related changes in affective processes, relative to the young, older adults report higher levels of positive state affect and lower levels of negative state affect (Carstensen et al., 2011). Such affective changes may lead older adults to focus less on information pertaining to the potential for unfavorable outcomes and thus perceive lower levels of risk. In addition to age-related changes in the everyday experience of emotion, an age-related preference for positive over negative information, “the positivity effect,” has been observed in numerous studies examining processes ranging from attention and memory to decision making (for reviews see Carstensen & Mikels, 2005; Reed, Chan, & Mikels, 2014). For example, with the use of eye-tracking methodologies, older adults (relative to younger adults) demonstrated an increased attentional preference towards positive stimuli and away from negative stimuli (Isaacowitz, Wadlinger, Goren, & Wilson, 2006). Compared to younger adults, older adults also attend to and recall more positive compared to negative information in decision tasks (Löckenhoff & Carstensen, 2007; Mather, Knight, & McCaffrey, 2005).

Considering the *affect as information* and *affect heuristic* models described above, the positivity effect could lead older adults to accept possible risks related to vaccination itself (e.g., side effects and potential complications) due to a reduced focus on negative information in favor of positive information (e.g., the probability of preventing the contraction of influenza). Moreover, it is important to consider research indicating that older adults are impacted by emotion induction procedures differently than are younger adults (Chou et al., 2007; Larcom & Isaacowitz, 2009). For instance, relative to younger adults, older adults reported more positive moods after positive emotion inductions and less negative moods after negative emotion induction (Chou et al., 2007). Based on these findings, the emotional facial stimuli present in the flu commercials was predicted to differentially impact older and younger adults.

Present Study

The present study utilized fEMG to measure facial responses to an incidental affect manipulation consisting of a commercial of doctors posing either positive (smiling) or negative (concerned brow furrowing) facial expressions while a recorded audio message presented a mixed-frame health message regarding influenza and vaccination. The goal of this manipulation was to change participant's evaluations of the flu and the flu vaccine. Specifically, the smiling-doctor commercial was predicted to make participants evaluate the vaccine as more beneficial and less risky in comparison to the concerned-doctor commercial. In conjunction with self-reported affect and discrete emotion measures, the fEMG measures allowed for the examination of whether affective responses to the commercials moderated the effect of the affect manipulation on changes in evaluations related to the flu and vaccinations. To be clear, it was not explicitly predicted that either physiologically measured or self-reported affect would fully explain, or in other words fully mediate, the relationship between the condition and changes in evaluations toward the vaccination. Rather, it was hypothesized that greater changes in self-reported feelings and/or affective facial activity, which correspond to the valence of the commercial condition, would yield greater changes in vaccine-related evaluations.

Regarding age effects, research indicates that older adults are impacted by emotion induction procedures differently than are younger adults (Chou et al., 2007). Thus, an age by condition interaction was predicted in which older (versus younger) adults would have more positive attitude change toward the flu vaccine in the positive condition and less negative attitude change toward the vaccine in the negative condition. Evidence suggests that older and younger adults show similar patterns of facial mimicry (Bailey, Henry, & Nangle, 2009), thus the relationship between facial responses and attitude change could be compared between older and younger adults.

Hypothesis I: There would be a main effect of condition on participants' changes in affective states. Affective states were measured by fEMG responses to the stimuli, as well as by changes in self-reported valence, arousal, and discrete emotions from before to after the commercial stimuli. Participants in the *smiling-doctor* condition were expected to report more positive change in valence and positive discrete emotions (joy and amusement) and less negative change in valence and discrete negative emotions (fear and sadness) compared to those in the *concerned-doctor* condition. No predictions were made regarding the influence of the facial expression manipulation on changes in self-reported measures of arousal. For the fEMG measures of affective responding, it was predicted that the *smiling-doctor* condition would elicit more *zygomaticus* activity and less *corrugator* activity than the *concerned-doctor* condition.

Hypothesis II: There would be an interaction between participants' age-group and expression condition on participants' changes in affective states. Compared to younger adults, older adults were expected report more positive change in valence and positive discrete emotions in the smiling-doctor condition and were expected to report less negative change in valence and negative discrete emotions in the concerned-doctor condition. This was based on findings from Chou et al. (2007), and Larcom and Issacowitz (2009), which indicate that older and younger adults respond differently to emotion inductions.

Hypothesis III: There would be a main effect of condition on changes in evaluations of the flu and the flu vaccine. Changes in flu and flu vaccine evaluations were assessed by the differences between the pre and post measures of participants' self-reported feelings, risk and benefit evaluations, and behavioral intentions. Each of the following hypotheses predicted relationships among variables that would occur after the following covariates were controlled for: experience with the flu, initial procedural risk perception (likelihood of side effects) and initial integral feelings toward the flu (worry) all taken from the pre-test measures.

III(a): In regards to feelings toward the flu itself, compared to those in the positive *smile* condition, participants in the negative *concerned-doctor* condition were expected to report a greater increase in how worried they were about getting the flu.

III(b): Regarding evaluations of the vaccination, participants in the smile condition were expected to feel that the vaccine would be more beneficial (reduce their perceived chances of getting the flu) and less risky (lower their perceived chance of experiencing negative side effects).

III(c): Participants in the *smiling-doctor* condition were expected to report more positive feelings toward the vaccine itself in comparison to those in the *concerned-doctor* condition.

III(d): Lastly, participants in the smile versus concerned-doctor condition were expected to report a greater increase in their likelihood of getting the flu vaccine in the next coming flu season, recommending the vaccine to their family and friends, and would be willing to pay more for the flu vaccine.

Hypothesis IV: There would be an interaction between age group and condition on changes in evaluations toward the flu and the flu vaccine. Compared to their younger counterparts, older adults were expected to have greater positive change in evaluations toward the flu and the flu vaccine in the smiling-doctor condition and less negative changes in evaluations of the flu in the concerned-doctor condition. This hypothesis was an extension from the predictions made by Hypotheses II and III. For instance, if the older adult group felt more positively after the smiling-doctor commercial (compared to the younger group), they should also have a greater change in positive evaluations.

Hypothesis V: Participants' affective responses (both self-reported and physiologically-measured) to the commercial were expected to moderate the effect of the condition on changes in evaluations toward the flu and flu vaccines. Participants in the *smiling-doctor* condition who either reported a greater versus lower positive change in valence, happiness, or contentment, or those who had higher versus lower rates of *zygomaticus* activity in response to the commercial would report a more positive change in evaluations toward the vaccines. Alternately, participants in the *concerned-doctor* condition who either reported a greater versus lower negative change in valence, sadness, or fear, or those who had higher versus lower rates of *corrugator* activity in response to the commercial would report a more negative change in evaluations toward the vaccines.

Methods

Sample

Forty older and forty younger adults were recruited for the study. Younger adults were recruited from the SONA system subject pool and were compensated for their time via course credit. Older adults were recruited from local senior centers and the Buehler Center on Aging, Health, & Society (BCAHS) subject pool made accessible to the host lab by the Feinberg School of Medicine of Northwestern University. Older adults were compensated $30 for their participation in a larger study, which includes this present experiment.

Measures and Stimuli

Audiovisual stimuli. To create the stimuli, videos of three actors dressed as doctors were obtained from the image and video archive website Pond5.com. Depending on their condition, participants either watched a video of three doctors smiling or a video of the same doctors looking concerned. Both videos contained three 16-second segments (one for each actor). The video segments were edited so that the doctors in the *smiling-doctor* commercial only displayed *zygomaticus* muscle activity (FACS AUs: 12 +/- 25) and cheek raises (AU 6) throughout the entire duration of the segments. The *concerned-doctor* (negative) video segments were edited so that the doctors only displayed *corrugator* activity (AU 4) (Ekman & Friesen, 1977) throughout the entire duration of the segments. In all video segments, the gaze of the doctors is focused on the viewer of the commercial. A message attempting to persuade the viewer to get the flu vaccine in the next flu season accompanied the video. The message was an audio recording read by a male voice actor and was created using information taken from the Centers for Disease Control (cdc.gov, retrieved April 2014) regarding the flu and the flu vaccine. The message included statements regarding the flu itself, the benefits of the vaccine, and the procedural risks related to the vaccine (see Appendix). The commercial was presented on a computer screen with the audio playing through desktop computer speakers. The videos in both conditions were accompanied by the same audio message.

Self-reported affect. Two measures of self-reported affect were administered prior to and after the presentation of the commercial. The degree to which participants' affect changed between the pre and post measures served as a manipulation check in addition to a moderating variable in the analysis.

The Affect Grid (Appendix A)**.** Similar to Study 1, the Affect Grid was used to measure valence and arousal.

The mDES (Appendix B)**.** This measure was selected in order to assess self-reported changes in the experience of discrete emotions from before to after the commercial. The original mDES measure evaluates emotions experienced in the last 24hrs (Fredrickson et al., 2003). The current study utilized a modified version if the measure designed to measure state affect. The questionnaire informed participants that "in any given circumstance, people often have a number of different feelings" then instructed them to indicate the extent to which they presently felt 19 different emotions on a scale of 0 (not at all) to 4 (extremely). The present investigation only examined the discrete emotions that were presumed to change as a function of age group and condition; joy, amusement, fear, and sadness.

Physiological measures of affect and apparatus. *Corrugator* activity, *zygomatic* activity, and Electrodermal Activity (EDA) was collected during a one-minute baseline period prior to the flu commercial and during the commercial itself. This study used same equipment and procedure to measure and process fEMG as Study 1 with one notable difference. The waveforms containing the facial activity were averaged into twenty, five-second windows (ten windows during the baseline period before the presentation of the commercial and ten windows during the presentation of the commercial). As in Study 1, EDA was collected for exploratory purposes.

Evaluations of and experience with the flu and flu vaccinations (Appendix C)**.** Measures of participants' feelings, risk/benefit evaluations, and behavioral intentions regarding flu vaccinations were assessed prior to the experimental session and after the commercial. The difference between the pre and post evaluations served as the dependent variables in this study. Questions regarding participants' experience with the flu and the flu vaccine were administered in order to serve as control variables in the analyses.

Feeling of worry toward the flu itself were assessed with a single item. "How worried are you about getting the flu?" Participants responded on a seven point, Likert-type scale that ranged from 0 (not at all worried) to 6 (extremely worried) with 3 (moderately worried) at the midpoint.

Feeling toward flu vaccines were assessed with a single item: "How do you feel about the flu vaccine?" Participants responded on a seven point, bi-polar Likert-type scale that ranged from -3 (extremely negative) to +3 (extremely positive) with 0 (neither negative nor positive) at the midpoint.

Perceived benefits of the flu vaccine were assessed by calculating the difference between participants' responses on two items: "How likely are you to get the flu if you *do not* get the flu vaccine" and "How likely are you to get the flu if you *do* get the flu vaccine?" Participants responded to each item on an eleven-point scale that ranged from "0% chance" to "100% chance" in 10% increments. Each participant's response to the second item were subtracted from their response to the first item in order to measure how beneficial they thought the flu vaccine was.

Perceived procedural risk of the flu vaccine was assessed with one item: "If you do get the flu vaccine, how likely are you to experience side effects related to the vaccine itself?" Participants responded to this item on an eleven-point scale that ranged from "0% chance" to "100% chance" in 10% increments. Importantly, this item was used both as a dependent measure (by subtracting the pre from the post measure of risk) and as a covariate in tests of all hypotheses given the previous finding that perceived risk mediates the effect of frame on vaccination behaviors (e.g., Ferguson & Gallagher, 2007).

A ***Risk/benefit score*** was created in order to reduce the number of outcome variables and analyses. This score was computed for each participant by subtracting the score representing perceived vaccine-related risk from the score representing perceived vaccine-related benefits. Positive scores indicated the participant perceived the vaccines to be more beneficial than risky.

Behavioral intentions regarding the flu vaccine were measured with three questions in order to consider multiple types of intentions. The first item that assessed intentions was: "How likely are you to get the flu vaccine in the following flu season?" Participants responded to this item on a seven point Likert-type scale that ranged from 1 (not at all likely) to 7 (extremely likely). The next item, "How much are you willing to pay for the vaccine?" was answered on a nine point scale that ranged from $0 to $40 in five dollar increments. The third item, "How likely are you to recommend the flu vaccine to a friend or family member?" was assessed on a seven point scale ranging from 1 (not at all likely) to 7 (extremely likely). Participants' responses to these items was then transformed into *z-scores* and averaged into one single *intention score*.

Experience with the flu and the flu vaccine: Four questions were used as covariate measures in the analyses in order prevent previous experience with the flu from obscuring the effects of the manipulation. Furthermore, these covariates helped to ensure that any difference found between the groups was not actually due to group differences in flu-related experiences. "Have you had the flu in the past year?"; "Did you get a flu vaccine this past flu season?"; and "Did a doctor recommend that you get the vaccine?" were each responded to with either a yes or a no. Lastly, "How often have you received the flu vaccine in the last 3 years?" was responded to with a number ranging from zero to three. The rationale for including these questions stems from studies which found that factors such as doctor recommendations and previous vaccine usage explained the majority of variance in vaccine evaluations and acceptance (for reviews see: Chapman & Coups, 1999, Zimmerman, Santibanez, & Fine, 2003).

Procedure

Prior to arriving at the lab session, participants completed the pre-test questions that included all of the questions related to participant's evaluations of and experience with the flu and flu vaccinations. Older adult participants were administered the pre-test questions over the phone (with some additional questions added in order to distract from the nature of the survey), whereas younger adults completed the questions in an online survey format (in addition to the other questionnaires in the DePaul SONA pre-screen study).

Upon arrival to the lab session, participants first signed consent forms prior to being fitted with the EMG and EDA sensors. The experimenter used the same procedure described in study 1 to attach the sensors to participants.

Participants were then instructed by the researcher to attend to the computer screen for instructions. The participants were first instructed to relax for a fine minute period. After the relaxation period, participants were asked to complete the first Affect Grid, followed by the first mDES measure. They ere then informed that the task was beginning. Participants were then instructed that they would first see a blank screen for 50 seconds, then a brief (.5 second) crosshair in the center of the screen followed by a short video. Participants were randomly assigned into either the *smiling* or *concerned* commercial condition and were subsequently presented with the commercial on the computer screen. After watching the commercial, participants completed the second Affect Grid and mDES. Next, participants completed the posttest measures of their evaluations of the flu and the flu vaccine.

Analyses and Results

Differences in self-reported affect across age groups and conditions. In order to test Hypotheses I and II, a series of 2 (commercial condition: smiling vs. concerned doctor) x 2 (age group) analyses of variance (ANOVAs) were used to compare differences in measures of affect across age groups (older versus younger adults) and conditions (*concerned doctor* versus *smiling doctor*). Insufficient inter-variable correlations were present within or across the categories of the affective responding variables (i.e., fEMG, valence/arousal, and discrete emotions) to justify MANOVA analyses. Thus, separate 2-way (age x condition) ANOVAs were run for each of the eight following outcome variables: *corrugator* activity, *zygomaticus* activity, change in self-reported valence (from the affect grid), change in self-reported arousal (from the affect grids), joy, amusement, fear, and sadness (from the mDES measures). Follow up one-way ANOVAs estimated the simple main effects of age and condition when a significant interaction between age and condition was found. Table 5 presents the means and standard deviations of each affective responding variable as a function of age group and commercial condition (smiling vs. concerned doctor). Complete statistics for the two ANOVAs examining the EMG data (*corrugator* and *zygomaticus*) are presented in Table 6.

Table 5.

Means and Standard Deviations for Affective Responding Variables by Condition and Age Group

		Corr	Zygo	Valen	Arou	Joy	Amus	Fear	Sad
Concerned doctor									
Young	*M*	2.13	0.67	-0.30	0.35	-0.25	-0.54	0.00	-0.13
	SD	(3.98)	(1.77)	(1.89)	(2.59)	(1.51)	(1.28)	(0.93)	(0.61)
Older	*M*	3.77	-0.22	0.00	0.10	-0.20	0.25	0.05	0.00
	SD	(1.30)	(0.78)	(1.65)	(2.49)	(0.95)	(0.72)	(0.51)	(0.65)
Smiling doctor									
Young	*M*	1.69	0.99	-0.09	0.57	-0.13	0.30	-0.13	-0.09
	SD	(3.22)	(2.34)	(0.79)	(1.73)	(0.76)	(0.88)	(0.55)	(0.51)
Older	*M*	0.97	0.15	-0.05	0.00	-0.33	0.29	-0.10	-0.05
	SD	(3.56)	(1.76)	(0.97)	(2.14)	(0.97)	(0.72)	(0.30)	(0.50)

Analysis of fEMG Measures

No significant main effects or interactions involving the condition or age group variables were found on *corrugator* activity (see Table 2). Thus, older and younger adults in did not produce different intensities of *corrugator* activity across the commercial conditions. For *zygomaticus* activity, a significant main effect of age group indicated that relative to older adults (M = -.04, SD = 2.05), younger adults (M = .83, SD = 2.10) produced more *zygomaticus* activity across both conditions. No other main or interaction effects were significant for *zygomaticus* activity. These findings were inconsistent with Hypotheses I and II.

Table 6.

ANOVA Results for the Effects of Age Group and Condition on fEMG

	df	*F*	*P*	η_p^2
Corr_avg				
Condition	(1,76)	1.18	0.281	0.014
AgeGroup	(1,76)	0.09	0.760	0.001
Condition * AgeGroup	(1,76)	0.63	0.430	0.007
Zyg_avg				
Condition	(1,76)	0.83	0.365	0.01
AgeGroup	(1,76)	5.12	0.026*	0.057
Condition * AgeGroup	(1,76)	0.00	0.952	0.000

Note. **p* < .05; ***p* < .01; ****p* < .001.

Analyses of Affect Grid Measures

There were no significant main effects or interactions involving the condition or age group variables in the ANOVAs examining participants' change in valence or arousal (see Table 7 for a complete reporting of the statistics). The absence of significant effects was inconsistent with Hypotheses I and II.

Table 7.

ANOVA Results for the Effects of Age Group and Condition on Valence and Arousal

	df	*F*	*P*	η_p^2
Valence				
Condition	(1,76)	0.08	0.779	0.001
AgeGroup	(1,76)	0.33	0.570	0.004
Condition * AgeGroup	(1,76)	0.19	0.662	0.002
Arousal				
Condition	(1,76)	0.02	0.904	0.000
AgeGroup	(1,76)	0.70	0.404	0.008
Condition * AgeGroup	(1,76)	0.11	0.744	0.001

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

Analyses of mDES Measures

There were no significant main or interaction effects involving the condition or age group variables in the ANOVAs examining participants' change in joy, fear, or sadness (see Table 8 for a report of the complete statistics). For the ANOVA conducted on the variable representing changes in amusement, a main effect of age approached significance. This result indicates a trend by which older adults (*M* = .27, *SD* = .72) across both conditions were more amused after the commercial in comparison to younger adults (*M* = -.12, *SD* = 1.08). Additionally, a main effect for the commercial condition indicated that participants who watched the smiling doctors (*M* = .30, *SD* = .80) were more amused compared to those who watched the concerned doctors (*M* = .23, *SD* = -1.23).

Lastly, the ANOVA examining amusement ratings indicated a significant age group by commercial condition interaction. To explore this interaction, separate one-way ANOVAs were conducted to examine the effect of the commercial condition on amusement for each age group separately. A significant main effect of commercial condition on amusement in the younger adult ANOVA indicated that younger adults watching the smiling doctor (*M* = 0.30, *SD* =0.88) were more amused than those watching the concerned doctor (*M* = -0.54, *SD* = 1.28), *F* (1, 39) = 6.90, *p* = 0.012, η_p^2 = .133. The main effect of the commercial condition on amusement was not significant for older adults (*F* (1, 39) = .03, *p* = 0.874, η_p^2 = .001).

Table 8.

ANOVA Results for the Effects of Age Group and Condition on mDES Measures

	df	*F*	*P*	η_p^2
Joy				
Condition	(1,76)	0.00	0.977	0.000
AgeGroup	(1,76)	0.11	0.745	0.001
Condition * AgeGroup	(1,76)	0.29	0.591	0.003
Ammusement				
Condition	(1,76)	4.77	0.032*	0.054
AgeGroup	(1,76)	3.67	0.059	0.042
Condition * AgeGroup	(1,76)	4.03	0.048*	0.046
Fear				
Condition	(1,76)	1.05	0.309	0.012
AgeGroup	(1,76)	0.10	0.753	0.001
Condition * AgeGroup	(1,76)	0.00	0.956	0.000
Sadness				
Condition	(1,76)	0.00	0.969	0.000
AgeGroup	(1,76)	0.45	0.503	0.005
Condition * AgeGroup	(1,76)	0.12	0.727	0.001

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

Differences in Flu and Flu Vaccine Evaluative Changes Across Conditions and Age Groups

In order to test Hypotheses III and IV, age differences in evaluative change regarding the flu vaccine across conditions were examined using an age x condition MANCOVA, with three dependent variables representing changes in vaccine-related evaluations after watching the commercial (feelings toward the vaccine, the risk/benefit score, and the behavioral intentions score). The fourth evaluative variable of interest, worry about getting the flu itself, was not included in the MANCOVA as it pertained to the flu itself rather than to the vaccine as the other outcome measures do. Furthermore, participants' worry about getting the flu was not significantly correlated with the other three dependent variables in the model (*p*'s >.05) and thus was not included in the multivariate analysis among the other outcomes which were all significantly correlated (*p*'s < .05). The outcome variable representing participants' worry about getting the flu itself was analyzed using a separate regression analysis described below. Table 9. provides the descriptive statistics for participants' feelings about the vaccine, risks/benefits score, and behavioral intentions toward vaccination organized by age group and condition.

Table 9.

Descriptive Statistics for the Changes in Evaluations of the Flu and Flu Vaccine by Age Group and Condition

	Age Group	*Condition*	*Mean*	*Std. Deviation*
Feel about vaccine	YA	Concerned	0.47	(1.42)
		Smiling	-0.11	(1.76)
	OA	Concerned	0.74	(1.28)
		Smiling	0.00	(1.11)
Worry about flu	YA	Concerned	0.53	(1.12)
		Smiling	-0.16	(0.96)
	OA	Concerned	-0.16	(1.77)
		Smiling	0.95	(1.49)
Risk/benefits of vaccine	YA	Concerned	-0.03	(0.29)
		Smiling	-0.01	(0.21)
	OA	Concerned	-0.05	(0.38)
		Smiling	-0.11	(0.34)
Intentions	YA	Concerned	0.10	(0.79)
		Smiling	-0.16	(0.60)
	OA	Concerned	-0.10	(0.73)
		Smiling	-0.03	(0.36)

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

MANCOVA for vaccine-related outcomes. As described above, a MANCOVA examined the main effects of age (older vs. younger) and commercial condition (smiling vs. concerned doctor) as well as the interaction of age and condition. The model also included six covariates; the four experience questions (in order to control for experience with the flu and the flu vaccine) the pre-test measure of procedural risk ("If you do get the flu vaccine, how likely are you to experience side effects related to the vaccine itself?") and the pre-test measure of worry toward getting the flu ("How worried are you about getting the flu?"). See Table 10 for a report of the multivariate effects. Regarding the covariates, only baseline risk perceptions of vaccine-related side-effects was a significant at the multivariate level (Wilk's = 0.845, F (3 ,68) = 3.90, p = 0.013, η_p^2 = 0.155). No other variables in the model were significant in the multivariate analysis.

Table 10.

Multivariate Effects of Age Group, Condition, and Covariates

Factor	*Wilks' Lambda*	*F*	*df*	*P*	η_p^2
Had flu last year?	0.993	0.14	(3, 68)	0.935	0.007
Vaccinated last year?	0.960	0.89	(3, 68)	0.452	0.040
# vac last 3 years?	0.941	1.33	(3, 68)	0.272	0.059
Doctor recommend?	0.947	1.21	(3, 68)	0.315	0.053
Pre-test Side-effect risk	0.845	3.90	(3, 68)	0.013*	0.155
Pre-Worry about flu	0.907	2.20	(3, 68)	0.097	0.093
AgeGroup	0.960	0.89	(3, 68)	0.451	0.040
Condition	0.911	2.08	(3, 68)	0.112	0.089
AgeGroup * Condition	0.956	0.98	(3, 68)	0.408	0.044

Note. **p* < .05; ***p* < .01; ****p* < .001.

At the univariate level, the analysis yielded a significant main effect for the commercial condition (smiling vs. concerned doctor) on feelings toward the flu vaccine ($F(1, 70) = 5.95$, $p = 0.017$, $\eta_p^2 = 0.083$). Overall, participants felt more positively about the flu vaccine in the concerned doctor condition (*M* = .65, *SD* = 1.35) compared to the smiling doctor condition (*M* = -.10, *SD* = 1.44). This finding was inconsistent with Hypothesis III. No other univariate main effects in the model were found to be significant (see Table 11).

Table 11.

Univariate F-test Results of Each Factor on Each of the Outcome Measures

Factor	*Outcome*	*df*	*F*	*P*	η_p^2
Had flu last year?	Feel Vac	(1, 70)	0.21	0.648	0.003
	Risk/ben	(1, 70)	0.29	0.594	0.004
	Intentions	(1, 70)	0.01	0.906	0.000
Vacc last year?	Feel Vac	(1, 70)	1.03	0.314	0.015
	Risk/ben	(1, 70)	0.05	0.821	0.001
	Intentions	(1, 70)	2.02	0.160	0.030
# vac last 3 years?	Feel Vac	(1, 70)	0.32	0.576	0.005
	Risk/ben	(1, 70)	0.26	0.610	0.004
	Intentions	(1, 70)	1.89	0.174	0.028
Doctor recommend?	Feel Vac	(1, 70)	3.33	0.072	0.048
	Risk/ben	(1, 70)	0.57	0.452	0.009
	Intentions	(1, 70)	0.14	0.711	0.002
Pre-test Side-effect risk	Feel Vac	(1, 70)	10.61	0.002*	0.139
	Risk/ben	(1, 70)	0.05	0.822	0.001
	Intentions	(1, 70)	0.43	0.516	0.006
Pre-test Worry about flu	Feel Vac	(1, 70)	2.29	0.135	0.033
	Risk/ben	(1, 70)	2.07	0.155	0.030
	Intentions	(1, 70)	0.39	0.536	0.006
Condition	Feel Vac	(1, 70)	5.95	0.017*	0.083
	Risk/ben	(1, 70)	0.00	0.982	0.000
	Intentions	(1, 70)	0.44	0.510	0.007
AgeGroup	Feel Vac	(1, 70)	1.27	0.263	0.019
	Risk/ben	(1, 70)	0.66	0.420	0.010
	Intentions	(1, 70)	0.51	0.478	0.008
Condition * AgeGroup	Feel Vac	(1, 70)	0.50	0.482	0.008
	Risk/ben	(1, 70)	0.02	0.878	0.000
	Intentions	(1, 70)	1.22	0.273	0.018

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

ANCOVA for flu-related worry. An ANCOVA was run on the outcome variable representing the extent to which participants' worried about getting the flu. The ANCOVA included the same predictors as the previous MANCOVA. A marginally significant age group by commercial condition interaction was found $F(1, 67) = 3.76$ $p = 0.057$. Given a priori predictions in Hypothesis 4 regarding potential interactions between age group and commercial condition, follow-up pairwise comparisons were conducted to examine if differences in the change of flu-related worry were present between older and younger adults in the same condition. In the concerned-doctor condition, changes in flu related worry did not differ between older (M =-.18) and younger (M = .45) adults $t(39) = -1.23$, p = .22. Similarly, no differences in the change of flu-related worry were found between older (M = .77) and younger (M = .14) adults in the smiling-doctor condition $t(39) = 1.32$, p = .192.

To better understand the nature of the interaction effect, changes in flu-related worry were compared across the commercial conditions separately for older and younger adults. The extent to which younger adults changed in their worry about getting the flu did not differ across the concerned (M = .45) and smiling-doctor (M = .14) commercial conditions, $t(39) = -.66$, p = .514. However, older adults who watched the smiling-doctor commercial reported an increase in worry about getting the flu (M = .77) compared to those who watched the concerned doctors (M = -.17), $t(39) = 2.16$, p = .034. Overall, this pattern of findings did not support the predictions made in Hypothesis IV.

Interaction Between Commercial Condition and Affective Responses on Changes in Participants' Evaluations

In order to test Hypothesis V, multi-step regression analyses examined whether the extent to which the participants' affective responding (to the commercial) related to their changes in evaluations differently across conditions. Three multi-step regressions were tested for each of the four outcome variables resulting in a total of 12 regressions. The first two steps were identical across all 12 regressions. The first step of each regression included the covariates (experience with the flu & flu vaccines). The second step included factors representing the main effects of age and condition. The factors included in the third step represented the influence of affective responding and were different across the three regressions for each outcome variable. In the first regression for each outcome variable, the third step included *corrugator* and *zygomaticus* activity.

For the second regression, the third step included variables representing changes in valence and arousal (as measured by the difference between the set of first and second affect grid scores). Lastly, the third regression included factors representing changes in joy, amusement, fear, and sadness (as measured by the difference between the first and second set of mDES scores). These models also included factors representing all possible interactions between the commercial condition and the affective responding variables. In total, 12 multi-step regressions were analyzed for each outcome variable. Given that steps 1 and 2 of each regression were not relevant to Hypothesis V, the results for those steps are presented in Tables 12 and 13 and are not discussed further.

Table 12.

Steps 1 and 2 of Hierarchical Regression Analyses Relating Covariates and Main Effects on Vaccine Feelings and Flu-Related Worry

	Feelings about vaccine						Worry about getting the flu					
	b	*SE*	*t*	*p*	ΔR^2	R^2	*b*	*SE*	*t*	*p*	ΔR^2	R^2
Step 1					0.17	0.17*					0.2	0.2*
Had flu last year?	-0.40	-0.49	-0.81	0.422			0.02	-0.49	0.03	0.972		
Vac last year?	-0.23	-0.27	-0.84	0.401			0.04	-0.27	0.15	0.883		
# vac last 3 years?	0.15	-0.14	1.12	0.266			0.15	-0.14	1.12	0.265		
Doctor recommend?	0.74	-0.37	1.96	0.053†			0.02	-0.37	0.06	0.905		
Pre-test worry about flu	-0.15	-0.12	-1.25	0.217			-0.44	-0.12	-3.68	0.000**		
Pre-test side-effect risk	1.97	-0.70	2.80	0.007*			-0.23	-0.70	-0.33	0.740		
Step 2					0.09	0.26*					0.07	0.27**
Had flu last year?	-0.22	0.48	-0.46	0.648			-0.02	0.48	-0.04	0.966		
Vac last year?	-0.27	0.26	-1.02	0.314			0.00	0.27	-0.01	0.995		
# vac last 3 years?	0.08	0.25	0.56	0.576			0.19	0.15	1.32	0.192		
Doctor recommend?	0.67	0.37	1.83	0.072			0.11	0.37	0.31	0.759		
Pre-test worry about flu	-0.19	0.12	-1.51	0.135			-0.37	0.12	-2.99	0.004**		
Pre-test side-effect risk	2.25	0.69	3.26	0.002**			-0.44	0.69	-0.64	0.526		
AgeGroup	0.61	0.48	1.26	0.21			-0.85	0.48	-1.76	0.083		
Condition	-0.53	0.44	-1.2	0.235			-0.56	0.44	-1.26	0.212		
AgeGroup*Cond	-0.44	0.62	-0.71	0.482			1.52	0.63	2.42	0.018**		

Note. **p* < .05; ***p* < .01; ****p* < .001; † *p* < .07

Table 13.

Steps 1 and 2 of Hierarchical Regression Analyses Relating Covariates and Main Effects on Risk/Benefits and Intentions Scores

	Risk/Benefits Score						**Behavioral Intentions Score**					
	b	*SE*	*t*	*p*	ΔR^2	R^2	*b*	*SE*	*t*	*p*	ΔR^2	R^2
Step 1					0.06	0.06					0.09	0.09
Had flu last year?	-0.05	-0.11	-0.46	0.645			-0.06	-0.23	-0.27	0.786		
Vac last year?	0.00	-0.06	0.06	0.952			-0.15	-0.13	-1.22	0.226		
# vac last 3 years?	0.01	-0.03	0.23	0.820			-0.08	-0.06	-1.27	0.207		
Doctor recommend?	0.08	-0.09	0.89	0.378			0.05	-0.18	0.27	0.790		
Pre-test worry about flu	0.05	-0.03	1.68	0.097			0.02	-0.06	0.35	0.730		
Pre-test side-effect risk	-0.04	-0.16	-0.25	0.801			0.22	-0.33	0.68	0.501		
Step 2					0.00	0.06					0.00	0.09
Had flu last year?	-0.06	0.12	-0.54	0.594			-0.03	0.23	-0.12	0.906		
Vac last year?	0.01	0.06	0.23	0.821			-0.18	0.13	-1.42	0.160		
# vac last 3 years?	0.02	0.04	0.51	0.610			-0.10	0.07	-1.37	0.174		
Doctor recommend?	0.07	0.09	0.76	0.452			0.07	0.18	0.37	0.711		
Pre-test worry about flu	0.04	0.03	1.44	0.155			0.04	0.06	0.62	0.536		
Pre-test side-effect risk	-0.04	0.17	-0.23	0.822			0.22	0.34	0.65	0.516		
AgeGroup	-0.06	0.12	-0.48	0.633			-0.05	0.24	-0.21	0.835		
Version	0.01	0.11	0.13	0.901			-0.27	0.23	-1.25	0.217		
AgeGroup*Cond	-0.02	0.15	-0.15	0.878			0.34	0.31	1.11	0.273		

Note. *$p < .05$; **$p < .01$; ***$p < .001$; † $p <$

Step 3 of the regressions examining effects of age, condition and fEMG activity on each outcome. There were no significant main effects or interactions involving the fEMG variables for any of the four outcomes (see Tables 14 and 15 for a full report of the Step 3 statistics). Interestingly, despite controlling for the direct and moderating effects of fEMG activity, the age-group by commercial condition interaction that was found in tests of Hypothesis IV remained significant (see Table 14). Thus even when controlling for fEMG activity, older adults watching the smiling-doctor commercial reported an increase in worry relative to older adults who watched the concerned-doctor commercial.

Table 14.

Step 3 of Hierarchical Regression Analyses Examining Effects of fEMG on Vaccine Feelings and Flu-Related Worry

	Feelings about vaccine						**Worry about getting the flu**					
	b	*SE*	*t*	*p*	ΔR^2	R^2	*b*	*SE*	*t*	*p*	ΔR^2	R^2
Step 3					0.06	0.32					0.1	0.37*
Had flu last year?	-0.31	0.50	-0.61	0.543			0.04	0.49	0.07	0.940		
Vac last year?	-0.28	0.28	-0.99	0.326			0.04	0.27	0.16	0.874		
# vac last 3 years?	0.06	0.15	0.41	0.681			0.25	0.15	1.64	0.106		
Doctor recommend?	0.46	0.39	1.19	0.238			0.06	0.38	0.16	0.875		
Pre-test worry about flu	-0.17	0.13	-1.31	0.196			-0.43	0.13	-3.35	0.001**		
Pre-test side-effect risk	2.21	0.76	2.89	0.005**			0.04	0.75	0.05	0.959		
AgeGroup	0.74	0.58	1.29	0.202			-0.83	0.56	-1.47	0.147		
Condition	-0.37	0.60	-0.61	0.541			-0.61	0.59	-1.03	0.309		
AgeGroup*Cond	-0.65	0.76	-0.85	0.397			1.57	0.74	2.11	0.039**		
Corr_avg	0.23	0.21	1.06	0.295			0.09	0.21	0.45	0.653		
Zyg_avg	-0.11	0.17	-0.67	0.506			-0.17	0.17	-1.02	0.312		
AgeGroup*Corr_avg	-0.25	0.21	-1.18	0.241			-0.13	0.21	-0.60	0.552		
Cond*Corr_avg	-0.21	0.24	-0.89	0.377			-0.11	0.23	-0.47	0.637		
AgeGroup* Cond*Corr_avg	0.27	0.25	1.09	0.280			0.07	0.24	0.28	0.777		
AgeGroup*Zyg_avg	-0.48	0.45	-1.08	0.285			-0.25	0.44	-0.56	0.575		
Cond*Zyg_avg	0.07	0.28	0.27	0.790			0.25	0.27	0.92	0.360		
AgeGroup*Cond*Zyg_avg	0.69	0.53	1.29	0.201			-0.22	0.52	-0.41	0.680		

Note. **p* < .05; ***p* < .01; ****p* < .001; † *p* < .07

Table 15.
Step 3 of Hierarchical Regression Analyses Examining Effects of fEMG on Risk/Benefits and Intentions Scores

	Risk/Benefits Score						Behavioral Intentions Score					
	b	*SE*	*t*	*p*	ΔR^2	R^2	*b*	*SE*	*t*	*p*	ΔR^2	R^2
Step 3					0.07	0.13					0.07	0.16
Had flu last year?	-0.02	0.12	-0.16	0.871			-0.03	0.25	-0.14	0.889		
Vac last year?	0.02	0.07	0.34	0.737			-0.21	0.14	-1.50	0.139		
# vac last 3 years?	0.02	0.04	0.59	0.560			-0.11	0.08	-1.43	0.157		
Doctor recommend?	0.11	0.10	1.18	0.245			0.07	0.19	0.36	0.718		
Pre-test worry about flu	0.04	0.03	1.22	0.228			0.01	0.06	0.11	0.913		
Pre-test side-effect risk	0.00	0.19	-0.02	0.982			0.47	0.38	1.25	0.216		
AgeGroup	-0.14	0.14	-0.98	0.330			-0.04	0.28	-0.14	0.889		
Version	-0.13	0.15	-0.89	0.380			-0.38	0.30	-1.28	0.206		
AgeGroup*Cond	0.08	0.19	0.45	0.657			0.41	0.37	1.11	0.272		
Corr_avg	-0.08	0.05	-1.59	0.117			0.03	0.11	0.29	0.777		
Zyg_avg	-0.03	0.04	-0.62	0.541			-0.08	0.08	-0.95	0.344		
AgeGroup*Corr_avg	0.08	0.05	1.59	0.117			-0.02	0.11	-0.23	0.822		
Cond*Corr_avg	0.10	0.06	1.66	0.103			0.03	0.12	0.29	0.774		
AgeGroup* Cond*Corr_avg	-0.08	0.06	-1.36	0.179			-0.01	0.12	-0.12	0.906		
AgeGroup*Zyg_avg	0.13	0.11	1.19	0.237			0.08	0.22	0.36	0.719		
Cond*Zyg_avg	0.03	0.07	0.47	0.638			0.03	0.14	0.22	0.824		
AgeGroup*Cond*Zyg_avg	-0.15	0.13	-1.12	0.266			-0.11	0.26	-0.42	0.679		

Step 3 of the regressions examining effects of age, condition, valence and arousal on each outcome. Tables 16 and 17 present a full report of the Step 3 statistics for the analyses examining effects of age, condition, valence and arousal on the four outcome variables. As can be seen on Table 16, a near-significant age x valence interaction (p = .057) was yielded in the regression predicting worry about getting the flu. Although not predicted, this interaction was further explored because of its potential relevance to the overarching topic of this study. To do so, the continuous valence-change scores of the participants were collapsed into three categorical levels: high, medium and low levels of valence change. The high level incorporated all valence change scores that were one standard deviation above the mean, the medium level incorporated all the valence change scores that were between one standard deviation below the mean and one standard deviation above the mean, and the low level incorporated scores that were one standard deviation below the mean. As mentioned previously, higher scores on this variable indicate increases in positive valence from before viewing the commercial to after viewing the commercial.

Subsequently, the worry scores of younger and older adults were separately examined, i.e., compared across the three valence-change levels. For younger adults, the worry scores at the three levels of the valence change variable (high M = .33, medium M = .28, low M = .23) were not significantly different from one another (p's >.05). For older adults, the worry scores at each level of the valence change variable were significantly different from one another (p's < .05). Thus, older adults who experienced high levels of valence change reported worrying less about the flu (*M* = -.56) than older adults who experienced medium (*M* = .37, *t*(39) = -3.83 , *p* < .001) and low levels of valence change (*M* = 1.30, *t*(39) = -3.83, *p* < .001). This indicates that increases in positive valence related to less flu-related worry for older adults. No other main or interaction effects involving effects of valence and arousal on any of the outcome variables were significant (see Tables 16 and 17).

Table 16.

Step 3 of Hierarchical Regression Analyses Examining Effects of Valence and Arousal on Vaccine Feelings and Flu-Related Worry

	Feelings about vaccine						**Worry about getting the flu**					
	b	*SE*	*t*	*p*	ΔR^2	R^2	*b*	*SE*	*t*	*p*	ΔR^2	R^2
Step 3					0.05	0.31					0.27	0.54**
Had flu last year?	-0.28	0.60	-0.48	0.635			0.42	0.50	0.85	0.398		
Vac last year?	-0.25	0.30	-0.83	0.411			0.04	0.25	0.15	0.885		
# vac last 3 years?	0.10	0.16	0.64	0.525			0.15	0.14	1.07	0.290		
Doctor recommend?	0.60	0.40	1.50	0.140			0.35	0.33	1.05	0.297		
Pre-test worry about flu	-0.22	0.13	-1.69	0.097			-0.32	0.11	-2.93	0.005**		
Pre-test side-effect risk	2.40	0.75	3.17	0.002**			-0.82	0.63	-1.30	0.199		
AgeGroup	0.50	0.51	0.97	0.339			-0.76	0.43	-1.77	0.082		
Condition	-0.50	0.48	-1.03	0.308			-0.72	0.40	-1.81	0.076		
AgeGroup*Cond	-0.45	0.67	-0.66	0.510			1.56	0.56	2.78	0.007**		
Valence	0.07	0.26	0.25	0.805			0.26	0.22	1.19	0.239		
AgeGroup*Valence	0.07	0.33	0.21	0.834			-0.53	0.28	-1.90	0.063†		
Cond*Valence	-0.18	0.63	-0.29	0.774			-0.42	0.52	-0.80	0.425		
AgeGroup*Cond*Valence	0.11	0.77	0.14	0.891			-0.34	0.64	-0.53	0.597		
Arousal	0.03	0.18	0.14	0.889			-0.03	0.15	-0.22	0.826		
AgeGroup*Arousal	-0.24	0.25	-0.96	0.339			0.36	0.21	1.70	0.095		
Cond*Arousal	-0.15	0.30	-0.51	0.610			0.08	0.25	0.31	0.756		
AgeGroup*Cond*Arousal	0.53	0.38	1.38	0.172			-0.58	0.32	-1.85	0.070		

Note. *$p < .05$; **$p < .01$; ***$p < .001$; † $p < .07$

Table 17.

Step 3 of Hierarchical Regression Analyses Examining Effects Of Valence and Arousal on Risk/Benefits and Intentions Scores

	Risk/Benefits Score						**Behavioral Intentions Score**					
	b	*SE*	*t*	*p*	ΔR^2	R^2	*b*	*SE*	*t*	*p*	ΔR^2	R^2
Step 3					0.14	0.2					0.06	0.15
Had flu last year?	0.03	0.14	0.19	0.850			0.00	0.29	0.02	0.987		
Vac last year?	0.03	0.07	0.44	0.663			-0.16	0.15	-1.09	0.281		
# vac last 3 years?	0.01	0.04	0.36	0.722			-0.08	0.08	-0.96	0.342		
Doctor recommend?	0.07	0.09	0.78	0.439			0.13	0.20	0.64	0.527		
Pre-test worry about flu	0.05	0.03	1.59	0.116			0.04	0.06	0.61	0.545		
Pre-test side-effect risk	-0.07	0.17	-0.41	0.681			0.10	0.37	0.26	0.793		
AgeGroup	-0.09	0.12	-0.77	0.445			-0.08	0.25	-0.33	0.742		
Version	-0.02	0.11	-0.22	0.829			-0.22	0.24	-0.92	0.363		
AgeGroup*Cond	0.03	0.15	0.20	0.844			0.30	0.33	0.92	0.361		
Valence	-0.07	0.06	-1.11	0.270			0.02	0.13	0.16	0.875		
AgeGroup*Valence	0.00	0.08	0.06	0.954			-0.09	0.16	-0.55	0.584		
Cond*Valence	0.10	0.14	0.70	0.489			-0.15	0.31	-0.50	0.622		
AgeGroup*Cond*Valence	-0.07	0.18	-0.42	0.677			0.23	0.38	0.62	0.540		
Arousal	0.05	0.04	1.25	0.216			0.00	0.09	-0.05	0.963		
AgeGroup*Arousal	-0.15	0.06	-2.63	0.011			0.00	0.12	0.00	0.998		
Cond*Arousal	-0.02	0.07	-0.32	0.753			-0.12	0.15	-0.80	0.427		
AgeGroup*Cond*Arousal	0.14	0.09	1.65	0.105			0.02	0.19	0.11	0.913		

Step 3 of the regressions examining effects of age, condition, and mDES emotions on each outcome. Tables 18 and 19 present a full report of the Step 3 statistics for the analyses examining effects of age, condition, and mDES emotions (joy, amusement, fear, and sadness) on the four outcome variables There were no significant main effects or interactions involving any of the mDES variables on the outcome variables representing feelings toward the flu and worry about contracting the flu. Interestingly, despite controlling for the influence of the mDES variables, the interaction found between age-group and commercial condition (smiling doctor vs. concerned doctor) in the test of Hypothesis IV remained significant such that older adults in the smiling-doctor condition reported more flu-related worry in comparison to older adults in the concerned-doctor condition.

Table 18.
Step 3 of Hierarchical Regression Analyses Examining Effects of mDES measures on Vaccine Feelings and Worry about Getting the Flu.

	Feelings about vaccine						**Worry about getting the flu**					
	b	*SE*	*t*	*p*	ΔR^2	R^2	*b*	*SE*	*t*	*p*	ΔR^2	R^2
Step 3					0.14	0.4					0.29	0.56**
Had flu last year?	-0.57	0.62	-0.91	0.368			0.19	0.54	0.34	0.733		
Vac last year?	-0.27	0.33	-0.80	0.425			-0.11	0.29	-0.37	0.714		
# vac last 3 years?	0.04	0.17	0.24	0.810			0.15	0.15	1.01	0.317		
Doctor recommend?	0.72	0.43	1.67	0.102			0.36	0.38	0.94	0.349		
Pre-test worry about flu	-0.17	0.15	-1.17	0.246			-0.30	0.13	-2.41	0.02*		
Pre-test side-effect risk	2.06	0.83	2.50	0.016			-0.52	0.72	-0.72	0.477		
AgeGroup	0.79	0.60	1.31	0.195			-0.52	0.53	-0.98	0.332		
Condition	-0.58	0.54	-1.06	0.292			-0.71	0.47	-1.49	0.141		
AgeGroup*Cond	-0.65	0.81	-0.80	0.426			1.52	0.71	2.14	0.037*		
Joy	0.15	0.29	0.53	0.599			-0.03	0.25	-0.13	0.893		
AgeGroup*Joy	0.19	0.54	0.35	0.730			0.39	0.48	0.83	0.411		
Cond*Joy	-0.50	0.57	-0.88	0.381			-0.24	0.50	-0.49	0.624		
AgeGroup*Cond*Joy	0.10	0.83	0.12	0.905			0.20	0.72	0.28	0.780		
Amusement	0.04	0.34	0.11	0.910			0.13	0.30	0.43	0.671		
AgeGroup*Amuse	-0.03	0.81	-0.04	0.967			-1.22	0.71	-1.72	0.092		
Cond*Amuse	-0.40	0.61	-0.66	0.515			0.00	0.53	0.01	0.996		
AgeGroup*Cond*Amuse	0.94	1.03	0.91	0.366			0.85	0.90	0.95	0.348		
Fear	0.21	0.35	0.60	0.551			0.54	0.30	1.78	0.081		
AgeGroup*Fear	-1.83	0.98	-1.88	0.066			1.33	0.85	1.56	0.124		
Cond*Fear	-0.64	1.10	-0.58	0.568			-0.85	0.96	-0.88	0.382		

AgeGroup*Cond*Fear	2.37	1.95	1.21	0.231	-2.74	1.70	-1.61	0.114
Sadness	-0.57	0.52	-1.09	0.279	-0.31	0.45	-0.67	0.503
AgeGroup*Sadness	0.14	0.82	0.17	0.869	1.09	0.71	1.53	0.132
Cond*Sadness	0.36	1.27	0.28	0.780	0.31	1.11	0.28	0.782
AgeGroup*Cond*Sadness	0.32	1.62	0.20	0.846	0.20	1.41	0.14	0.890

For the outcome variable representing the difference between the risk and benefits of flu vaccines, a significant age group by fear interaction was observed (see Table 19). As mentioned above, positive values for the risk/benefit score indicate that the participant perceived more benefits and fewer risks related to the flu vaccine. The interaction was explored further by testing simple slopes for the association between age group and changes in self-reported fear on the mDES. To do so, the continuous fear-change scores of the participants were collapsed into three categorical levels: high, medium and low levels of fear change (i.e., change from before to after viewing the stimulus face). The high level incorporated all fear-change scores that were one standard deviation above the mean, the medium level incorporated all the fear-change scores that were between one standard deviation below the mean and one standard deviation above the mean, and the low level incorporated scores that were one standard deviation below the mean. As mentioned previously, higher scores on this variable indicate increases in fear from before viewing the commercial to after viewing the commercial. Subsequently, the risk/benefit scores of younger and older adults were separately examined, i.e., compared across the three fear-change levels. For younger adults, the slopes (representing the relation between fear change and the risk/benefit score) at the three levels of the fear change variable (high M = -.01, medium M = -.02, low M = -.05) did not differ from one another (p’s >.05). For older adults, the slopes at each level of fear change were significantly different from one another. Thus, older adults who experienced high levels of changes in fear demonstrated lower risk/benefit scores (M = -.34,) in comparison to older adults who experienced medium (*M* = -.05, *t*(39) = -2.59, *p* = .013) and lower levels (*M* = .23, *t*(39) = -2.59, *p* = .013) of changes in fear. This indicates that for older adults, greater increases in fear were related to lower risk/benefit scores. More specifically, the more fear older adults experienced as a result of viewing the commercial, the more risky they perceived the flu vaccine to be.

For the variable representing changes in behavioral intentions regarding the flu vaccine, a three-way (age group by condition by joy) interaction emerged (see Table 12). The interaction between condition and change in joy (i.e., differences in joy score from before to after viewing the commercial) was also significant but was not interpretable in the model as it was qualified by the significant three-way interaction. To further examine the three-way interaction, regression analyses were conducted for older and younger adults separately. For the younger adults, the interaction between commercial condition and joy-change scores was significant, *b* = -.67, *t*(39) = -2.34, *p* = .030, whereas the interaction was not significant in the regression for older adults, *b* = .46, *t*(39) = 1.55, *p* = .134.

The significant commercial x joy interaction in the younger adult regression was explored further by examining the simple slopes representing the influence of changes in joy on the intentions score for each commercial condition separately. As in the previous examinations of simple effects, the continuous joy-change scores of the participants were collapsed into three categorical levels: high, medium and low levels of joy change (i.e., change from before to after viewing the stimulus face). The high level incorporated all joy-change scores that were one standard deviation above the mean, the medium level incorporated all the joy-change scores that were between one standard deviation below the mean and one standard deviation above the mean, and the low level incorporated scores that were one standard deviation below the mean. As mentioned previously, higher scores on this variable indicate increases in joy from before viewing the commercial to after viewing the commercial. Subsequently, the intentions scores of younger adults in the smiling and concerned-doctor condition were separately examined, i.e., compared across the three joy-change levels. The analyses showed that changes in intentions scores differed across conditions only for those younger adults who experienced changes in joy that were one standard deviation above the mean. Younger adults in the concerned doctor condition who experienced high levels of increases in joy had marginally greater intentions (M = .38) compared to the younger adults in the smiling doctor condition who also had the highest increases in joy (M = -.46) $t(39) = -2.04$, $p = 0.055$.

Table 19.

Step 3 of Hierarchical Regression Analyses Examining Effects of mDES measures on Risk/Benefits and Intentions Scores

	Risk/Benefits Score						Behavioral Intentions Score					
	b	*SE*	*t*	*p*	ΔR^2	R^2	*b*	*SE*	*t*	*p*	ΔR^2	R^2
Step 3-					0.22	0.28					0.28	0.37
Had flu last year?	-0.17	0.15	-1.14	0.260			-0.17	0.28	-0.61	0.547		
Vac last year?	0.00	0.08	0.06	0.951			-0.18	0.15	-1.20	0.235		
# vac last 3 years?	0.00	0.04	0.08	0.940			-0.15	0.08	-1.87	0.067		
Doctor recommend?	0.03	0.10	0.30	0.766			0.04	0.20	0.20	0.841		
Pre-test worry about flu	0.03	0.03	0.98	0.331			0.04	0.07	0.62	0.539		
Pre-test side-effect risk	0.01	0.20	0.03	0.974			0.00	0.38	-0.01	0.991		
AgeGroup	-0.03	0.14	-0.24	0.814			0.04	0.27	0.16	0.874		
Version	-0.02	0.13	-0.17	0.865			-0.33	0.25	-1.33	0.188		
AgeGroup*Cond	-0.12	0.19	-0.63	0.531			0.47	0.37	1.26	0.213		
Joy	0.04	0.07	0.59	0.559			0.23	0.13	1.74	0.088		
AgeGroup*Joy	-0.10	0.13	-0.75	0.457			-0.46	0.25	-1.84	0.071		
Cond*Joy	-0.01	0.14	-0.09	0.926			-0.59	0.26	-2.27	0.027*		
AgeGroup*Cond*Joy	-0.09	0.20	-0.45	0.654			0.79	0.38	2.10	0.041*		
Amusement	-0.01	0.08	-0.10	0.922			-0.13	0.15	-0.83	0.411		
AgeGroup*Amuse	0.00	0.19	0.01	0.992			-0.14	0.37	-0.39	0.699		
Cond*Amuse	0.10	0.15	0.66	0.514			-0.19	0.28	-0.68	0.500		
AgeGroup*Cond*Amuse	-0.06	0.25	-0.24	0.814			0.27	0.47	0.57	0.568		
Fear	0.01	0.08	0.16	0.873			-0.13	0.16	-0.85	0.402		
AgeGroup*Fear	-0.51	0.23	-2.17	0.035*			0.01	0.44	0.02	0.988		
Cond*Fear	0.06	0.26	0.22	0.826			0.28	0.50	0.55	0.584		

AgeGroup*Cond*Fear	0.01	0.46	0.03	0.980	0.16	0.89	0.18	0.856
Sadness	-0.03	0.12	-0.26	0.794	-0.21	0.24	-0.88	0.384
AgeGroup*Sadness	-0.26	0.19	-1.32	0.193	0.46	0.37	1.22	0.227
Cond*Sadness	-0.23	0.30	-0.76	0.450	-0.66	0.58	-1.15	0.255
AgeGroup*Cond*Sadness	0.28	0.39	0.73	0.466	0.51	0.74	0.69	0.494

Discussion

The aim of this study was to explore how affective responses to emotional expressions presented during an influenza vaccine commercial could change participants' evaluations of the flu vaccine (i.e., behavioral intentions, risk perceptions, and integral feelings). The study also included older and younger adults to examine whether age-related increases in the preference for positive over negative information could lead to differential influences of positive and negative facial expressions on the above-mentioned evaluations.

The overall pattern of results indicates that younger adults were somewhat more affected than older adults by the facial expression manipulation in terms of self-reported changes in affect. Regarding the influence of the manipulation on evaluations, the concerned doctors elicited more positive feelings about the flu vaccine for both older and younger adults. Furthermore, a significant interaction between age group and condition on flu-related worry demonstrated that in comparison to their younger counterparts, the facial manipulation only influenced the worry evaluations of older adults. In addition, findings suggest that the evaluations of older and younger adults depended on their changes in affect from before to after watching the commercial. The next sections discuss the results for the tests of each hypothesis in greater detail.

The Influence of Age Group and Condition on Affective Responding

For Hypothesis I, an effect of the commercial condition (smiling vs. concerned doctor) on participants' changes in affective states was predicted. Specifically, it was predicted that relative to the concerned-doctor commercial, participants watching the smiling-doctor commercial would report increases in positive affect, joy, amusement, and *zygomaticus* activity. This prediction was partially supported. Across age groups, participants who watched the smiling doctor were more amused than those who watched the concerned doctor. No other affective measure, including fEMG measures, differed across the commercial conditions.

Hypothesis II predicted an age group by condition interaction in which older adults would report more positive change in valence and positive discrete emotions in the smile condition than would younger adults and would report less negative change in valence and negative discrete emotions in the concerned-doctor condition. A significant age group by condition interaction was obtained, yet it was not in line with the predictions. That is, only younger adults differed in affective responding across commercial conditions. Specifically, younger adults who watched the smiling doctor reported a greater increase in amusement than those who watched the concerned doctor. In fact, the latter reported a decrease in amusement.

The lack of difference in amusement across conditions for older adults implies that younger adults may be more likely to be impacted by incidental facial expressions in terms of their self-reported affect. Interestingly, the marginally significant main effect of age group on amusement indicated that older adults might have been more amused across both conditions. This finding may indicate a general tendency for older adults to experience more positive affect (albeit amusement) regardless of the facial expressions they observed during the commercial. However, given that the effect did not reach a conventional level of significance, no conclusion can be confidently drawn.

Interestingly, older adults demonstrated lower levels of baseline-relative *zygomaticus* activity in both conditions. This finding is consistent with previous work suggesting that older adults have overall lower levels of facial responding to affective facial stimuli (e.g., Slessor et al., 2014). However, lower levels of facial responding may not necessarily reflect lower levels of experienced emotion. This possible dissociation between facial activity and self-reported emotion is also suggested by this study's finding that younger adults did not differ in their *corrugator* or *zygomaticus* activity across conditions but did report increases in amusement.

The Influence of Age Group and Condition on Evaluations of the Flu and Flu Vaccine

For Hypothesis III it was proposed that participants in the negative concerned-doctor condition would report a greater increase in how much they were worried about getting the flu and their perceived risks of vaccination compared to participants in the positive smiling-doctor condition. In addition, it was predicted that participants in the positive smiling-doctor condition would report a greater increase in how positively they felt about the vaccines themselves, and in their behavioral intentions regarding vaccines compared to those in the negative concerned-doctor condition.

Although a significant effect was found for the influence of commercial condition on evaluations of the flu vaccine, it was not in the predicted direction.

Across age groups, participants felt more positively about the flu vaccine in the concerned-doctor condition compared to the smiling-doctor condition. Due to the complexity of the stimuli (see limitations), it is difficult to determine exactly why participants felt more positively about the vaccine after watching the concerned doctors.

An examination of the effects (or lack thereof) of the commercial condition on the other outcome measures potentially could shed some light on why concerned doctors made participants feel better about the vaccine. Across age groups, the expressions of the doctors had no impact on either the risk/benefit or behavioral intentions scores (other than for a small subset of younger adults who experienced relatively high increases in the experience of joy, see discussion below). Moreover, as will be discussed below in greater detail, changes in flu-related worry differed by condition only for older adult participants. Thus it is especially difficult to determine participants watching the concerned doctors felt better about the vaccine relative to those who watched the smiling doctors.

It is possible that the increase in positive feelings about the flu vaccine for participants in the concerned-doctor condition resulted from greater affective compatibility between the facial expressions and audio message in the concerned doctor condition. Insofar as the expressions of the concerned doctors matched the serious tone of the recorded message, feelings about the vaccine may have been bolstered. In contrast, the jovial expressions and the serious messages in the smiling-doctor condition may have been perceived as incongruent. Future research is needed to examine how participants' feelings toward a target are influenced by the affective congruence between the visual and informational components of a message.

For Hypothesis IV an interaction was predicted between age group and condition on changes in evaluations toward the flu and the flu vaccine. Specifically, it was predicted that compared to their younger counterparts, older adults would have greater positive changes in evaluations toward the flu and the flu vaccine in the smiling-doctor condition and less negative changes in evaluations of the flu in the concerned-doctor condition. The results only indicated a significant age group by condition interaction on changes in the extent to which participants were worried about getting the flu after watching the commercial. For Hypothesis IV, it was predicted that evaluations would differ between older and younger adults within the same condition. Although the results did not support this specific prediction, it was discovered that older adults' who watched the smiling-doctors reported an increase in worry about getting the flu compared their age mates who watched the concerned doctors. In fact, older adults in the concerned-doctor condition actually reported being less worried about the flu than before viewing the commercial. Younger adults were not differentially influenced by the commercial condition.

Given that older (and younger) adults felt more positively about the flu vaccine after watching the concerned doctors, it follows that they would then also be less worried about contracting the flu. Interestingly, younger adults did not differ in their worry-change scores across commercial conditions. This may imply that younger adults' perceived susceptibility for contracting the flu is not easily manipulated by affective facial expressions in flu commercials.

Overall, the presence of direct and moderating effects of the commercial condition on some outcomes and not others may imply that manipulating the doctors' facial expressions only impacted more general affective evaluations (i.e., worry about the flu and feelings about the vaccine) rather than more cognitive evaluations of risks and benefits or behavioral intentions.

The Moderating Influences of Changes in Affective Responding on Flu Vaccine and Flu-Related Evaluations

Hypothesis V proposed that the extent to which participants changed their evaluations of the flu and flu vaccines would not only differ across conditions and age groups, but that it would also depend on how the participants were emotionally impacted by the commercials. Partial support for this prediction was present for two of the outcome variables: feelings about the flu vaccine, and the risk/benefit score. Importantly, significant moderating effects of only the self-reported measures of affective valence and discrete emotions were observed. Measures of fEMG activity did not have any direct or moderating effects on any of the outcome variables.

The interaction of age group and valence change on feelings about the flu vaccine was marginally significant. Although this interaction was not predicted, the simple slopes were further explored because of the potential relevance of such an interaction to the overarching topic of this study. Across conditions, older adults who reported greater pre- vs. post-viewing increases in positive valence were less worried about contracting the flu than were older adults who reported lesser increases in positive valence. No effect of valence on flu-related worry was present for younger adults. Similarly, for the risk/benefit score, an age group by fear change interaction was found. Follow-up analyses indicated that the more fear older adults experienced as a result of the commercial, the more risky they perceived the flu vaccine to be.

Given that older and younger adults did not differ in terms of their changes in valence or fear across conditions, this pattern of results may imply that evaluations of potentially negative outcomes (i.e., risk of contracting the flu, experiencing side effects) are influenced by changes in state affect for older adults only. More research is needed to confirm that this influence of affect is only evident for potentially negative outcomes or if it can be extended to positive outcomes as well for older adults.

Lastly, for intentions toward vaccination, an age group by condition interaction was moderated further by the extent to which participants changed in their experience of joy. Specifically, younger adults in the concerned-doctor condition who experienced the highest increases in joy had greater behavioral intentions compared to the younger adults in the smiling-doctor condition who also had the highest increases in joy. This pattern of results is difficult to explain given that changes in the experience of joy (or any other affective variable) did not predict changes in other evaluations (e.g., risk/benefit score, feelings about the vaccine or worry about the flu) for younger adults. Therefore, based on the other patterns in the data, it is not clear why the intentions of younger adults with high levels of joy differed across the emotion conditions. Furthermore, this finding is limited in its external generalizability given that younger adults' intention scores changed across condition only when they experienced above average changes in joy. Thus, relative to older adults, younger adults' affective responding to the commercial was not as closely related to changes in evaluations.

Limitations and Future Directions

Several limitations of the current study restricted the interpretability of the results. First and foremost, the commercial stimuli were extremely complex as they were originally intended to resemble a commercial advertisement. This complexity stemmed in part from the content of the messages, which discussed information about the flu and flu vaccines. Information about the flu pertained to its symptomology and contagiousness. Information about the vaccine consisted of framed messages promoting vaccination and a brief mention of the potential for vaccine-related side effects. A mix of positively and negatively framed messages was used in order to provide an affectively balanced promotion of flu vaccines. This balance was important given that the differential framing of health promotion messages can change affective evaluations of those messages (Mikels et al., under revision).

In summary, the main stimuli in this study included mixed affective information accompanied by videos in which facial expressions were either consistent or inconsistent with the serious tone of the messages. This complexity made it difficult to interpret whether the affective and evaluative reactions to the task were due to the messages or the faces. Future research with aims similar to the present investigation should thus use more concise and uniformly framed messages that pertain to one target (e.g., the vaccine itself).

Furthermore, given that the commercial conditions failed to elicit different patterns of facial activity, certain methodological changes to the task can be considered for future research. For instance, more control could have been achieved by presenting participants with a video of the doctors posing a neutral expression rather than a blank screen during the baseline period. Such a video would provide researchers with a baseline period that was more comparable to the actual facial stimuli, thus making the baseline-relative fEMG scores more valid measures of differences in facial responding to affective stimuli.

Conclusion

Overall, results of this study suggest that concerned rather than happy facial expression may be more effective at increasing positive feelings toward vaccinations given that both older and younger adults who watched the concerned doctors felt more positively about the vaccine. Furthermore, older adults' evaluations of the flu and the flu vaccine were dependent on their changes in affective responding to the commercial. Specifically, increased self-reported positive affect was related to decreased worry about getting the flu. Furthermore, when older participants reported increased fear they also perceived the flu vaccine to be more risky than beneficial. These findings imply that changes in state affect resulting for acquiring information about a target behavior can change evaluations of that behavior, especially for older adults.

General Discussion

Affect, regardless of whether it is related (integral) or unrelated (incidental) to the present decision or evaluation target, can influence how individuals evaluate uncertain prospects and can thus have significant implications for decisions involving risk (Lerner, Li, Valdesolo, & Kassam, 2014). Specifically, incidental affective states that are positive have been associated with increased risk-seeking behavior whereas negative states have been associated with risk-averse behavior.

Some of the most prominent and potent sources of incidental affect are facial expressions. Merely viewing facial expressions has in some cases been sufficient enough to elicit emotional experiences that corresponded to the viewed expression (Lishner, Cooter, & Zald, 2008; Schneider, Gur, Gur, & Muenz, 1994). Moreover, in demonstrations of the facial feedback hypothesis, the production of emotional facial expressions (either through spontaneous mimicry or through instructed posing) has elicited affective experiences that corresponded to the produced expression (e.g., Larsen et al., 1992). Converging evidence suggests that facial expressions can create an affective context that can impact risk-related evaluations and decisions (e.g., Habib, Cassotti, Moutier, Houdé, & Borst, 2015; Murphy, & Zajonc, 1993; Ottati, Terkildsen, & Hubbard, 1997). Given these findings, it is surprising that so few studies have examined whether emotional facial expressions are capable of influencing more complex risk-related decisions and evaluation in the real world domains of health and finance.

Thus, the overarching goal of the present investigation was to examine the role of emotional facial expressions in risk-related judgments and decisions. The first study aimed to examine how posing emotional facial expressions influenced risk-taking and risk-avoidant behavior in a financial investment task. The second study aimed to examine how emotional expressions presented during an influenza vaccine commercial could change participants' evaluations and feelings regarding the flu and the flu vaccine. Each study also examined how either risk-related decisions or evaluations were associated with individuals' affective responding to either the posing (Study 1) or passive viewing (Study 2) of facial expressions.

Furthermore, both studies assessed whether multiple forms of affective responding could moderate the influence that different affective facial expressions had on the decision or evaluation being made. In addition to assessing affective responding via self-report measures of affect, both studies measured facial electromyography (fEMG) in order to capture participants' facial muscle activity as they either posed or passively viewed facial expressions. Each study examined whether decisions or evaluations were guided not only by the valence of a facial expression, but also by the extent to which participants modeled the facial expression stimuli (either via instructions in Study 1 or spontaneously in Study 2). Overall, the effects of posing and viewing facial expressions that were found in previous research were not replicated in either of the present studies.
Although the main hypotheses were not supported, there was limited support for the general relations between affective responding and risk-related decisions (Study 1) and evaluations (Study 2). The next section contextualizes the findings

of each study in the larger literature on facial expressions and affective responding. Afterwards, a discussion will follow regarding the overall implications of the present research on our understanding of how emotional facial expressions can influence complex risk-related decisions and evaluation.

Impact of Present Research on Understanding How Emotional Facial Expressions Influence Self-Reported Affect

In both studies, the manipulations of facial expressions did not have the expected influence on participants' affective responding. The first study predicted that posing facial expressions would influence self-reported affect. Specifically, it was predicted that posing fearful faces would induce the greatest decrease in self-reported valence and that posing happy expressions would result in an increase in valence. Even though these predictions were well reasoned and based on previous research, the results were not consistent with the above-mentioned findings in the previous literature. Specifically, although participants' patterns of fEMG activity demonstrated that they followed the instructions in the posing task overall, participants reported the greatest reduction in valence in the neutral affect condition.

One can speculate that methodological differences between Study 1 and previous research may have contributed to the absence of the predicted effects. Perhaps the current posing task had more of an integral rather than incidental effect as it was performed embedded between the blocks of the investment task. In addition the instructions, which required participants to rate the intensity of the faces, could have also introduced an integral focus on the facial expressions. Thus, it is possible that from the participants' perspective, the posing task was a central part of the investment task rather than an unrelated, incidental component. Such an explicit posing procedure is methodologically different from previous research that used less explicit techniques. For instance, holding a pen in the mouth in a manner that creates different expressions has been shown to manipulate participants' feeling states (Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001; Strack, Martin, & Stepper, 1988).

Alternately, it is important to note that explicit posing tasks used in early research on facial feedback and emotion were successful in changing self-reported affective states (e.g., Laird, 1974). Such early studies embedded the facial posing manipulation within a larger experimental context that involved making *social* evaluations. Thus it is possible that facial posing manipulations may be more affectively influential if embedded within social decisions rather than financial decisions which are more individualistic in nature and may thus restrict the influence of more socially-manifested phenomena such as facial feedback.

The second study examined whether manipulating the facial expressions of doctors (smiling vs. concerned) in a flu vaccine commercial could alter participants' affective responses as assessed by fEMG and self-reported measures of affect and emotion. The study included older and younger adult samples as the presence of an age-related shift in the preference for positive over negative information suggests that positive and negative facial expressions could differ in how they influence the affective responding of older and younger adults. Age differences in patterns of self-reported affective responding did indeed emerge and were somewhat consistent with overall greater age-related positivity in response to emotion inductions (Chou et al., 2007). Specifically, in the current study, younger adults who watched the concerned doctors demonstrated reduced amusement relative to their age mates who watched the smiling doctors. In contrast, older adult participants reported similar levels of amusement across the video conditions and reported marginally greater amusement overall in comparison to younger adults.

Moreover, no effects of the doctors' expressions were found on participants' fEMG responses to the commercials. Based on previous research, the positive expressions of the doctors should have elicited greater *zygomaticus* activation, whereas the negative expressions should have elicited greater *corrugator* activation (Bailey et al., 2009). Importantly, previous research examining the effect of viewing different facial expressions on fEMG activity has used only pictures or videos of facial expressions (e.g., Bailey et al., 2009; Hess, & Blairy, 2001). However, facial EMG activity is sensitive to emotional words and affective pictures in addition to facial expressions (Lang et al, 1993; Larsen et al., 2003). Thus, it is possible that the predicted fEMG responses to smiling and concerned faces were obscured by the fEMG responses to the complex audio message, which included affectively mixed messages regarding risks and benefits.

Unlike Study 1, in which the affective responses to the faces were due to only the facial posing task, affective responses in Study 2 could have been due to the messages that were in the commercials. Thus, future research using complex stimuli (affective faces and messages) may consider asking participants how specific components of a commercial made them feel. For instance, participants could be asked “how did the doctors in the commercial make you feel?” separately from “how did the information in the commercial make you feel?”. Furthermore, to fully understand the differential effects of the audio and visual components of the commercials, future studies should present participants with affective videos and recorded messages at separate times in order to isolate affective responses to each type of stimuli.

Impact of Present Research on Understanding How Emotional Facial Expressions can Influence Risk-Related Decisions and Evaluations

In Study 1, it was predicted that relative to the other facial posing conditions, participants would mistakenly select more safe bonds (i.e., be more risk averse) when they posed the negative fear faces. Participants were also expected to make more risk-seeking mistakes when they posed the positive affective expressions (happy) relative to the other posing conditions. Although these predictions were based on the previously described relations between incidental affect and risk-related decision making, the facial posing manipulation did not have the predicted effect on risk-related decision making.

Furthermore, the predictions made regarding the moderating role of affective responding on the relationship between the posing condition and risk-related decision making were not supported. Interestingly though, a relationship did emerge between fEMG activity and risk seeking in the neutral condition. Although participants were instructed to pose the neutral faces, decreased *corrugator* activation and increased *zygomaticus* activation were related to increased risk seeking. It is possible that fEMG activity during the posing of neutral faces was evidence of feeling states that were not consciously recognized. If this were the case, fEMG may be more sensitive than other self-report measures of emotion, especially in decision making research that aims to assess how affective responses to facial or other emotional stimuli can guide risky decision making.

Although unexpected, the associations between facial responding and risk seeking were consistent with previous research linking *corrugator* (vs. *zygomaticus*) activity to negative (vs. positive) affect, which is associated to decreased (vs. increased) risk seeking. This study is among the first to link fEMG responses to risk-related decision making in a manner that reflects the previously defined relations between affective experiences and risk seeking. Thus, Study 2 demonstrated the potential utility of fEMG measures in decision-making research.

In contrast to Study 1, Study 2 did not find any relations between participants' fEMG activity and their changes in evaluations of the flu or the flu vaccine. Nonetheless, the study demonstrated that viewing incidentally presented facial expressions can influence evaluations of unrelated targets such as the flu or flu vaccines. Compared to those who watched the smiling doctors, older and younger adults who watched the concerned doctors felt more positively about the vaccine. Moreover, older adults who watched the smiling doctors reported increased worry about the flu relative to those who watched the concerned doctors. Despite these effects, the complexity of the video stimuli makes it difficult to determine exactly why participants' evaluations differed across the commercial conditions. Further research is needed to explore the possibility that feelings toward a target (e.g., a vaccine) are influenced by the congruence between the affective and informational components of a message about that target. Such research could reveal whether incongruent information results in more negative evaluations. Further research with actual behavioral outcomes is necessary before it can be considered that concerned rather than happy facial expressions accompany health information may be more effective at increasing preventative behavior.

Conclusion

Despite the limitations and further questions that arise from the findings of the present studies, this research has made small yet informative contributions to understanding how facial expressions can influence evaluations and decisions related to risky or uncertain prospects. Specifically, Study 1 suggests that fEMG may be a useful tool when attempting to evaluate how participants' affective responses to stimuli relate to their risk seeking behavior in financial decision tasks. Study 2 suggests that facial expression can have a direct effect on participants' general affective evaluations such as those pertaining to feelings rather than more cognitive evaluations of specific attributes (e.g., risks/benefits). Furthermore, the findings of Study 2 open the door for future research examining whether concerned rather than smiling facial expressions may be differentially effective in promoting more positive evaluations of the flu vaccine. More generally, it is proposed that future research may benefit from including fEMG measures in order to examine the influence of incidentally presented facial expression on evaluations and decisions involving risk.

References

Adelmann, P. K., & Zajonc, R. B. (1989). Facial efference and the experience of emotion. *Annual Review of Psychology*, *40*(1), 249-280.

Ariely, D., & Loewenstein, G. (2006). The heat of the moment: The effect of sexual arousal on sexual decision making. *Journal of Behavioral Decision Making*, *19*(2), 87-98.

Alhakami, A. S., & Slovic, P. (1994). A psychological study of the inverse relationship between perceived risk and perceived benefit. *Risk Analysis*, *14*(6), 1085-1096.

Bailey, P. E., Henry, J. D., & Nangle, M. R. (2009). Electromyographic evidence for age-related differences in the mimicry of anger. *Psychology and Aging*, *24*(1), 224.

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition*, *50*(1), 7-15.

Bechara, A., Tranel, D., Damasio, H., & Damasio, A.R. (1996). Failure to respond autonomically to anticipated future outcomes following damage to prefrontal cortex. *Cerebral Cortex*, *6*(2), 215-225.

Betsch, C., Ulshöfer, C., Renkewitz, F., & Betsch, T. (2011). The influence of narrative v. statistical information on perceiving vaccination risks. *Medical Decision Making*, *31*(5), 742-753.

Bolls, P. D., Lang, A., & Potter, R. F. (2001). The effects of message valence and listener arousal on attention, memory, and facial muscular responses to radio advertisements. *Communication Research, 28*(5), 627-651.

Bonanno, G. A., & Keltner, D. (1997). Facial expressions of emotion and the course of conjugal bereavement. *Journal of Abnormal Psychology*, *106*(1), 126.

Bower, G. H. (1981). Mood and memory. *American Psychologist*, *36*(2), 129.

Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001). Emotion and motivation : Defensive and appetitive reactions in picture processing. *Emotion*, *1*(3), 276.

Bish, A., Yardley, L., Nicoll, A., & Michie, S. (2011). Factors associated with uptake of vaccination against pandemic influenza: A systematic review. *Vaccine*, *29*(38), 6472-6484.

Brown, S. L., & Schwartz, G. E. (1980). Relationships between facial electromyography and subjective experience during affective imagery. *Biological Psychology*, *11*(1). 49-62.

Larsen, J. T., Berntson, G. G., Poehlmann, K. M., Ito, T. A., & Cacioppo, J. T. (2008). The psychophysiology of emotion. In R. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), The handbook of emotions (3rd ed., 180-195). New York: Guilford.

Cacioppo, J. T., Petty, R. E., Losch, M. E., & Kim, H. S. (1986). Electromyographic activity over facial muscle regions can differentiate the valence and intensity of affective reactions. *Journal of Personality and Social Psychology*, *50*(2), 260.

Cannon, P. R., Hayes, A. E., & Tipper, S. P. (2009). An electromyographic investigation of the impact of task relevance on facial mimicry. *Cognition and Emotion*, 23(5), 918-929.

Carstensen, L. L., & Mikels, J. A. (2005). At the intersection of emotion and cognition aging and the positivity effect. *Current Directions in Psychological Science, 14*(3), 117-121.

Carstensen, L. L., Turan, B., Scheibe, S., Ram, N., Ersner-Hershfield, H., Samanez-Larkin, G. R., ... & Nesselroade, J. R. (2011). Emotional experience improves with age: Evidence based on over 10 years of experience sampling. *Psychology and Aging, 26*(1), 21.

Caruso, E. M., & Shafir, E. (2006). Now that I think about it, i'm in the Mood for laughs: Decisions focused on Mood. *Journal of Behavioral Decision Making*, *19*(2), 155-169.

Chapman, G. B., & Coups, E. J. (2006). Emotions and preventive health behavior: Worry, regret, and influenza vaccination. *Health Psychology, 25*(1), 82.

Chou, K., Lee, T. C., & Ho, A. Y. (2007). Does mood state change risk taking tendency in older adults? *Psychology and Aging, 22*(2), 310-318.

Constans, J. I., & Mathews, A. M. (1993). Mood and the subjective risk of future events. *Cognition & Emotion*, *7*(6), 545-560.

Darwin, C. (1872/2005). *The expression of emotions in man and animals*. Whitefield , MT : Kessinger Publishing

Davis, J. I., Senghas, A., Brandt, F., & Ochsner, K. N. (2010). The effects of BOTOX injections on emotional experience. *Emotion*, *10*(3), 433.

De Martino, B., Kumaran, D., Seymour, B., & Dolan, R. J. (2006). Frames, biases, and rational decision-making in the human brain. *Science*, *313*(5787), 684-687.

Dimberg, U., & Öhman, A. (1996). Behold the wrath: Psychophysiological responses to facial stimuli. *Motivation and Emotion*, *20*(2), 149-182.

Dimberg, U., Thunberg, M., & Elmehed, K. (2000). Unconscious facial reactions to emotional facial expressions. *Psychological Science, 11*(1), 86-89.

Duclos, S. E., Laird, J. D., Schneider, E., Sexter, M., Stern, L., & Van Lighten, O. (1989). Emotion-specific effects of facial expressions and postures on emotional experience. *Journal of Personality and Social Psychology*, *57*(1), 100.

Ekman, P., Davidson, R. J., & Friesen, W. V. (1990). The Duchenne smile: Emotional expression and brain physiology: II. *Journal of Personality and Social Psychology*, *58*(2), 342.

Ekman, P., & Friesen, W. V. (1977). *Facial action coding system.*

Ekman, P., Levenson, R. W., & Friesen, W. V. (1983). Autonomic nervous system activity distinguishes among emotions. *Science*, *221*(4616), 1208-1210.

Ekman, P., & Rosenberg, E. L. (Eds.). (1997). What the face reveals: Basic and applied studies of spontaneous expression using the Facial Action Coding System (FACS). Oxford University Press.

Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, *13*(1), 1-17.

Fontaine, J. R., Scherer, K. R., Roesch, E. B., & Ellsworth, P. C. (2007). The world of emotions is not two-dimensional. *Psychological Science*, *18*(12), 1050-1057.

Forgas, J. P. (1994). Sad and guilty? Affective influences on attributions for simple and serious interpersonal conflicts. *Journal of Personality and Social Psychology*, *66*(1), 56–68.

Forgas, J. P. (1995). Mood and judgment: The affect infusion model (AIM). *Psychological Bulletin*, *117*(1), 39.

Frank, M. G., Ekman, P., & Friesen, W. V. (1993). Behavioral markers and recognizability of the smile of enjoyment. *Journal of Personality and Social Psychology*, *64*(1), 83.

Fredrickson B.L., Tugade M., Waugh C.E., Larkin G.R. (2003). What good are positive emotions in crises?: A prospective study of resilience and emotions following the terrorist attacks on the United States on September 11th, 2001. *Journal of Personality and Social Psychology*, *84*, 365–376.

Fridlund, A. J., & Cacioppo, J. T. (1986). Guidelines for human electromyographic research. *Psychophysiology*, *23*(5), 567-589.

Ferguson, E., & Gallagher, L. (2007). Message framing with respect to decisions about vaccination: The roles of frame valence, frame method and perceived risk. *British Journal of Psychology*, *98*(4), 667-680.

Galvani, A. P., Reluga, T. C., & Chapman, G. B. (2007). Long-standing influenza vaccination policy is in accord with individual self-interest but not with the utilitarian optimum. *Proceedings of the National Academy of Sciences, 104*(13), 5692-5697.

Isaacowitz, D. M., Wadlinger, H. A., Goren, D., & Wilson, H. R. (2006). Selective preference in visual fixation away from negative images in old age? An eye-tracking study. *Psychology and Aging, 21*(1), 40.

Habib, M., Cassotti, M., Moutier, S., Houdé, O., & Borst, G. (2015). Fear and anger have opposite effects on risk seeking in the gain frame. *Frontiers in Psychology, 6*.

Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1994). Emotional contagion: Studies in emotion and social interaction. *Editions de la Maison des sciences de l'homme*.

Havas, D. A., Glenberg, A. M., Gutowski, K. A., Lucarelli, M. J., & Davidson, R. J. (2010). Cosmetic use of botulinum toxin-A affects processing of emotional language. *Psychological Science, 21*(7), 895-900.

Hess, U., Banse, R., & Kappas, A. (1995). The intensity of facial expression is determined by underlying affective state and social situation. *Journal of Personality and Social Psychology, 69*(2), 280.

Hess, U., & Blairy, S. (2001). Facial mimicry and emotional contagion to dynamic emotional facial expressions and their influence on decoding accuracy. *International Journal of Psychophysiology, 40*(2), 129-141.

Hess, U., Philippot, P., & Blairy, S. (1999). Mimicry: Facts and fiction. In P.

Philippot, R. S. Feldman, E. J. Coats, P. Philippot, R. S. Feldman, E. J. Coats (Eds.), *The social context of nonverbal behavior* (pp. 213-241). New York, NY, US; Paris, France: Cambridge University Press

Johnson, E. J., & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology*, *45*(1), 20.

King, L. A., & Hicks, J. A. (2009). Positive affect, intuition and referential thinking. *Personality and Individual Differences*, *46*(7), 719-724.

King, L. A., Burton, C. M., Hicks, J. A., & Drigotas, S. M. (2007). Ghosts, UFOs, and magic: Positive affect and the experiential system. *Journal of Personality and Social Psychology*, *92*(5), 905.

Kuhnen, C. M., & Knutson, B. (2005). The neural basis of financial risk taking. *Neuron*, *47*(5), 763-770.

Lang, P. J., Greenwald, M. K., Bradley, M. M., & Hamm, A. O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology*, *30*(3), 261-273.

Larcom, M. J., & Isaacowitz, D. M. (2009). Rapid emotion regulation after mood induction: Age and individual differences. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, gbp077*.

Larsen, J. T., Norris, C. J., & Cacioppo, J. T. (2003). Effects of positive and negative affect on electromyographic activity over zygomaticus major and corrugator supercilii. *Psychophysiology*, *40*(5), 776-785.

Laird, J. D. (1974). Self-attribution of emotion: the effects of expressive behavior on the quality of emotional experience. *Journal of Personality and Social Psychology*, *29*(4), 475.

Larsen, R. J., Kasimatis, M., & Frey, K. (1992). Facilitating the furrowed brow: An unobtrusive test of the facial feedback hypothesis applied to unpleasant affect. *Cognition & Emotion*, *6*(5), 321-338.

Lerner, J. S., Gonzalez, R. M., Small, D. A., & Fischhoff, B. (2003). Effects of fear and anger on perceived risks of terrorism a national field experiment. *Psychological Science*, *14*(2), 144-150.

Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and decision making. *Annual Review of Psychology*, *66*.

Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgment and choice. *Cognition & Emotion*, *14*(4), 473-493.

Lerner, J. S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology*, *81*(1), 146-159.

Lerner, J. S., Small, D. A., & Loewenstein, G. (2004). Heart strings and purse strings carryover effects of emotions on economic decisions. *Psychological Science*, *15*(5), 337-341.

Levenson, R. W., Ekman, P., & Friesen, W. V. (1990). Voluntary facial action generates emotion-specific autonomic nervous system activity. *Psychophysiology*, *27*(4), 363-384.

Lipkus, I. M., Samsa, G., & Rimer, B. K. (2001). General performance on a numeracy scale among highly educated samples. *Medical Decision Making*, 21, 37–44

Lishner, D. A., Cooter, A. B., & Zald, D. H. (2008). Rapid emotional contagion and expressive congruence under strong test conditions. *Journal of Nonverbal Behavior*, *32*(4), 225-239.

Lo, A. W., & Repin, D. V. (2002). The psychophysiology of real-time financial risk processing. *Journal of Cognitive Neuroscience*, *14*(3), 323-339.

Löckenhoff, C. E., & Carstensen, L. L. (2007). Aging, emotion, and health-related decision strategies: Motivational manipulations can reduce age differences. *Psychology and Aging*, *22*(1), 134.

Mano, H. (1992). Judgments under distress: Assessing the role of unpleasantness and arousal in judgment formation. *Organizational Behavior and Human Decision Processes*, *52*(2), 216-245.

Mano, H. (1994). Risk-taking, framing effects, and affect. *Organizational Behavior and Human Decision Processes*, *57*(1), 38-58.

Mather, M., Knight, M., & McCaffrey, M. (2005). The allure of the alignable: Younger and older adults' false memories of choice features. *Journal of Experimental Psychology: General*, *134*(1), 38.

Matthews, G., Pitcaithly, D., & Mann, R. L. E. (1995). Mood, neuroticism, and the encoding of affective words. *Cognitive Therapy and Research, 19,* 563–587.

Mayer, J. D., Gaschke, Y. N., Braverman, D. L., & Evans, T. W. (1992). Mood-congruent judgment is a general effect. *Journal of Personality and Social Psychology, 63*, 119-132.

McCaul, K. D., Johnson, R. J., & Rothman, A. J. (2002). The effects of framing and action instructions on whether older adults obtain flu shots. *Health Psychology, 21*(6), 624.

McIntosh, D. N. (1996). Facial feedback hypotheses: Evidence, implications, and directions. *Motivation and Emotion*, *20*(2), 121-147.

Moody, E. J., & McIntosh, D. N. (2006). Bases and consequences of rapid, automatic matching behavior. *Imitation and the social mind: Autism and Typical Development, 71*.

Murphy, S. T., & Zajonc, R. B. (1993). Affect, cognition, and awareness: Affective priming with optimal and suboptimal stimulus exposures. *Journal of Personality And Social Psychology, 64*(5), 723- 739.

Nichol, K. L., Lind, A., Margolis, K. L., Murdoch, M., McFadden, R., Hauge, M., ... & Drake, M. (1995). The effectiveness of vaccination against influenza in healthy, working adults. *New England Journal of Medicine, 333*(14), 889-893.

Nichol, K. L., Margolis, K. L., Wuorenma, J., & Von Sternberg, T. (1994). The efficacy and cost effectiveness of vaccination against influenza among elderly persons living in the community. *New England Journal of Medicine, 331*(12), 778-784.

Nicotra, A., Critchley, H. D., Mathias, C. J., & Dolan, R. J. (2006). Emotional and autonomic consequences of spinal cord injury explored using functional brain imaging. *Brain*, *129*(3), 718-728.

Niedenthal, P. M. (1990). Implicit perception of affective information. *Journal of Experimental Social Psychology*, *26*(6), 505-527.

Niedenthal, P. M., Brauer, M., Halberstadt, J. B., & Innes-Ker, Å. H. (2001). When did her smile drop? Facial mimicry and the influences of emotional state on the detection of change in emotional expression. *Cognition & Emotion*, *15*(6), 853-864.

Niedenthal, P.M., & Kitayama, S. (Eds.) (1994). *The Heart's Eye: Emotional Influences in Perception and Attention*. New York: Academic Press.

Niedenthal, P. M., & Setterlund, M. B. (1994). Emotion congruence in perception. *Personality and Social Psychology Bulletin*, *20*(4), 401-411.

Ottati, V., Terkildsen, N., & Hubbard, C. (1997). Happy faces elicit heuristic processing in a televised impression formation task: A cognitive tuning account. *Personality and Social Psychology Bulletin*, 23, 1144-1156.

Parkinson, B., & Simons, G. (2009). Affecting others: Social appraisal and emotion contagion in everyday decision making. *Personality and Social Psychology Bulletin. 35*(8).

Peters, E., Västfjäll, D., Slovic, P., Mertz, C. K., Mazzocco, K., & Dickert, S. (2006). Numeracy and decision making. *Psychological Science, 17*(5), 407-413.

Raghunathan, R., & Pham, M. T. (1999). All negative moods are not equal: Motivational influences of anxiety and sadness on decision making. *Organizational Behavior and Human Decision Processes, 79*(1), 56-77.

Reed, A. E., Chan, L., & Mikels, J. A. (2014). Meta-analysis of the age-related positivity effect: Age differences in preferences for positive over negative information. *Psychology and Aging, 29*(1), 1.

Rolison, J. J., Hanoch, Y., Wood, S., & Liu, P. J. (2013). Risk-taking differences across the adult life span: A question of age and domain. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences.*

Rosenberg, E. L., & Ekman, P. (1994). Coherence between expressive and experiential systems in emotion. *Cognition & Emotion, 8*(3), 201-229.

Rothman, A. J., Salovey, P., Antone, C., Keough, K., & Martin, C. D. (1993). The influence of message framing on intentions to perform health behaviors. *Journal of Experimental Social Psychology, 29*(5), 408-433.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39*(6), 1161.

Russell, J. A., Weiss, A., & Mendelsohn, G. A. (1989). Affect grid: A single-item scale of pleasure and arousal. *Journal of Personality and Social Psychology*, *57*(3), 493.

Samanez-Larkin, G. R., Kuhnen, C. M., Yoo, D. J., & Knutson, B. (2010). Variability in nucleus accumbens activity mediates age-related suboptimal financial risk taking. *The Journal of Neuroscience, 30*(4), 1426-1434.

Savage, L. J. (1954). *The Foundations of Statistics.* New York, NY: Wiley. 294

Schaller, M., & Cialdini R. M., (1990). "Happiness, Sadness, and Helping." In *Handbook of Motivation and Cognition*, vol. 2, (Eds). E. T. Higgins and R. M. Sorrentino, pp. 265-96. New York: Guilford.

Schneider, F., Gur, R. C., Gur, R. E., & Muenz, L. R. (1994). Standardized mood induction with happy and sad facial expressions. *Psychiatry Research, 51*(1), 19-31.

Schwarz, N. (2002). Situated cognition and the wisdom of feelings: Cognitive tuning. In L. Feldman Barrett & P. Salovey (Eds.), *The wisdom in feelings* (pp.144-166). New York: Guilford.

Schwarz, N. (2011). Feelings-as-information theory. In P. Van Lange, A., Kruglanski, E. T., Higgins (Eds). *Handbook of Theories of Social Psychology*, 1, 289-308. Thousand Oaks, CA: Sage Publications;

Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgments of well-being: Informative and directive functions of affective states. *Journal of Personality and Social Psychology, 45*(3), 513.

Schwarz, N., & Clore, G. L. (2007). Feelings and phenomenal experiences. In A. W. Kruglanski & E. T. Higgins (Eds.), *Social Psychology: Handbook of basic principles* (2nd ed., pp. 385-407). New York, NY: Guilford Press.

Slovic, P., Peters, E., Finucane, M. L., & MacGregor, D. G. (2005). Affect, risk, and decision making. *Health Psychology, 24*(4S), S35-S40.

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, *48*(4), 813.

Soussignan, R. (2002). Duchenne smile, emotional experience, and autonomic reactivity: A test of the facial feedback hypothesis. *Emotion, 2*(1), 52.

Starr, M. J., Gogolushko, Y., & Winkielman, P. (2008). Influence of affective pictures and words on consumption behavior and facial expressions. *Psychophysiology*, *45*, 121.

Stern, R. M., Ray, W. J., & Quigley, K. S. (2001). *Psychophysiological Recording*. Oxford University Press.

Strack, F., Martin, L. L., & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: A nonobtrusive test of the facial feedback hypothesis. *Journal of Personality and Social Psychology*, *54*(5), 768.

Tassinary, L. G., Cacioppo, J. T., & Geen, T. R. (1989). A psychometric study of surface electrode placements for facial electromyographic recording: I. The brow and cheek muscle regions. *Psychophysiology*, *26*(1), 1-16.

Tiedens, L. Z., & Linton, S. (2001). Judgment under emotional certainty and uncertainty: The effects of specific emotions on information processing. *Journal of Personality and Social Psychology*, *81*(6), 973-988.

Tomkins, S. S. (1962). *Affect, imagery, consciousness: Vol. I. The positive affects.* New York, Springer.

Tukey, J. W. (1977). Exploratory data analysis. Reading, Ma, 231, 32.

Wallbott, H. G. (1991). Recognition of emotion from facial expression via imitation? Some indirect evidence for an old theory. *British Journal of Social Psychology*, *30*(3), 207-219.

Watkins, P. C., Vache, K., Verney, S. P., & Mathews, A. (1996). Unconscious mood-congruent memory bias in depression. *Journal of Abnormal Psychology*, *105*(1), 34.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063.

Weber, E. U., Siebenmorgen, N., & Weber, M. (2005). Communicating asset risk: How name recognition and the format of historic volatility information affect risk perception and investment decisions. *Risk Analysis, 25*(3), 597-609.

Wilson, M., & Daly, M. (2004). Do pretty women inspire men to discount the future?. *Proceedings of the Royal Society of London, Series B: Biological sciences*, *271*(4), 177-179.

Winkielman, P., Berridge, K. C., & Wilbarger, J. L. (2005). Unconscious affective reactions to masked happy versus angry faces influence consumption behavior and judgments of value. *Personality and Social Psychology Bulletin, 31*(1), 121-135.

Winkielman, P., Knutson, B., Paulus, M., & Trujillo, J. L. (2007). Affective influence on judgments and decisions: Moving towards core mechanisms. *Review of General Psychology, 11*(2), 179-192.

Winkielman, P., Niedenthal, P., & Oberman, L. (2008). The embodied emotional mind. In Semin, G. R., & Smith, E. R. (Eds.) *Embodied grounding: Social, cognitive, affective, and neuroscientific approaches.* 263-288. New York: Cambridge University Press.Wright,

W. F., & Bower, G. H. (1992). Mood effects on subjective probability assessment. *Organizational Behavior And Human Decision Processes, 52*(2), 276-291.

Zimmerman, R. K., Santibanez, T. A., Janosky, J. E., Fine, M. J., Raymund, M., Wilson, S. A., ... & Nowalk, M. P. (2003). What affects influenza vaccination rates among older patients? An analysis from inner-city, suburban, rural, and Veterans Affairs practices. *The American Journal of Medicine, 114*(1), 31-38.

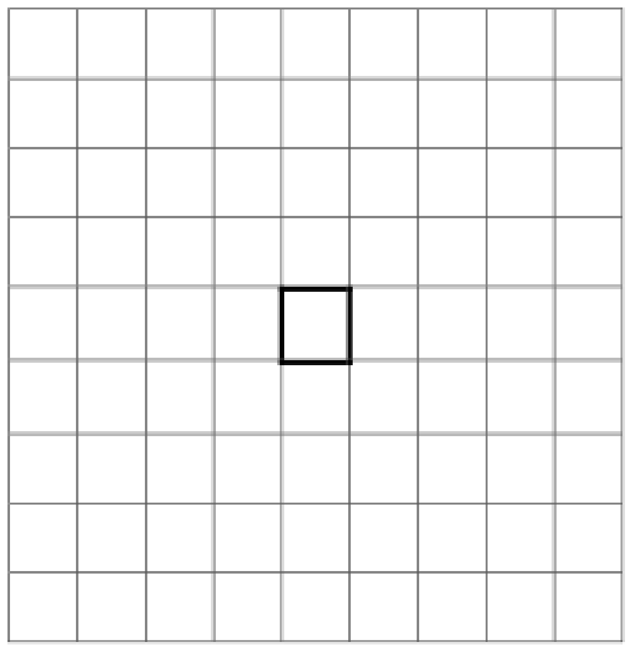
Appendix A

Affect Grid

Instructions: Using the grid below, please mark an "X" in one of the boxes that best describes how you are feeling right now, that is, at this moment. The **bolded** box in the center represents neutrality.

Anger/Stress/Anxiety **High Arousal** **Joy/Excitement**

Unpleasantness



Pleasantness

Sadness/Depression **Sleepiness** **Contentment/ Relaxation**

Appendix B

mDES state

In any given circumstance, people often have a number of different feelings. Please indicate how much of each emotion you feel right now, that is, at the present moment.

	not at all	**a little bit**	**moderately**	**quite a bit**	**extremely**
	1	**2**	**3**	**4**	**5**
1. amusement	O	O	O	O	O
2. hope	O	O	O	O	O
3. fear	O	O	O	O	O
4. guilt	O	O	O	O	O
5. sadness	O	O	O	O	O
6. compassion	O	O	O	O	O
7. awe	O	O	O	O	O
8. anger	O	O	O	O	O
9. surprise	O	O	O	O	O
10. joy	O	O	O	O	O
11. shame	O	O	O	O	O
12. contempt	O	O	O	O	O
13. love	O	O	O	O	O
14. pride	O	O	O	O	O
15. contentment	O	O	O	O	O
16. embarrassment	O	O	O	O	O
17. interest	O	O	O	O	O
18. disgust	O	O	O	O	O
19. gratitude	O	O	O	O	O

Appendix C

Please answer for the following questions to the best of your ability.

1. Imagine that we roll a fair, six-sided die 1, 000 times. Out of 1,000 rolls, how many times do you think the die would come up even?
   Answer: _____________

2. In the BIG BUCKS LOTTERY, the chances of winning a $10.00 prize is 1%. What is your best guess about how many people would win a $10.00 prize if 1,000 people each buy a single BIG BUCKS ticket?
   Answer: _____________

3. In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets in the ACME PUBLISHING SWEEPSTAKES win a car?
   Answer: _____________

4. Which of the following numbers represents the biggest risk of getting a disease? (mark one)

   ___ 1 in 100
   ___ 1 in 1000
   ___ 1 in 10

5. Which of the following numbers represents the biggest risk of getting a disease? (mark one)

   ___ 1%
   ___ 10%
   ___ 5%

6. If Person A's risk of getting a disease is 1% in ten years, and person B's risk is double that of A's, what is B's risk?
   Answer: _____________

7. If Person A's chance of getting a disease is 1 in 100 in ten years, and person B's risk is double that of A's, what is B's risk?
   Answer: _____________

8. If the chance of getting a disease is 10%, how many people would be expected to get the disease?
   A: Out of 100? _________________________
   B: Out of 1000? ________________________

9. If the chance of getting a disease is 20 out of 100, this would be the same as having a ____% chance of getting the disease.
   Answer: _____________

10. The chance of getting a viral infection is .0005. Out of 10,000 people, about how many people are expected to get infected? Answer: _____________

Appendix D

Pre-Flu Questionnaire

Instructions: For each of the following statements please circle the number that best represents your answer.

Q1. Would you say that your overall health is…

1) Very Poor
2) Poor
3) Fair
4) Good
5) Very Good

Q2. How do you feel about flu vaccines?

1	2	3	4	5	6	7
Very Negative	Negative	Slightly Negative	Neither Negative Nor Positive	Slightly Positive	Positive	Very Positive

Q3. How worried are you about getting the flu?

1	2	3	4	5	6	7
Not At All Worried			Moderately Worried			Very Worried

Q4. If you do not get the flu vaccine, how likely are you to get the flu?

0%----- 10%-----20% ----30% ---- 40%---- 50%-----60% ----70% ---- 80%---- 90% ---100%
Chance **Chance** **Chance**

Q5. If you do get the flu vaccine, how likely are you to get the flu?

0%----- 10%-----20% ----30% ---- 40%---- 50%-----60% ----70% ---- 80%---- 90% ---100%
Chance **Chance** **Chance**

Q6. If you do get the flu vaccine, how likely are you to experience negative side effects related to the vaccine itself?

0%----- 10%-----20% ----30% ---- 40%---- 50%-----60% ----70% ---- 80%---- 90% ---100%
Chance **Chance** **Chance**

Q7. How likely are you to get the flu vaccine next flu season?

1	2	3	4	5	6	7
Not At All Likely			**Moderately Likely**			**Very Likely**

Q8. How much would you be willing to pay for the flu vaccine?

$0 -------- $5 ------- $10 ------- $15 ------ $20 ----- $25 ----- $30 ------- $35 ----- $40

Q9. How likely are you to recommend a flu shot for your friends and family members?

1	2	3	4	5	6	7
Not At All Likely			**Moderately Likely**			**Very Likely**

Q10. Do you smoke or use any tobacco products?

1. Yes
2. No

Q11. Have you had the flu in the past year?

1. Yes
2. No

Q12. Did you get a flu vaccine this past flu season?

1. Yes
2. No

Q13. How many times have you received the flu vaccine in the last 3 years?

____

Q14. Did a doctor recommend that you get the vaccine?

1. Yes
2. No

Q15. Do you take medications, over-the-counter or prescription, on a regular basis?

1. Yes
2. No

**** Questions 1, and 10-15 are asked to older adults only as distraction questions.**

Appendix E

Post-Commercial Questionnaire

Instructions: For each of the following statements please circle the number that best represents your answer.

Q1. How do you feel about flu vaccines?

1 ------------ 2 ----------- 3 ------------ 4 ------------ 5 ----------- 6 ----------- 7

Extremely Negative | Negative | Slightly Negative | Neither Negative Nor Positive | Slightly Positive | Positive | Extremely Positive

Q2. How worried are you about getting the flu?

1 ------------ 2 ----------- 3 ------------ 4 ------------ 5 ----------- 6 ----------- 7

Not At All Worried | Moderately Worried | Extremely Worried

Q3. If you do not get the flu vaccine, how likely are you to get the flu?

0% ----- 10% -----20% ---- 30% ---- 40% ---- 50% -----60% ---- 70% ---- 80% ---- 90% --- 100%

Chance | **Chance** | **Chance**

Q4. If you do get the flu vaccine, how likely are you to get the flu?

0% ----- 10% -----20% ---- 30% ---- 40% ---- 50% -----60% ---- 70% ---- 80% ---- 90% --- 100%

Chance | **Chance** | **Chance**

Q5. If you do get the flu vaccine, how likely are you to experience negative side effects related to the vaccine itself?

0% ----- 10% -----20% ---- 30% ---- 40% ---- 50% -----60% ---- 70% ---- 80% ---- 90% --- 100%

Chance | **Chance** | **Chance**

Q6. How likely are you to get the flu vaccine next flu season?

1 ------------ 2 ----------- 3 ------------ 4 ------------ 5 ----------- 6 ----------- 7

Not At All Likely | **Extremely Likely**

Q7. How much would you be willing to pay for the flu vaccine?

$0 -------- $5 ------- $10 ------- $15 ------ $20 ----- $25 ----- $30 ------- $35 ----- $40

Q8. How likely are you to recommend a flu shot for your friends and family members?

1 ------------ 2 ----------- 3 ------------ 4 ------------ 5 ----------- 6 ----------- 7

Not At All Likely | **Moderately Likely** | **Extremely Likely**

Appendix F

Flu Commercial Script:

Stay healthy this flu season by getting vaccinated. An annual flu vaccine is the best way to reduce your chances of getting and spreading the flu.

The "flu," is a contagious infection that affects the respiratory system. Symptoms include fever, cough, sore throat, runny nose, body aches, chills and fatigue.

Remember, the flu can easily be avoided with a simple vaccination that can allow you to keep your life on track this flu season.

Influenza is a serious disease that can lead to hospitalization. Even healthy people can get very sick from the flu and spread it to their friends, family, and co-workers.

Protect yourself and your community before the coming flu season. Don’t let the flu slow you down!

Side effects of the flu vaccine include Soreness, redness, or swelling at the site of the inoculation. A low-grade fever and aches.