Testing the Compensatory Health Belief Scale: The Role of Cognitive Factors
and Their Relationship to Health Outcomes

A thesis presented to
the faculty of
the College of Arts and Sciences of Ohio University

In partial fulfillment
of the requirements for the degree
Master of Science

Bethany D. Lavins
August 2013

© 2013 Bethany D Lavins. All Rights Reserved.
This thesis titled
Testing the Compensatory Health Belief Scale: The Role of Cognitive Factors
and Their Relationship to Health Outcomes

by
BETHANY D. LAVINS

has been approved for
the Department of Psychology
and the College of Arts and Sciences by

Claudia González-Vallejo
Associate Professor of Psychology

Robert Frank
Dean, College of Arts and Sciences
ABSTRACT

LAVINS, BETHANY D., M.S., August 2013, Psychology

Testing the Compensatory Health Belief Scale: The Role of Cognitive Factors and Their Relationship to Health Outcomes

Director of Thesis: Claudia González-Vallejo

The health problems associated with childhood and adult obesity may result from certain cognitive patterns of thought, specifically, adherence to compensatory health beliefs (CHBs; Knäuper, Rabiau, Cohen & Patriciu, 2004; Rabiau, Knäuper & Miquelon, 2006). CHBs have often been described as an individual’s belief that the negative effects of an unhealthy behavior can be compensated for or neutralized by engaging in another, healthy behavior. For example, an individual may claim, “I can eat this piece of cake now because I will exercise this evening” (Rabiau et al., 2006, p.139). Studies have shown that these beliefs are prevalent among the U.S. and Canadian population, and that the numbers of such beliefs are correlated with many health outcomes.

Little research has explored the thought processes behind these beliefs. This study investigates how the need for cognition, decision-making coherence, self-control and risk perception, influence the endorsement of CHBs, and subsequent health outcomes such as self-reported risk behaviors and body mass index. Using structural equation modeling, this study addresses several hypothesis that link cognitive latent variables to the endorsement of CHB and its influence on health outcomes. Two groups of individuals were assessed (students at Midwestern University and an online, adult, U.S. sample (MTurk)). A model that related cognitive consistency and health behavioral patterns to CHB was found to describe key variable relationships in the data of the MTurk sample. Low levels of a latent Health Behaviors variable (containing measures of self-control, measures of Health Behaviors, and of risk perception) and a
latent Decision Making Coherence variable were associated with increased endorsement of CHB. Although no structural equation model fitted the OU sample data, results demonstrated that increases in need for cognition, self-control and Decision Making Coherence, were associated with increased perception of risk and decreased risky behavior. Overall, the present study highlighted important validity issues regarding CHB and its use in understanding Health Behaviors. Results from this study can help clarify the relationship between health-related cognitions and actions, and impact the design of interventions to help people to manage a healthy weight over their life span.
DEDICATION

I would like to dedicate this thesis to Greg Lavins for statistical contributions, Kathy and Eric Lavins for their unfailing support through this process, Susan and Wally Lavins for enabling my pursuit of higher education, and Barbara Jacquet for her ceaseless encouragement and excitement for science and research.
ACKNOWLEDGMENTS

I would like to thank my advisor Professor Claudia González-Vallejo and my committee members, Professor Frank Bellezza and Professor Peggy Zoccola, for their insight, feedback, guidance and support.
TABLE OF CONTENTS

| Abstract............................................................................................................................... | 3 |
| Dedication........................................................................................................................... | 5 |
| Acknowledgments............................................................................................................... | 6 |
| List of Tables ...................................................................................................................... | 9 |
| List of Figures ................................................................................................................... | 11 |
| Compensatory Health Beliefs ........................................................................................... | 12 |
| Endorsing CHBs and Negative Health Outcomes ........................................................ | 17 |
| Self-Control....................................................................................................................... | 19 |
| The Need for Cognition (NFC) ....................................................................................... | 21 |
| Decision Making Coherence............................................................................................. | 23 |
| Risk Taking and Risk Perception.................................................................................... | 26 |
| The Compensatory Health Belief (CHB) Scale ............................................................... | 28 |
| Compensatory Health Beliefs Scale Validity Issues and a Preliminary Test ............... | 33 |
| Pilot Study......................................................................................................................... | 34 |
| CHB Structural Equation Model....................................................................................... | 52 |
| Observed and Unobserved Variables............................................................................... | 52 |
| Relationships Among Variables .................................................................................... | 54 |
| Hypotheses....................................................................................................................... | 57 |
| Summary............................................................................................................................ | 58 |
| Methods............................................................................................................................... | 60 |
| Participants....................................................................................................................... | 60 |
| Design............................................................................................................................... | 61 |
| Measures........................................................................................................................... | 61 |
| Procedure......................................................................................................................... | 69 |
| Results............................................................................................................................... | 71 |
| Descriptive Statistics..................................................................................................... | 71 |
| Demographics.................................................................................................................... | 71 |
| Scale Measures............................................................................................................... | 74 |
| Group Comparisons......................................................................................................... | 80 |
Correlations ............................................................................................................... 85
Structural Equation Model Testing ........................................................................... 88
Variable Diagnostics ................................................................................................. 88
Correlations ............................................................................................................... 89
Model 1: Initial Model Testing .................................................................................. 90
Model 2: Predicting Health Outcomes from CHB .................................................... 98
Model 3: Decision Making Coherence Predicting CHB ......................................... 102
Model 4: Other Independent Variables Predictive of CHB .................................... 104
Model 5: Creation of a Final Model ........................................................................ 106
Model Testing in the Ohio University (OU) Sample .............................................. 115
Model Testing Combined Samples ......................................................................... 116
Discussion ....................................................................................................................... 123
Reasons for Changes to the Initial Model ................................................................. 124
Explanation for Risk Perception as a Predictor of Health Behavior ...................... 126
Discussion Concerning Removal of BMI from the Final Model ............................. 128
Implications of Results from the OU Sample .......................................................... 130
Limitations .................................................................................................................. 132
Future Implications ................................................................................................... 133
Conclusion ...................................................................................................................... 136
References ....................................................................................................................... 137
Appendix A ..................................................................................................................... 151
Compensatory Health Beliefs Scale ........................................................................ 151
Compensatory Health Beliefs Scale – OTHERS ..................................................... 153
Compensatory Health Beliefs Scale - Likelihood ..................................................... 155
Omission Bias .............................................................................................................. 156
Health Behaviors Checklist (HBCL) ....................................................................... 159
Demographics Questionnaire ...................................................................................... 162
Appendix B ..................................................................................................................... 163
18-Item Short Form Need for Cognition Scale ....................................................... 163
The Self Control Scale developed by Tangney et al. (2004) .................................. 164
Domain-Specific Risk-Taking (Adult) Scale – Risk Taking ................................... 165
LIST OF TABLES

Table 1: Compensatory Health Beliefs (CHBs): Item Wording and Factor Loadings ...30
Table 2: Intercorrelations of Compensatory Health Belief (CHB) Factors ....................31
Table 3: Internal Consistency: Comparison of Canadian, Dutch and Pilot Subscales ...38
Table 4: Overall Correlation Between Others Measures (N = 84)..............................40
Table 5: Correlations Between Corresponding Items on the Scales (17 items) ..........43
Table 6: Compensatory Health Beliefs (CHBs): Item Wording and Factor Loadings Pilot Study .................................................................45
Table 7: Descriptive Statistics for the Quantitative Variables .....................................72
Table 8: Descriptive Statistics for the Categorical Variables .......................................73
Table 9: Descriptive Statistics of Nonstandardized A-DMC Components OU (N = 212) ...............................................................................................................75
Table 10: Descriptive Statistics of Nonstandardized A-DMC Components MTurk (N = 217) ..............................................................................................................75
Table 11: Internal Consistency: Ohio University and MTurk ........................................76
Table 12: MTurk Descriptive Statistics for the Variable Measures (N = 217) ..............77
Table 13: OU Descriptive Statistics for the Variable Measures (N = 212) .................77
Table 14: Internal Consistency: Comparison of the Pilot and Current Study Subscales 78
Table 15: MTurk Correlations (N = 217).....................................................................86
Table 16: Ohio University (OU) Correlations (N = 212)..........................................87
Table 17: 2-Factor Solution for the ADMC¹ (MTurk data)² ....................................95
Table 18: 4-Factor Solution for Variables (MTurk data)$^2$ .......................................................97

Table 19: Goodness-of-Fit Test Results For Each Model - MTurk ($N = 217$) ..........108

Table 20: Standardized and Unstandardized Coefficients for MTurk Final Model ($N = 217$) ...............................................................................................................................110

Table 21: Goodness-of-Fit Test Results for Each Model - OU ($N = 212$).................115

Table 22: 2-Factor Solution for the ADMC$^1$ (OU data)$^2$ .........................................................117

Table 23: 5-Factor Solution for the Variables (OU data)$^2$ ..........................................................119
LIST OF FIGURES

Figure 1: The Compensatory Health Beliefs Model, adapted from Rabiau, Knäuper & Miquelon (2006) .............................................................................................................14

Figure 2: Modified CHB Model .....................................................................................53

Figure 3: Model 1: Modified Compensatory Health Belief (CHB) Model. .................92

Figure 4: Model 2: Predicting Health Outcomes from CHB. ........................................101

Figure 5: Model 3: Decision Making Coherence Predicting CHB. ..............................103

Figure 6: Model 4: Independent Variables Predictive of CHB.......................................105

Figure 7: Model 5: Final SEM Model for CHBs. ............................................................109
COMPENSATORY HEALTH BELIEFS

The health problems associated with childhood and adult obesity have come to the forefront of public attention in recent years due to the dramatic pervasiveness of obesity levels across much of the industrialized west, particularly in the United States (The Center for Disease Control, 2007 – 2010). The CDC reported that in 2010, the prevalence of obesity was greater than 20% in every state in the U.S., and 36 states had a prevalence rate of 25% or more. These health problems may result from certain cognitive patterns of thought, specifically, adherence to compensatory health beliefs (CHBs; Knäuper, Rabiau, Cohen & Patriciu, 2004; Rabiau, Knäuper & Miquelon, 2006).

CHBs have often been described as an individual’s belief that the negative effects of an unhealthy behavior can be compensated for or “neutralized” by engaging in another, healthy behavior. For example, an individual may claim, “I can eat this piece of cake now because I will exercise this evening” (Rabiau et al., 2006, p.139). Studies have shown that these beliefs are prevalent among the U.S. and Canadian population, and that the numbers of such beliefs are correlated with many negative health outcomes for instance, increased endorsement of CHBs have been found to be associated with higher body mass indexes (BMIs), increased risky-health and weight-regulating behaviors (e.g., dieting), and decreased health-related self-efficacy (Knäuper et al., 2004).

To measure the construct of CHBs, a 17-item CHB scale was developed by Knäuper et al. (2004). In this scale, participants are asked to read each sentence and respond by indicating how much they agree or disagree with each sentence on a 5-point Likert type scale (“not at all” (0), “a little” (1), “somewhat” (2), “quite a bit” (3) and
“very much” (4)). The scale is scored by creating an overall total score for the participant (potential range of 0 to 68), as well as the creation of four subscales: (1) substance use - six items concerning behaviors that could compensate for alcohol and coffee consumption and smoking, (2) eating/sleeping - four items concerning behaviors to compensate for lack of sleep or poor eating choices, (3) stress - four items concerning behavior to compensate for stress and (4) weight regulation – three items concerning behaviors to compensate for excessive calorie intake. Higher scores on the CHB scale, and higher averages for the subscales indicate a greater propensity to endorse CHBs.

The development of the CHB scale was accompanied by attempts to clarify the relationship between the CHB construct and other variables, particularly because the association between CHBs and negative health outcomes could stem from many different factors. This study focuses on three possible relationships. It could be that: (1) poor health outcomes lead to high levels of CHBs, (2) holding high levels of CHBs leads to poor health outcomes, or (3) some third variable(s) causes both. Knäuper et al. (2004) suggested that there is a third variable, proposing a CHB model (Figure 1) in which the motivational conflict between an individual’s immediate, visceral desires, and the long-term health goals often leads to the formation of CHBs. In their model, they focus on cognitive dissonance as the basic mechanism (Knäuper et al., 2004). An individual faced with cognitive dissonance has an internal conflict between what an individual wants and what he/she knows is right. For example the person may have the conflict between wanting to smoke a cigarette to ease anxiety, and not wanting to do it because smoking can lead to lung cancer.
According to Knäuper et al., an individual in health cognitive dissonance has three options to alleviate the conflict: (1) Resist the temptation; (2) modify the perception of the degree of harm/risk associated with the desire; or (3) form CHBs. Knäuper et al. (2004) argued that individuals tend to choose the third option, forming CHBs, because this strategy requires the least cognitive effort. That is, this strategy offers the best of both worlds; they can indulge in the temptation and the activated belief reduces dissonance. Their model states that the decision to form CHBs or take one of the other two options above is moderated by self-efficacy and influenced by the degree of desirability of the tempting object, along with the person’s health-goals of self-concordance (i.e., the extent to which goals are congruent with the person’s needs for self-determination, competence, and relatedness) (see Figure 1). Self-efficacy describes the degree to which the person believes that they can adhere to their goals. Thus, a person who is high in self-efficacy,
when faced with a very desirable tempting object, may not need to form CHBs because they can use an alternate cognitive strategy (e.g., deciding not to indulge).

In addition to the reduction of cognitive dissonance, the Knäuper et al.’s (2004) model describes an implementation stage. After forming the compensatory health belief intentions, these must be carried out, and self-efficacy plays an important role in the follow-through (see Figure 1). For example, the intention to exercise: “I intend to exercise at the gym when I leave work at 1800 hours for the aerobics class” (Rabiau, Knäuper & Miquelon, 2006, p.145), would be implemented if an appropriate self-regulatory strategy is in place. Individuals high in self-efficacy could thus develop, implement and maintain CHBs in order to resolve these guilty-pleasure dilemmas without negative consequences (Rabiau, Knäuper & Miquelon, 2006). On the other hand, a lack of self-regulation would result in formation of CHBs that ultimately have negative health outcomes.

The two components of the Compensatory Health Beliefs model, formation and implementation of CHBs, may have very different impacts on health outcomes. As suggested by Rabiau, Knäuper and Miquelon’s (2006) model, forming high levels of CHBs leads to poor health outcomes to the extent that (1) the compensatory behavior does not fully compensate for the negative effects and/or (2) the individual fails to follow through with the intended behavior (see Figure 1). Based on their model, therefore, an individual could hold high levels of CHBs and be healthy, as long as the CHBs are accurate, and the individual engages in the intended behavior (e.g., running three miles to make up for the piece of cake they ate).
The model proposed by Rabiau, Knäuper and Miquelon (2006) implies that in the face of a motivational conflict, individuals form or activate CHBs because doing so is the easiest strategy to reduce the associated cognitive dissonance (the other options being adapting the perception of the risk, or resisting the temptation) (see Figure 1). Whether or not the belief is put into action is then determined by implementation intention and self-efficacy. However, the authors are less clear on other cognitive factors influencing whether or not the individual will endorse that CHB (a step between formation of the CHB and action), a factor that should be considered prior to determining whether or not they will act on the belief.

Finally, it is important to also note that the research by Knäuper et al. (2004, 2006) does not address the more temporal nature of CHBs. While their research looks at the impact of CHBs from a prospective manner, it might also be interesting to explore their impact in a post-hoc manner. For instance, individuals may exercise, or avoid eating unhealthy sweets for a certain period of time, and then reward themselves by engaging in an aversive behavior because they have already complete the compensatory part of the equation, e.g., they run five miles, and then decide to eat the cake because they have already burned off the calories. This could also suggest more self-control on the part of these individuals in that they have successfully engaged in a compensatory behavior, before engaging in the said indulgence.

Potentially, this takes care of one of the problems which Knäuper et al (2004) suggest stems from CHBs, namely that they will result in negative outcomes to the extent that individuals fail to follow through with the behavior. However, it does not guarantee
that the CHB is accurate or that the behavior is actually compensating for the indulgence. A person may exercise, and then decide to smoke believing that they have already compensated for it, but exercising does not negate the effects of smoking. Although this is an interesting angle that merits consideration, the focus of the current study is on beliefs in predicting intentions and behavior at the present time, and not decisions made at a later point. Future work exploring the role of and potential difference in outcomes between pre-compensatory and post-compensatory behavior and CHB endorsement also posits another realm in which more research can be done.

**Endorsing CHBs and Negative Health Outcomes**

Several studies by Knäuper and colleagues have suggested that in general, high levels of CHBs are associated with more negative health outcomes (e.g., higher BMIs and lack of proper weight-regulating behavior; Knäuper et al., 2004). In Knäuper’s (2004) study, as scores on the CHB scale increased, so did BMIs, specifically, individuals with BMIs greater than or equal to 27 (a cutoff determined by the authors for being overweight or obese) scored significantly greater ($M = 23.74$) on the CHB scale (scores range from 0 to 68) than those with BMIs less than 27 ($M = 19.54$). Researchers have also found that holding CHBs and forming compensatory intentions are predictive of caloric intake in dieters (e.g., higher calorie intake is associated with higher levels of CHBs) (Kronick, Auerbach, Stich & Knäuper, 2011), and that dieters high in CHBs are more likely to indulge in a high calorie cookie than those low in CHBs (Kronick & Knäuper, 2010).
CHBs have also been associated with poor health outcomes for patients with diabetes. In a study on adolescent diabetics, researchers found that patients holding glucose testing compensatory beliefs had poorer HbA1c (calculated as the SD of the participant’s five past HbA1c glucose measures in the past year, including the one at the time of the visit) and poorer adherence to self-care behaviors (Rabiau, Knäuper, Nguyen, Sufrategui & Polychronakos, 2009). Further, glucose testing compensatory beliefs also predicted blood glucose control and adherence to treatment, even after accounting for diabetes and insulin knowledge concerning health outcomes (Rabiau et al., 2009).

This research appears to support the idea that high levels of CHBs will always lead to negative health outcomes, despite the fact that the model by Rabiau, Knäuper and Miquelon (2006) suggests moderation by self-efficacy and implementation intentions. In designing their scale and model, the authors’ main concern was the direct impact endorsing large numbers of CHBs has on health consequences – not on factors which may influence whether or not a person high in CHBs ends up endorsing them or not, which could result in differential health outcomes. While it appears they assume some relationship between CHBs and other variables, as evinced through their attempt to correlate a limited number of constructs with CHBs (e.g., risk behavior, social desirability and health self-efficacy), a comprehensive analysis has not been conducted.

Further, the importance of individual differences cannot be overstated. It may be that a combination of factors leads an individual to endorse these beliefs, thus more research is needed in order to delineate the role individual difference variables play in the endorsement of CHBs. Focusing on the three main components that connect conflict to
action in Figure 1: resist desire, activate CHB, and adapt risk perception, four key constructs are identified that may influence the endorsement of CHBs. Related to resisting desire, individuals’ self-control levels would seem to be an important factor.

With regards to beliefs that are consistent with actions, both levels of need for cognition and levels of coherent cognitions may play a role, perhaps also via a self-control mechanism. Finally, risk perceptions as well as risk behaviors are assumed to relate to CHBs. Each is discussed in turn.

**Self-Control**

Self-control refers to taking a course of action that yields a more positive outcome in the long-term than in the short term (Baumeister & Heatherton, 1996). Research has suggested that both the energy needed to exert self-control, as well as lack of it, may contribute to diet failure, as well as increasing levels of CHBs. For example, a study by Baumeister, Bratslavsky, Muraven and Tice (1998), deprived participants of food for several hours and then exposed them to several visceral influences: the aroma of fresh-baked chocolate chip cookies, the sight of chocolate chip cookies, and chocolate candy. While some of the participants were allowed to eat the sweets, others were told they could only eat from a bowl of radishes. The researchers found that people who forced themselves to eat radishes instead of tempting chocolate gave up more quickly when faced with “unsolvable” puzzles, than those who had not had to exert self-control when eating. This suggest a role not only for self-control, but also for the influence of visceral states (e.g., being hungry, and the smell and sight of tempting food) in an individual’s ability to resist temptation and exercise self-control.
Further, when dieters were presented with either chocolate or reduced-fat cookies, compensatory beliefs (as measured through both a “Open Response” and “Food Palatability” questionnaire) were more prevalent when a person was primed with the temptation (the chocolate cookies) (Monson, Knäuper & Knonick, 2008). This suggests that priming participants with different food items can play a significant role in the formation of CHBs. Another study by Heatherton and Vohs (1997) also found that dieters who were presented with tempting food, but did not eat it were more likely to break their diet than those who had not been presented with the tempting food. However, the temptation conditions had no influence on non-dieters. This suggests that visceral states along with priming may interact to influence an individual’s ability to exert self-control, potentially through the formation and endorsement of CHBs.

Finally, affect, commonly associated with less thoughtful processing and impulse, has also been studied and found to play a complex role in self-control (Giner, 2001), and in particular, delay of gratification (Weitheim & Schwarz, 1983). While some studies have implied that negative affective states, relative to positive ones, encourage immediate rewards to alleviate the unpleasant mood state (Moore, Clyburn & Underwood, 1976; Schwarz & Pollack, 1977; Wertheim & Schwarz, 1983), other research (Wertheim & Schwarz, 1983) suggests that negative affective states can be influenced by self-conscious feelings, and increase delay of gratification.

In a study by Wertheim and Schwarz (1983), participants were told they would have to complete three unpleasant tasks (an electroshock pain-threshold task, a SAT-like test (they were shown extremely difficult samples from the test), and a social skills task
which involved a videotape recording to be shown to a panel of judges), and given a choice of when to do them. A participants “delay-of-punishment” score was calculated by summing the number of unpleasant tasks the participant deferred until the next session. The authors found that men dispositionally high in guilt (as measured through the Mosher Forced-Choice Guilt Inventory (MGI; Mosher, 1966; Mosher, 1968)) were more likely to choose to undergo unpleasant events immediately instead of delaying them, suggesting that self-conscious feelings may act as an inducement to lead the participants to make self-controlled choices and delay gratification, choosing the short-term unpleasant event in return for a long term positive outcome (Giner, 2001).

Together, these studies suggest that both the effort used to exert self-control, visceral influences, emotions and affective states play a role in the ability of a person to exert self-control, and potentially in the formation of CHBs as well. However, these studies dealt with the manipulation of temptation itself, and not with self-control as an individual difference variable. Therefore, this study’s focus was on the individual’s ability to exert self-control in the face of a temptation, and whether or not people with a greater capacity to exert self-control across situations would be less likely to endorse CHBs. It was predicted that higher levels of self-control would be associated with decreased endorsement of CHBs.

The Need for Cognition (NFC)

The need for cognition (NFC) has been described as, “A need to structure relevant situations in meaningful, integrated ways. It is a need to understand and make reasonable the experiential world” (Cohen, Stotland & Wolf, 1955, p. 291). Other researchers have
used the term to describe individuals who have a tendency to enjoy cognitive challenges, often termed “thinkers,” or individuals who “love to think” (Murphy, 1947, p. 407), and possess a “need to understand” (Katz, 1960, p. 170).

In 1982, Cacioppo and Petty developed a scale to measure an individual’s preference to engage in and enjoy complex thought, or the need for cognition (NFC, Cacioppo & Perry, 1982). This measure of an individual’s thinking tendencies has become widespread and found to correlate with other constructs such as epistemic curiosity, intellectual engagement and openness to ideas, as well as emotional stability (Mussell, 2010). It has also been found to be positively related to openness to experience and conscientiousness (of the Big Five model of personality) (Fleischhauer, Enge, Brocke, Ullrich, Strobel, A. Strobel, A., 2009; Pacini & Epstein, 1999; Sadowski & Cogburn, 1997), persistence, and negatively related to harm avoidance (although no relation was found to reward dependence or novelty seeking, Fleischauer et al., 2009).

Rabiau, Knäuper and Miquelon’s (2006) model suggests that people form CHBs because this is the easiest cognitive strategy to reduce the cognitive dissonance that arises when an individual is faced with a temptation. Therefore, it is possible that individuals high in the need for cognition may be less likely to form and to endorse CHBs as they will be eager to engage in thought concerning the detriments and merits of indulging in a temptation as opposed to taking an “easy way out” by forming a CHB. Further, characteristics associated with the NFC such as persistence suggest that individuals higher in the NFC may possess additional traits which would increase their adherence to positive health goals and deter either the formation or use of CHBs. Alternatively, it may
be that individuals high in the NFC may actually form more CHBs, as they ponder over the situation and design elaborate strategies to employ in order to compensate for a behavior. The interesting question is whether or not those high in the NFC have better health outcomes than those who are low in the NFC, and, if so, whether that relationship is related to their endorsement of CHBs. It is, therefore, an important construct to consider when examining the endorsement of CHBs. For this study, it was predicted that higher scores on the NFC would be associated with decreased endorsement of CHBs.

Decision Making Coherence

A study by Knäuper, Cheema, Rabiau and Borten (2005) found that poor adherence to self-set dieting goals, as opposed to sustained (consistent) adherence to those goals, undermined weight loss success. This suggests that individuals who are able to remain consistent with long-term adherence to effective rules are better able to achieve and maintain weight loss over time.

In the decision making literature, coherence refers to a level of internal consistency and is the cornerstone of models of rational choice such as subjective expected utility (Edwards, 1955; Hammond, 1996; Quiggin, 1980; Ramsey, 1931; Savage, 1954). In this rational decision making framework, individuals are assumed to behave so that their personal expected utility is maximized and the theory rests on some basic principles of consistency, called axioms (Plous, 1993; Schoemaker, 1982). For example, the axiom of transitivity states that if a person prefers product A to product B and product B to product C, they should prefer product A to product C (i.e., a coherent set of preferences). In terms of poor adherence to dieting goals, it is possible that
individuals who desire to lose weight but do not follow through are particularly prone to
lacks of self-coherence which may be evidenced by holding inconsistent choice patterns.

A wide range of experiments have shown that humans tend to violate the axioms of
coherence across multiple situations and settings (Budescu and Weiss, 1987; Lindman
and Lyons, 1978; Loomes, Starmer & Sugden, 1991; Roelofsma and Read, 2000;
Tversky, 1969). Other models of decision making, such as Simon’s (1955) notion of
bounded rationality, and Tversky and Kahneman’s heuristics (Kahneman & Tversky
1972, 1973; Tversky & Kahneman 1973, 1974, 1983) attempted to provide an
explanation for the observed failures to adhere to rational principles in making decisions.
The emerging research supports the idea that these failures do not result from
computational overload, but rather from the specific ways people process information and
make decisions (Shafir & LeBoeur, 2002).

Although the vast literature on judgment and decision making biases has not
focused on individual differences, variability in behavior is not absent, as demonstrated
by Schneider and Lopes (1986) who showed that some individuals were more likely to
take risks when confronted with lotteries offering positive payoffs than others, with
reverse patterns when the lotteries offered losses. Another study by González-Vallejo,
Reid and Schiltz (2003) also confirmed this, showing that changes in risk attitudes (e.g.,
moving from a gain to a loss situation) depended both on the stimuli and on the
individual’s difference threshold (e.g., the individual’s risk attitude, or how sensitive they
are to payoff vs. probability differences when making choices). Many factors have been
found to affect decision-making, such as affect, availability of cognitive resources, and
framing, can lead to overconfidence, adherences to sunk cost and failure to apply appropriate decision rules. In a study by Shiv (1999), participants with limited processing resources (e.g., memorizing a complex number) were more likely to choose an affectively rich, yet cognitively poor choice of food, chocolate cake, as opposed to fruit salad, when compared to those who had high processing resources available (e.g., memorizing an easy number).

Another study by Kahneman et al. (1993), also demonstrated a breakdown of decision coherence. In the study, participants underwent two trials; a short trial where their hand was immersed in ice water (14°C) for 60s, and a long trial where it was immersed in the ice water for 60s, and then an extra 30s when the water was warmed slightly (although they were not made aware that the second trial was longer). When asked which trial they would rather repeat, participants chose the second, despite the fact that this trial was longer, leading the authors to suggest that the slight improvement of water temperature at the end caused them to ignore the temporal dimension and focus on their affective response. A model is developed which focus on individual differences in coherence patterns of preferences and their relationship to CHBs. It is proposed here that holding high levels of CHBs may lead to poor health outcomes in individuals with higher levels of incoherence because inconsistency in decision-making translates to incoherence between intention and behavior related to health decisions. Holding high levels of CHBs undermines health goals when the decision maker is inconsistent in following through with the stated goals.
Because little research has focused on the role of consistency in health-related choices, decision-making coherence may offer a unique and unexplored explanation for the relationship between CHBs and health outcomes. For those with high levels of CHBs, a relationship between negative health outcomes and lack of decision coherence may suggest that holding high levels of CHBs is problematic because inconsistency in life choices translates to lack of follow-through. Therefore, relying on the beliefs to “negate” the adverse effects of indulgence ultimately backfires because the individual is not consistent in forming an intention (e.g., forming the intention to exercise to make up for eating cake) and following through (e.g., actually exercising). However, lack of a relationship may be equally informative, suggesting that inconsistency may not be a flaw in the person’s decision making, but rather a function of the motivational forces unique to the dieting situation. For this study, it was predicted that higher levels of decision making coherence would be associated with decreased endorsement of CHBs.

**Risk Taking and Risk Perception**

Previous research has suggested that risky health behaviors may be responsible for as much as 40% of the premature mortality in the United States (McGinnis & Foege, 1993; McGinnis, Williams-Russo & Knickmann, 2002). Concerning risk, the 2006 CHB model presented by Rabiau, Knäuper, and Miquelon suggests that when faced with a temptation, risk adaptation is one of three separate choices an individual can make to resolve the situation (e.g., forming CHBs, adapt their perception of the risk or resisting the desire). Knäuper et al.’s (2004) study reported that higher CHB scores were significantly related to health risk behaviors.
However, their model and research fails to account for the role which risk may play in CHB endorsement, and underscores a lack of understanding concerning the action-outcome relationship between CHBs and health. Riskiness was only measured in one domain, asking the individuals a series of health-risk behavior questions drawn from an instrument developed by Thompson, Nelson, Caldwell and Harris (1999). The measure assessed 13 health variables, including lifetime and current smoking and alcohol use; number of fruits and vegetables consumed per day; amount of physical exercise per day; use of drugs for nonmedical purposes; use of vitamin supplements; time since last general health check-up; time since last dental check-up, and sun protection factors (Knäuper et al., 2004). While individuals with higher risk scores also tended to report a greater number of illness symptoms, the authors do not offer a clear explanation for why.

On one hand, forming CHBs may be a strategy to justify risky behaviors, increasing the probability that the individuals will engage in them. Alternatively, individuals with low risk perception (e.g., they perceive dangerous situations as less risky) may be more inclined to endorse CHBs because they don’t view indulgence in a maladaptive behavior as having a serious risk to their health. This is problematic because justifying risky behavior concerning health involves a gamble with one’s life – hedging that enjoying something pleasurable (but potentially harmful) now, can be nullified with a later action. A person’s perception of risk surrounding a health-related situation, therefore, may play a significant role in determining the health behaviors they take and ultimately the degree to which they adhere to health goals and intentions.
What past research has failed to explore is whether individuals who engage in risky behaviors (e.g., endorsing CHBs) do so because of a tendency to misperceive the risks, which then leads to poor health outcomes. A study by Weber, Blais, and Betz (2002) found that self-reported frequencies of past risky behaviors were significantly correlated with behavioral intentions, suggesting that poor understanding of perception of risk may be related to actual risk-taking behavior. Therefore, further research is merited to delineate this link between risk-perception, action, and health outcomes. Specifically, it would be interesting to explore how both risk perception and risk taking relate to CHBs. For this study, it is predicted that higher self-reported risk taking behavior will be associated with decreased risk perception and increased endorsement of CHBs.

The Compensatory Health Belief (CHB) Scale

The CHB scale was developed by Knäuper et al. (2004) to measure the construct of CHB and was used in the current study. The original Knäuper et al. scale is the only CHB scale which has been used consistently throughout the literature.

To design their scale, Knäuper et al. (2004) collected an initial CHB item pool through a large internet survey posted on numerous search engines and research websites with the goal of generating as large and diverse a sample as possible. Participants were given the definition of a CHB and asked to respond in an open format, writing down any CHB that came to mind. 523 submissions were made from 142 individuals. From those, a 67-item scale draft was sent to 12 experts in the fields of health psychology and psychometrics, who were provided with the background and definition of CHBs and asked to evaluate each item based on (1) whether it was a reflection of the CHB
construct, (2) whether the wording was clear, (3) whether and why an item should be deleted from the item pool, and (4) whether the response format was clear and feasible.

Based on feedback from the experts, the scale was then modified and reduced to 40 items which was then administered to 381 undergraduate students at McGill University in Canada, and subsequently analyzed for item analysis, confirmatory factor analysis and reliability (internal consistency and test-retest reliability). The scale questions asked participants to rate on a 5-point Likert type scale to what degree they endorse certain beliefs: not at all”(0), a little (1), somewhat (2), quite a bit (3) and very much (4).

A confirmatory factor analysis showed the four factor model fit well to the data ($\chi^2$ (113, $N=141$) = 248.42; df-ratio = 1.76; $CFI = 0.89$) (see Table 1). Based on the analysis, 23 items were eliminated from the scale.
Table 1
Compensatory Health Beliefs (CHBs): Item Wording and Factor Loadings

<table>
<thead>
<tr>
<th>Factor and item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factor I: Substance Use (α = 0.74)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. The effects of regularly drinking alcohol can be made up for by eating healthy</td>
<td>0.735</td>
<td>-0.043</td>
<td>0.096</td>
<td>-0.133</td>
</tr>
<tr>
<td>16. It is alright to drink a lot of alcohol as long as one drinks lots of water to flush it</td>
<td>0.581</td>
<td>0.242</td>
<td>-0.092</td>
<td>0.007</td>
</tr>
<tr>
<td>17. Smoking from time to time is OK if one eats healthy</td>
<td>0.534</td>
<td>0.077</td>
<td>0.029</td>
<td>-0.119</td>
</tr>
<tr>
<td>13. The effects of drinking coffee can be balanced by drinking equal amounts of water</td>
<td>0.52</td>
<td>-0.160</td>
<td>0.036</td>
<td>0.136</td>
</tr>
<tr>
<td>5. The effects of drinking too much alcohol during the weekend can be made up for by not drinking during the week</td>
<td>0.489</td>
<td>0.053</td>
<td>0.156</td>
<td>0.019</td>
</tr>
<tr>
<td>3. Smoking can be compensated for by exercising</td>
<td>0.405</td>
<td>-0.041</td>
<td>-0.061</td>
<td>0.235</td>
</tr>
<tr>
<td><strong>Factor II: Eating/Sleeping Habits (α = 0.66)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Too little sleep during the week can be compensated for by sleeping in on the weekends</td>
<td>-0.012</td>
<td>0.704</td>
<td>0.06</td>
<td>-0.038</td>
</tr>
<tr>
<td>4. It is OK to go to bed late if one can sleep longer the next morning (only the number of hours count)</td>
<td>-0.034</td>
<td>0.591</td>
<td>0.044</td>
<td>-0.054</td>
</tr>
<tr>
<td>14. It is OK to skip breakfast if one eats more during lunch or dinner</td>
<td>0.052</td>
<td>0.52</td>
<td>-0.007</td>
<td>0.038</td>
</tr>
<tr>
<td>8. Eating whatever one wants in the evening is OK if one did not eat during the entire day</td>
<td>0.108</td>
<td>0.425</td>
<td>-0.188</td>
<td>0.297</td>
</tr>
<tr>
<td><strong>Factor III: Stress (α = 0.63)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Stress during the week can be made up for by relaxing on the weekend</td>
<td>-0.106</td>
<td>0.338</td>
<td>0.557</td>
<td>0.045</td>
</tr>
<tr>
<td>7. A stressful day can be compensated for by relaxing in front of the T.V.</td>
<td>0.141</td>
<td>-0.257</td>
<td>0.543</td>
<td>0.056</td>
</tr>
<tr>
<td>11. The bad effects of stress can be made up for by exercising</td>
<td>-0.019</td>
<td>0.181</td>
<td>0.494</td>
<td>0.005</td>
</tr>
<tr>
<td>15. Sleep compensates for stress</td>
<td>0.102</td>
<td>0.033</td>
<td>0.417</td>
<td>0.018</td>
</tr>
<tr>
<td><strong>Factor IV: Weight Regulation (α = 0.57)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Eating dessert can be made up for by skipping the main dish</td>
<td>-0.014</td>
<td>0.051</td>
<td>-0.118</td>
<td>0.661</td>
</tr>
<tr>
<td>2. Using artificial sweeteners compensates for extra calories</td>
<td>-0.054</td>
<td>-0.061</td>
<td>0.217</td>
<td>0.563</td>
</tr>
<tr>
<td>12. Breaking a diet today may be compensated for by starting a new diet tomorrow</td>
<td>0.001</td>
<td>0.029</td>
<td>0.174</td>
<td>0.456</td>
</tr>
</tbody>
</table>

Published in Knäuper et al. (2004).

Note. Loadings are taken from the pattern matrix. Loadings in bold are values above 0.40. Response format used was 0 (not at all), 1 (a little), 2 (somewhat), 3 (quite a bit), 4 (very much). The following instruction was given: “Different people believe different things regarding their health. Below is a list of beliefs that everyone may hold to some degree. Please read each sentence carefully and rate how closely the idea matches your own belief by marking the appropriate number. Since we all believe different things, there are no correct or incorrect choices. As well, most of these beliefs have not been scientifically tested. How closely does each of the following ideas match your own belief?”.
After items had been eliminated, four sub-scales were created based on a principal axis factor analysis (PFA), which showed modest inter-correlations among the scales (see Table 2). The four subscales resulting from the factor analysis were: (1) substance use - six items concerning behaviors that could compensate for alcohol and coffee consumption and smoking, (2) eating/sleeping - four items concerning behaviors to compensate for lack of sleep or poor eating choices, (3) stress - four items concerning behavior to compensate for stress and (4) weight regulation – three items concerning behaviors to compensate for excessive calorie intake.

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Substance Use</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Eating/Sleeping Habits</td>
<td>0.45</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3. Stress</td>
<td>0.28</td>
<td>0.35</td>
<td>-</td>
</tr>
<tr>
<td>4. Weight Regulation</td>
<td>0.48</td>
<td>0.54</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Published in Knappe et al. (2004).

Higher scores on each of the behaviors indicated higher risk. They also used the results to build specific risk behavior indices which corresponded to the subscales of the CHB scale by summing responses to questions concerning: (1) smoking and alcohol related risk behavior, (2) (un)healthy eating behaviors (e.g., fruit and vegetable intake, use of vitamin supplements), (3) risk behavior related to weight regulation (fruit and
vegetable intake, exercising), and (4) stress and relaxation behavior (e.g., sleeping to compensate for stress).

All factor loadings were also significant at the $p = 0.01$ level, and analysis of the 17-item scale (after the extraneous items were eliminated) had an internal consistency of $\alpha = 0.80$ and a test-retest reliability of $.75, p < .01, N = 141$ at the 4.5 – 5 month interval.

Finally, a third study of 111 students from McGill University was used to validate the revised, 17-item scale, examining the convergent validity of the CHB scale as it related to health control beliefs, procrastination, and health-related self-efficacy. This study also examined the concurrent validity of the scale to people’s health-related risk behaviors and symptom reports.

Cronbach’s alpha as an indicator of internal consistency was $\alpha = 0.76$. The scale was found to negatively correlate with health self-efficacy providing evidence for convergent validity with health self-efficacy ($r = -.20$) and ‘conscientiousness’ measured by the NEO Five-Factor Inventory (NEO-FFI) ($r = -.19$), and discriminant validity with other measures of personality such as health locus of control, and social desirability (all $p$’s < .05).

More generally speaking, these correlations suggest that as CHBs increase, health self-efficacy and conscientiousness decrease. This suggests that people who are high in CHBs use them because they are not very self-efficacious, or are unable to motivate themselves to properly take care of their health. Higher CHB scores were also significantly related to more health risk behaviors, ($r = .29$), reported more illness symptoms ($r = .28$) (both $p$’s < .05), and a variety of other health related factors. Most
importantly, individuals holding a BMI of 27 or greater (considered overweight or obese) had higher CHB scores ($M = 23.74$) than individuals with BMIs lower than 27 ($M = 19.54$), $t(109) = -2.00$, $p = 0.048$ (marginally significant). These results suggest that poor health outcomes may be associated with high scores on the CHB scale, but the exact nature of the relationship has not been investigated. The current proposal attempts to determine this relationship through the development of a model to explain the influence of a range of health-related constructs on CHBs and subsequent health outcomes.

Compensatory Health Beliefs Scale Validity Issues and a Preliminary Test

CHBs have been used rather extensively in the area of health behavior research, but fewer studies have focused on its psychometric properties, including tests of validity. One group, deNooijer, Puijk-Hekman, and van Assema (2009), further assessed the original CHB scale as part of an attempt to culturally adapt it for use in the Netherlands. While they found low internal consistency among the four subscales (substance use, eating/sleeping habits, stress and weight regulation), the overall scale showed high internal consistency (Cronbach’s $\alpha = 0.78$) and a high Pearson correlation between the first and second measures ($r = 0.82$), suggesting the existence of an underlying construct, and good stability, respectively (deNooijer et al., 2009).

At the moment, the scale by Knäuper et al. (2004) and the adapted version for the Netherlands (deNooijer et al., 2009) are the only two scales that have been developed for the study of CHBs, although others have modified the scale for research concerning additional problems such as diabetes research (Rabiau et al., 2009).
Therefore, a pilot study using college students from the psychology participant pool at Ohio University was conducted to examine the reliability of the scale, and its relation to other measures of health (the Health Behaviors Checklist (HBCL); Vickers, Conway & Hervig, 1990, and BMI), and to decision making beliefs that were meant to tap into the construct of decision coherence (the Omission Bias; Baron & Ritov, 2009).

Pilot Study

Participants

A total of 86 subjects, recruited online through the psychology department’s website, participated in the study which was conducted using the Qualtrics survey program (Qualtrics Labs Inc., Provo, UT). Participants were largely freshman (60.5%), followed by sophomores (23.3%), juniors (9%) and seniors (5.8%), and had a mean age of 19.63 (SD = 1.55). 57% were female, and 21.2% reported that they were currently dieting.

Methods

The original CHB scale along with the HBCL, a modified CHB scale, and a Likelihood scale were tested. The Others and Likelihood scales were created in order to try and gain a more comprehensive picture of what the CHB scale was actually measuring. The Others scale was designed to measure how much the participants believed that their peers would endorse a measure, and may have also served as an informal gauge of the social-acceptability of the behaviors. This modified Others CHB scale asked participants how strongly they thought their peers would endorse the original CHB items, labeled the Others scale.
A Likelihood scale was also created as a counterpart to the CHB scale in an attempt to gain a better picture of the relationship between endorsing CHBs and actual behavior. The goal of this scale was to determine whether strong endorsement of CHBs was related to the individual’s beliefs that they would engage in the same item, e.g., an indirect measure of purported future behavior. The Likelihood scale asked participants to, “Please select the likelihood from 0 to 100%\(^1\) that you would engage in the described activity of behavior, if you were to find yourself in that situation.” Items were created to replicate items found in the CHB scale, related to likelihood. For example, item three on the Likelihood scale asks how likely you are to, “Exercise to compensate for smoking,” whereas item three on the CHB scale asks how much you agree or disagree with the sentence, “Exercise compensates for smoking.”

Omission Bias questions were drawn from three prior experiments: Greene, Nystrom, Engell, Darley, & Cohen (2004); Greene, Sommerville, Nystrom, Darley, & Cohen, (2001); and Baron, & Ritov (2009) (all questions are found in Appendix A). Participants were asked to read a series of 12 morally controversial statements and indicate which of two responses they found more acceptable. Participants also answered demographic questions about their height and weight in order to determine self-reported BMI, they also reported their age, year in school, and gender. All of the scales and items used in this study, including the demographic questions, are included in Appendix A.

---

\(^1\) This information was recorded by Qualtrics using a response scale from 1 to 11.
**Procedures**

Data was analyzed via SPSS 18.0. A sum score of the 17 items on the CHB scale was created (ranging from 11 to 47), with higher scores indicating a person was more inclined to believe that they can compensate for unhealthy behaviors.²

Psychometric analyses were conducted to evaluate the performance of the scale and its modified versions, including reliability, item analyses and a principal axis factor analysis with Varimax rotation. Similar tests were performed for the Likelihood and the Others scale and correlations among the measures were obtained.

**Results**

The sample was relatively homogenous with regards to age ($M = 19.63, SD = 1.55$), with the majority of the participants in their freshman year (60.5%). The distribution of BMI scores was negatively skewed with values ranging from 17.97 to 34.43, and a mean score of 23.19 ($SD = 3.04$), indicating that self-reported BMIs fell largely within a healthy range (the CDC considers BMIs of 18.5 to 24.9 “healthy”).

Average scores for the original CHB scale (minimum 0, maximum 68) ($M = 30.58, SD = 8.23, N = 86$) were lower than those for the modified Other scale ($M = 37.74, SD = 8.24$). However, scores were higher than those reported in the Knäuper et al. (2004) study ($M = 20.15 (SD = 7.88, N = 111$), and the deNooijer et al. (2009) scale ($M = 23.91 (SD 7.61), N = 244$). Average scores for Likelihood of engaging in a CHB (minimum 1, maximum 11) had a mean of 5.98 ($SD = 1.54$), suggesting that participants were slightly more inclined than not to engage of CHBs implied behaviors. In terms of Omission

²Our scale was scored from 1 to 5 as a default of the Qualtrics program. In order to make the results comparable to the results from Knäuper et al. (2004) and deNooijer’s (2009) the scale was rescored from 0 to 4 for comparison.
measures, participants tended to slightly favor omissions over commissions, with a mean score of 5.73 ($SD = 2.62$) out of a possible 12 points, where lower scores indicate preference for acts of omission. Average scores on the HBCL were relatively high ($M = 3.25, SD = 0.381$) on a scale of 1 to 5 where higher scores indicate healthier behaviors (wellness ($M = 3.33, SD = 0.61$), traffic risk ($M = 3.02, SD = 0.66$), accident control ($M = 3.14, SD = 0.66$), and substance risk ($M = 3.28, SD = 0.28$). Thus, the sample was generally fairly healthy.

Reliability, item analysis, and principal component analysis of the CHB scale.

Reliability. Reliability analysis showed that the Others and Likelihood scales had higher Cronbach’s alpha than the CHB scale. The alphas for the Others, Likelihood, and CHB scales were $\alpha = 0.908$, $\alpha = 0.852$, and $\alpha = 0.752$, respectively.

Reliability results in relation to CHB in other studies. As earlier reported, the overall $\alpha$ of the 17-item scale was 0.752. The subscales’ reliability were lower than those reported in the original CHB study (see Table 3), but results were similar to those found by deNooijer et al. (2009). Cronbach’s alpha was highest for the substance use scale ($\alpha = 0.705$), followed by stress ($\alpha = 0.594$), eating/sleeping ($\alpha = 0.515$) and weight regulation ($\alpha = 0.465$). It should be noted, however, that the substance use scale contained the greatest number of items, 6, and theoretically, reliability increases with the increase in the number of items. In contrast, the stress and eating/sleeping subscale contains 4 items, and weight regulation only 3 items. Overall, scores were highest for the stress subscale ($M = 15.407, SD = 2.56$), followed by substance use ($M = 14.129, SD = 4.342$), eating/sleeping ($M = 10.860, SD = 2.874$) and weight regulation ($M = 7.221, SD = 2.209$). This suggests
that the sampled students were more likely to endorse CHBs related to stress and substance use than to eating and sleeping or weight regulation behaviors habits.

Table 3

<table>
<thead>
<tr>
<th>Subscales and items</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Original</td>
</tr>
<tr>
<td>Substance Use: six items</td>
<td>0.74</td>
</tr>
<tr>
<td>Eating/Sleeping: four items</td>
<td>0.66</td>
</tr>
<tr>
<td>Stress: four items</td>
<td>0.63</td>
</tr>
<tr>
<td>Weight Regulation: three items</td>
<td>0.57</td>
</tr>
</tbody>
</table>

¹Published in Knäuper et al. (2004)
²Published in deNooijer et al. (2009)

Examining the reliability of subscales of Others, Cronbach’s alpha was highest for substance abuse (α = .902), followed by eating/sleeping (α = .765), stress (α = .731), and weight regulation (α = .731). Likewise, average scores were higher for substance abuse ($M = 17.30, SD = 6.23$), followed by stress ($M = 15.73, SD = 2.81$), eating/sleeping ($M = 12.82, SD = 3.82$), and weight regulation ($M = 9.17, SD = 2.90$).

Similar analyses for the Likelihood subscales found Cronbach’s alpha was highest for stress (α = .802), followed by substance abuse (α = .776), eating/sleeping (α = .663) and weight regulation (α = .626). Scores for the subscales were the highest for substance abuse ($M = 31.74, SD = 12.74$), followed by stress ($M = 31.55, SD = 8.02$), eating/sleeping ($M = 25.48, SD = 7.62$) and weight regulation ($M = 12.86, SD = 6.37$).
**Correlations among measures.** Correlations were not high between the CHB scale and the other studied measures (see Table 4). Although total scores on the CHB scale were found to correlate with average scores on the Likelihood scale ($r = 0.512, p < .01$), they did not significantly correlate with the Others scale ($r = 0.188$), omission bias ($r = -0.012$) and HBCL ($r = -0.207$). CHB scores were not found to correlate with BMI ($r = -0.064$). Among the other measures, body mass index (BMI) was found to correlate with the HBCL Traffic Risk ($r = -0.253$) and the total HBCL Average ($r = -0.220$), both $p < .05$. Finally, there did not seem to be any correlation between scores on the Omission bias task and the CHB scale ($r = -0.012$).
Table 4

*Overall Correlation Between Others Measures (n = 84)*

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>BMI</td>
<td>23.19</td>
<td>3.04</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Total CHB Score</td>
<td>47.57</td>
<td>8.24</td>
<td>-0.064</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Total CHB Other</td>
<td>54.67</td>
<td>12.62</td>
<td>-0.065</td>
<td>0.188</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>HBCL Wellness</td>
<td>3.33</td>
<td>0.61</td>
<td>-0.168</td>
<td>-0.138</td>
<td>-0.050</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>HBCL Traffic Risk</td>
<td>3.02</td>
<td>0.66</td>
<td>-0.253*</td>
<td>-0.138</td>
<td>-0.110</td>
<td>0.248**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>HBCL Accident</td>
<td>3.14</td>
<td>0.66</td>
<td>-0.091</td>
<td>-0.085</td>
<td>-0.097</td>
<td>0.473**</td>
<td>0.149</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>HBCL Substance Risk</td>
<td>3.26</td>
<td>0.68</td>
<td>0.036</td>
<td>-0.090</td>
<td>0.119</td>
<td>0.374**</td>
<td>0.122</td>
<td>0.418**</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Omission Bias Total</td>
<td>5.73</td>
<td>2.62</td>
<td>-0.007</td>
<td>-0.012</td>
<td>0.041</td>
<td>-0.139</td>
<td>-0.059</td>
<td>-0.054</td>
<td>0.088</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Total HBCL Avg.</td>
<td>3.25</td>
<td>0.38</td>
<td>-0.220*</td>
<td>-0.207</td>
<td>-0.070</td>
<td>0.818**</td>
<td>0.485**</td>
<td>0.725**</td>
<td>0.606**</td>
<td>-0.099</td>
<td>-</td>
</tr>
<tr>
<td>10.</td>
<td>Avg. Likelihood</td>
<td>5.98</td>
<td>1.54</td>
<td>-0.078</td>
<td>0.512**</td>
<td>0.179</td>
<td>0.100</td>
<td>-0.140</td>
<td>0.085</td>
<td>0.119</td>
<td>0.105</td>
<td>0.067</td>
</tr>
</tbody>
</table>

*Note.* CHB (Compensatory Health Beliefs) Scores range from a possible 17 to 85. HBCL (Health Behaviors Checklist).

* p < 0.05, 2-tailed.

**p < 0.01, 2-tailed.
**Item Analysis.** Overall, there were low correlations among items on the original CHB scale, with values ranging from -0.010 to 0.565. The worst item-total correlations were for item 1 (“Relaxing on the weekend can make up for stress during the week”) ($r = 0.033$) and item 2 (“Using artificial sweeteners compensates for extra calories”) ($r = 0.072$). However, analyses indicate that they should remain in the scale. Removing items from the original CHB scale did not appear to improve its Cronbach’s $\alpha = 0.752$, as only 2 items would increase it. Removing item 1, “Relaxing on the weekend can make up for stress during the week” would increase $\alpha$ to 0.764, and removing item 2, “Using artificial sweeteners compensates for extra calorie,” would increase $\alpha$ to 0.762.

Other poorly correlated items seemed to cluster around eating and drinking habits, and relaxation patterns. For example, item 8, “Eating whatever one wants in the evening is OK if one didn’t eat during the day,” was correlated with item 5, “Not drinking alcohol during the week…” ($r = 0.352$), and item 6, “Skipping the main dish…” ($r = 0.358$). Items 9, “Eating healthy can make up for the effects of regularly drinking alcohol, and 14, “It is OK to skip breakfast if one eats more during lunch or dinner,” were also strongly correlated with other eating and drinking habits ($r = 0.363$).

Among those items with the strongest correlations, item 11, “Exercising can make up for the bad effects of stress,” was also found to correlate well with other items, such as item 1, “Relaxing on the weekend…” ($r = 0.317$), item 7, “Relaxing in front of the TV can make up for a stressful day,” ($r = 0.505$) and item 8, “Eating whatever one wants…” ($r = 0.338$).
Analyses were also run exploring the item-total correlations among the 17 questions on the CHB scale, and the corresponding questions on the Others and Likelihood scales (See Table 5). Results showed all three measures to be correlated but a stronger overall relationship between CHB and the Likelihood scale was observed. Thus, because the Likelihood scale performed well, it will be included in the subsequent studies as a good way to examine the relationship between beliefs and behavior related to CHBs.
Table 5
Correlations Between Corresponding Items on the Scales (17 items)

<table>
<thead>
<tr>
<th>Compensatory Health Belief Items (α = 0.752)</th>
<th>Others (α = 0.908)</th>
<th>Likelihood (α = 0.852)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Relaxing on the weekend can make up for stress during the week.</td>
<td>0.281**</td>
<td>0.424**</td>
</tr>
<tr>
<td>2. Using artificial sweeteners compensates for extra calories.</td>
<td>0.419**</td>
<td>0.348**</td>
</tr>
<tr>
<td>3. Exercising can compensate for smoking.</td>
<td>0.273*</td>
<td>0.116</td>
</tr>
<tr>
<td>4. It is OK to go to bed late if one can sleep longer the next morning (only the number of hours count).</td>
<td>0.580**</td>
<td>0.327**</td>
</tr>
<tr>
<td>5. Not drinking alcohol during the week can make up for the effects of drinking too much alcohol during...</td>
<td>0.459**</td>
<td>0.217*</td>
</tr>
<tr>
<td>6. Skipping the main dish can make up for eating dessert.</td>
<td>0.407**</td>
<td>0.563**</td>
</tr>
<tr>
<td>7. Relaxing in front of the TV can compensate for a stressful day.</td>
<td>0.331**</td>
<td>0.500**</td>
</tr>
<tr>
<td>8. Eating whatever one wants in the evening is OK if one did not eat much during the day.</td>
<td>0.288**</td>
<td>0.295**</td>
</tr>
<tr>
<td>9. Eating healthy can make up for the effects of regularly drinking alcohol.</td>
<td>0.146</td>
<td>0.397**</td>
</tr>
<tr>
<td>10. Sleeping in on the weekends can compensate for too little sleep during the week.</td>
<td>0.470**</td>
<td>0.568**</td>
</tr>
<tr>
<td>11. Exercising can make up for the bad effects of stress.</td>
<td>0.573**</td>
<td>0.254*</td>
</tr>
<tr>
<td>12. Starting a new diet tomorrow compensates for breaking a diet today.</td>
<td>0.310**</td>
<td>0.457**</td>
</tr>
<tr>
<td>13. The effects of drinking coffee can be balanced by drinking equal amounts of water.</td>
<td>0.411**</td>
<td>0.474**</td>
</tr>
<tr>
<td>14. It is OK to skip breakfast if one eats more during lunch or dinner.</td>
<td>0.456**</td>
<td>0.356**</td>
</tr>
<tr>
<td>15. Sleep compensates for stress.</td>
<td>0.290**</td>
<td>0.305**</td>
</tr>
<tr>
<td>16. It is alright to drink a lot of alcohol as long as one drinks lots of water to flush it.</td>
<td>0.358**</td>
<td>0.229*</td>
</tr>
<tr>
<td>17. Smoking from time to time is OK if one eats healthy.</td>
<td>0.384**</td>
<td>0.146</td>
</tr>
</tbody>
</table>

* p < 0.05 level (2-tailed).
** p < 0.01 level (2-tailed).
When compared to the Likelihood and CHB scales, item correlations tended to be higher in the Others scale. Similar to the original CHB scale, item total correlations for the Others scale ranged from 0.002 to 0.696, with a median correlation of $r = 0.35$. However, unlike the original CHB scale, item 17 had modest correlations with the other items while item 12 (“Starting a new diet tomorrow compensates for breaking a diet today”) had the lowest correlation ($r = 0.002$ with item 4), and was poorly correlated with many of the other items as well.

Of the three scales, the Likelihood scale had the highest overall average item correlations, with a range from 0.00 to 0.686. However, it also had the lowest value for a correlation; item 11 (“Exercising can make up for the bad effects of stress”) had a correlation of 0.00 with item 16, and was poorly correlated with almost all the other items on the scale.

**Principal Component Analysis.** The three scales, CHB, Others and Likelihood, were submitted to a Principal Component Analysis with Varimax rotation. The Likelihood and Others scales outperformed the original CHB scale in terms of accounted variance by the extracted components. Five components were extracted accounting for 69.99% of the variance in the Likelihood scale, and three components accounted for 64.02% of the variance in the Others scale, when compared to only 58.07% for the Original CHB scale. For the CHB scale, the principal component analysis indicated 5 groupings of variables, as compared to 4 in the original CHB scale. Table 6 shows the highest factor loadings (printed in bold).
Table 6
Compensatory Health Beliefs (CHBs): Item Wording and Factor Loadings Pilot Study

<table>
<thead>
<tr>
<th>Factor and item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor I: Substance Use ($\alpha = 0.74$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. The effects of regularly drinking alcohol can be made up for by eating healthy</td>
<td>0.320</td>
<td><strong>0.626</strong></td>
<td>0.155</td>
<td>-0.029</td>
<td>0.127</td>
</tr>
<tr>
<td>16. It is all right to drink a lot of alcohol as long as one drinks lots of water to flush it</td>
<td>0.259</td>
<td><strong>0.621</strong></td>
<td>0.024</td>
<td>-0.330</td>
<td>0.095</td>
</tr>
<tr>
<td>17. Smoking from time to time is OK if one eats healthy</td>
<td>-0.008</td>
<td><strong>0.546</strong></td>
<td>-0.063</td>
<td>-0.050</td>
<td>0.048</td>
</tr>
<tr>
<td>13. The effects of drinking coffee can be balanced by drinking equal amounts of water</td>
<td><strong>0.468</strong></td>
<td>0.277</td>
<td>0.069</td>
<td>-0.111</td>
<td>0.326</td>
</tr>
<tr>
<td>5. The effects of drinking too much alcohol during the weekend can be made up for by not drinking during the week</td>
<td>0.408</td>
<td><strong>0.498</strong></td>
<td>0.157</td>
<td>-0.210</td>
<td>0.365</td>
</tr>
<tr>
<td>3. Smoking can be compensated for by exercising</td>
<td>0.089</td>
<td><strong>0.673</strong></td>
<td>-0.011</td>
<td>0.368</td>
<td>-0.147</td>
</tr>
<tr>
<td>Factor II: Eating/Sleeping Habits ($\alpha = 0.66$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Too little sleep during the week can be compensated for by sleeping in on the weekends</td>
<td><strong>0.432</strong></td>
<td>-0.033</td>
<td>0.626</td>
<td>-0.070</td>
<td>-0.042</td>
</tr>
<tr>
<td>4. It is OK to go to bed late if one can sleep longer the next morning (only the number of hours count)</td>
<td>0.058</td>
<td>0.068</td>
<td>0.018</td>
<td>0.057</td>
<td><strong>0.872</strong></td>
</tr>
<tr>
<td>14. It is OK to skip breakfast if one eats more during lunch or dinner</td>
<td><strong>0.667</strong></td>
<td>0.334</td>
<td>0.206</td>
<td>-0.125</td>
<td>-0.218</td>
</tr>
<tr>
<td>8. Eating whatever one wants in the evening is OK if one did not eat during the entire day</td>
<td><strong>0.713</strong></td>
<td>0.209</td>
<td>0.120</td>
<td>-0.060</td>
<td>0.037</td>
</tr>
<tr>
<td>Factor III: Stress ($\alpha = 0.63$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Stress during the week can be made up for by relaxing on the weekend</td>
<td>0.128</td>
<td>-0.385</td>
<td><strong>0.568</strong></td>
<td>-0.267</td>
<td>-0.091</td>
</tr>
<tr>
<td>7. A stressful day can be compensated for by relaxing in front of the T.V.</td>
<td>0.045</td>
<td>0.077</td>
<td><strong>0.586</strong></td>
<td>0.432</td>
<td>0.344</td>
</tr>
<tr>
<td>11. The bad effects of stress can be made up for by exercising</td>
<td>-0.029</td>
<td>-0.051</td>
<td><strong>0.719</strong></td>
<td>0.257</td>
<td>0.172</td>
</tr>
<tr>
<td>15. Sleep compensates for stress</td>
<td>-0.080</td>
<td>0.278</td>
<td><strong>0.695</strong></td>
<td>0.014</td>
<td>-0.099</td>
</tr>
<tr>
<td>Factor IV: Weight Regulation ($\alpha = 0.57$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Eating dessert can be made up for by skipping the main dish</td>
<td><strong>0.713</strong></td>
<td>-0.143</td>
<td>-0.106</td>
<td>0.228</td>
<td>0.160</td>
</tr>
<tr>
<td>2. Using artificial sweeteners compensates for extra calories</td>
<td>0.037</td>
<td>-0.126</td>
<td>0.143</td>
<td><strong>0.742</strong></td>
<td>0.015</td>
</tr>
<tr>
<td>12. Breaking a diet today may be compensated for by starting a new diet tomorrow</td>
<td><strong>0.596</strong></td>
<td>0.155</td>
<td>-0.079</td>
<td>0.452</td>
<td>0.024</td>
</tr>
</tbody>
</table>

Note: Loadings in **bold** are those with the highest values for each factor.
Looking at Tables 2 and 6, the factor structure of the scale appeared similar, but not identical to the original Canadian scale. Given their loadings, there was a fairly strong match between the original CHB scale groupings and three of the ones found in the study: eating and sleeping habits, substance use, and stress. However, the last two clusters from the analysis were harder to identify (as the highest loading items did not seem related to one another). Further, items compromising the original weight regulation subscale were poorly correlated with one another in the sample; the items were also not correlated with other items.

Five of the 17 items clustered differently from what was found in the Canadian factor structure. First, item 4, “The effects of drinking coffee can be balanced by drinking equal amounts of water,” loaded into Factor II as opposed to Factor I of the original scale. Secondly, item 4, “It is OK to go to bed late if one can sleep longer the next morning (only the number of hours count),” was poorly correlated with all of the factors, and was clustered into a new Factor V. As mentioned above, the weight regulation subscale did not appear consistent with the original scales clustering. Two of the items, items 6 and 12 (see Table 5) clustered with Factor II, and the third item, “Using artificial sweeteners compensates for extra calories,” was unrelated to any items, in the Factor IV cluster.

In terms of the Likelihood and Others scales components, none of their factors matched very well with the original CHB groupings. For the Likelihood scale, items clusters varied, and were hard to name, but the four strongest seemed to group around ideas related to recovery from stress, dieting strategies (e.g., skipping meals), healthy eating/living strategies (e.g., eating healthier), and alcohol/exercise. The fifth factor did
not appear to have any consistent theme. For the Others scale, the PC resulted in only 3 factors, which accounted for 64.012% of the variance. The three item clusters for the Others scale were around eating and dieting, relaxing and sleeping, and smoking and drinking.

**Discussion of the CHB scales**

Through this analysis, some similarities and differences emerged between the three CHB scales which suggest important conceptual applications, and direction for future studies. When compared to the original analysis done by Knäuper et al. (2004), the clusters of eating and sleeping habits, substance use, and stress, appeared in some form in the analyses of the three scales tested. However, the Others scale differed slightly in that items dealing with eating and dieting were distinct from items addressing relaxing (or stress reduction) and sleeping. This may be a more parsimonious breakdown than the original CHB scale offered, particularly in light of the fact that the original CHB scale’s weight regulation subscale consistently performed the worst across all of the analyses.

Factor loadings were higher both for the Likelihood and for the Others scales as compared to the original CHB scale, however, the factor structure was not the same. As suggested by the deNooijer et al. (2009) study, the subscales for the CHB scale consistently display poor internal consistency, and future work may benefit from redefining the scale and creating a more parsimonious and consistent factor structure. Further, while there were moderate inter-correlations among items for the three scales (see Table 5), these were not as high as might have been expected, particularly between
the CHB scale and the Likelihood scale, if they were truly asking participants the same question.

The Others scale is clearly of a different nature, as it is not about personal endorsement of CHBs, but rather beliefs about what other people would endorse. Therefore, it is measuring a different construct and its factor structure is not expected to be in line with that of the CHB scale. The Likelihood scale, on the other hand, is expected to tap into the same construct, however, it is possible that the reason correlations were not higher between it and the CHB scale is because individuals differ in endorsement of CHBs and their belief that they will actually engage in them. Therefore, the differing factor structures between these scales suggests that further construct validity assessment is needed for the CHB scale, as well as the Likelihood scale. Correlating the Likelihood scale with actual risk taking behavior may be one way to gauge whether individuals who believe they are likely to engage in CHBs also report engaging in risky behavior as well. This might signify a relationship between Likelihood and health outcomes in that risky behavior often leads to aversive health decisions and consequences.

Overall, use of these three measures of CHBs offers insight into future directions to explore in subsequent studies. Results suggest that while the scales may be measuring some similar concepts, the three scales also capture different aspects of CHB endorsement. Future work is thus needed to clarify not only what should be measured with a CHB scale, but what is actually being measured by the current Knäuper et al. (2004) scale.
Summary and Conclusions

Psychometric analyses of the original CHB scale showed lower internal consistency and reliability of the scale when compared to results from the Canadian and Dutch studies. The PC analysis suggested that the Likelihood and Other scales could account for a greater proportion of the variance than the original CHB scale, although different factor structures were created for each of the variants. Though one scale does not stand out, each has detriments and merits in assessing and gaining a more comprehensive picture of the CHB construct.

In terms of relationship of CHB with other variables, there was no correlation between decision coherence (as measured through the omission bias) and BMI. As expected, the CHB scale correlated well with the Likelihood scale, but not with the Others scale. Negative correlations between the CHB scale and the HBCL suggested that declines in healthy habits were associated with both higher endorsement of CHBs.

As was clear from the observed distribution of BMI, the majority of the participants fell within the CDCs range of healthy BMIs (18.5 to 24.9). In addition, they were fairly healthy as measured by high scores on the HBCL across the various subscales. This differs from much of the past CHB research which been done with dieting or weight restrictive populations; only 21.2% of the sample indicated that they were currently dieting.

The Likelihood version more closely related to the CHB scale and also had a higher overall reliability than the CHB scale. Theoretically, the Likelihood scale also offered the additional benefit of potentially tapping into the individuals behavioral
intentions. These factors suggest that the Likelihood scale may therefore offer a good additional measurement of the CHB construct. Differences between these two scales and the Others scale suggest, however, that people appear to think differently about their own beliefs toward health, and those of their peers. Given that the present work is focused on the understanding of variables that relate to an individual’s endorsement of CHBs, the Others scale was not included in the subsequent study.

Finally, the original CHB scale is problematic in the sense that it does not differentiate between items which may have less beneficial (from a health standpoint) or more extreme compensatory properties, e.g., “It is all right to drink a lot of alcohol as long as one drinks lots of water to flush it,” or, “Smoking from time to time is OK if one eats healthy,” and more moderate or “reasonable” (although not necessarily beneficial) CHBs, such as, “It is OK to go to bed late if one can sleep longer the next morning (only the number of hours counts).” The fact that the pilot study failed to replicate the item pairings in the four subscales from the original study, and the low alpha levels within the subscales may therefore, reflect different patterns of item endorsement. The subsequent study thus further assessed issues of construct validity.

In sum, the results from the current analysis point to the need for further testing the original CHB with a more variable sample and further investigate its construct and criterion validity. In doing so, this study hoped to provide a more comprehensive insight into the relationship between holding these beliefs and health outcomes.
The Present Study

The purpose of this thesis was to provide further tests of the endorsement of CHBs and their relationship to health outcomes. This study also explored the cognitive components which were hypothesized to be related to the CHB construct as well. To that end, this work designed and tested a structural equation model that combined theoretical features of the model proposed by Rabiau, Knäuper, and Miquelon (2006) depicted in Figure 1, with other psychological considerations such as the influence of cognitive factors. In particular, the model paid special attention to the endorsement of CHBs in relation to the constructs of self-control, need for cognition, risk-perceptions and behaviors, and Decision Making Coherence.

Furthermore, the study investigated the relationship of CHBs to key health outcomes such as BMI and self-reports of health behavior. The CHB scale can only provide meaningful guidance in understanding the role of health beliefs in health behaviors and actions to the extent that it accurately captures what it claims to measure. That is, to the extent to which it has good construct and criterion validity. A closer investigation of this scale and related constructs purported not only to shed light on what is becoming an increasingly well-recognized measure in the literature, but to gain more knowledge of variables which may predict health outcomes based on these cognitive beliefs and patterns of thinking. Therefore, this exploration of the CHB scale has the potential to positively impact the design of interventions that can help people to manage a healthy weight over their life span.
CHB Structural Equation Model

Observed and Unobserved Variables

The model proposed here began by assuming that when faced with a motivational conflict, individuals either resist the desire or form CHBs, and that forming CHBs seems to necessarily entail some adaptation of one’s perception of risk related to the behavior. This is in contrast to the suggestion by Rabiau, Knäuper and Miquelon (2006) who assume that when faced with a motivational conflict, individuals must choose between three options: adapting their risk perception, forming CHBs, or resisting the desire. Because past research suggested that most people do tend to activate these beliefs, it was important to explore the factors influencing how strongly they endorse them, and the relationship between endorsement and health outcomes. A new CHB model is proposed in which the latent variables of self-control, need for cognition, Decision Making Coherence, and risk-perception influenced how strongly an individual endorsed CHBs, which in turn would predict Health Outcomes (see Figure 2).
In this model (Figure 2), standard structural equation model labels are used; circles represent the latent variables (unobserved constructs) and squares represent observed or measured variables. Error terms (Err#) in the model represent error in measurement. The model is composed of three latent variables, five endogenous variable and six exogenous variables. Endogenous variables are influenced by other variables in the model, whereas exogenous variables influence other variables in the model. Here, the latent variables are Decision Making Coherence, compensatory health beliefs (CHB) and Health Outcomes. The model contains several exogenous variables that are observed:
Self-control, risk perceptions, and need for cognition. The latent variable of Decision Making Coherence was assumed to be measured by different aspects: consistency in risk perception, resistance to framing, under/over confidence, applying decision rules, and resistance to sunk cost. Furthermore, the construct of compensatory health beliefs was measured with both the original CHB scale and the Pilot Study Likelihood scale. The latent variable pertaining to Health Outcomes was measured with the HBCL scale and BMI. Details of all of the measures used in this study appear in the Method section below.

**Relationships Among Variables**

The model in Figure 2 shows several connections between the unobserved (latent) and the observed variables and these are represented by straight arrows indicating causal relationships in the direction of the arrows. Curved, double-headed arrows represent correlation and thus causation is not implied.

Beginning on the far left, arrows flow from four measures which predicted to influence the endorsement of CHBs, namely self-control, risk-perception, the need for cognition and Decision Making Coherence. It was expected that lower levels of self-control would result in higher endorsement of CHB. Further, low risk-perception was predicted to contribute to a higher endorsement of CHB, if individuals did not see them as hazardous to their health; this would ultimately lead to increased risk-taking behavior.

Individuals high in the need for cognition and Decision Making Coherence were expected to be less likely to endorse CHB. Individuals high in the need for cognition were expected to take more time to consider the potency of the CHB and to employ more
complex decision strategies to reach the correct decision (e.g., resist the desire to eat the cake) as opposed to simply choosing the easiest option (e.g., endorsing the CHB).

In terms of Decision Making Coherence, the model assumed that this is a multifaceted construct that could be assessed with scales that measure consistency in risk perception, resistance to framing, under/over confidence, applying decision rules and resistance to sunk cost. Consistency in risk perception tests a person’s ability to follow probability rules (e.g., the probability of an event happening in one year should be the same as the probability of it occurring in 5 years). Resistance to framing refers to whether or not a person’s assessment of the value of some item is influenced by irrelevant variations in how a choice is described. Under/over confidence assesses how well a person “knows what they know” (e.g., you are 100% confident that that President Lincoln was the 16th president, and he actually is). Applying decision rules refers to how well a person can take a given decision rules (e.g., choose the DVD player with the highest overall rating) and apply it consistently and accurately to subsequent decisions and be accurate. Finally, resistance to sunk cost measures a person’s ability to ignore prior investments, which from a normative economic perspective should not influence future decisions (Arkes & Blumer, 1985).

Together, these constructs have been found to represent an individual’s decision consistency across domains. While each may assess consistency in a different realm of decision making, it was hypothesized that individuals high in CHB would be more likely to fall prey to sunk cost and framing effects, be overconfident in their decisions, as well as be less consistent in applying decision rules and in their perception of risk when
comparing present and future events. Together and separately, the individual measures of the ADMC, representing Decision Making Coherence, were also expected to lend insight into predictions of Health Outcomes related to CHB endorsement. For example, it was proposed that individuals whose scores on the ADMC indicated they were overconfident might be more likely to have aversive Health Outcomes related to holding CHB because they were overly optimistic about their ability to complete the CHB which would compensate for the negative behavior. Likewise, inconsistency in risk perception might suggest a greater propensity for aversive Health Outcomes related to CHB endorsement, in that individuals who discount future risk, may be less likely to appropriately assess the potential long-term consequences of engaging in a negative behavior now.

Overall Decision Making Coherence, therefore, was assumed to affect CHB by decreasing their endorsement among those with the highest levels of coherence. Because individuals high in decision coherence tend to display consistency in decisions across various domains, they were expected to be less likely to endorse CHBs as endorsing and following through with these beliefs would represent violations of their beliefs that these statements/activities are hazardous. In other words, they would not endorse behavior in one instance that they would disapprove of in another setting.

Moving to the right, the construct of CHB was measured with both the CHB and the Likelihood scales. Furthermore, arrows flow from the latent CHB variable toward the construct of Health Outcomes and to measures of risk-behavior. Health Outcomes were measured with BMI and with HBCL. Higher levels of CHB are expected to result in poorer Health Outcomes and higher levels of risk-taking. Further, it was also expected
that Health Outcomes and risk-taking would be correlated, such that as risk-taking increased, optimal Health Outcomes would decrease.

Hypotheses

As noted above, the arrows in the model indicate specific hypotheses of causal relationships that were tested to see how well this model described or fit the data. This was first tested by fitting the model to the variance-covariance structure. Assuming good fit, hypotheses were then tested by setting certain parameters equal to each other, or testing whether the model’s estimates were significantly different from zero. More specifically, lower levels of Decision Making Coherence, risk perception (e.g., seeing activities as less risky), self-control, and the need for cognition are expected to result in higher levels of CHB endorsement. Further, a strong relation between higher levels of CHB and Health Outcomes (as determined by BMI, scores on the HBCL, and self-reported risky behavior) is also expected. Based on past research, indirect relationships should also be observed between self-control, the need for cognition, Decision Making Coherence and risk perception and Health Outcomes via the CHB construct. See Figure 2 for variables in hypothesis tests.

H1: Coefficients B1 and B2 should be negative and significantly different from zero indicating that higher scores on self-control and risk-perception are correlated with lower endorsement of CHB.

H2: Coefficients B3 and B4 should be negative and significantly different from zero, indicating that higher levels of the need for cognition and increased Decision Making Coherence are associated with decreased endorsement of CHB.
H3: Coefficients α1 to α5 are expected to be positive and significantly different from zero, as well as correlated with one another as they are all hypothesized to be measuring the latent construct of Decision Making Coherence. As scores on these scales increase, decision coherence is expected to increase.

H4: Coefficients d1 and d2 are expected to be positive and significantly different from zero, as well as correlated with one another as they are both hypothesized to be measuring the construct of decision coherence. As scores on these scales increase, decision endorsement of CHBs is expected to increase.

H5: Coefficient d3 is expected to be negative and significantly different from zero, indicating that as endorsement of CHB increases, Health Outcomes will decrease.

H5a: Coefficient d5 is expected to be negative and significantly different from zero, indicating that as BMI increases, Health Outcomes will decline.

H5b: Coefficient d6 is expected to be positive and significantly different from zero, indicating that as scores on the HBCL increase, Health Outcomes will improve.

H6: Coefficient d4 is expected to be positive and significantly different from zero, indicating as endorsement of CHB increases, risk-taking behavior will also increase.

Summary

The structural equation models tested the hypotheses that self-control, risk-perception, the need for cognition and Decision Making Coherence influence the endorsement of CHB. It also tested whether or not endorsement of CHB influenced Health-Outcomes and risk perception. Based on the hypotheses, to test for goodness of fit, the links between self-control, risk-perception, the need for cognition, Decision
Making Coherence, CHB scale, Likelihood Scale, Health Outcomes, HBCL, BMI and risk-taking were tested against zero. Accuracy of the model and hypotheses, thereafter, was established by tests of goodness of fit between the hypothesized model and the observed data. Performing a construct validity analysis with a larger, diverse sample, allowed us to better analyze the usefulness and generalizability of the Knäuper (2004) CHB scale in assessing compensatory health beliefs. Further, creating and testing a model describing the interactions between these constructs contributed to a better understanding of the strength and impact of these variables in influencing CHB and health.
METHODS

Participants

Participants were 212 students recruited from the psychology participant pool at Ohio University, and 217 individuals recruited through amazon.com’s Mechanical Turk, and. A review of Mechanical Turk by Buhrmester, Kwang and Gosling (2011) suggests that the tool can provide high-quality data at least as reliable as what could be obtained through traditional recruitment methods, with significantly more diversity than the average college sample.

Recommendations by MacCallum, Browne and Sugawara (1996) for power estimates for selected levels of degrees of freedom (df) and sample size were used to determine the sample size for testing the overall model. Based on the predicted CHB model with 63 degrees of freedom, for a power of 80%, the present study required a sample of 200 per group (Ohio University and Mechanical Turk).

Participants from Ohio University were recruited via the psychology department’s online research website, and signed up for the experiment using a Psychology Subject pool online. Participants recruited through Mechanical Turk were adults older than 18, living in the United States, reflecting a wide range of health, weight and social economic status (SES). Participants from Mechanical Turk signed up for the study on https://www.mturk.com/.

All participants, after signing up, were redirected to the Qualtrics website where they completed the online portion of the study. The study lasted between 45 and 60 minutes. Ohio University participants were compensated for their time with one research
participation experience credit. Participants on Mechanical Turk were given a code at the end of the Qualtrics survey which they put into https://www.mturk.com/in order to receive compensation ($0.90) for their participation. While there was the potential that participants might try and take the survey several times, an option on Qualtrics prevented participants from taking the survey twice from the same IP address.

**Design**

The study was broken into four parts in which the participant was presented with the various surveys, or took part in tasks to measure the constructs (see Appendices A and B). At the end of the study, they completed demographic information and were debriefed.

**Measures**

*Measures of Self-Control*

*Self-control scale (Tangney, Baumeister & Boone, 2004).* This scale was developed to address inconsistencies in previous measures of self-control. The original scale consists of either a long (36 items) or short (13 items) version in which participants respond to questions (e.g., “I am good at resisting temptation”) about self-control on a 1 to 5 scale (1 – “Not at All” to 5 – “Very Much”). Other items include, “I wish I had more self-discipline,” and, “I spend too much money.” The full version was used for the present study.

In their analysis of the scale, as demonstrated by past research, better self-control was associated with fewer problems regulating eating, and negatively correlated with most EDI scales, such as the drive for thinness, bulimia, body dissatisfaction,
ineffectiveness, and interpersonal distrust. The scale was found to have high internal
reliability ($\alpha = .89$) with a sample of 233 participants, and test-retest reliability of .89 for
the total self-control scale score, and .87 for the brief self-control scale. Lack of self-
control was also commonly associated with alcohol abuse, and consistent with this, high
self-control was found to be associated with an absence of problem drinking patterns.
Self-control scores were also negatively correlated with all measures of psychological
symptoms from the SCL-90, such as somatization, obsessive-compulsive patterns,
depression, anxiety, hostility and anger. Finally, self-control was also found to be
positively associated with conscientiousness (from the Big Five personality factors) and
better interpersonal relationships.

**Measure of Need for Cognition**

*18-Item need for cognition scale (Cacioppo, Petty & Kao, 1984).* The short form
of the Need for Cognition Scale is an 18-item questionnaire in which participants indicate
how much they agree or disagree with a statement on a 5 point -likert-type scale ranging
from 1 = extremely uncharacteristic, to 5 = extremely characteristic. It was developed by
ranking the 34 items from the original NCS in terms of their factor loadings, calculating
Cronbach’s alpha as each successive item was added, and using a screen test to determine
how many items to retain (Cacioppo, Petty & Kao, 1984). Half of the items are worded
positively and half are worded negatively. Sample items include, “I prefer watching
educational to entertainment programs,” “I am not satisfied unless I am thinking,” and, “I
prefer my life to be filled with puzzles that I must solve.” Items such as, “It’s enough for
me that something gets the job done, I don't care how or why it works,” and, “Ignorance
is bliss,” are reverse scored. Higher scores on the test indicate a greater need for cognition.

The original scale was found to have high internal reliability ($\alpha = .90$) with a sample of 527 participants. A review of the scale by Sadowski (1999) indicated a clear, dominant factor, and the measurement of a single underlying construct, as found by Cacioppo, Petty and Kao’s (1984) initial review of the short form. An assessment of reliability found good internal consistency with a Cronbach’s alpha of .86 (Sadowski, 1999) as compared to Cacioppo, Petty and Kao’s (1982) original Cronbach’s alpha coefficient of .90. Average correlations between each item on the scale ranged from .17 to .34. A principal component analysis found one dominant factor with an eigenvalue of 5.57 to account for 30.92% of the variance and the eigenvalue for the second factor, 1.61, accounted for 8.95% of the variance.

Discriminate validity was confirmed in the initial scale through a lack of correlation between the subjects’ need for cognition and test anxiety ($r = .02, N = 419, ns$); however, need for cognition was found to correlate with cognitive style ($r = .19, N = 419, p < .001$) which was expected based on the constructs they both tap (Cacioppo, & Petty, 1982). Further, no significant sex difference was found for any of the measures; a Kolmogorov-Smirnov test indicated the frequency distributions were close to one another $\chi^2 (2) = 2.75, ns$, and the means for the total NCS scores did not differ as well, $t(1216) = 0.49, ns$. 

Measures of Decision Coherence

Adult - decision making competence (ADMC; Bruin, Parker & Fischoff, 2007).

The ADMC assesses how well individuals make decisions across a variety of domains, and is composed of 7 assorted task groups, which make up 7 sub-scales (resistance to framing, recognizing social norms, under/ overconfidence, applying decision rules, consistency in risk perception, resistance to sunk costs, and path independence), for a total of 87 items. However, to shorten the survey and include only elements germane to the study, the present study only used five of the sub-scales. In addition, path independence was not used because of low reliability and validity.

These scales are being used in order to gain a comprehensive picture of how consistent a person’s decision-making is across situations. Having good overall health entails consistency in health decisions across a wide range of situations, from shopping at the supermarket, to food choices in restaurants and adherence to doctor recommendations. By testing how consistent an individual is across a wide range of decisions tasks, from how well they can resist framing effects to whether or not they are overconfident in their beliefs, the ADMC can help to mirror real-life decision satiations. Theoretically, consistency in decision making may reflect consistency in beliefs. Thus an individual high in decision-making consistency who sets a dieting goal will be less likely to break that goal when faced with a temptation (e.g., forming a CHB), because this would be inconsistent with their overall plan. Therefore, consistency was assessed by comparing results across five scales: resistance to framing, under/ overconfidence,
applying decision rules, consistency in risk Perception, and Resistance to Sunk Costs. The subscales used are described in detail below.

(1) Resistance to Framing (28 items, 7 items per set). This task Measures whether a person’s choice assessment is affected by irrelevant information. The participant is presented with seven risky-choice tasks that have an equal number of gain and loss decision problems which each present a sure thing and a risky-choice option. For example, an item taken from Schneider (1992) is as follows: A pesticide threatens the lives of 1,200 endangered animals. Gain version: A choice between (a) saving 600 endangered animals for sure and (b) a 75% chance that 800 animals will be saved, and a 25% chance that no animals will be saved. Loss Frame: A choice between (a) losing 600 animals for sure and (b) a 75% chance that 400 animals will be lost, and a 25% chance that 1,200 animals will be lost.

There are also seven attribute framing items which ask the participant to rate positively and negatively described versions of seven normative events (e.g., Judge the quality of ground beef labeled 80% lean or 20% fat (Levin & Gaeth, 1988).

(2) Under/overconfidence (34 items). This section assesses how aware a person is of their own knowledge, or how much they know. Participants were presented with a set of statements to which they had to state whether they are true or false, and then rate their confidence in their choice on a scale from 50% (just guessing) to 100% (absolutely sure). Under/overconfidence is considered one minus the absolute difference between mean confidence and percentage correct across items. Thus higher scores reflect better performance.
(3) Applying Decision Rules (10 items). This task measures how well participants can apply decision rules across a range of situations. In this task, the participant is asked to indicate which of five DVD players a hypothetical consumer would like to buy, based on different decision rules (e.g., Lisa wants the DVD player with the highest average rating across features is an example of an equal weights rule). Decision rules are taken from Payne, Bettman, and Johnson (1993) and include elimination by aspects, satisficing, lexicographic, and equal weights rules.

(4) Consistency in Risk Perception (20 items). This section measures the participants' ability to follow decision rules. They answered a series of 10 events twice (once for the next year, and once for the next five years) for a total of 20 questions, judging the probability of an event happening to them on a scale from 0% (no chance) to 100% (certainty). Correct answers are those in which the probability of an event occurring in the next year is not greater than the probability of it happening in the next 5 years.

(5) Resistance to Sunk Costs (10 items). This section measures the participants' ability to ignore prior investments when making decisions (Arkes & Blumer, 1985). This section has 10 items (drawn from past sunk-cots literature (Arkes & Blumer, 1985; Baron, Granato, Spranca, & Teubal, 1993; Bornstein & Chapman, 1995; Frisch, 1993), and others created for the project) and uses a rating scale ranging from 1 (most likely to choose [the sunk-cost option]) to 6 (most likely to choose [the normatively correct option]). Likelihood to adhere to sunk costs is measured by averaging across the 10 items, where higher scores indicate less likelihood to adhere to sunk costs.
Participants are given the items in the following order in order to maximize the distance between related tasks (e.g., for Resistance to Framing and Recognizing Social Norms): (1) positive-item versions of Resistance to Framing, (2) Under/overconfidence, (3) Applying Decision Rules, (4) Consistency in Risk Perception, (5) Resistance to Sunk Costs, (6) negative-item versions of Resistance to Framing.

**Measures of Risk**

*Risk scale (Blais & Weber, 2006).* This 30-item scale developed by Weber et al. (2006) assesses both risk-perceptions and risk-behavior in five content domains (8 items per subscale): financial decisions (separately for investing versus gambling), health/safety, and recreational, ethical, and social decisions. It was modified from the original 40-item scale to be 25% shorter, and found to still remain stable in its psychometric properties. There are two parts to the survey. In Part I, respondents rate the likelihood on a scale from 1 (extremely unlikely) to 7 (extremely likely) that they would engage in each activity or behavior (e.g., bungee-jumping off a tall bridge). In part II, participants indicate how risky they perceive different situations (e.g., going camping in the wilderness) on a scale from 1 (not at all risky) to 7 (extremely risky), in order to assess the respondents’ perceptions of the magnitude of the risks of the activities judged in Part I.

**Other Measures of CHBs**

*The likelihood scale (Pilot study).* This scale was tested in the pilot study presented earlier. It consists of 17 items, and is a modified version of the original CHB scale developed by Knäuper et al., 2004. In the pilot, it was found to have good reliability
(α = 0.852), in a sample of 86 participants, correlating strongly with total scores on the CHB scale (r = 0.512, p < .01).

**Measures of Health**

*The health behaviors checklist (HBCL; Vickers, Conway & Hervig, 1990).* The Health Behaviors Checklist measures four behavioral factors thought to contribute to a person’s health. The checklist contains 40 items, 27 of which are used in scoring to represent four health domains in two general areas: preventative health behaviors and risk taking behaviors. Preventative health behaviors concern (1) wellness maintenance behaviors (e.g., “I take vitamins”), (2) traffic-related risk taking (e.g., “I speed while driving”), (3) accident control behaviors (e.g., “I have a first aid kit in my home”), and (4) the use of potentially harmful substances (e.g., “I don’t drink alcohol”).

In the survey, the participant responds to each of the 40 questions by indicating the accuracy with which the specific health behavior describes their typical behavior (e.g., “I use dental floss regularly”). Participants respond on a 5-item response scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Scores are averaged for each participant within each of the four health related behaviors: Wellness maintenance (10 items), accident control (6 items), traffic related (7 items), and the use of potentially harmful substances (4 items) (Vickers, Conway & Hervig, 1990). Items are reverse coded when necessary so that higher scores indicate greater care to their health.

*Body Mass Index (BMI).* Body Mass index is calculated as the individuals weight divided by height squared (lbs/in²) multiplied by a conversion factor of 703. The Center for Disease Control and Prevention’s standard weight categories’ for men and women 20
and older are as follows: Below 18.5, Underweight; 18.5 – 24.9, Normal; 25.0 – 29.9, Overweight; and 30.0 and above, Obese (Center for Disease Control, 2011). Higher scores indicate an unhealthier BMI. This information was collected via the self-report demographics questions on the survey.

**Procedure**

An online survey format was used to collect information on CHB scores, risk perception and behavior, the need for cognition, self-control, and decision coherence, as well as demographic information on height, weight, age, gender, year in school, employment status, income, ethnicity and dieting. Criteria measures were scores on the health behavior checklist (HBCL), BMI, and self-reported risky behavior. See Appendices A and B for measures used.

Participants were recruited from Mechanical Turk at https://www.mturk.com/ and the Psychology Research participant pool. Individuals from Mechanical Turk were directed via https://www.mturk.com/ to follow a link to Qualtrics to complete the survey online. Individuals from the Psychology Research pool were recruited via an online sign-up system. Applicants were asked not to participate if they had difficulty reading or speaking English. After signing up to participate in the study, participants sat at a computer to complete the survey online through a link to Qualtrics. The study was broken into four parts.

In part one, participants were presented with the 17-item compensatory health belief (CHB) Scale. In part two, participants completed the short form of the need for cognition scale (Cacioppo, Petty & Kao, 1984), risk perception and behavior survey
(Weber et al., 2002), self-control scale (Tangney, Baumeister and Boone, 2004, and ADMC questions.

In the third part of the experiment, participants completed the 40-item Heath Behaviors Checklist (HBCL; Vickers, Conway & Hervig, 1990). Finally, the participants ended the experiment answering demographic questions about their height, weight, age, gender, year in school, employment status, income, ethnicity and whether or not they were currently dieting (i.e., yes, no). Questions concerning height and weight were used to calculate the participant’s BMI. After they finished, the participants read a brief online debriefing describing the nature of the study and thanking them for their participation.
RESULTS

Descriptive Statistics

Demographics

Descriptive statistics for both the MTurk and Ohio University (OU) data sets are reported in Tables 7 and 8. Participants in the MTurk group ($N = 217$) were predominantly female (69.59%), and not currently dieting (76.50%), with 52.53% reporting that they were employed, and 10.14% reporting that they were currently students. While the sample was largely Caucasian (79.26%), it also included African Americans (7.37%), Hispanics (4.15%), Asians (2.76%) and Native Americans (2.76%). The mean age was 38.62 ($SD = 13.42$), and the average BMI for this group was 27.12 ($SD = 7.35$). 81.1% reported an annual income of less than $59,000 per year.

Participants in the Ohio University sample ($N = 212$) had a close gender split; 51.89% of the participants were female, and 79.25% reported not currently dieting. 78.77% of the OU participants were students, and 13.68% reported being currently employed. 89.15% of the sample was Caucasian, 3.77% African American, 1.42% Hispanic, and 4.25% Asian. The mean age was 19.18 ($SD = 1.56$), and the average BMI for this group was 23.73 ($SD = 4.50$). 97.17% reported an annual income of below $20,000.
Table 7

Descriptive Statistics for the Quantitative Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mechanical Turk (N = 217)</th>
<th>Ohio University (N = 212)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>1. Age</td>
<td>38.62</td>
<td>13.42</td>
</tr>
<tr>
<td>2. BMI</td>
<td>27.12</td>
<td>7.35</td>
</tr>
<tr>
<td>3. Weight in pounds</td>
<td>171.8</td>
<td></td>
</tr>
<tr>
<td>4. Height (inches)</td>
<td>66.62</td>
<td>3.83</td>
</tr>
</tbody>
</table>
### Descriptive Statistics for the Categorical Variables

<table>
<thead>
<tr>
<th></th>
<th>Mechanical Turk (N = 217)</th>
<th>Ohio University (N = 212)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>66</td>
<td>102</td>
</tr>
<tr>
<td>Female</td>
<td>151</td>
<td>110</td>
</tr>
<tr>
<td>6. Year In School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>4</td>
<td>113</td>
</tr>
<tr>
<td>Sophomore</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>Junior</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>Senior</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Other</td>
<td>98</td>
<td>1</td>
</tr>
<tr>
<td>Not a Student</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7. Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>172</td>
<td>189</td>
</tr>
<tr>
<td>African American</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Hispanic</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Asian</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Native American</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>8. Employment Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>22</td>
<td>167</td>
</tr>
<tr>
<td>Employed</td>
<td>114</td>
<td>29</td>
</tr>
<tr>
<td>Not-Employed</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Disability</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Homemaker</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>Retired</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>9. Are You Currently Dieting (Yes/No)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>51</td>
<td>44</td>
</tr>
<tr>
<td>No</td>
<td>166</td>
<td>168</td>
</tr>
<tr>
<td>10. Annual Income Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below $20,000</td>
<td>69</td>
<td>206</td>
</tr>
<tr>
<td>$20,000 - $29,999</td>
<td>34</td>
<td>1</td>
</tr>
<tr>
<td>$30,000 - $39,999</td>
<td>31</td>
<td>0</td>
</tr>
<tr>
<td>$40,000 - $49,999</td>
<td>29</td>
<td>0</td>
</tr>
<tr>
<td>$50,000 - $59,999</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>$60,000 - $69,999</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>$70,000 - $79,999</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>$80,000 - $89,999</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>$90,000 or more</td>
<td>13</td>
<td>3</td>
</tr>
</tbody>
</table>
Scale Measures

Adult Decision Making Competence (ADMC)

The ADMC (ADMC; Bruin, Parker & Fischhoff, 2007) was scored according to the authors’ instructions obtained via email correspondence. Scores for each of the five component tasks were computed independently, and the overall ADMC score was calculated by computing z-scores across all subscales from the raw scores of the five components. The five subscales were found to have fairly good reliability (range from α = .54 to .77 MTurk, .58 to .83 OU), with samples of 217 and 212, respectively.

Resistance to framing is computed by subtracting the mean absolute difference between related frames from five, with higher scores indicating greater resistance to framing. The subscale has a potential range of 0 to 5. Under/overconfidence is computed by subtracting the absolute difference between mean confidence and percent of answers correct from one, with higher scores reflecting better performance. The scale has a potential range from 0 to 1. Applying decision rules is computed by calculating the percent of correct responses, with higher values indicating greater consistency in rule application. The subscale has a potential range from 0 to 1. Consistency in risk perception is computed by calculating the percent of consistent risk judgment pairs, with higher scores indicating greater consistency. The subscale has a potential range from 0 to 1. Finally, Sunk cost is computed by creating an average of the ratings across the items, and has a potential range from 0 to 6. Higher scores indicate a greater propensity to choose the normatively correct option as opposed to the sunk cost option.
Descriptive statistics for the ADMC subscales are presented in Tables 9 to 10. Overall, higher scored on ADMC indicate more normative, coherent decision making.

Table 9
Descriptive Statistics of Nonstandardized A-DMC Components OU (N = 212)

<table>
<thead>
<tr>
<th>ADMC Component</th>
<th>Potential Range</th>
<th>Observed Range</th>
<th>Mdn</th>
<th>M</th>
<th>SD</th>
<th>Cronbach's a</th>
<th># of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance to Framing</td>
<td>0 - 5</td>
<td>2.5 - 4.86</td>
<td>3.86</td>
<td>3.85</td>
<td>0.46</td>
<td>0.62</td>
<td>14</td>
</tr>
<tr>
<td>Under/overconfidence Applying Decision Rules</td>
<td>0 - 1</td>
<td>.32 - 1</td>
<td>0.91</td>
<td>0.89</td>
<td>0.09</td>
<td>0.83</td>
<td>34</td>
</tr>
<tr>
<td>Consistency in Risk Perception</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0.50</td>
<td>0.50</td>
<td>0.26</td>
<td>0.74</td>
<td>10</td>
</tr>
<tr>
<td>Resistance to Sunk Costs</td>
<td>1 - 6</td>
<td>1.2 - 6</td>
<td>3.80</td>
<td>3.91</td>
<td>0.67</td>
<td>0.58</td>
<td>10</td>
</tr>
</tbody>
</table>

Note. All Adult Decision Making Competence (ADMC) components are scored so that higher numbers reflect better performance.

Table 10
Descriptive Statistics of Nonstandardized A-DMC Components MTurk (N = 217)

<table>
<thead>
<tr>
<th>ADMC Component</th>
<th>Potential Range</th>
<th>Observed Range</th>
<th>Mdn</th>
<th>M</th>
<th>SD</th>
<th>Cronbach's a</th>
<th># of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance to Framing</td>
<td>0 - 5</td>
<td>2.29 - 4.93</td>
<td>4.07</td>
<td>4.01</td>
<td>0.47</td>
<td>0.60</td>
<td>14</td>
</tr>
<tr>
<td>Under/overconfidence Applying Decision Rules</td>
<td>0 - 1</td>
<td>0.62 - 1</td>
<td>0.91</td>
<td>0.90</td>
<td>0.07</td>
<td>0.77</td>
<td>34</td>
</tr>
<tr>
<td>Consistency in Risk Perception</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0.70</td>
<td>0.64</td>
<td>0.25</td>
<td>0.76</td>
<td>10</td>
</tr>
<tr>
<td>Resistance to Sunk Costs</td>
<td>1 - 6</td>
<td>2.4 - 6</td>
<td>4.20</td>
<td>4.25</td>
<td>0.69</td>
<td>0.54</td>
<td>10</td>
</tr>
</tbody>
</table>

Note. All Adult Decision Making Competence (ADMC) components are scored so that higher numbers reflect better performance.

Compensatory Health Beliefs

The Compensatory Health Belief scale (Knäuper et al., 2004) was scored by creating a sum score of the participant’s responses (on a scale from 0 to 4) for the 17 CHB items (possible range of 0 to 68). Higher totals indicate greater propensity to
endorse CHBs. Averages (ranging from 0 to 4) were also created for the subscales:

Substance use (6 items), eating/sleeping (4 items), stress (4 items) and weight regulation (3 items).

Table 11 presents Cronbach’s alpha for the CHB and its subscales in the different studies.

<table>
<thead>
<tr>
<th>Subscales and items</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OU</td>
</tr>
<tr>
<td>Substance use: six items</td>
<td>0.76</td>
</tr>
<tr>
<td>Eating/sleeping: four items</td>
<td>0.55</td>
</tr>
<tr>
<td>Stress: four items</td>
<td>0.55</td>
</tr>
<tr>
<td>Weight regulation: three items</td>
<td>0.52</td>
</tr>
</tbody>
</table>

As seen in Tables 3 and 11, the OU and MTurk CHB alphas for the subscales, along with those found in the Dutch study by deNooijer et al. (2009), are consistently lower than those found in the original CHB scale. In terms of reliability of its components, the substance use scale seems to be performing best, with an alpha of 0.71 in the pilot study and 0.76 for both the MTurk and OU data as compared to 0.74 for the original CHB scale and 0.66 for the deNooijer et al (2009) study. However, the three other subscales, eating/sleeping, stress and weight regulation, consistently had lower alpha levels than the original Knäuper et al. (2004) study. This, along with findings from the pilot study, shows lower reliability for these subscales in the current sample.
Tables 12 and 13 display descriptive statistics for the CHB scale, as well as the other measures used in this study. Scoring descriptions for the HBCL, NFC, Self-Control, Risk Perception and Risk Taking scales are reported below.

Table 12
*MTurk Descriptive Statistics for the Variable Measures (N = 217)*

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Min</th>
<th>Max</th>
<th>M</th>
<th>SD</th>
<th>Cronbach's a</th>
<th># of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHB Total¹</td>
<td>55</td>
<td>7</td>
<td>62</td>
<td>29.07</td>
<td>9.42</td>
<td>0.80</td>
<td>17</td>
</tr>
<tr>
<td>Likelihood Avg.</td>
<td>0.85</td>
<td>0.02</td>
<td>0.88</td>
<td>0.43</td>
<td>0.16</td>
<td>0.85</td>
<td>17</td>
</tr>
<tr>
<td>HBCL Avg.</td>
<td>2.59</td>
<td>2.11</td>
<td>4.7</td>
<td>3.40</td>
<td>0.52</td>
<td>0.83</td>
<td>27</td>
</tr>
<tr>
<td>NFC Total</td>
<td>69</td>
<td>21</td>
<td>90</td>
<td>60.82</td>
<td>14.95</td>
<td>0.94</td>
<td>18</td>
</tr>
<tr>
<td>Self-Control Total</td>
<td>106</td>
<td>74</td>
<td>180</td>
<td>121.67</td>
<td>20.90</td>
<td>0.92</td>
<td>36</td>
</tr>
<tr>
<td>Risk Perception Total</td>
<td>134</td>
<td>76</td>
<td>210</td>
<td>143.27</td>
<td>22.24</td>
<td>0.88</td>
<td>30</td>
</tr>
<tr>
<td>Risk Taking Total</td>
<td>172</td>
<td>38</td>
<td>210</td>
<td>91.07</td>
<td>28.47</td>
<td>0.91</td>
<td>30</td>
</tr>
</tbody>
</table>

*Note. HBCL (Health Behaviors Checklist), NFC (Need for Cognition).*

¹CHB (Compensatory Health Beliefs) had a possible range from 0 to 68.

Table 13
*OU Descriptive Statistics for the Variable Measures (N = 212)*

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Min</th>
<th>Max</th>
<th>M</th>
<th>SD</th>
<th>Cronbach's a</th>
<th># of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHB Total¹</td>
<td>64</td>
<td>4</td>
<td>68</td>
<td>33.38</td>
<td>9.37</td>
<td>0.80</td>
<td>17</td>
</tr>
<tr>
<td>Likelihood Avg.</td>
<td>0.98</td>
<td>0.02</td>
<td>1</td>
<td>0.51</td>
<td>0.15</td>
<td>0.84</td>
<td>17</td>
</tr>
<tr>
<td>HBCL Avg.</td>
<td>2.41</td>
<td>1.85</td>
<td>4.26</td>
<td>3.18</td>
<td>0.41</td>
<td>0.78</td>
<td>27</td>
</tr>
<tr>
<td>NFC Total</td>
<td>57</td>
<td>22</td>
<td>79</td>
<td>55.19</td>
<td>9.46</td>
<td>0.84</td>
<td>18</td>
</tr>
<tr>
<td>Self-Control Total</td>
<td>91</td>
<td>62</td>
<td>153</td>
<td>108.45</td>
<td>16.18</td>
<td>0.88</td>
<td>36</td>
</tr>
<tr>
<td>Risk Perception Total</td>
<td>110</td>
<td>86</td>
<td>196</td>
<td>135.35</td>
<td>20.79</td>
<td>0.88</td>
<td>30</td>
</tr>
<tr>
<td>Risk Taking Total</td>
<td>161</td>
<td>48</td>
<td>209</td>
<td>113.29</td>
<td>26.31</td>
<td>0.89</td>
<td>30</td>
</tr>
</tbody>
</table>

*Note. HBCL (Health Behaviors Checklist), NFC (Need for Cognition).*

¹CHB (Compensatory Health Beliefs) had a possible range from 0 to 68.
Likelihood Scale

The other measure of the CHB construct, the Likelihood scale (ranging from 0 to 1.00), measured estimated likelihood of engaging in the CHBs. Scores were calculated by creating an average of the participants reported likelihood of engaging in each of the 17 items (with higher scores indicating a greater likelihood of engaging in the behavior).

Results for the Likelihood subscales are summarized in Table 14, which compares Cronbach’s alpha for the subscales between the pilot study and the present studies in which the CHB scale was used.

<table>
<thead>
<tr>
<th>Subscales and items</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pilot</td>
</tr>
<tr>
<td>Substance use: six items</td>
<td>0.78</td>
</tr>
<tr>
<td>Eating/sleeping: four items</td>
<td>0.66</td>
</tr>
<tr>
<td>Stress: four items</td>
<td>0.80</td>
</tr>
<tr>
<td>Weight regulation: three items</td>
<td>0.63</td>
</tr>
</tbody>
</table>

When exploring the subscales, the Likelihood scale appeared to perform better for the substance use and eating/sleeping subscales when comparing the MTurk data to the original pilot study, but worse for the stress and weight regulation subscales (see Table 14). For the OU data, Cronbach’s alpha was slightly higher for the substance use and for the weight regulation subscales, and lower for the eating /sleeping and stress subscales. It
appears the performance of the scale is comparable for the OU and pilot study, which both used OU students.

*Health Outcomes - The HBCL and BMI*

The HBCL (HBCL; Vickers, Conway & Hervig, 1990) was scored by creating an average (potential range from 1 to 5) of the participants score across the twenty-seven items used for the subscales, with higher scores indicating healthier behaviors. For the subscales, scores are averaged for each participant within each of the four health related behaviors: wellness maintenance (10 items), accident control (6 items), traffic related (7 items), and the use of potentially harmful substances (4 items). The overall scale was found to have an overall reliability of $\alpha = .83$ for the MTurk sample ($n = 217$) and $\alpha = .78$ for the OU sample ($n = 212$).

BMI was computed as Body Mass index, and is calculated as the individuals weight divided by height squared (lbs/in²) multiplied by a conversion factor of 703. The Center for Disease Control and Prevention’s standard weight categories’ for men and women 20 and older are as follows: Below 18.5, Underweight; 18.5 – 24.9, Normal; 25.0 – 29.9, Overweight; and 30.0 and above, Obese (Center for Disease Control, 2011). Descriptive statistics for the HBCL and BMI are presented in Tables 7, 12 and 13.

*Need for Cognition*

The Need for Cognition (Cacioppo, Petty & Kao, 1984) is scored by creating a sum total score for the responses (1 to 5) to the 17 items on the scale (potential range of 17 to 85). It was found to have high internal reliability ($\alpha = .94$ MTurk, $\alpha = .84$ OU) with a sample of 217, and 212 participants, respectively. Higher scores indicate a greater
propensity to engage in complex cognitive thought. Descriptive statistics for the Need for Cognition are presented in Tables 12 and 13.

**Self-Control**

The Self-Control scale total (Tangney, Baumeister &Boone, 2004) is scored by creating a sum total of responses (1 to 5) to the 36 items (potential range of 36 to 180), with higher scores indicating a greater degree of self-control. It was found to have good reliability ($\alpha=.92$ MTurk, $\alpha=.88$ OU) with a sample of 217 and 212 participants, respectively. Results for the Self-Control scale are presented in Tables 12 and 13.

**Risk Perception and Risk Taking**

The risk perception and risk taking scales (Blais & Weber, 2006) were scored by creating a sum total of responses (1 to 7) to the 30 items on the risk perception, and risk taking scales (potential range of 30 to 210). The risk perception scale here is a different measure from the consistency in risk perception ADMC measure used in Decision Making Coherence. Higher scores indicate a greater propensity to perceive situations as risky, and engage in risky behavior, respectively. In a sample of 217 MTurk and 212 OU participants, the scale was found to have good overall reliability for both risk-perception ($\alpha=.88$ MTurk and OU) and risk-taking ($\alpha=.91$ MTurk, .89 OU). Results for risk perception and risk taking are presented in Tables 12 and 13.

**Group Comparisons**

Independent sample $t$-tests with Bonferroni correction (Bonferroni adjusted, $\alpha = .05/13 = 0.003846$) were conducted in order to determine if significant differences existed between the MTurk and OU sample means for the 13 key variables. There was a
significant difference in the means of the two groups for all of the variables in the study (found in Tables 7, 9, 10, 12 and 13), except for the under/overconfidence measure of the ADMC. These results suggested that the two groups were in fact very different; therefore, subsequent analyses were conducted in each group. Specifics regarding these relationships will be discussed in detail below with reference to the relevant scale.

**Adult Decision Mailing Competence (ADMC)**

In Tables 9 and 10, means and standard deviations, along with ranges for the ADMC scale are presented. Results from the ADMC for both the MTurk and OU student data were very similar to those found in the study by Bruine de Bruin, Fischhoff and Parker (2007). For the resistance to framing subscale, the mean for the OU sample was slightly lower than the mean for the MTurk sample, \( t(427) = -3.51, p < .003 \). Cronbach’s alpha was also almost identical among the Bruin de Bruine, OU and MTurk samples (\( \alpha = 0.62, 0.62, \) and 0.60, respectively).

For the under/overconfidence subscale, means and standard deviations were almost identical for the three samples, and Cronbach’s alpha was also very consistent; these was no significant difference in the means for the OU sample (\( \alpha = 0.83 \)) as compared to the Bruin de Bruine (\( \alpha = 0.77 \)) and MTurk (\( \alpha = 0.77 \)) samples, \( t(427) = -0.95, p = .340 \).

The applying decision rules subscale appeared to vary a bit more among samples. Mean scores for this scale were lowest for OU sample and highest for the MTurk sample, \( t(427) = -5.73, p < .003 \). Nevertheless, the measure had consistent Cronbach alpha levels
for the Bruin de Bruine, OU and MTurk data samples ($\alpha = 0.73, 0.74$ and $0.76$, respectively).

For consistency in risk perception the mean score was higher for the sample than it was for the OU sample, $t (427) = -8.79, p < .003$. Cronbach’s alpha also differed among the three groups, and was much higher for the Bruin de Bruine sample ($\alpha = 0.72$) than it was for either the OU ($\alpha = 0.64$) or the MTurk sample ($\alpha = 0.66$).

Finally, for the resistance to sunk cost subscale, similar to the consistency in risk perception subscale, scores were higher for the MTurk sample than for the OU sample, $t (427) = -5.28, p < .003$. Cronbach’s alpha also identical for the Bruin de Bruine and MTurk samples ($\alpha = 0.54$), but slightly higher for the OU sample ($\alpha = 0.58$).

Overall, it appears that the ADMC subscales performed fairly consistently across samples. Comparing results and alpha levels among the three groups suggests that the Bruin de Bruine sample and the MTurk sample may be slightly more similar to each other than the OU sample. While performance among the various subscales differed among the groups, the MTurk sample had the overall highest ADMC average (displayed the most normative/consistent judgments), followed by Bruin de Bruine sample and finally the OU sample.

**Compensatory Health Beliefs**

Results for the CHB scale are reported in Tables 12 and 13. The mean CHB score for the MTurk sample, was lower than that of the OU sample, $t (427) = 4.75, p < .003$. Further, Cronbach’s alpha for the overall CHB scale of both groups ($\alpha = .801, N = 429$) was similar to that in the initial Knäuper et al. (2004) study ($\alpha = .800, N = 141$), and
slightly higher than in the pilot study ($\alpha = 0.752$), and the deNooijer et al. (2009) study ($\alpha = .780, N = 145$).

Likelihood Scale

In Tables 12 and 13, means and standard deviations, along with ranges for the Likelihood scale are presented. Analyses showed that the Likelihood scale also displayed values similar to those found in the pilot study ($M = 0.503$, $SD = 0.152$, $N = 86$). However, scores for the MTurk data were significantly lower than the OU data, $t(427) = 5.35, p < .003$. Cronbach’s alpha for the pilot study ($\alpha = 0.852$) was also very similar to that found for the OU ($\alpha = 0.838$) and the MTurk sample ($\alpha = 0.849$), suggesting that this scale provides a robust and consistent complimentary measure to CHB across studies.

Body Mass Index (BMI)

Results for BMI, along with height and weight are reported in Table 7. As discussed previously, the student group appeared to be constrained by a restricted range problem in that their BMI values were not only much lower than those for the MTurk data, $t(427) = -5.74, p < .003$. The average for OU also fell into what is considered a healthy weight by the CDC (BMIs from 18.5 to 24.9) whereas the average for the MTurk data was considered to be overweight (BMIs from 25 to 29.5).

The Health Behaviors Checklist (HBCL)

Scores on the HBCL are reported in Tables 12 and 13. Results were slightly higher (indicating more healthy behaviors) for the MTurk sample when compared to the OU sample, $t(427) = -4.93, p < .003$, although the range of responses was similar for the two groups (2.59 vs. 2.41, respectively). While seemingly contradictory, this pattern
makes sense; the students may have lower BMIs and be healthier simply as a function of age, despite their poor health habits (e.g., reflected in lower scores on the HBCL) which may be a result of their inexperience and the college lifestyle. On the other hand, the older MTurk sample may engage in more healthy habits as a function of maturity and education, but also be subject to more chronic illness and diseases as a function of time and the aging process.

The Need for Cognition

Scores for the Need for Cognition are reported in Tables 12 and 13. Results were higher for the MTurk sample as compared to the OU sample, \( t (427) = -4.66, p < .003 \), suggesting that MTurk participants, overall, displayed a greater desire for cognitive thought and challenge. However, the MTurk data also appeared to have a greater variability in responses and a much larger range of scores (69 vs. 57, respectively), and Cronbach’s alpha was slightly higher for the MTurk (\( \alpha = 0.92 \)) as compared to the OU (\( \alpha = 0.84 \)) sample.

Self-Control

Scores on the self-control scale are presented in Tables 12 and 13. Results were higher for the MTurk sample as compared to the OU sample, \( t (427) = -7.31, p < .003 \), with the MTurk data also showing a much wider range (106 vs. 91, respectively), although the alpha levels were more comparable (\( \alpha = 0.92 \) and 0.88, respectively).

Risk Perception and Risk Taking

Risk perception scores are reported in Tables 12 and 13. Results were higher for the MTurk sample as compared to the OU sample, \( t (427) = -3.81, p < .03 \), and showed
greater variability and range (134 vs. 110, respectively); this suggests that the OU students appeared to be less likely to see situations as risky. In terms of reliability, Cronbach’s alpha was identical for the two groups ($\alpha = 0.88$).

For risk taking, OU students scored higher on risk taking compared to the MTurk sample, $t(427) = 8.39$, $p < .003$, suggesting they were more likely to engage in risky behavior than the MTurk participants.

In conclusion, these results suggest that the OU sample may not be as representative of the general U.S. population as the MTurk data, and instead profile health and cognitive trends unique to the college lifestyle. The healthier BMIs for the OU sample, alongside decreased propensity to engage in beneficial health behaviors may be a function of the college lifestyle, as suggested by the much higher scores for OU students on the risk taking scales.

**Correlations**

Correlational analyses were conducted between the key variables in the model and results are presented in Tables 15 and 16. Correlations that were significant at the $p < .05$ and $p < .01$ level are noted in the Tables and discussed later. In general, for both samples, CHBs were found to be highly correlated with the Likelihood scale, self-control, and risk taking. They were also correlated, although to a lesser extent, with the HBCL and risk perception, as well as the overall ADMC scores. They were uncorrelated with the NFC and BMI for both samples. Implications of the results will be discussed in greater detail in relevance to structural equation model testing.
<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. BMI</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. CHB</td>
<td>-.114</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Likelihood</td>
<td>-.093</td>
<td>.639**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Resistance to Framing¹</td>
<td>.049</td>
<td>-.057</td>
<td>-.041</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Under/overconfidence¹</td>
<td>.209**</td>
<td>-.226**</td>
<td>-.136*</td>
<td>.008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Applying Decision Rules¹</td>
<td>.115</td>
<td>-.171*</td>
<td>-.006</td>
<td>.301**</td>
<td>.171*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Consistency in Risk Perception¹</td>
<td>.079</td>
<td>-.282**</td>
<td>.211**</td>
<td>.183**</td>
<td>.257**</td>
<td>.478**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Resistance to Sunk Cost¹</td>
<td>-.006</td>
<td>-.061</td>
<td>.011</td>
<td>.103</td>
<td>.037</td>
<td>.139*</td>
<td>.249**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. HBCL Average (27)</td>
<td>-.035</td>
<td>-.150*</td>
<td>.184**</td>
<td>-.090</td>
<td>.062</td>
<td>.211**</td>
<td>-.038</td>
<td>-.031</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. NFC</td>
<td>-.027</td>
<td>-.089</td>
<td>.054</td>
<td>.141*</td>
<td>-.043</td>
<td>.272**</td>
<td>.212**</td>
<td>.141*</td>
<td>-.021</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Self Control</td>
<td>-.158*</td>
<td>-.240**</td>
<td>.236**</td>
<td>-.010</td>
<td>.087</td>
<td>-.029</td>
<td>.102</td>
<td>.009</td>
<td>.507**</td>
<td>.185**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Risk perception</td>
<td>.055</td>
<td>-.142*</td>
<td>.188**</td>
<td>-.009</td>
<td>.026</td>
<td>.250**</td>
<td>.024</td>
<td>.044</td>
<td>.340**</td>
<td>-.158*</td>
<td>.197**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Risk taking</td>
<td>-.078</td>
<td>.366**</td>
<td>.375**</td>
<td>.007</td>
<td>.267**</td>
<td>-.102</td>
<td>-.310**</td>
<td>-.026</td>
<td>-.267**</td>
<td>.172*</td>
<td>.386**</td>
<td>-.404**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. ADMC_Z_total</td>
<td>.150*</td>
<td>-.268**</td>
<td>-.129</td>
<td>.536**</td>
<td>.495**</td>
<td>.702**</td>
<td>.729**</td>
<td>.514**</td>
<td>-.104</td>
<td>.243**</td>
<td>.053</td>
<td>-.056</td>
<td>.235**</td>
<td></td>
</tr>
</tbody>
</table>

*Note. CHB (Compensatory Health Belief Scale), NFC (Need for Cognition), HBCL (Health Behaviors Checklist).

¹Measures are part of the ADMC (Adult Decision Making Competence).

* p < 0.05, 2-tailed.

**p < 0.01, 2-tailed.
Table 16
Ohio University (OU) Correlations (N = 212)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. BMI</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. CHB</td>
<td></td>
<td>-.068</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Likelihood</td>
<td></td>
<td></td>
<td>-.078</td>
<td>.613**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Resistance to Framing¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.068</td>
<td>-.126</td>
<td>-.070</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Under/overconfidence¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.015</td>
<td>.208**</td>
<td>.171*</td>
<td>.027</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Applying Decision Rules¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.027</td>
<td>.290**</td>
<td>-.143*</td>
<td>.258**</td>
<td>.093</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Consistency in Risk Perception¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.079</td>
<td>.296**</td>
<td>.199**</td>
<td>.202**</td>
</tr>
<tr>
<td>8. Resistance to Sunk Cost¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.089</td>
<td>.056</td>
<td>.012</td>
</tr>
<tr>
<td>9. HBCL Average (27)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.082</td>
<td>.020</td>
</tr>
<tr>
<td>10. NFC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.046</td>
<td>-.105</td>
</tr>
<tr>
<td>11. Self Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Risk perception</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Risk taking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. ADMC_Z_total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. CHB (Compensatory Health Belief Scale), NFC (Need for Cognition), HBCL (Health Behaviors Checklist).
¹Measures are part of the ADMC (Adult Decision Making Competence).
* p < 0.05, 2-tailed.
**p < 0.01, 2-tailed.
Structural Equation Model Testing

Variable Diagnostics

Prior to performing SEM model tests, scales were examined for outliers, skewness, and kurtosis. With the exception of BMI, all of the variables appeared to me normally distributed, and there was relatively little skewness or kurtosis; no distinct patterns were found as explained below.

BMI was slightly positively skewed for both data sets, although this was expected due to the unique nature of BMI. The data appeared to show that the MTurk sample had a much greater positive skew ($M = 27.12, \text{Mdn} = 25.102, \text{Mode} = 20.52$), than the healthier OU sample ($M = 23.73, \text{Mdn} = 23.14, \text{Mode} = 25.11$) which displayed a more normal distribution of BMIs, as the median was only slightly below the mean, and the mode was higher than both. The OU sample did have a greater skew (1.670) than the MTurk sample (1.342), whose BMI distribution was more representative of a less healthy U.S. population.

The OU data had a higher value for kurtosis (9.255) than the MTurk sample (1.888), although the MTurk sample displayed much greater variability ($SD = 7.35, IQR = 8.97$) than the OU data ($SD = 4.50, IQR = 4.22$) due to a smaller range of BMIs which clustered heavily about the OU mean. This is in line with the findings that the OU data had much lower BMIs, and also had a much smaller range of BMIs than the MTurk sample. There were a few outliers within each BMI data set, but removal did not cause any significant changes to the means or standard deviations, skew or kurtosis, and thus all values were retained in the data.
Further, there was no missing data, and thus all samples were analyzed. While within each group (OU and MTurk data) the distributions appeared fairly normal, key differences of interest emerged when comparing results from the two samples.

Correlations

Correlation Analyses for the MTurk Data Set

As earlier described, there were strong correlations between CHBs and the other variables (see Table 15). As was expected, the CHB scale was positively correlated with the Likelihood scale ($r = 0.639, p < .01$). CHBs were also correlated with a majority of the individual components of the ADMC, as well as the overall ADMC score ($r = -0.268, p < .01$), implying the greater coherence in decision making was associated with decreased endorsement of CHB as predicted. Of the other predictors of CHBs, self-control ($r = -0.240, p < .01$) and risk perception ($r = -0.142, p < .05$) were also significantly related, suggesting that as self-control and risk perception increased, scores on the CHB scale decreased. Need for Cognition, on the other hand, was not significantly related to CHBs ($r = -0.089, ns$).

The health outcome variables of HBCL ($r = -0.150, p < .05$) and risk taking ($r = 0.336, p < .01$), were also related to CHBs, suggesting that higher levels of CHBs were associated with decreases in health, and increased risk taking. The relationship between CHBs and BMI was not significant, suggesting that higher endorsement of CHBs was unrelated to BMI.

Overall, CHB correlated with key variables in the expected direction, thus providing preliminary support for the hypotheses.
Correlation Analyses for the OU Data Set

The OU data displayed similar correlational trends to the MTurk sample; however, there were some key differences (see Table 16). As with the MTurk data, the CHB scale was positively correlated with the Likelihood scale ($r = 0.613, p < .01$). It was also negatively correlated with the overall ADMC scale score ($r = -0.381, p < .01$) and this correlation was slightly higher than that observed in the MTurk sample. For the predictors of CHBs, Self-Control was found to be negatively correlated with CHBs ($r = -0.205, p < .01$), and uncorrelated with the Need for Cognition ($r = -0.105, ns$) as in the MTurk sample. However, in the OU sample, it was also uncorrelated with risk perception ($r = 0.095, ns$).

As far as outcome variables, CHBs were only significantly related to risk taking ($r = 0.320, p < .01$). As in the MTurk sample, they were not significantly related to BMI ($r = -0.068, ns$) nor to HBCL ($r = 0.020, ns$). The lack of correlations could be due to a range restriction of BMI in the OU student sample.

Model 1: Initial Model Testing

Based on the previous analyses demonstrating good variability and expected patterns of correlations in the MTurk sample, the SEM model (Figure 2) proposed was first tested with this group. Raw scores were used for all variables except for the measures of decision coherence in the ADMC which were converted into z-scores as earlier described. This variable’s subscales were also used as individual variables rather than as a composite in the model.
The first model tested, Model 1, appears in Figure 3 and was significant, $\chi^2 (60, N = 217) = 265.723, p = .000$ with a root mean square of approximation (RMSEA), $RMSEA = .126, 90\% CI [0.111, 0.142]$. Browne and Cudeck (1993) suggest that an RMSEA value of .08 or less, with a confidence interval that does not exceed .08 as a reasonable error of approximation; Model 1 in Figure 3 does not satisfy this criterion.

Further, Mardia’s test for non-normality was conducted and found to be significant (kurtosis = 11.985, critical ratio = 4.470) suggesting that the underlying assumptions of the traditional maximum likelihood methods used in SEM had been violated and that the variables were not multivariate normal. (In Mardia’s test, a sample is considered multivariate normal at the 0.05 significance level if the critical ratio of Mardia's coefficient of multivariate kurtosis is less than 1.96.) Besides its poor fit, this model had multiple problems, such as negative error variances. Because AMOS would not display the standardized correlation estimates Figure 3 is simply schematic.
Figure 3. Model 1: Modified Compensatory Health Belief (CHB) Model.
Subsequent analyses were conducted on Model 1 in order to improve it through inspection of model diagnostics such as modification indexes, and regression weights. Suggestions in the modification indices were applied to the data to see if the addition of certain paths would reduce the overall chi-square and improve model fit. Likewise, the regression weights were used to identify which variables appeared to be highly related to one another. Models were tested in which low performing items (e.g., BMI) were removed from the model.

Further, results were also examined for the presence of negative error variances, squared multiple correlations greater than 1.00, and non-significant correlations. Model 1 was found to have a negative error variance and the squared multiple correlation for BMI was greater than one. Because removal of BMI from the model did not produce any significant improvements, however, it was retained at this point.

Other reasonable changes to this model were conducted based on prior research. Past work suggested that higher levels of self-control are associated with or may lead to more positive health outcomes, and that those high in the NFC may be high in decision coherence as individuals high in the NFC are more likely to engage in complex thought, rather than fall prey to decision traps such as sunk cost and framing. Based on these assumptions, additional paths were added to the model flowing from self-control to the HBCL, and correlating Decision Making Coherence with the NFC, however, these changes did not yield any significant improvements. For example, a double headed arrow was added correlating the NFC with Decision Making Coherence, resulting in \( \chi^2 (59, N = 217) = 252.112, p = .000 \), and \( RMSEA = 0.123, 90\% CI [0.108, 0.139] \).
Health Outcomes is a latent variable that was hypothesized to represent general health and BMI that were affected by levels of CHB; however, due to the poor performance of BMI, Health Outcomes was removed from the model making the relation between CHB and risk taking flow directly. This change did result in a slight improvement in the model, yet it was still significant with poor RMSEA values, $\chi^2 (60, N = 217) = 226.606, p = .000$, and $RMSEA = 0.113$, 90% CI [0.098, 0.129]. No other changes were able to produce any improvements in the model. The following section describes an exploratory analysis carried out in order to redefine a workable model.

*Exploratory Factor Analysis to Redefine the Model*

Before proceeding with further model modifications, there was concern over whether or not the variables in the model had been grouped together in the most parsimonious manner. In particular, there was concern over the measurement model of the Decision Making Coherence construct. A principal component analysis with varimax rotation was conducted first on the measures of Decision Making Coherence, and subsequently on all of the variables included in the model. Results were used to guide further redefinition of the model.

*Analysis of Decision Making Coherence*

Decision Making Coherence is composed of several different measures that may tap into different constructs. For example, the under/overconfidence responses may not represent the same type of decision coherence as the sunk cost measure. Therefore, it was a relevant concern that an overall Decision Making Coherence latent variable itself might not be providing the best grouping for the five different subscales. The hope was that in
exploring how the components of the Decision Making Coherence functioned, they could be better incorporated into the final model.

Results for the principal component analysis with varimax rotation on Decision Making Coherence are summarized in Table 17.

<table>
<thead>
<tr>
<th>Rotated Component</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance to Framing</td>
<td>0.50</td>
<td>-0.58</td>
</tr>
<tr>
<td>Under/overconfidence</td>
<td>0.42</td>
<td>0.77</td>
</tr>
<tr>
<td>Applying Decision Rules</td>
<td>0.78</td>
<td>-0.07</td>
</tr>
<tr>
<td>Consistency in Risk Perception</td>
<td>0.80</td>
<td>0.15</td>
</tr>
<tr>
<td>Resistance to Sunk Costs</td>
<td>0.44</td>
<td>-0.22</td>
</tr>
</tbody>
</table>

¹ADMC (Adult Decision Making Competence).
²Results of Principal Component Analysis with Varimax Rotation.

Note. Loadings in Bold are >.32.

The rotated component matrix suggested that a two-factor solution explained 57.44% of the variance, with applying decision rules, consistency in risk perception and resistance to sunk cost loading onto factor one, and resistance to framing and under/overconfidence loading onto factor two. This implied that decomposing Decision Making Coherence into two components might improve its fit in the final model. Further, shared final communalities between the variables were all greater than 0.593 (range 0.593 to 0.775), except for Sunk Cost which had a value of 0.239. This analysis suggested that
deleting sunk cost from Decision Making Coherence could potentially improve its performance.

In light of these findings, analyses in SEM were run using two separate latent variables for Decision Making Coherence in the initial, proposed model, based on the results from the principal component analysis; one latent variable contained applying decision rules, consistency in risk perception and resistance to sunk cost, and the other resistance to framing and under/overconfidence. However, this did not result in improved model fit $\chi^2 (59, N = 217) = 288.803, p = .000$, and $RMSEA = 0.134, 90\% CI [0.119, 0.105]$. The model also contained negative error variances and squared multiple correlations greater than 1.00.

In subsequent tests, all possible combinations of the Decision Making Coherence measures into two separate latent variables were tested, but did not yield significant improvement. Further, various other combinations were explored. Sunk cost, and later each individual subcomponent of the Decision Making Coherence variable was removed from the model in various combinations to see if model fit could be improved; in other instances, different formulations were explored, such as a model, with under/overconfidence as a separate variable from the other four. However, all resulted in a poorer model fit. Therefore, because removing any component of Decision Making Coherence from the model, or breaking the variables down into the two factors in AMOS led to poorer model fit, this measure was left intact.
Analysis of the Other Variables in the Model

Subsequent analyses explored how well the other variables in the model fit together in order to help model modification. A principal component analysis with varimax rotation was conducted on all the variables Table 18 presents these results.

Together, a four-factor solution was found to explain 56.39% of the variance. The results formed four rather distinct and theoretically sound latent constructs, in which related variables seemed to group together in discernible patterns. Component one was
composed of four items from Decision Making Coherence, while component two contained the HBCL, risk perception, risk taking and self-control. Component three consisted of the CHB and Likelihood scales, and component four contained the under/overconfidence measure from Decision Making Coherence, along with BMI and the need for cognition.

First, these groupings further confirmed the decision to retain Decision Making Coherence as a complete latent variable as, with the exception of the under/overconfidence measure, the other four components loaded highly onto factor one. Second, these results indicated a four factor solution. This was used to create a saturated model that had four latent variables all inter-correlated, guided by the factor loadings: (1) all components of Decision Making Coherence, (2) HBCL, risk perception, risk taking and self-control, (3) CHBs and the Likelihood scale and (4) BMI and the NFC. In this model, there were no paths, but rather, it was tested to see whether or not the latent variables would be related to one another. This model did not fare well either, with a $\chi^2 (59, N = 217) = 189.882, p = 0.000$, and $RMSEA = 0.101, 90\% CI [0.085, 0.118]$.

**Model 2: Predicting Health Outcomes from CHB**

Given the lack of success with previous modifications, further tests were run rebuilding the model from the ground up, exploring how subsets of the variables may fit together. Using still the factor groupings found in the principal component analysis, and the correlations among the variables, a series of subsequent models were created and tested. To begin, initial tests examined whether a model containing the CHB latent variable alone (CHBs and Likelihood variables) could produce significant paths leading
from CHB to the Health Outcomes of risk taking, the HBCL and BMI (see Figure 4). Results showed that the CHB construct predicted measures of CHBs along with the Health Outcomes; the model was non-significant, $\chi^2 (5, N = 217) = 9.485, p = 0.091$, and the root mean square of approximation (RMSEA) goodness of fit test suggested that it was a good fit for the data, $RMSEA = 0.064, 90\% CI [0.000, 0.127]$. Mardia’s test for non-normality was significant (kurtosis = 5.139, critical ratio = 4.524), but low.

Regression weights showed that both the CHB scale and Likelihood scale were strongly correlated with CHB, as was expected, and both had a fairly large amount of their variance explained. For the outcome variables, regression weights appeared to be much stronger for risk taking and the HBCL than for BMI. Thus, even in a model in which CHB is the only predictor, BMI does not seem to be strongly correlated with CHB. Also, it is once again negatively correlated with CHB, suggesting that higher endorsement of CHB, contrary to past research (Kanüper et al., 2004; Kronick, Auerbach, Stich & Knäuper, 2011; Kronick & Knäuper, 2010) results in decreased BMI.

Further, while performing better than BMI, the HBCL also had a fairly low beta weight and as this was considered to be one of the most important outcomes predicted to be associated with BMI, this raised a significant concern. It suggested that the relationship between CHB and the HBCL should be reexamined, and that perhaps the initially proposed path from CHB to the HBCL was incorrect. Theoretically, while health behaviors could stem from the endorsement of CHBs, it is also highly plausible that behavioral patterns could lead to the formation of CHB in order to justify those behaviors. For example, if an individual already drinks and smokes (thus they would
score lower on the HBCL), they may then be more likely to endorse CHB in order to justify their behavior. Future models took this possibility into consideration by testing models in which the directionality for the HBCL was changed, from an outcome variable stemming from CHB, to a predictor of CHB.
Figure 4. Model 2: Predicting Health Outcomes from CHB. Values reported are standardized regression weights. All path coefficients are significant with the exception of the path between CHB and BMI, $p = .095$. 
Model 3: Decision Making Coherence Predicting CHB

Subsequent tests were then conducted to determine whether Decision Making Coherence could predict CHB (CHBs and Likelihood scales) and thus Model 3 was tested (see Figure 5). The test model was significant, $\chi^2 (13, N = 217) = 24.194, p = 0.029$, and contained a negative error variance, with $RMSEA = 0.063$, 90% CI [0.020, 0.102]. Mardia’s test for non-normality was significant (kurtosis = 3.536, critical ratio = 2.230), but lower than in the previous models.

These results suggested that despite the low RMSEA value, there were significant challenges with the Decision Making Coherence only model and CHB. While regression weights among Decision Making Coherence were fairly high, framing and sunk cost performed poorly. Removing framing and sunk cost from the Decision Making Coherence only model, did not improve model fit significantly; the new, higher chi-square, $\chi^2 (4, N = 217) = 10.983, p = .027$, and RMSEA value, $RMSEA = .090$, 90% CI [0.028, 0.115], reflected poorer model fit. The model also contained negative error variances and squared multiple correlations greater than one. Overall, the Decision Making Coherence only model suggested a fairly strong, negative relationship between Decision Making Coherence and CHB, as predicted, but did not perform particularly well in terms of model fit.
Figure 5. Model 3: Decision Making Coherence Predicting CHB. Values reported are standardized regression weights. All path coefficients are significant at the $p < .05$ level.
Model 4: Other Independent Variables Predictive of CHB

Tests also explored whether NFC, self-control, Decision Making Coherence and risk perception could predict CHB (CHB and Likelihood scales) alone. The results of this test, which are displayed in Model 4, show self-control, risk perception and the NFC with fairly low beta weights on the paths from those variables to CHB. Further, all of those weights are substantially lower than the beta weight for the path from Decision Making Coherence to CHB. This suggests that Decision Making Coherence may be more closely related to CHB than the other predictors. Within Decision Making Coherence, sunk cost once again performed poorly, but this time the under/overconfidence variable also showed a low value, as the beta weight for framing improved. This model was significant, $\chi^2 (30, N = 217) = 61.553, p = 0.001$, and contained a higher root mean square of approximation (RMSEA) goodness of fit statistic for the data, $RMSEA = 0.070$, 90% CI [0.045, 0.095] (see Figure 6). Mardia’s test for non-normality was conducted and found to be significant (kurtosis = 5.856, critical ratio = 2.784).

The poor performance of this model suggested that the initial conceptualization of the predictors of CHB (NFC, risk perception and self-control) in the model as independent variables might not produce the most parsimonious solution, and that it might be beneficial to remove very low performing predictors from the model. The NFC, which had a beta weight of 0.09, was thus identified as a possible candidate for removal from the final model. This is not surprising given the lack of correlation between the NFC and CHB found in the correlational analyses.
Figure 6. Model 4: Independent Variables Predictive of CHB. Values reported are standardized regression weights. All path coefficients are significant with the exception of the path between the Need for Cognition and CHBs, $p = .293$. 
Model 5: Creation of a Final Model

A model based on the previous considerations and results was created. Using models 2, 3 and 4 as a guide, the path coefficients for the initial model were examined and all paths that were not statistically significant were deleted from the model. In this case, both the NFC and risk taking were removed. While the NFC was removed due to its consistent low beta weights and lack of correlation with the other variables ($r = -.089$, ns), risk taking was removed because while highly correlated with CHBs ($r = .366$, $p < .01$), it was also highly correlated with risk perception (as would be expected). Conceptualization of risk taking as an outcome, therefore, might not be adding much to the model, and in fact, when a model was tested with either risk perception, or risk taking as measures of a Health Behaviors latent construct as a predictor of CHB, model fit declined significantly when risk taking was in the model, $\chi^2 (42, N = 217) = 103.917$, $p = 0.000$, $RMSEA = 0.083$, 90% CI [0.063, 0.103], as compared to risk perception, $\chi^2 (42, N = 217) = 83.537$, $p = 0.000$, $RMSEA = 0.068$, 90% CI [0.046, 0.089]. Thus removal of risk taking from the model improved model fit.

As discussed above, the path flow between CHB and HBCL was also reversed based on the performance of the HBCL in Model 2. It was hypothesized that perhaps, contrary to the initial hypothesis, HBCLs influenced the endorsement of CHB, rather than the other way around. Further, individuals who are able to exert high levels of self-control should be better able to maintain healthy diets and habits in the face of temptation, and the perception of situations as risky should translate into more
conservative, safety health behaviors (e.g., an individual who perceives their risk of getting cancer as high may be more likely to engage in health-promoting behaviors to prevent its occurrence). Thus in the creation of the Health Behaviors latent variable, the HBCL, the risk perception and self-control scales were hypothesized to measure this construct as they all were highly correlated with one another and with CHB. At this point, BMI was also removed from the model as it was not significantly correlated with any of the variables in the model (with the exception of self-control and under/overconfidence) and did not have a significant influence on model fit.

A final model (Model 5) was tested in which the causal flow is from the latent variable representing Decision Making Coherence and the latent variable representing health behaviors (Health Behaviors) to the CHB variable (see Figure 7). This means that the initial hypothesized path flow relating the HBCL to CHB was reversed; this change in directionality suggests that rather than resulting from CHB, the HBCL may in fact be influencing their endorsement.

The resulting trimmed model was re-fit, and good model fit was found. Although it had a significant chi-square test, $\chi^2 (33, N = 217) = 62.51, p = 0.001$, the resulting root mean square of approximation (RMSEA) goodness of fit test for the data, $RMSEA = 0.064, 90\% CI [0.039, 0.088]$, suggested that this model was able to capture what might be a pattern of coherent relationships. Model statistics for this model, and all the other models tested with the MTurk sample can be found in Table 19. The path coefficients in Figure 7 are from the trimmed model. Mardia’s test for non-normality was conducted and found to be significant (kurtosis = 6.39), although the critical ratio (3.04), was very
close to the cutoff value of 1.95, and thus the low skew and kurtosis suggest that the underlying assumptions of the traditional maximum likelihood methods used in SEM were sound.

Table 19

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$ (df)¹</th>
<th>p</th>
<th>CFI²</th>
<th>RMSEA³</th>
<th>RMSEA CI⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1: SEM Modified CHB Model</td>
<td>265.723(60)</td>
<td>0</td>
<td>0.603</td>
<td>0.126</td>
<td>0.111, 0.142</td>
</tr>
<tr>
<td>Model 2: Predicting Health Outcomes from CHBs</td>
<td>9.485(5)</td>
<td>0.091</td>
<td>0.973</td>
<td>0.064</td>
<td>0.000, 0.127</td>
</tr>
<tr>
<td>Model 3: Decision Making Coherence Predicting CHBs</td>
<td>24.194 (13)</td>
<td>0.029</td>
<td>0.952</td>
<td>0.063</td>
<td>0.020, 0.102</td>
</tr>
<tr>
<td>Model 4: Independent Variables Predictive of CHBs</td>
<td>61.553(30)</td>
<td>0.001</td>
<td>0.896</td>
<td>0.07</td>
<td>0.045, 0.095</td>
</tr>
<tr>
<td>Model 5: Final SEM Model for CHBs</td>
<td>62.51 (33)</td>
<td>0.001</td>
<td>0.916</td>
<td>0.064</td>
<td>0.039, 0.088</td>
</tr>
</tbody>
</table>

¹A non-significant chi-square is desirable.
²Range 0.00 - 1.00, > 0.95 acceptable.
³Lower limit = 0.00, < 0.06 acceptable.
⁴Range 0.00 - 1.00, < 0.08 acceptable.

In addition, more focused fit tests (e.g., examination of modification indices, standardized residuals) also suggested adequate model fit. The regression weights were all significant at the $p < .01$ level, and displayed fairly strong relationships between the variables (almost all were .300 or greater). There were no squared multiple correlations greater than 1.00, and no negative error variances. Because this model provided the closest fit and contained all but two of the initial proposed variables, and because interpretation of this model is plausible and theoretically sound, this model is proposed as the best fit for the data given prior theoretically considerations.
Figure 7. Model 5: Final SEM Model for CHBs. Values reported are standardized regression weights. All path coefficients are significant at the \( p < .01 \) level.
Results from AMOS indicated that the final model captured several important relationships among the variables. Standardized and unstandardized coefficients for the final model and the relationships among the variables are summarized in Table 20. All the relationships were significant at the $p < .01$ level. The following section will begin at the top of Figure 7 (Model 5) and describe the paths of the variables from predictors, to CHBs and finally outcomes.

Table 20

<table>
<thead>
<tr>
<th>Observed Variable</th>
<th>Latent Construct</th>
<th>$\beta$</th>
<th>$B$</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHB</td>
<td>Health Behaviors</td>
<td>-0.32</td>
<td>-0.21</td>
<td>0.06</td>
</tr>
<tr>
<td>Self-control</td>
<td>Health Behaviors</td>
<td>0.63</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Risk Perception</td>
<td>Health Behaviors</td>
<td>0.40</td>
<td>0.68</td>
<td>0.15</td>
</tr>
<tr>
<td>HBCL</td>
<td>Health Behaviors</td>
<td>0.80</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>CHB</td>
<td>Decision Making Coherence</td>
<td>-0.38</td>
<td>-10.38</td>
<td>3.40</td>
</tr>
<tr>
<td>Consistency in Risk Perception</td>
<td>Decision Making Coherence</td>
<td>0.78</td>
<td>2.48</td>
<td>0.68</td>
</tr>
<tr>
<td>Resistance to Framing</td>
<td>Decision Making Coherence</td>
<td>0.29</td>
<td>0.93</td>
<td>0.36</td>
</tr>
<tr>
<td>Under/overconfidence</td>
<td>Decision Making Coherence</td>
<td>0.31</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Applying Decision Rules</td>
<td>Decision Making Coherence</td>
<td>0.62</td>
<td>1.98</td>
<td>0.56</td>
</tr>
<tr>
<td>Resistance to Sunk Costs</td>
<td>Decision Making Coherence</td>
<td>0.28</td>
<td>0.89</td>
<td>0.34</td>
</tr>
<tr>
<td>Likelihood Total</td>
<td>CHB</td>
<td>0.71</td>
<td>0.23</td>
<td>0.05</td>
</tr>
<tr>
<td>CHB Total</td>
<td>CHB</td>
<td>0.90</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

*Note. CHB (Compensatory Health Belief Scale), HBCL (Health Behaviors Checklist).

*Measures are part of the ADMC (Adult Decision Making Competence).

*p = 0.092, all other p's < .01

Health Behaviors

Beginning at the top left corner of Figure 7, a latent variable called Health Behaviors is assumed to predict CHBs and is composed of self-control, risk perception
and the HBCL. Within this construct, all three variables, self-control, risk perception and the HBCL had fairly high beta weights suggesting they were strongly related to the Health Behaviors construct. The Health Behaviors latent variable displayed positive, fairly strong correlations with self-control ($\beta = 0.63$) and risk perception ($\beta = 0.41$), and very strong correlations with the HBCL ($\beta = 0.80$).

With the exception of risk perception, the squared multiple correlations (or communality estimates) for the indicator variables were also relatively high (e.g., HBCL = .641, CHB Total = .841), suggesting that a large amount of the variance for the given indicator variables could be explained by the latent variable (or factor). This can be interpreted that the indicator variables had high internal consistency. Overall, Health Behaviors was negatively related to CHBs ($\beta = -0.32$) suggesting that individuals with higher self-control, risk perception and better health habits are less likely to endorse CHBs.

*Adult Decision Making Competence*

On the bottom left side of the model is the latent Decision Making Coherence variable, which is also assumed to predict the latent variable CHB. For Decision Making Coherence, the performance of the subcomponents within the latent construct varied. The consistency in risk perception ($\beta = 0.78$) and decision rules ($\beta = 0.62$) subscales appeared to be strongly correlated with Decision Making Coherence, whereas framing ($\beta = 0.29$), under/overconfidence ($\beta = 0.31$) and sunk cost ($\beta = 0.28$) were not as strongly related to Decision Making Coherence. All correlations were positive and this was expected, as it
was hypothesized that higher values on the subcomponents of Decision Making Coherence would signal higher, more normative decision coherence.

In terms of variance explained, consistency in risk perception and applying decision rules also performed well, however, framing, under/overconfidence and sunk cost had very low values suggesting that the amount of variance in these variables explained by the latent Decision Making Coherence factor was relatively low. The overall Decision Making Coherence, like the Health Behaviors construct, was also negatively related to CHBs (β = -0.38) suggesting that higher levels of decision coherence are associated with lower endorsement of CHBs. This was expected given that higher levels of decision coherence were hypothesized to result in lower endorsement of CHBs.

**Compensatory Health Beliefs**

The CHB latent variable is measured by the CHB and the Likelihood scales which positively related to it (for the Likelihood scale β = 0.71; for the CHB scale, β = 0.90), both of which also had a large amount of their variance explained (.51 and .81, respectively) by the CHB latent variable. This suggests that these two scales provide a consistent and accurate measure of the key CHB construct.

As discussed above, previous research on compensatory health beliefs has found CHB scores to be positively related to BMI. However, in both samples in this study, BMI was not significantly related to CHBs, and performed poorly in model tests which is why it was removed from the final model. It is important that future researchers consider that the previously proposed relationship between CHBs and BMI may not be as sound as
once thought. A more focused overview concerning BMI is presented in greater detail in the discussion section.

*Hypothesis Tests*

The final Model 5 displayed in Figure 7 was found to support all of the initial hypotheses (see page 57) with the exception of hypothesis that dealt with variables removed from the model (i.e., need for cognition and risk taking). This section will be broken down into two parts: Hypotheses tested in the model, and individual model free hypotheses.

**Hypotheses Tested in the Model**

Hypothesis 1: *Risk Perception and Self-Control*. The final model in Figure 3 supports hypothesis 1. Paths flowing from self-control and risk perception were negatively and significantly related both to the Health Behaviors construct and to the CHB latent variable indicating that higher scores on self-control and risk-perception are correlated with lower CHB.

Hypotheses 2 and 3: *The Decision Making Coherence Sub-Components*. Hypothesis 3 was supported as path coefficients for the five subcomponents of the ADMC (consistency in risk perception, framing, under/overconfidence, applying decision rules and sunk cost) were all found to be positive and significantly correlated with the latent Decision Making Coherence construct, as well as correlated with one another. This suggests that as scores on these scales increase, decision coherence increases.

Hypothesis 2 was also supported, as paths flowing from Decision Making Coherence to CHB were negative and significantly different from zero. As predicted, this
suggests that levels of decision coherence increase, individuals are less likely to sustain compensatory health beliefs.

Hypothesis 4: CHB. This hypothesis was supported as both the Likelihood scale and the CHB scale were positively related to CHB, as well as highly correlated with one another, confirming that they are both measuring the construct of decision coherence.

Hypothesis 6: Risk Taking. This was not supported as analyses suggested that risk taking had a strong, positive and significant relationship with the endorsement of CHBs, indicating that as the endorsement of CHBs increased, scores on the risk taking measure also increased. However, risk taking was removed from the model because in the presence of the other variables, it was not useful in helping to build a model explaining the interrelationships among other predictors and outcomes related to CHB. Further, the final model performed significantly worse when risk taking was included, $\chi^2 (42, N = 217) = 103.917, p = 0.000, (RMSEA = 0.083, 90\% CI [0.063, 0.103])$, as compared to risk perception, $\chi^2 (42, N = 217) = 83.537, p = .000, RMSEA = 0.068, 90\% CI [0.046, 0.089]$.

Hypotheses Which Could Not be Tested in the Model

Hypothesis 2: The Need for Cognition. The NFC component of Hypothesis 2 was not supported. Correlation analyses for both the OU and MTurk sample found the NFC to be negatively, but not significantly related to CHBs.

Hypothesis 5: Health Outcomes. Hypothesis 5 and its subcomponents could not be directly tested because the latent variable of Health Outcomes was removed from the final model. Based on correlational analyses, hypothesis 5a was not supported; BMI was not positively related to CHB, and this relationship was not significant.
Hypothesis 5b could not be directly tested; however, the correlation between CHB and the HBCL was negative and significant as predicted, indicating that as CHB increased, Health Outcomes declined. In the final model, the path flow was from CHB to HBCL suggesting that as health HBCL increased, endorsement of CHBs decreased.

Model Testing in the Ohio University (OU) Sample

The models tested with the MTurk group were also tested with the OU data, however, none of these models fit this group. The resulting model statistics for these analyses are reported in Table 21.

<table>
<thead>
<tr>
<th>Model</th>
<th>Model 1: SEM Modified CHB Model</th>
<th>Model 2: Predicting Health Outcomes from CHBs</th>
<th>Model 3: Decision Making Coherence Predicting CHBs</th>
<th>Model 4: Independent Variables Predictive of CHBs</th>
<th>Model 5: Final SEM Model for CHBs</th>
</tr>
</thead>
<tbody>
<tr>
<td>χ² (df)¹</td>
<td>234.24 (60)</td>
<td>10.53 (5)</td>
<td>26.90 (13)</td>
<td>74.10 (30)</td>
<td>11.26 (33)</td>
</tr>
<tr>
<td>p</td>
<td>0</td>
<td>0.06</td>
<td>0.01</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CFI²</td>
<td>0.558</td>
<td>0.955</td>
<td>0.926</td>
<td>0.814</td>
<td>0.735</td>
</tr>
<tr>
<td>RMSEA³</td>
<td>0.117</td>
<td>0.072</td>
<td>0.071</td>
<td>0.083</td>
<td>0.106</td>
</tr>
<tr>
<td>RMSEA CI⁴</td>
<td>0.102, 0.133</td>
<td>0.000, 0.134</td>
<td>0.032, 0.109</td>
<td>0.060, 0.108</td>
<td>0.085, 0.128</td>
</tr>
</tbody>
</table>

¹A non-significant chi-square is desirable.
²Range 0.00 - 1.00, > 0.95 acceptable.
³Lower limit = 0.00, < 0.06 acceptable.
⁴Range 0.00 - 1.00, < 0.08 acceptable.

Overall, the performance of these sub-models was comparable, but in most cases worse, than those for the MTurk sub-models. As seen in Table 21, all of the chi-square tests are significant with the exception of values for Model 2. Further, none of the RMSEA values or 90% confidence intervals are within the acceptable range. Even Model
5 performed poorly and Mardia’s test for non-normality was conducted and found to be highly significant (kurtosis = 22.907, critical ratio = 9.861) suggesting that the underlying assumptions of the traditional maximum likelihood methods used in SEM were not sound and that the variables for the OU data set were not multivariate normal.

**Model Testing Combined Samples**

Model 5 was also tested with both the MTurk and OU groups simultaneously and it did not fit the data. The resulting model had a joint chi-square, $\chi^2 (66, N = 429) = 173.8$, $p = 0.000$, and the change in chi-square between the model with MTurk only and the model containing both groups was non-significant, $\Delta\chi^2 (33, N = 212) = 111.262$, $p = 0.000$. The RMSEA = 0.062, 90% CI [0.051, 0.073] dropped near to what would be called a “close fit” (RMSEA value less than 0.05). The joint model also contained negative error variances, as well as squared multiple correlations greater than one, further indications that the model was not appropriate.

**Exploration of Lack of Model Fit for the OU Sample**

In light of these findings, a principal component analysis with varimax rotation was performance for both Decision Making Coherence and all the latent variables in the model in order to identify whether or not there were distinct trends for the OU sample that differed from the MTurk sample. It was also hoped that the results from these tests could be used to guide creation of a new model for the OU data set.

**Analysis of Decision Making Coherence**

A principal component analysis with varimax rotation of the measures of Decision Making Coherence was conducted. Similar to what was found with the MTurk
sample, a two factor solution was produced; however, its composition was slightly different. Table 22 presents these results.

Table 22

2-Factor Solution for the ADMC¹ (OU data)²

<table>
<thead>
<tr>
<th></th>
<th>Rotated Component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Resistance to Framing</td>
<td>0.62</td>
</tr>
<tr>
<td>Under/overconfidence</td>
<td>0.10</td>
</tr>
<tr>
<td>Applying Decision Rules</td>
<td>0.80</td>
</tr>
<tr>
<td>Consistency in Risk Perception</td>
<td>0.73</td>
</tr>
<tr>
<td>Resistance to Sunk Costs</td>
<td>0.05</td>
</tr>
</tbody>
</table>

¹ ADMC (Adult Decision Making Competence).
² Results of Principal Component Analysis with Varimax Rotation.

*Note.* Loadings in Bold are >.32.

Factor one contained resistance to framing, applying decision rules, and consistency in risk perception; the second factor contained under/overconfidence and resistance to sunk cost. The two-factor solution accounted for 56.12% of the variance which was lower than what was found in the other sample. Final shared communalities among the measures of Decision Making Coherence for the OU data were also much lower, ranging from 0.385 for framing to 0.650 for sunk cost which interestingly had had the lowest shared communality for the MTurk data. Communalities were: resistance to framing, 0.385; consistency in risk perception, 0.560; under/overconfidence 0.568; decision rules, 0.643, and sunk cost, 0.65).
Analysis of the Other Variables in the Model

A principal component analysis with varimax rotation was conducted on all the variables (Table 23 presents these results). Together, a five (instead of four) factor solution was found to explain 62.16% of the variance. Component one was composed of three components of Decision Making Coherence (applying decision rules, resistance to framing, and consistency in risk perception), and the risk perception and risk taking measures, while component two contained CHB and Likelihood scales. Component three consisted of the HBCL and self-control, and component four contained the under/overconfidence measure of Decision Making Coherence, along with BMI. The NFC did not load highly onto any of the other factors, but was placed in component five. While the variance was higher than that found in the other sample, the components did not suggest a coherent picture of variable groupings.
Table 23

5-Factor Solution for Variables (OU data)²

<table>
<thead>
<tr>
<th>Rotated Component</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applying Decision Rules¹</td>
<td>0.70</td>
<td>-0.19</td>
<td>-0.11</td>
<td>0.11</td>
<td>0.07</td>
</tr>
<tr>
<td>Resistance to Framing¹</td>
<td>0.64</td>
<td>0.08</td>
<td>0.02</td>
<td>0.04</td>
<td>0.00</td>
</tr>
<tr>
<td>Consistency in Risk Perception¹</td>
<td>0.71</td>
<td>-0.22</td>
<td>0.05</td>
<td>-0.08</td>
<td>-0.03</td>
</tr>
<tr>
<td>Resistance to Sunk Costs¹</td>
<td>-0.03</td>
<td>-0.04</td>
<td>-0.01</td>
<td>0.79</td>
<td>0.09</td>
</tr>
<tr>
<td>Under/overconfidence¹</td>
<td>-0.04</td>
<td>-0.43</td>
<td>-0.16</td>
<td>-0.54</td>
<td>-0.17</td>
</tr>
<tr>
<td>BMI</td>
<td>0.09</td>
<td>-0.18</td>
<td>-0.19</td>
<td>0.46</td>
<td>-0.33</td>
</tr>
<tr>
<td>CHB</td>
<td>-0.23</td>
<td>0.82</td>
<td>-0.09</td>
<td>-0.07</td>
<td>-0.04</td>
</tr>
<tr>
<td>HBC</td>
<td>-0.17</td>
<td>0.15</td>
<td>0.81</td>
<td>0.12</td>
<td>0.06</td>
</tr>
<tr>
<td>Likelihood</td>
<td>-0.06</td>
<td>0.85</td>
<td>0.05</td>
<td>0.00</td>
<td>-0.12</td>
</tr>
<tr>
<td>NFC</td>
<td>0.01</td>
<td>-0.17</td>
<td>0.21</td>
<td>0.12</td>
<td>0.74</td>
</tr>
<tr>
<td>Risk Perception</td>
<td>-0.47</td>
<td>-0.04</td>
<td>0.37</td>
<td>0.34</td>
<td>-0.47</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>-0.49</td>
<td>0.31</td>
<td>-0.45</td>
<td>0.24</td>
<td>0.39</td>
</tr>
<tr>
<td>Self Control</td>
<td>0.21</td>
<td>-0.20</td>
<td>0.68</td>
<td>-0.22</td>
<td>0.34</td>
</tr>
</tbody>
</table>

¹Measures are part of the ADMC (Adult Decision Making Competence).
²Results of Principal Component Analysis with Varimax Rotation.

Note. Loadings in Bold are >.32.

**Creation of a Final Ohio University (OU) Model**

In light of the failure to fit any of the tested models in the OU sample, the results from the principal component analyses were again used to guide the creation of a new OU model.

First, because sunk cost and under/overconfidence did not load onto the same component as the other Decision Making Coherence factors, and were put into a separate factor in the Decision Making Coherence principal component analysis, model variations were tested in which two separate latent variables were used to index CHB; one with sunk cost and under/overconfidence, and the other with consistency in risk perception,
framing and applying decision rules. Every other possible combination of variables for Decision Making Coherence into two separate components, including deleting the poorly performing variables such as sunk cost, was also tried. However, as with the MTurk sample, Decision Making Coherence performed best in the model as a whole.

Using the results from the principal component analysis of all the factors in the model, a saturated model was tested with four latent variables all inter-correlated, suggested by the factor loadings: (1) Decision Making Coherence and risk taking, (2) CHB and Likelihood, (3) HBCL and self-control, (4) BMI, NFC and risk perception. In this model, there were no paths, but rather, it was tested to see whether or not the latent variables would be related to one another. This model did not fare well. Guided by the correlations and relationships shown in the rotated factor analysis, other possible combinations of variables were tried. Direction of path changes were explored, changing the directionality of HBCL, risk perception, and risk taking from outcomes to predictors of CHBs. Weak paths were deleted based on the regression weights, and suggestions from the modification indices in terms of addition of paths were applied, however, no successful model was found.

Correlational analyses of the OU sample shed light on a number of important relationships concerning cognition and health that have the potential to positively influence future research concerning decision making and health.
Model-Free Hypothesis Testing for the Ohio University (OU) Sample

The initial hypotheses were tested in an individual, model free fashion. Using correlational analyses (see Tables 15 & 16), the OU data was found to support some but not all of the predicted hypotheses.

Hypothesis 1: Risk Perception and Self-Control. This hypothesis was not supported. Self-control was significantly, negatively related to CHB, but risk perception was not significantly related to the CHB latent variable. This suggests that for the OU sample, while higher self-control results in decreased CHB endorsement, higher scores on risk-perception are not correlated with lower CHB.

Hypotheses 2: The Need for Cognition. The NFC component of Hypothesis 2 was not supported. Correlation analyses found the NFC was not significantly related to CHBs. The Decision Making Coherence part of hypothesis 2 was supported; Decision Making Coherence was negatively and significantly correlated with CHB. As predicted, this suggests that levels of decision coherence increase, individuals are less likely to sustain compensatory health beliefs.

Hypothesis 3: Decision Making Coherence Sub-Components. Hypothesis 3 was supported as the five subcomponents of the ADMC (consistency in risk perception, framing, under/overconfidence, applying decision rules and sunk cost) were all found to be positive and significantly correlated with the latent Decision Making Coherence construct, as well as correlated with one another. This suggests that as scores on these scales increase, decision coherence increases.
Hypothesis 4: CHB. This hypothesis was supported as both the Likelihood scale and the CHB scale were highly correlated with one another, confirming that they are both measuring the construct of decision coherence.

Hypothesis 5: Health Outcomes. Based on correlational analyses, hypothesis 5a was not supported; BMI was not positively related to CHB, and this relationship was not significant. Hypothesis 5b was not supported; the correlation between CHB and the HBCL was non-significant, indicating that CHB was unrelated to Health Outcomes for this sample.

Hypothesis 6: Risk Taking. This was supported as analyses suggested that risk taking had a strong, positive and significant relationship with the endorsement of CHBs, indicating that as the endorsement off CHBs increased, scores on the risk taking measure also increased.
DISCUSSION

In summary, the primary goal of this study was to provide further tests of the endorsement of CHBs and their relationship to Health Outcomes. The goal was to design and test a structural equation model that combined the theoretical features of the model proposed by Rabiau, Knäuper, and Miquelon (2006) depicted in Figure 1, with other psychological considerations. In particular, the model focused on the endorsement of CHBs in relation to the constructs of self-control, need for cognition, risk-perceptions and behaviors, and decision coherence. This study also sought to further investigate the relationship of CHBs to key Health Outcomes such as BMI and self-reports of health behavior. The hope was that doing so would clarify the relationship between the endorsement of CHBs and beliefs about health, and further reveal how this relationship influences Health Behaviors and actions.

Results found that many of the constructs were related in the directions predicted. There appeared to be fairly strong correlations between the CHBs and the Likelihood scale. Higher decision coherence, self-control and the need for cognition were associated with lower endorsement of CHBs, and more positive Health Outcomes. Further, while the final adopted model is not the same as the one initially proposed, it does lend insight into the relationships that may exist between CHBs, cognition and health – as well as relationships that may not play as great a role as initially hypothesized (e.g., BMI and CHBs, and CHBs and the HBCL). Analysis of the data and the process of model creation in this study shed light on a number of important relationships with the potential to aide in the study and understanding of health beliefs and behaviors.

Therefore, the findings resulting from the exploration of the CHB scale through the models created and tested in this study have the potential to positively impact the
design of interventions that can help people to manage a healthy weight over their life span. Explanation for the decisions made in this study related to model creation, limitations and avenues for future research will be discussed in light of these findings.

Reasons for Changes to the Initial Model

As discussed above, the initial model did not provide a good fit for the data, and thus another model was created and fit. In doing so, three important changes were made in the model which merit discussion.

First, the construct of the need for cognition was removed from the model. It was initially hypothesized that individuals who enjoy and engage in complex cognitive thoughts would be less likely to endorse CHBs. However, the data found that there was no correlation between CHBs and the need for cognition. While the NFC was associated with Decision Making Coherence, as well as other variables such as the self-control, risk perception and risk taking, it was not related to the other Health Outcomes such as the HBCL and BMI. As scores on the need for cognition increased, indicating greater propensity for engaging in complex thought, individuals saw increases in self-control, risk taking and Decision Making Coherence, and decreases in their perception of risk. Thus it appears that individuals high in the NFC are also high in self-control and consistent in their decisions, but also see situations as less risky and are more likely to take risks. This may suggest a future model in which the NFC predicts decision making consistency, which in turn predicts the CHBs.

Secondly, risk taking was also removed from the model. While risk taking was found to be significantly related to CHBs, negatively related to HBCL, self-control and
risk perception, and positively related to the NFC, it did not fit well into the model as either a health outcome or a predictor of CHBs. Because the construct was fairly highly correlated with risk, and the two were grouped together in the factor analysis, it is likely that the multicolinearity would affect other relationships. The measure was thus removed and when this was done, the model and any subsequent models were found to improve significantly, thus, because it is theoretically plausible that measures of risk taking and risk propensity should be measuring the same construct, risk taking was left out of the model. This also suggests a possible future model may be needed, including a latent variable (e.g., Risk Attitudes) which would deal solely with risk. This latent variable could be measured with the Weber (2005) risk perception and risk taking measures, as well as the consistency in risk perception measure from the ADMC.

Finally, the HBCL was changed from an outcome variable to a predictor variable, which was placed in a latent variable labeled Health Behaviors along with self-control and risk perception, and the directionality was changed to have HBCL predicting CHBs. While it was initially predicted that health behaviors would be influenced by CHBs, the model suggests an alternative which may be equally explanatory and insightful in an attempt to understand this complex relationship.

Items on the HBCL focus on specific health behaviors, such as visiting the doctor on a regular basis, eating a balanced diet, and avoiding dangerous behaviors such as smoking and crossing the street against traffic. It is possible that as individuals age, these habits become a more ingrained part of who they are, and thus they want to justify the lifestyles that they lead. Many of the items reflect daily routines and strategies used by
people to cope with the challenges of life, such as relaxing in front of the TV after a stressful day, or using artificial sweeteners instead of sugar to “healthify” their tea or coffee. Thus, it would make sense that the HBCL would be predictive of CHBs, rather than the other way around, because individuals are forming CHBs to justify the behaviors they engage in.

This relates back to the cognitive dissonance theory espoused by Knaüper et al. (2004), in that the authors initially hypothesized that CHBs would be formed because they were the easiest of three options (i.e., resist the temptation, modify perceptions or form CHBs) to reduce the cognitive dissonance that arises when an individual’s desire is in conflict with their health goals. Therefore, engaging in more unhealthy behaviors (as indexed by the HBCL) may lead to greater levels of cognitive dissonance, and result in increased formation of CHBs to reduce this dissonance. Reducing cognitive dissonance, therefore, could also be seen as a form of “rationalization of behavior.” Results found HBCL was negatively related to CHB which suggests that as scores on the HBCL increase (indicating increased wellness) CHB endorsement should decrease. Thus, healthy individuals do not need to form CHBs to justify unhealthy behaviors.

Explanation for Risk Perception as a Predictor of Health Behavior

While the negative relationship between self-control and CHBs was expected, based on a large body of past research correlating it with higher levels of CHBs and negative Health Outcomes, interpretation of the other variable (risk perceptions) in the latent Health Behaviors construct, risk perception, may not be so readily apparent. These findings indicated that those high in risk perception also showed decreased formation of
CHBs, and the associated healthier outcomes could be the result of the activation of reward mechanisms in the brain. In a study by Galván and colleagues (2007) on individual differences in risk-taking behaviors, researchers used functional magnetic resonance imaging (fMRI) scans, along with self-report scales for risky behavior, perception and impulsivity, to examine the association between activity in reward-related neural circuitry (in anticipation monetary reward), and personality trait measures of risk-taking and impulsivity.

They found that there was a positive association between ventral striatal activity and the likelihood of engaging in risky behavior, which varied based on how the individuals perceived the consequences of the behavior. Individuals perceiving activities as highly risky were found to activate the ventral straitum less to reward, than those who did not (Galván, 2007). Therefore, when faced with a dilemma over health choices, individuals who see situations as highly risky may activate the ventral straitum less in response to the reward (e.g., eating the cake), and therefore be less likely to form CHBs or engage in negative behaviors which may stem from them, thus enhancing their overall health.

Finally, another important area which may merit future research concerns the relationship between CHBs and mental health. When studying the overall construct of a person’s health, consideration should also be given to their mental health status as well. A Health Status construct could be created which is composed of both mental and physical health, each of which is measured by several scales.
Discussion Concerning Removal of BMI from the Final Model

It is also important to note that BMI was removed from the final model as it was not significantly related to or predicted by CHBs. Its relationship was also contrary to that predicted in the hypotheses and prior CHB literature (Kanüper et al., 2004; Kronick, Auerbach, Stich & Knäuper, 2011; Kronick & Knäuper, 2010) which found BMI to be positively related to CHBs. However, it is crucial to report these findings concerning BMI for several important reasons, one of which is that it is a measure that has been found to be correlated with health outcomes in a variety of other studies through the literature and has been noted as an important variable by other CHB researchers. Findings from both samples indicated that BMI was not significantly related to CHBs or the Likelihood scale. This raises an important question about the relationship concerning CHBs and health that needs to be brought to the attention of health researchers. Namely, are CHBs predictive of poor health outcomes, or could an alternative relationship exist?

While it was hypothesized that BMI and the HBCL were both indexing health, perhaps the relationship between Health Behaviors and obesity is not as strong as thought. Results, particularly for the OU sample which had lower scores on the HBCL (perhaps because of the stereotypical “unhealthy” college life), suggest that it is possible to live an unhealthy lifestyle and still maintain a healthy weight. Many of the HBCL items concern questions about visiting the doctor, or walking against traffic – behaviors that would influence an individual’s chance of mortality, but not necessarily weight. As was found in model creation, where the Health Outcomes latent variable was removed
due to poor fit, these variables may then represent different outcomes or predictors of CHBs.

What the above analysis suggests is that a differentiation may need to be made between overall health as indexed by the HBCL, and physical health, specifically health concerning obesity. Future research should take this into consideration; it is possible that the HBCL is dealing with a different construct pertaining to healthy habits, whereas BMI is more a measure of physical health status. Other physical status measures should thus be employed to determine an individual’s overall health separately from their health habits; the lack of clarity concerning the relationship between CHBs and specific health outcomes merits further exploration. Future research could explore a model which includes both the HBCL and a Health Status construct, composed of both mental and physical health, each of which is measured by several scales. This would provide a more comprehensive picture of a person’s overall health status, aside from a single measure such as BMI, and allow comparison to health behaviors (i.e., the HBCL) as well.

The concept of mental health should be on its own and perhaps discussed along health behaviors. There was nothing in your study about mental health so it does not seem relevant here. I think in future directions it is a good idea to include indices of mental health when studying the overall construct of a person’s health status (thus the construct is Health Status which is composed of both mental and physical health and each is measured by several scales, etc.).
Finally, it may also be relevant to explore whether or not awareness or indexing of CHBs could be used as a tool by dieters or health-conscious individuals to monitor, improve adhere to, or enhance the outcome of their health plans.

Implications of Results from the OU Sample

Model testing with the OU sample was unsuccessful and future studies are needed to better understand the relationships found. The OU sample reported more unhealthy behaviors than the MTurk group, but had lower (healthier) BMIs, despite an increased propensity for risk taking. Thus, when exploring relationships among cognitive constructs with health outcomes, this is a difficult group to model as not enough time has elapsed for the consequences of their risky/unhealthy behavior to translate into perceptible health problems – age may have played a significant role as a moderating factor in our results.

Although a model could not be found to fit the OU sample, potentially due to its extreme healthfulness, the analyses performed revealed theoretical relationships within this group among the cognitive variables that have important implications for future research concerning cognition and health.

First, the NFC was significantly correlated with self-control, and Decision Making Coherence was significantly correlated with both risk-perception and risk taking. These results suggest that students high in the NFC also were high in self-control and that higher decision coherence was associated with decreased perception of situations as risky and decreases in risky behavior. This is an interesting trend which is present in both groups, although the correlations are much stronger and more significant for the OU as compared to the MTurk data set (see Tables 15 & 16). This suggests that individuals who
are consistent in their decision making are more likely to see situations as less risky, and subsequently indicate a propensity to engage in more risky behavior.

A possibility for the above patterns is that these individuals feel confident taking risks and see situation as less risky because they have a more developed sense of self, in that they know themselves well and thus make consistent decisions across a variety of situations. Self-awareness, in the form of self-esteem and self-perception, therefore, may also play a role in the CHB – health relationship. For example, individuals with low self-esteem may be more prone to engage in unhealthy behaviors and thus form more CHBs to justify these actions, and in fact, research suggests that low self-esteem is associated with health-compromising behaviors in adolescents (McGee & Williams, 2000). Further, self-perception also appears to play a significant role in health as well; studies in numerous areas of health, such as cardiology and psychiatry have found that an individual’s subjective perception of health predicts health status and outcomes, even after adjusting for other indicators of health (Fielding, 1991; Goodwin & Engstrom, 2002; Mossey & Shapiro, 1982; Scheier et al., 1989; Welin et al., 1992).

In relation to the present study, individuals with high self-esteem or a well-developed sense of self (e.g., good self-perception) may behave in a more risky manner because they are more aware of their own boundaries and confident about which actions will actually lead to their harm. Thus, it could be argued that among college-age students, coherent decision making and increased levels of self-control may be predictive of increased levels of riskiness and self-control, respectively. This could potentially be
explored through further, longitudinal studies tracking cognition, CHBs and health outcomes over time.

Limitations

While using Mechanical Turk did provide us with a much more representative sample of individuals in terms of health, education, SES, racial and age, it was also a convenient sample of individuals registered as workers on amazon’s mturk.com, who presumably enjoy engaging in online surveys and were motivated to participate for little monetary compensation. However, research by Buhrmester, Kwang and Gosling (2011) suggests that samples drawn from Mechanical Turk are not only more diverse than the average college sample, but also do provide high-quality data at least as reliable as what could be obtained through traditional recruitment via traditional methods.

Because the use of a college population restricts both the age range and, in general, the health status of the sample, using amazon’s mturk.com, therefore, allowed us the opportunity to collect quality data concerning health-cognition relationships in a sample which was much more diverse and ideally more representative of the U.S. population. Indeed, comparing the health statuses alone of the OU vs. the MTurk sample showed that the MTurk sample had a much wider range of BMIs, and differed significantly from the OU group on health-related outcome variables of the HBCL and risk-taking. The diversity of the MTurk sample and ease of accessibility of the online survey to individuals across the U.S. also enhances the generalizability of the results to other U.S. adult samples as well.
The use of the BMI measure also proved a significant limitation for this study. Within the OU sample, it was subject to a range restriction which contributed to a lack of relationships with other variables. BMI in our study was also a self-report measure which is subject to other factors such as social desirability bias, and lying. Further, as evinced by the results, BMI and the HBCL seem to be tapping into different aspects of health. Conceptualizing physical health as a latent variable, clearly BMI is insufficient as the only indicator of it. Future research would benefit from a more comprehensive battery of indices measuring the individual’s physical health (e.g., cholesterol levels), as well as more accurate measures of obesity.

Future Implications

An important finding from this study was the statistical significance of several of the reduced models relating CHBs and health. In particular, it does seem that independent of the other constructs, CHBs do have the ability to predict significant and important health-related outcomes (see Figure 4). The model containing CHBs (composed of the CHB and Likelihood scale) alone, with paths flowing from CHBs to Health Outcomes of risk-taking, the HBCL and BMI was both non-significant and performed well on the goodness of fit indices (i.e., RMSEA). This suggests not only that a relationship between CHBs and health exists, but that in the absence of other variables, levels of CHBs can be used as a partial index of health.

Further, the model containing only Decision Making Coherence, with paths flowing from Decision Making Coherence to CHB (composed of the CHB and Likelihood scale), while not non-significant also had a fairly robust value for the
goodness of fit indices (see Figure 5). This relationship between CHB and Decision Making Coherence, further supported by a strong, negative correlation between CHB and Decision Making Coherence suggests that Decision Making Coherence and CHB may be capturing very similar aspects of a person’s cognitions related to decision processes. As was initially predicted, higher ADMC values indicating greater levels of Decision Making Coherence were related to decreases in the endorsement of the CHB latent variable. Thus, this suggests that consistency in decisions across all areas of life may lead to better outcomes across a variety of domains, including health.

Finally, as noted above, the relationship between CHB and BMI and health needs to be further redefined and explored; CHB should be explored in relationship to multiple indexes of health, including both physical and psychological, as well as behavioral measures. Because BMI fared so poorly, future research should consider indexing physical health with a battery of other indices, such as cholesterol levels, health conditions (such as diabetes and heart disease), mobility, and mental health. If obesity is a focus, other more accurate measures of adiposity could be employed in addition or in lieu of BMI, such as dual energy X-ray absorptiometry (DEXA), waist-to-hip ratio, bioelectrical impedance analysis (BIA), hydrostatic weighing and skinfold tests. As mentioned previously, a model could be explored in which both the HBCL (as a measure of health behaviors) and a Health Status construct, composed of the measures suggested above (e.g., cholesterol and blood glucose levels, mobility, the presence of chronic health conditions, etc.) influence, or are influenced by CHBs.
Directionality should be also explored concerning the relationship between both Health Status and Health Behaviors and CHBs. Further, researchers should also explore the directionality of the CHB – health relationship in a variety of samples. It is possible that the relationship may differ based on the age, demographic or dieting status of the sample. More research is needed to determine exactly how CHB are either influenced or influence health, and whether or not there are situations in which they may, as the government in the Netherlands believes, contribute to improved overall health.
CONCLUSION

In summary, the goal of this study was to gain insight into the cognitive mechanisms associated with beliefs concerning health. The structural equation model suggested that relationships between decision-making coherence, self-control and risk perception, endorsement of compensatory health beliefs, and subsequent health outcomes, do exist, and can provide a useful tool in enhancing understanding of and clarifying the relationship between health-related cognitions and actions.

Additionally, more comprehensive analysis and comparison of the CHB scale to other related constructs served to provide clarification as to the validity of, and the extent to which the scale is a beneficial tool for research concerning health outcomes. The different OU and MTurk samples also lent insight into both health and cognitive relationships with important implications for research in wellness and decision making. Finally, findings concerning BMI and the HBCL suggest that further work needs to be done clarifying the relationship between CHB, obesity and health, more generally.
REFERENCES


Different people believe different things about their health. Below is a list of beliefs that someone might have about staying healthy. **Please read each sentence carefully and tell us how much YOU agree or disagree with each sentence by choosing** one of the following responses: Totally disagree; Somewhat disagree; Neither agree nor disagree; Somewhat agree; or Totally agree. Remember that there are **no right or wrong answers**, because everybody believes different things.

1. **Relaxing on the weekend can make up for stress during the week.**
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

2. **Using artificial sweeteners compensates for extra calories.**
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

3. **Exercising can compensate for smoking.**
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

4. **It is OK to go to bed late if one can sleep longer the next morning (only the number of hours count).**
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

5. **Not drinking alcohol during the week can make up for the effects of drinking too much alcohol during the weekend.**
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

6. **Skipping the main dish can make up for eating dessert.**
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

7. **Relaxing in front of the TV can compensate for a stressful day.**
8. Eating whatever one wants in the evening is OK if one did not eat much during the day.
   Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree

9. Eating healthy can make up for the effects of regularly drinking alcohol.
   Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree

10. Sleeping in on the weekends can compensate for too little sleep during the week.
    Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree

11. Exercising can make up for the bad effects of stress.
    Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree

12. Starting a new diet tomorrow compensates for breaking a diet today.
    Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree

13. The effects of drinking coffee can be balanced by drinking equal amounts of water.
    Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree

14. It is OK to skip breakfast if one eats more during lunch or dinner.
    Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree

15. Sleep compensates for stress.
    Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree

16. It is alright to drink a lot of alcohol as long as one drinks lots of water to flush it.
    Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree

17. Smoking from time to time is OK if one eats healthy.
    Totally disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Totally agree
Different people believe different things about their health. Below is a list of beliefs that someone might have about staying healthy. Please read each sentence carefully and tell us how much you believe OTHERS would agree or disagree with each sentence by choosing one of the following responses: Totally disagree; Somewhat disagree; Neither agree nor disagree; Somewhat agree; or Totally agree. Remember that there are no right or wrong answers, because everybody believes different things.

1. Relaxing on the weekend can make up for stress during the week.
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

2. Using artificial sweeteners compensates for extra calories.
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

3. Exercising can compensate for smoking.
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

4. It is OK to go to bed late if one can sleep longer the next morning (only the number of hours count).
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

5. Not drinking alcohol during the week can make up for the effects of drinking too much alcohol during the weekend.
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

6. Skipping the main dish can make up for eating dessert.
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

7. Relaxing in front of the TV can compensate for a stressful day.
   - Totally disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Totally agree

8. Eating whatever one wants in the evening is OK if one did not eat
much during the day.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  Agree

9. Eating healthy can make up for the effects of regularly drinking alcohol.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  agree

10. Sleeping in on the weekends can compensate for too little sleep during the week.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  agree

11. Exercising can make up for the bad effects of stress.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  agree

12. Starting a new diet tomorrow compensates for breaking a diet today.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  agree

13. The effects of drinking coffee can be balanced by drinking equal amounts of water.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  agree

14. It is OK to skip breakfast if one eats more during lunch or dinner.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  agree

15. Sleep compensates for stress.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  agree

16. It is alright to drink a lot of alcohol as long as one drinks lots of water to flush it.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  Agree

17. Smoking from time to time is OK if one eats healthy.
Totally   Somewhat  Neither agree  Somewhat  Totally
disagree  disagree  nor disagree  agree  agree
Compensatory Health Beliefs Scale - Likelihood

**Instructions:** Different people believe different things about their health. Below is a list of beliefs that someone might have about staying healthy. **Please read each sentence carefully. For each of the following statements, please select the LIKELIHOOD from 0 to 100%, that you would engage in the described activity of behavior, if you were to find yourself in that situation,** by typing the appropriate number into the box below. Remember that there are no right or wrong answers, because everybody believes different things.

1. Relax on the weekend to make up for stress during the week.
2. Use artificial sweeteners to compensate for extra calories.
3. Exercise to compensate for smoking.
4. Go to bed later than usual because you can sleep in the next morning.
5. Avoid drinking alcohol, or drinking a lot of alcohol during the week so you can drink more on the weekends?
6. Skip the main dish to make up for eating dessert.
7. Watch TV to relax and recover from a stressful day.
8. Skip a meal or two so that you can eat more later in the day.
9. Try to eat healthier to make up for the effects of regularly drinking alcohol.
10. Sleep in on the weekends to compensate for too little sleep during the week.
11. Exercise to make up for the bad effects of stress.
12. Start a new diet to make up for poor eating behaviors the previous day.
13. Drink a lot of water to balance out the effects of drinking too much coffee.
14. Compensate for the negative effects of skipping breakfast by eating more for lunch and dinner.
15. Try and get more sleep to compensate for stress.
16. Drink a lot of water to flush out your body when you drink a lot of alcohol.
17. Eat healthy to make up for the negative effects of smoking.
Omission Bias

*Items for the Omission Bias questions were drawn from three different studies. Items are listed under the study from which they were taken.*


**Participants are told the following:** “Each page describes some outcome that is morally controversial. Most of these questions involve choices between two bad outcomes. Please take seriously the possibility that such choices arise. For each item, chose the option which you find more acceptable.

1.) Fail: 10 percent of the population is expected to get a flu that is sometimes fatal. A government official must decide what to do. A vaccine will prevent the flu, but the vaccine itself causes side effects that are just as bad as the flu (with the same chance of death), in 5 percent of those who are vaccinated. A second vaccine has no side effects, but it fails half the time. The result is that 5 percent of those who are vaccinated will get the flu.

   A. The official recommends the first vaccine and makes sure there is enough of it. 5 percent of those vaccinated will get the side effects, and 10 percent of those not vaccinated get the flu.
   B. The official recommends the second vaccine and makes sure there is enough of it. 5 percent of those vaccinated get the flu, and 10 percent of those not vaccinated get the flu.

2.) Trolley: A trolley car in the repair yard is rolling down a hill toward five workers who do not see it or hear it. It will kill them if nothing is done. The director of the yard can switch the trolley to another track with one worker, who would be killed, but the five would be saved.

   A. The director switches the trolley to the other track, and one worker is killed.
   B. The director does nothing, and five workers are killed.

3.) Flu25: 25 percent of the U.S. population is expected to get a flu that is sometimes fatal. A government official must decide what to do. A vaccine will prevent the flu, but the vaccine itself causes side effects that are just as bad as the flu (with the same chance of death), in 5 percent of those who are vaccinated.

   A. The official recommends the vaccine and makes sure there is enough of it. 5 percent of those vaccinated get the side effects, and 25 percent of those not vaccinated.
   B. The official does not recommend the vaccine. 25 percent get the flu.

4.) Flu10: 10 percent of the U.S. population is expected to get a flu that is sometimes fatal. A government official must decide what to do. A vaccine will prevent the flu, but
the vaccine itself causes side effects that are just as bad as the flu (with the same chance of death), in 5 percent of those who are vaccinated.

A. The official recommends the vaccine and makes sure there is enough of it. 5 percent of those vaccinated get the side effects, and 10 percent of those not vaccinated.

B. The official does not recommend the vaccine. 10 percent get the flu.

5.) Push: A trolley car in the repair yard is rolling down a hill toward five workers who do not see it or hear it. It will kill them if nothing is done. The director of the yard can push another worker into the path of the trolley. The worker would be killed, but the five would be saved.

A. The director pushes the worker in front of the trolley. The trolley stops, and this worker is killed.

B. The director does nothing, and five workers are killed.

6.) Guns: A terrorist is holding ten Israeli soldiers and will shoot nine of them, picked by lot, unless an Israeli government official shoots the single other soldier himself at close range.

A. The official shoots the one soldier and nine soldiers are set free.

B. The official does not shoot. The terrorist shoots the nine and the one is set free.

7.) Button: A terrorist is holding ten Israeli soldiers and will shoot nine of them, picked by lot, unless an Israeli government official executes the single other soldier himself but pushing a button in the next room, causing a gun to fire.

A. The official executes the one soldier and nine soldiers are set free.

B. The official does not execute the soldier. The terrorist shoots the nine and the one is set free.

8.) Mall: Jill has been stalked by a crazy man who shows up with a gun in a crowded mall where Jill is shopping and points a gun at her.

A. Jill moves 3 feet to the left so that she is behind another person. The crazy man shoots but hits another person. Jill is unharmed.

B. Jill moves 3 feet to the left, thinking that the crazy man would not change the position of the gun before he shot. Jill knows there is another person behind her. The crazy man does not change the position of the gun so he hits the person who is standing behind Jill. Jill is unharmed.

9.) Plane: A missile has just been mistakenly fired at a large commercial airline from a military base. If nothing is done, 200 passengers will die. A military air traffic controller can change the course of airplanes.

A. The controller alters the course of a smaller commercial airline with 20 passengers so this it is placed in the path of the missile. The large airliner is safe, but the missile destroys the smaller aircraft. The controller knew this would happen.

B. The controller alters the course of the commercial airliner. The airliner is safe, but the missile destroys a smaller commercial airline with 20 passengers flying right behind the large airliner. The controller knew this would happen.

10.) Species: Scientists planted a forest in order to preserve endangered species of trees and other plants. Most of the species in the forest are extinct everywhere else. The forest
is now threatened by an infestation of insects. One of the scientists must decide what to do. If nothing is done, ten species will become extinct.

A. The scientist sprays the forest with a chemical that will destroy the three plant species in which the insects make their nests, thus killing the insects and saving other plants.
B. The scientist sprays the forest with a chemical that will destroy the insects. The same chemical will kill three of the plant species as a side effect.


11.) Baby: Enemy soldiers have taken over your village. They have orders to kill all remaining civilians. You and some of your townspeople have sought refuge in the cellar of a large house. Outside you hear the voices of soldiers who have come to search the house for valuables. Your baby begins to cry loudly. You cover his mouth to block the sound. If you remove your hand from his mouth his crying will summon the attention of the soldiers who will kill you, your child, and the others hiding out in the cellar. To save yourself and the others you must smother your child to death.

Would you smother your child in order to save yourself and the other townspeople?
YES
NO

12.) Doctor: You are a doctor. You have five patients, each of whom is about to die due to a failing organ of some kind. You have another patient who is healthy. The only way that you can save the lives of the first five patients is to transplant five of this young man’s organs (against his will) into the bodies of the other five patients. If you do this, the young man will die, but the other five patients will live.

Is it appropriate for you to perform this transplant in order to save five of your patients?

YES
NO
Health Behaviors Checklist (HBCL)

Please indicate how well the specific health behaviors describe your typical behavior. In each case, you will be asked to indicate how much you agree or disagree with each statement by choosing the corresponding number.

1 = Strongly Disagree  2 = Disagree  3 = Neutral  4 = Agree  5 = Strongly Agree

1. I eat a balanced diet.................................................................1 2 3 4 5
2. I get enough sleep .................................................................1 2 3 4 5
3. I keep emergency numbers near the phone .......................1 2 3 4 5
4. I choose my spare time activities to help me relax ............1 2 3 4 5
5. I take chances when crossing the street ..........................1 2 3 4 5
6. I have a first aid kit in my home ........................................1 2 3 4 5
7. I destroy old or unused medicines ....................................1 2 3 4 5
8. I see a doctor for regular checkups ..................................1 2 3 4 5
9. I pray or live by principles of religion ...............................1 2 3 4 5
10. I avoid getting chilled .........................................................1 2 3 4 5
11. I watch my weight ................................................................1 2 3 4 5
12. I carefully obey traffic rules so I won’t have accidents ..........1 2 3 4 5
13. I watch for possible signs of major health problems (eg, cancer, hypertension, heart disease) ..............1 2 3 4 5
14. I exercise to stay healthy ......................................................1 2 3 4 5
15. I cross the street against the stop light ............................1 2 3 4 5
16. I avoid high crime areas ......................................................1 2 3 4 5
17. I don’t smoke ......................................................................1 2 3 4 5
18. I don’t take chemical substances which might injure my health (e.g., food additives, drugs, stimulants) ...................... 1 2 3 4 5

19. I check the condition of electrical appliances (e.g., the car, etc.) to avoid accidents ............................................. 1 2 3 4 5

20. I stay away from places where I might be exposed to germs ...... 1 2 3 4 5

21. I fix broken things around my home right away ....................... 1 2 3 4 5

22. I see a dentist for regular checkups ........................................ 1 2 3 4 5

23. I limit my intake of foods like coffee, sugar, fats, etc. ............... 1 2 3 4 5

24. I avoid over-the-counter medicines ...................................... 1 2 3 4 5

25. I take vitamins ........................................................................ 1 2 3 4 5

26. I do not drink alcohol ................................................................ 1 2 3 4 5

27. I wear a seat belt when in a car ................................................. 1 2 3 4 5

28. I cross busy streets in the middle of the block ......................... 1 2 3 4 5

29. I avoid areas with high pollution ............................................. 1 2 3 4 5

30. I discuss health with friends, neighbors, and relatives ............. 1 2 3 4 5

31. I gather information on things that affect my health by watching television and reading books, newspapers, or magazine articles ... 1 2 3 4 5

32. I use dental floss regularly ....................................................... 1 2 3 4 5

33. I speed while driving ............................................................... 1 2 3 4 5

34. I brush my teeth regularly ....................................................... 1 2 3 4 5

35. I take health food supplements (e.g., protein additives, wheat germ, bran, lecithin) ........................................ 1 2 3 4 5

36. I learn first aid techniques ....................................................... 1 2 3 4 5

37. I get shots to prevent illness ..................................................... 1 2 3 4 5
38. I take more chances doing things than the average person ..........1  2  3  4  5

39. I drive after drinking ........................................................................1  2  3  4  5

40. I engage in activities or hobbies where accidents are possible (e.g., motorcycle riding, skiing, using power tools, sky or skin diving, hang gliding, etc) ........................................................................1  2  3  4  5
Demographics Questionnaire

1.) What is your height in feet and inches?
2.) What is your weight in pounds?
3.) What is your age?
4.) What is your gender?
5.) What year of school are you (freshman, sophomore, junior, senior, other)?
6.) What is your current employment status (student, employed, not employed, disability, homemaker, retired, other)?
7.) Are you currently dieting?
8.) What is your annual income range?
   a. Below $20,000
   b. $20,000 - $29,999
   c. $30,000 - $39,999
   d. $40,000 - $49,999
   e. $50,000 - $59,999
   f. $60,000 - $69,999
   g. $70,000 - $79,999
   h. $80,000 - $89,999
   i. $90,000 or more
9.) What is your race?
   a. White/Caucasian
   b. African American
   c. Hispanic
   d. Asian
   e. Native American
   f. Pacific Islander
   g. Other
APPENDIX B

18-Item Short Form Need for Cognition Scale

**Instructions:** For each of the statements below, please indicate to what extent the statement is characteristic of you. If the statement is extremely uncharacteristic of you (not at all like you) please choose "1"; if the statement is extremely characteristic of you (very much like you) please choose "5". Of course, a statement may be neither extremely uncharacteristic nor extremely characteristic of you; if so, please use the number in the middle of the scale that describes the best fit. Please keep the following scale in mind as you rate each of the statements below: 1 = extremely uncharacteristic; 2 = somewhat uncharacteristic; 3 = uncertain; 4 = somewhat characteristic; 5 = extremely characteristic.

1. I would prefer complex to simple problems.
2. I like to have the responsibility of handling a situation that requires a lot of thinking.
3. **Thinking is not my idea of fun. a**
4. I would rather do something that requires little thought than something that is sure to challenge my thinking abilities?
5. I try to anticipate and avoid situations where there is a likely chance I will have to think in-depth about something."
6. I find satisfaction in deliberating hard and for long hours.
7. I only think as hard as I have to. a
8. I prefer to think about small, daily projects to long-term ones?
9. I like tasks that require little thought once I've learned them?
10. The idea of relying on thought to make my way to the top appeals to me.
11. I really enjoy a task that involves coming up with new solutions to problems.
12. **Learning new ways to think doesn't excite me very much?**
13. I prefer my life to be filled with puzzles that I must solve.
14. The notion of thinking abstractly is appealing to me.
15. I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.
16. **I feel relief rather than satisfaction after completing a task that required a lot of mental effort.**
17. *It's enough for me that something gets the job done; I don't care how or why it works?*
18. I usually end up deliberating about issues even when they do not affect me personally.

*a Reverse scored.*

Note. From “The Efficient Assessment of Need for Cognition,” by J. T. Cacioppo, R. E. Petty, and C. F. Kao, 1984, *Journal of Personality Assessment, 48*, pp. 306-307. Copyright 1984 by Lawrence Erlbaum. The number of response options on the scales used across studies has typically ranged from five to nine, and the labels for these response options have varied from agreement—disagreement to extremely uncharacteristic—extremely characteristic. Although these variations across studies may influence the total scores obtained, they have not had dramatic effects on the relationships between inter-individual variations in need for cognition and other variables in a given study.
The Self Control Scale developed by Tangney et al. (2004).

The Self Control Scale developed by Tangney et al. (2004). Items included in Rasch analysis are bold. Items with an * represent the short form of the self-control scale. Items with an (R) are reverse coded.

---

**Self-Control Scale**

Using the scale provided, please indicate how much each of the following statements reflects how you typically are on a scale from 1 = Not at all to 5 = Very Much.

1. I am good at resisting temptation *
2. I have a hard time breaking bad habits (R) *
3. I am lazy (R) *
4. I say inappropriate things (R) *
5. I never allow myself to lose control
6. I do certain things that are bad for me, if they are fun (R) *
7. People can count on me to keep on schedule
8. Getting up in the morning is hard for me (R)
9. I have trouble saying no (R)
10. I change my mind fairly often (R)
11. I blurt out whatever is on my mind (R)
12. People would describe me as impulsive (R)
13. I refuse things that are bad for me
14. I spend too much money (R)
15. I keep everything neat
16. I am self-indulgent at times (R)
17. I wish I had more self-discipline (R) *
18. I am reliable
19. I get carried away by my feelings (R)
20. I do many things on the spur of the moment (R)
21. I don't keep secrets very well (R)
22. People would say that I have iron self-discipline *
23. I have worked or studied all night at the last minute (R)
24. I'm not easily discouraged
25. I'd be better off if I stopped to think before acting (R)
26. I engage in healthy practices
27. I eat healthy foods
28. Pleasure and fun sometimes keep me from getting work done (R) *
29. I have trouble concentrating (R) *
30. I am able to work effectively toward long-term goals *
31. Sometimes I can't stop myself from doing something, even if I know it is wrong (R) *
32. I often act without thinking through all the alternatives (R) *
33. I lose my temper too easily (R)
34. I often interrupt people (R)
35. I sometimes drink or use drugs to excess (R)
36. I am always on time.
Domain-Specific Risk-Taking (Adult) Scale – Risk Taking


For each of the following statements, please indicate the likelihood that you would engage in the described activity or behavior if you were to find yourself in that situation. Provide a rating from Extremely Unlikely to Extremely Likely, using the following scale:

1. Admitting that your tastes are different from those of a friend. (S)
2. Going camping in the wilderness. (R)
3. Betting a day’s income at the horse races. (F/G)
4. Investing 10% of your annual income in a moderate growth mutual fund. (F/I)
5. Drinking heavily at a social function. (H/S)
6. Taking some questionable deductions on your income tax return. (E)
7. Disagreeing with an authority figure on a major issue. (S)
8. Betting a day’s income at a high-stake poker game. (F/G)
9. Having an affair with a married man/woman. (E)
10. Passing off somebody else’s work as your own. (E)
11. Going down a ski run that is beyond your ability. (R)
12. Investing 5% of your annual income in a very speculative stock. (F/I)
13. Going whitewater rafting at high water in the spring. (R)
14. Betting a day’s income on the outcome of a sporting event (F/G)
15. Engaging in unprotected sex. (H/S)
16. Revealing a friend’s secret to someone else. (E)
17. Driving a car without wearing a seat belt. (H/S)
18. Investing 10% of your annual income in a new business venture. (F/I)
19. Taking a skydiving class. (R)
20. Riding a motorcycle without a helmet. (H/S)
21. Choosing a career that you truly enjoy over a more secure one. (S)
22. Speaking your mind about an unpopular issue in a meeting at work. (S)
23. Sunbathing without sunscreen. (H/S)
24. Bungee jumping off a tall bridge. (R)
25. Piloting a small plane. (R)
26. Walking home alone at night in an unsafe area of town. (H/S)
27. Moving to a city far away from your extended family. (S)
28. Starting a new career in your mid-thirties. (S)
29. Leaving your young children alone at home while running an errand. (E)
30. Not returning a wallet you found that contains $200. (E)

Note. E = Ethical, F = Financial, H/S = Health/Safety, R = Recreational, and S = Social.
Domain-Specific Risk-Taking (Adult) Scale – Risk Perceptions

People often see some risk in situations that contain uncertainty about what the outcome or consequences will be and for which there is the possibility of negative consequences. However, riskiness is a very personal and intuitive notion, and we are interested in your gut level assessment of how risky each situation or behavior is.

For each of the following statements, please indicate how risky you perceive each situation. Provide a rating from Not at all Risky to Extremely Risky, using the following scale:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all Risky</td>
<td>Slightly Risky</td>
<td>Somewhat Risky</td>
<td>Moderately Risky</td>
<td>Risky</td>
<td>Very Risky</td>
<td>Extremely Risky</td>
</tr>
</tbody>
</table>

166
The Adult Decision-Making Competence (A-DMC)


**Note to researchers:**

The Adult Decision-Making Competence (A-DMC) consists of six validated components, each of which may be used individually or as part of the overall measure. Please refer to the code at the top right of each page to identify each of the components.

They include

- Resistance to Framing (consisting of positive framing items in RC1 and A1, and corresponding negative items in RC2 and A2)
- Recognizing Social Norms (SN1 and SN2)
- Under/Overconfidence (CAL)
- Applying Decision Rules (DR)
- Consistency in Risk Perception (RP)
- Resistance to Sunk Costs (SC)

For more information about the measures and how they are scored, please check the paper below or contact Wändi Bruine de Bruin at wandi@cmu.edu.

**Reference**

Instructions:
Each of the following problems presents a choice between two options. Each problem is presented with a scale ranging from 1 (representing one option) through 6 (representing the other option). For each item, please circle the number on the scale that best reflects your relative preference between the two options.

Problem 1
Imagine that recent evidence has shown that a pesticide is threatening the lives of 1,200 endangered animals. Two response options have been suggested:

If Option A is used, 600 animals will be saved for sure.

If Option B is used, there is a 75% chance that 800 animals will be saved, and a 25% chance that no animals will be saved.

Which option do you recommend to use?

1  2  3  4  5  6
Definitely would choose A
Definitely would choose B

Problem 2
Because of changes in tax laws, you may get back as much as $1200 in income tax. Your accountant has been exploring alternative ways to take advantage of this situation. He has developed two plans:

If Plan A is adopted, you will get back $400 of the possible $1200.

If Plan B is adopted, you have a 33% chance of getting back all $1200, and a 67% chance of getting back no money.

Which plan would you use?

1  2  3  4  5  6
Definitely would choose A
Definitely would choose B
Problem 3
Imagine that in one particular state it is projected that 1000 students will drop out of school during the next year. Two programs have been proposed to address this problem, but only one can be implemented. Based on other states’ experiences with the programs, estimates of the outcomes that can be expected from each program can be made. Assume for purposes of this decision that these estimates of the outcomes are accurate and are as follows:

If Program A is adopted, 400 of the 1000 students will stay in school.

If Program B is adopted, there is a 40% chance that all 1000 students will stay in school and 60% chance that none of the 1000 students will stay in school.

Which program would you favor for implementation?

1 2 3 4 5 6
Definitely would
choose A

Definitely would
choose B

Problem 4
Imagine that the U.S. is preparing for the outbreak of an unusual disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

If Program A is adopted, 200 people will be saved.

If Program B is adopted, there is a 33% chance that 600 people will be saved, and a 67% chance that no people will be saved.

Which program do you recommend to use?

1 2 3 4 5 6
Definitely would
choose A

Definitely would
choose B
Problem 5
Imagine that your doctor tells you that you have a cancer that must be treated. Your choices are as follows:

Surgery: Of 100 people having surgery, 90 live through the operation, and 34 are alive at the end of five years.

Radiation therapy: Of 100 people having radiation therapy, all live through the treatment, and 22 are alive at the end of five years.

Which treatment would you choose?

1 2 3 4 5 6
Definitely would choose surgery

Definitely would choose radiation

Problem 6
Imagine that your client has $6,000 invested in the stock market. A downturn in the economy is occurring. You have two investment strategies that you can recommend under the existing circumstances to preserve your client’s capital.

If strategy A is followed, $2,000 of your client’s investment will be saved.

If strategy B is followed, there is a 33% chance that the entire $6,000 will be saved, and a 67% chance that none of the principal will be saved.

Which of these two strategies would you favor?

1 2 3 4 5 6
Definitely would choose A

Definitely would choose B

Problem 7
Imagine a hospital is treating 32 injured soldiers, who are all expected to lose one leg. There are two doctors that can help the soldiers, but only one can be hired:

If Doctor A is hired, 20 soldiers will keep both legs.

If Doctor B is hired, there is a 63% chance that all soldiers keep both legs and a 37% chance that nobody will save both legs.

Which doctor do you recommend?

1 2 3 4 5 6
Definitely would choose A

Definitely would choose B
Instructions:
Each of the following problems ask you to rate your judgment of a product or a situation. Each problem is presented with a scale ranging from 1 (representing the worst rating) through 6 (representing the best rating). For each problem, please circle the number on the scale that best reflects your judgment.

Problem 1
Imagine that a type of condom has a 95% success rate. That is, if you have sex with someone who has the AIDS virus, there is a 95% chance that this type of condom will prevent you from being exposed to the AIDS virus.

Should the government allow this type of condom to be advertised as "an effective method for lowering the risk of AIDS?"

1 2 3 4 5 6
Definitely no Definitely yes

Problem 2
Imagine the following situation. You are entertaining a special friend by inviting them for dinner. You are making your favorite lasagna dish with ground beef. Your roommate goes to the grocery store and purchases a package of ground beef for you. The label says 80% lean ground beef.

What’s your evaluation of the quality of this ground beef?

1 2 3 4 5 6
Very low Very high

Problem 3
In a recent confidential survey completed by graduating seniors, 35% of those completing the survey stated that they had never cheated during their college career.

Considering the results of the survey, how would you rate the incidence of cheating at your university?

1 2 3 4 5 6
Very low Very high
Problem 4
As R&D manager, one of your project teams has come to you requesting an additional $100,000 in funds for a project you instituted several months ago. The project is already behind schedule and over budget, but the team still believes it can be successfully completed. You currently have $500,000 remaining in your budget unallocated, but which must carry you for the rest of the fiscal year. Lowering the balance by an additional $100,000 might jeopardize flexibility to respond to other opportunities.

Evaluating the situation, you believe there is a fair chance the project will not succeed, in which case the additional funding would be lost; if successful, however, the money would be well spent. You also noticed that of the projects undertaken by this team, 30 of the last 50 have been successful.

What is the likelihood you would fund the request?

1 2 3 4 5 6
Very unlikely Very likely

Problem 5
Suppose a student got 90% correct in the mid-term exam and 70% correct in the final-term exam, what would be your evaluations of this student’s performance?

1 2 3 4 5 6
Very poor Very good

Problem 6
Imagine that a woman parked illegally. After talking to her, you believe that there is a 20% chance that she did not know she parked illegally.

With this in mind, how much of a fine do you believe this woman deserves?

1 2 3 4 5 6
Minimum fine Maximum fine

Problem 7
Imagine that a new technique has been developed to treat a particular kind of cancer. This technique has a 50% chance of success, and is available at the local hospital.

A member of your immediate family is a patient at the local hospital with this kind of cancer. Would you encourage him or her to undergo treatment using this technique?

1 2 3 4 5 6
Definitely no Definitely yes
Instructions:
The following problems ask whether it is sometimes OK to do different things. For each question, please indicate whether in your opinion the answer is yes or no.

1. Do you think it is sometimes OK …
   … to steal under certain circumstances?
   
   Yes  No

2. Do you think it is sometimes OK …
   … to smoke cigarettes?
   
   Yes  No

3. Do you think it is sometimes OK …
   … to commit a crime which could put you in jail?
   
   Yes  No

4. Do you think it is sometimes OK …
   … to keep things you find in the street?
   
   Yes  No

5. Do you think it is sometimes OK …
   … to experiment with marijuana?
   
   Yes  No

6. Do you think it is sometimes OK …
   … to use your fists to resolve a conflict?
   
   Yes  No

7. Do you think it is sometimes OK …
   … to drink and drive?
   
   Yes  No

8. Do you think it is sometimes OK …
   … to yell and argue to solve a conflict?
   
   Yes  No
9. Do you think it is sometimes OK …
   … not to hold the door open for people?
   Yes       No

10. Do you think it is sometimes OK …
    … not to tell the police when you witness a crime?
    Yes       No

11. Do you think it is sometimes OK …
    … not to give directions to someone who is lost?
    Yes       No

12. Do you think it is sometimes OK …
    … not to be on time for appointments?
    Yes       No

13. Do you think it is sometimes OK …
    … not to return something you borrowed?
    Yes       No

14. Do you think it is sometimes OK …
    … not to keep secrets that a friend told you?
    Yes       No

15. Do you think it is sometimes OK …
    … not to return phone calls right away?
    Yes       No

16. Do you think it is sometimes OK …
    … not to spend time with friends in need?
    Yes       No
Instructions:
This survey presents true/false questions about various aspects of everyday life. Please indicate, for each statement, whether you believe it to be true or false, by circling the “true” or “false”. You may think that some items do not have a clear-cut answer. For those items, please try to give the answer that would be true in general, or in most cases.

Please read through the following examples to find out more about this survey.

Example 1:

Pittsburgh's hockey team is the Bruins.

We want you to do two things:

First, answer the question. In this example, you might think “No, it's the Penguins. So the statement is FALSE.” Then you would circle ‘False’.

Pittsburgh's hockey team is the Bruins.
This statement is [ True/False].

Second, think about how sure you are of your answer. Give a number from 50% to 100%. In other words, what is the percent chance that you are right? Circle one of the numbers on the scale.

<table>
<thead>
<tr>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>just guessing</td>
<td>absolutely sure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If your answer is a total guess, circle 50%. This means that there is a 50% chance that you are right, and a 50% chance that you are wrong. If you are absolutely sure, circle 100%. If you aren’t sure, then circle a number in between, to show how sure you are.

In this example, you might think “I'm absolutely sure it's false, so 100%.” So you would circle 100%.

Pittsburgh's hockey team is the Bruins.
This statement is [ True/False].

<table>
<thead>
<tr>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>just guessing</td>
<td>absolutely sure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Please read the examples below. They show answers given by other people. Read them closely, and make sure you understand their answers.

Example 2:
**Thanksgiving Day is on the fourth Thursday of November.**
- **Yes, I think that’s when Thanksgiving is. I would say TRUE.**
- **I’m pretty sure, but it might be on the third Thursday of November, so 80%.**

Your answer would look like this:
**Thanksgiving Day is on the fourth Thursday of November.**
This statement is [True/False].

just guessing
50%  60%  70% 80%  90%  100%
absolutely sure

Example 3:
**Amman is the capital of Jordan.**
- **I really don’t know, so I’ll just take a guess. I’ll say, uh, TRUE.**
- **I’m guessing, so 50%.**

Your answer would look like this: **Amman is the capital of Jordan.** This statement is [True/False].

just guessing
50%  60%  70% 80%  90%  100%
absolutely sure

Example 4:
**The Hudson River doesn’t run past New York City.**
- **Oh yes it does! I think it’s one of the rivers. So that’s FALSE.**
- **I’m almost positive that’s false, so I’ll say 90%.**

Your answer would look like this:
**The Hudson River doesn’t run past New York City.**
This statement is [True/False].

just guessing
50%  60%  70% 80%  90%  100%
absolutely sure
For each of the following statements, circle true or false to indicate your answer. Then circle a number on the scale to indicate how sure you are of your answer. The scale ranges from 50% (meaning that you were just guessing) to 100% (meaning that you were absolutely sure).

1. Many smokers use the nicotine in cigarettes to treat depression.
   This statement is [True / False ].
   
   50% 60% 70% 80% 90% 100%  
   just guessing  absolutely sure

2. Stress makes it easier to form bad habits.
   This statement is [True / False ].
   
   50% 60% 70% 80% 90% 100%  
   just guessing  absolutely sure

3. You can take wrinkles out of your clothes by putting them in the dryer with a damp towel.
   This statement is [True / False ].
   
   50% 60% 70% 80% 90% 100%  
   just guessing  absolutely sure

4. After a fight with your partner, you should not focus on who was to blame.
   This statement is [True / False ].
   
   50% 60% 70% 80% 90% 100%  
   just guessing  absolutely sure

5. There is no way to improve your memory.
   This statement is [True / False ].
   
   50% 60% 70% 80% 90% 100%  
   just guessing  absolutely sure

6. The grace period on your credit card is the amount of time you do not have to pay interest on outstanding payments.
   This statement is [True / False ].
   
   50% 60% 70% 80% 90% 100%  
   just guessing  absolutely sure
Example 5:
Bill Clinton doesn’t have a beard.
• That’s right, he doesn’t. TRUE
• I think that’s right, but I’m not sure, he might have grown one. I’ll say 70%.

Your answer would look like this:
Bill Clinton doesn’t have a beard.
This statement is [True / False].

<table>
<thead>
<tr>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>just guessing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>absolutely sure</td>
</tr>
</tbody>
</table>

If you have any questions, please ask now.
For each of the following statements, circle true or false to indicate your answer. Then circle a number on the scale to indicate how sure you are of your answer. The scale ranges from 50% (meaning that you were just guessing) to 100% (meaning that you were absolutely sure).

1. Many smokers use the nicotine in cigarettes to treat depression.
   This statement is [True / False ].
   
   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

2. Stress makes it easier to form bad habits.
   This statement is [True / False ].
   
   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

3. You can take wrinkles out of your clothes by putting them in the dryer with a damp towel.
   This statement is [True / False ].
   
   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

4. After a fight with your partner, you should not focus on who was to blame.
   This statement is [True / False ].
   
   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

5. There is no way to improve your memory.
   This statement is [True / False ].
   
   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

6. The grace period on your credit card is the amount of time you do not have to pay interest on outstanding payments.
   This statement is [True / False ].
   
   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure
7. Red wine stains are easier to remove than beer stains.
   This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing
   absolutely sure

8. Muscles do not burn calories when you are at rest.
   This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing
   absolutely sure

9. Alcohol causes dehydration.
   This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing
   absolutely sure

10. Problems with in-laws contribute to more than 30% of divorces.
    This statement is [True / False ].

    50%  60%  70%  80%  90%  100%
    just guessing
    absolutely sure

11. Homosexual couples are not legally allowed to adopt.
    This statement is [True / False ].

    50%  60%  70%  80%  90%  100%
    just guessing
    absolutely sure

12. A promotion means that you will get a more satisfying job.
    This statement is [True / False ].

    50%  60%  70%  80%  90%  100%
    just guessing
    absolutely sure

13. IRS forms are available on-line.
    This statement is [True / False ].

    50%  60%  70%  80%  90%  100%
    just guessing
    absolutely sure
14. **Procrastination is worse when you work in a cluttered environment.**
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

15. **A venture capital fund invests in new businesses by providing startup capital.**
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

16. **It is wise to handle all negotiations yourself, even if your opponent uses a lawyer.**
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

17. **Carbohydrates are fattening no matter how much you eat of them.**
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

18. **Young people face few stereotypes when looking for a job.**
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

19. **It can be instructive for children to see their parents resolve a fight.**
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

20. **There are nonprofit organizations that help people with debt counseling.**
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure
21. **Assertive behavior makes your brain experience an increase in pleasure.**
This statement is [True / False ].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

22. **Credit card companies can offer lower payments if you can come up with a lump sum settlement.**
This statement is [True / False ].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

23. **Contracting a sexually transmitted disease is not an automatic sign that your partner has had an affair.**
This statement is [True / False ].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

24. **Some sexually transmitted diseases can cause infertility.**
This statement is [True / False ].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

25. **Self-employed people pay the same amount of taxes as people who work for an employer.**
This statement is [True / False ].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

26. **When buying a new home, there is little need to have it inspected before you buy it.**
This statement is [True / False ].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

27. **Creating a routine is an important step in getting unpleasant work done.**
This statement is [True / False ].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure
28. Once you have experienced an event, your memory of it can not be changed.  
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

29. Meditation slows the heart rate.  
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

30. If you get into an auto accident, let the other person take the lead in handling the details.  
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

31. There is no way you can negotiate a lower rate with a credit card company.  
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

32. Obesity increases your risk of type 2 diabetes.  
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

33. Talking about sex helps romantic relationships.  
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure

34. Hard evidence is lacking that acupuncture helps you to quit smoking.  
This statement is [True / False ].

   50%  60%  70%  80%  90%  100%
   just guessing  absolutely sure
Instructions:
Please read the practice problems on this page carefully before going on to the problems on the next page.

Imagine Chris is going to buy a DVD player with the $369 he received for his birthday. He wants to find out how the DVD players that are available for that price compare to each other. A magazine rated DVD players on each of five features as follows, where higher is better:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Very Low</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

For example, two DVD players and their ratings are listed in the table below:

<table>
<thead>
<tr>
<th>DVD</th>
<th>Picture Quality</th>
<th>Sound Quality</th>
<th>Programming Options</th>
<th>Reliability of Brand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>$369</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>$369</td>
</tr>
</tbody>
</table>

The following examples use the table above. Please read each carefully.

Example 1. Chris selects the DVD player with the highest rating in Programming Options. Which one of the presented DVD player would Chris prefer? _________ A _________

Example 2. Chris only wants a DVD player with a sound quality that is rated higher than 4. Which one of the presented DVD player would Chris prefer? _______ none _______

Example 3. Chris only wants the best in Picture Quality. Which two of the presented DVD players would Chris prefer? _______ A _____, and _______ B _____
The following questions are about other people choosing between DVD players, like the ones above. **Please read each question carefully, because they ask for different answers.** For each question, think about how each person makes their choice, then pick the DVD they choose. But be careful, because the DVD players will change from question to question.

<table>
<thead>
<tr>
<th>Very Low</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**Question 1:**

<table>
<thead>
<tr>
<th>Features</th>
<th>DVD</th>
<th>Picture Quality</th>
<th>Sound Quality</th>
<th>Programming Options</th>
<th>Reliability of Brand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>$369</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>$369</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>$369</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>$369</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>$369</td>
</tr>
</tbody>
</table>

Brian selects the DVD player with the highest number of ratings greater than “Medium”

Which **one** of the presented DVD players would Brian prefer? ________________

**Question 2:**

<table>
<thead>
<tr>
<th>Features</th>
<th>DVD</th>
<th>Picture Quality</th>
<th>Sound Quality</th>
<th>Programming Options</th>
<th>Reliability of Brand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>$369</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>$369</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>$369</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>$369</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>$369</td>
</tr>
</tbody>
</table>

Sally first selects the DVD players with the best Sound Quality. From the selected DVD players, she then selects the best on Picture Quality. Then, if there is still more than one left to choose from, she selects the one best on Programming Options.

Which **one** of the presented DVD players would Sally prefer?
### Question 3:

<table>
<thead>
<tr>
<th></th>
<th>Picture Quality</th>
<th>Sound Quality</th>
<th>Programming Options</th>
<th>Reliability of Brand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>$369</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>$369</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>$369</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>$369</td>
</tr>
<tr>
<td>E</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>$369</td>
</tr>
</tbody>
</table>

Pat doesn’t want to read through the entire table. He decides to read the table row by row until he finds the very first DVD player that has no ratings below “Medium.” He will just choose that DVD player.

Which one of the presented DVD players would Pat prefer? ____________

### Question 4:

<table>
<thead>
<tr>
<th></th>
<th>Picture Quality</th>
<th>Sound Quality</th>
<th>Programming Options</th>
<th>Reliability of Brand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>$369</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>$369</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>$369</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>$369</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>$369</td>
</tr>
</tbody>
</table>

LaToya only wants a DVD player that got a “Very High” rating on Reliability of Brand. Which one of the presented DVD players would LaToya prefer? ____________
Question 5:

<table>
<thead>
<tr>
<th>DVD</th>
<th>Picture Quality</th>
<th>Sound Quality</th>
<th>Programming Options</th>
<th>Reliability of Brand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>$369</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>$369</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>$369</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>$369</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>$369</td>
</tr>
</tbody>
</table>

From the DVD players with the best available Picture Quality, Tricia selects the DVD players with the lowest number of ratings below “Medium.” If there is more than one DVD player left to choose from, she then picks the one that has the best rating on “Reliability of Brand.”

Which one of the presented DVD players would Tricia prefer? ________________

Question 6:

<table>
<thead>
<tr>
<th>DVD</th>
<th>Picture Quality</th>
<th>Sound Quality</th>
<th>Programming Options</th>
<th>Reliability of Brand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>$369</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>$369</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>$369</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>$369</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>$369</td>
</tr>
</tbody>
</table>

Lisa wants the DVD player with the highest average rating across features.

Which one of the presented DVD players would Lisa prefer? ________________
Question 7:

<table>
<thead>
<tr>
<th>Features</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture Quality</td>
<td></td>
</tr>
<tr>
<td>Sound Quality</td>
<td></td>
</tr>
<tr>
<td>Programming Options</td>
<td></td>
</tr>
<tr>
<td>Reliability of Brand</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DVD</th>
<th>Picture Quality</th>
<th>Sound Quality</th>
<th>Programming Options</th>
<th>Reliability of Brand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>$369</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>$369</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>$369</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>$369</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>$369</td>
</tr>
</tbody>
</table>

Andy wants the DVD player with the highest average rating he can get while still making sure to keep the best rating on Sound Quality.

Which **one** of the presented DVD players would Andy prefer? __________

Question 8:

<table>
<thead>
<tr>
<th>Features</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture Quality</td>
<td></td>
</tr>
<tr>
<td>Sound Quality</td>
<td></td>
</tr>
<tr>
<td>Programming Options</td>
<td></td>
</tr>
<tr>
<td>Reliability of Brand</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DVD</th>
<th>Picture Quality</th>
<th>Sound Quality</th>
<th>Programming Options</th>
<th>Reliability of Brand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>$369</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>$369</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>$369</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>$369</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>$369</td>
</tr>
</tbody>
</table>

Shane wants no DVD players that score below “Medium” on Picture Quality, no DVD players that score below “Medium” on Sound Quality, and no DVD players that score “Very Low” on any other feature.

Which **two** of the presented DVD players would Shane prefer? __________ and
Question 9:

Tyrone wants a DVD player that either has a “Very High” rating for Programming Options, or one that scores at least “Medium” on every feature.

Which three of the presented DVD players would Tyrone prefer? ______, ______, and ______.

Question 10:

Julie wants the best Reliability of Brand, but is willing to give up one point on Reliability of Brand for each increase of at least two points in the rating of Picture Quality. She isn’t concerned about the other features.

Which three of the presented DVD players would Julie prefer? ______, ______, and ______.
Instructions:
Each of these questions asks for your best guess at the chance that something will happen in the future. They use the “probability” scale that you see below. To answer each question, please put a mark on the scale at one specific tick mark, as follows:

If you think that something has no chance of happening, mark it as having a 0% chance. If you think that something is certain to happen, mark it as having a 100% chance.

Just to make sure that you are comfortable with the scale, please answer the following practice questions.

What is the probability that you will eat pizza during the next year?

What is the probability that you will get the flu during the next year?

That is the end of the practice. If you have any questions, please
A. The following questions ask about events that may happen some time during the next year.

1. What is the probability that you will get into a car accident while driving during the next year?

2. What is the probability that you will have a cavity filled during the next year?

3. What is the probability that you will die (from any cause -- crime, illness, accident, and so on) during the next year?

4. What is the probability that someone will steal something from you during the next year?

5. What is the probability that you will move your permanent address to another state some time during the next year?
6. What is the probability that you will die in a terrorist attack during the next year?

7. What is the probability that someone will break into your home and steal something from you during the next year?

8. What is the probability that you will keep your permanent address in the same state during the next year?

9. What is the probability that you will visit a dentist, for any reason, during the next year?

10. What is the probability that your driving will be accident-free during the next year?
B. The following questions ask about events that may happen some time during the next 5 years.

1. What is the probability that you will get into a car accident while driving during the next 5 years?

2. What is the probability that you will have a cavity filled during the next 5 years?

3. What is the probability that you will die (from any cause -- crime, illness, accident, and so on) during the next 5 years?

4. What is the probability that someone will steal something from you during the next 5 years?

5. What is the probability that you will move your permanent address to another state some time during the next 5 years?
6. What is the probability that you will die in a terrorist attack during the next 5 years?

7. What is the probability that someone will break into your home and steal something from you during the next 5 years?

8. What is the probability that you will keep your permanent address in the same state during the next 5 years?

9. What is the probability that you will visit a dentist, for any reason, during the next 5 years?

10. What is the probability that your driving will be accident-free during the next 5 years?
Instructions:
Each of the following problems presents a choice between two options. Each problem is presented with a scale ranging from 1 (representing one option) through 6 (representing the other option). For each item, please circle the number on the scale that best reflects your relative preference between the two options.

Problem 1
You are buying a gold ring on layaway for someone special. It costs $200 and you have already paid $100 on it, so you owe another $100. One day, you see in the paper that a new jewelry store is selling the same ring for only $90 as a special sale, and you can pay for it using layaway. The new store is across the street from the old one. If you decide to get the ring from the new store, you will not be able to get your money back from the old store, but you would save $10 overall.

Would you be more likely to continue paying at the old store or buy from the new store?

1 2 3 4 5 6
Most likely to continue paying at the old store

Most likely to buy from the new store

Problem 2
You enjoy playing tennis, but you really love bowling. You just became a member of a tennis club, and of a bowling club, both at the same time. The membership to your tennis club costs $200 per year and the membership to your bowling club $50 per year. During the first week of both memberships, you develop an elbow injury. It is painful to play either tennis or bowling. Your doctor tells you that the pain will continue for about a year.

Would you be more likely to play tennis or bowling in the next six months?

1 2 3 4 5 6
Most likely to play tennis

Most likely to play bowling

Problem 3
You have been looking forward to this year’s Halloween party. You have the right cape, the right wig, and the right hat. All week, you have been trying to perfect the outfit by cutting out a large number of tiny stars to glue to the cape and the hat, and you still need to glue them on. On the day of Halloween, you decide that the outfit looks better without all these stars you have worked so hard on.

Would you be more likely to wear the stars or go without?

1 2 3 4 5 6
Most likely to wear stars

Most likely to not wear stars
Problem 4
After a large meal at a restaurant, you order a big dessert with chocolate and ice cream. After a few bites you find you are full and you would rather not eat any more of it.

Would you be more likely to eat more or to stop eating it?

1 2 3 4 5 6
Most likely to eat more
Most likely to stop eating

Problem 5
You are in a hotel room for one night and you have paid $6.95 to watch a movie on pay TV. Then you discover that there is a movie you would much rather like to see on one of the free cable TV channels. You only have time to watch one of the two movies.

Would you be more likely to watch the movie on pay TV or on the free cable channel?

1 2 3 4 5 6
Most likely to watch pay TV
Most likely to watch free cable

Problem 6
You have been asked to give a toast at your friend’s wedding. You have worked for hours on this one story about you and your friend taking drivers’ education, but you still have some work to do on it. Then you realize that you could finish writing the speech faster if you start over and tell the funnier story about the dance lessons you took together.

Would you be more likely to finish the toast about driving or rewrite it to be about dancing?

1 2 3 4 5 6
Most likely to write about driving
Most likely to write about dancing

Problem 7
You decide to learn to play a musical instrument. After you buy an expensive cello, you find you are no longer interested. Your neighbor is moving and you are excited that she is leaving you her old guitar, for free. You’d like to learn how to play it.

Would you be more likely to practice the cello or the guitar?

1 2 3 4 5 6
Most likely to play cello
Most likely to play guitar
**Problem 8**

You and your friend are at a movie theater together. Both you and your friend are getting bored with the storyline. You’d hate to waste the money spent on the ticket, but you both feel that you would have a better time at the coffee shop next door. You could sneak out without other people noticing.

Would you be more likely to stay or to leave?

1 2 3 4 5 6

Most likely to stay

Most likely to leave

---

**Problem 9**

You and your friend have driven halfway to a resort. Both you and your friend feel sick. You both feel that you both would have a much better weekend at home. Your friend says it is "too bad" you already drove halfway, because you both would much rather spend the time at home. You agree.

Would you be more likely to drive on or turn back?

1 2 3 4 5 6

Most likely to drive on

Most likely to turn back

---

**Problem 10**

You are painting your bedroom with a sponge pattern in your favorite color. It takes a long time to do. After you finish two of the four walls, you realize you would have preferred the solid color instead of the sponge pattern. You have enough paint left over to redo the entire room in the solid color. It would take you the same amount of time as finishing the sponge pattern on the two walls you have left.

Would you be more likely to finish the sponge pattern or to redo the room in the solid color?

1 2 3 4 5 6

Most likely to finish sponge pattern

Most likely to redo with a solid color
Instructions:
Each of the following problems presents a choice between two options. Each problem is presented with a scale ranging from 1 (representing one option) through 6 (representing the other option). For each item, please circle the number on the scale that best reflects your relative preference between the two options.

Problem 1
Imagine a hospital is treating 32 injured soldiers, who are all expected to lose one leg. There are two doctors that can help the soldiers, but only one can be hired:

If Doctor A is hired, 12 soldiers will lose one leg.

If Doctor B is hired, there is a 63% chance that nobody loses a leg and a 37% chance that all lose a leg.

Which doctor do you recommend?

1 Definitely would choose A

2 3 4 5 6 Definitely would choose B

Problem 2
Imagine that the U.S. is preparing for the outbreak of an unusual disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

If Program A is adopted, 400 people will die.

If Program B is adopted, there is a 33% chance that nobody will die, and a 67% chance that 600 people will die.

Which program do you recommend to use?

1 Definitely would choose A

2 3 4 5 6 Definitely would choose B
Problem 3
Imagine that your client has $6,000 invested in the stock market. A downturn in the economy is occurring. You have two investment strategies that you can recommend under the existing circumstances to preserve your client’s capital.

If strategy A is followed, $4,000 of your client’s investment will be lost.

If strategy B is followed, there is a 33% chance that the nothing will be lost, and a 67% chance that $6,000 will be lost.

Which of these two strategies would you favor?

1 2  3  4  5  6
Definitely would
choose A

Problem 4
Because of changes in tax laws, you may get back as much as $1200 in income tax. Your accountant has been exploring alternative ways to take advantage of this situation. He has developed two plans:

If Plan A is adopted, you will lose $800 of the possible $1200.

If Plan B is adopted, you have a 33% chance of losing none of the money, and a 67% chance of losing all $1200.

Which plan would you use?

1 2  3  4  5  6
Definitely would
choose A

Problem 5
Imagine that recent evidence has shown that a pesticide is threatening the lives of 1,200 endangered animals. Two response options have been suggested:

If Option A is used, 600 animals will be lost for sure.

If Option B is used, there is a 75% chance that 400 animals will be lost, and a 25% chance that 1,200 animals will be lost.

Which option do you recommend to use?

1 2  3  4  5  6
Definitely would
choose A
**Problem 6**

Imagine that your doctor tells you that you have a cancer that must be treated. Your choices are as follows:

**Surgery:** Of 100 people having surgery, 10 die because of the operation, and 66 die by the end of five years.

**Radiation therapy:** Of 100 people having radiation therapy, none die during the treatment, and 78 die by the end of five years.

Which treatment would you choose?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Definitely would choose surgery

Definitely would choose radiation

**Problem 7**

Imagine that in one particular state it is projected that 1000 students will drop out of school during the next year. Two programs have been proposed to address this problem, but only one can be implemented. Based on other states’ experiences with the programs, estimates of the outcomes that can be expected from each program can be made. Assume for purposes of this decision that these estimates of the outcomes are accurate and are as follows:

If Program A is adopted, 600 of the 1000 students will drop out of school.

If Program B is adopted, there is a 40% chance that none of the 1000 students will drop out of school and 60% chance that all 1000 students will drop out of school.

Which program would you favor for implementation?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Definitely would choose A

Definitely would choose B
Instructions:
Each of the following problems ask you to rate your judgment of a product or a situation. Each problem is presented with a scale ranging from 1 (representing the worst rating) through 6 (representing the best rating). For each problem, please circle the number on the scale that best reflects your judgment.

Problem 1
As R&D manager, one of your project teams has come to you requesting an additional $100,000 in funds for a project you instituted several months ago. The project is already behind schedule and over budget, but the team still believes it can be successfully completed. You currently have $500,000 remaining in your budget unallocated, but which must carry you for the rest of the fiscal year. Lowering the balance by an additional $100,000 might jeopardize flexibility to respond to other opportunities.

Evaluating the situation, you believe there is a fair chance the project will not succeed, in which case the additional funding would be lost; if successful, however, the money would be well spent. You also noticed that of the projects undertaken by this team, 20 of the last 50 have been unsuccessful.

What is the likelihood you would fund the request?

1 2 3 4 5 6
Very unlikely  Very likely

Problem 2
Imagine that a woman parked illegally. After talking to her, you believe that there is an 80% chance that she knew she parked illegally.

With this in mind, how much of a fine do you believe this woman deserves?

1 2 3 4 5 6
Minimum fine  Maximum fine

Problem 3
In a recent confidential survey completed by graduating seniors, 65% of those completing the survey stated that they had cheated during their college career.

Considering the results of the survey, how would you rate the incidence of cheating at your university?

1 2 3 4 5 6
Very low  Very high
Problem 4
Imagine that a new technique has been developed to treat a particular kind of cancer. This technique has a 50% chance of failure, and is available at the local hospital.

A member of your immediate family is a patient at the local hospital with this kind of cancer. How likely are you to encourage him or her to undergo treatment using this technique?

1 2 3 4 5 6
Definitely no Definitely yes

Problem 5
Imagine the following situation. You are entertaining a special friend by inviting them for dinner. You are making your favorite lasagna dish with ground beef. Your roommate goes to the grocery store and purchases a package of ground beef for you. The label says 20% fat ground beef.

What’s your evaluation of the quality of this ground beef?

1 2 3 4 5 6
Very low Very high

Problem 6
Imagine that a type of condom has a 5% failure rate. That is, if you have sex with someone who has the AIDS virus, there is a 5% chance that this type of condom will fail to prevent you from being exposed to the AIDS virus.

Should the government allow this type of condom to be advertised as "an effective method for lowering the risk of AIDS?"

1 2 3 4 5 6
Definitely no Definitely yes

Problem 7
Suppose a student got 10% incorrect in the mid-term exam and 30% incorrect in the final-term exam, what would be your evaluations of this student’s performance?

1 2 3 4 5 6
Very poor Very good
Instructions:
The following problems ask out of 100 people your age, how many would say that it is sometimes OK to do different things. For each question, please circle a number between 0 (meaning no one thinks that it is sometimes OK) and 100 (meaning everyone thinks that it is sometimes OK).

1. Out of 100 people your age, how many would say it is sometimes OK …
   … to steal under certain circumstances?

   0  10  20  30  40  50  60  70  80  90  100
   No one  Everyone

2. Out of 100 people your age, how many would say it is sometimes OK …
   … to smoke cigarettes?

   0  10  20  30  40  50  60  70  80  90  100
   No one  Everyone

3. Out of 100 people your age, how many would say it is sometimes OK …
   … to commit a crime which could put you in jail?

   0  10  20  30  40  50  60  70  80  90  100
   No one  Everyone

4. Out of 100 people your age, how many would say it is sometimes OK …
   … to keep things you find in the street?

   0  10  20  30  40  50  60  70  80  90  100
   No one  Everyone

5. Out of 100 people your age, how many would say it is sometimes OK …
   … to experiment with marijuana?

   0  10  20  30  40  50  60  70  80  90  100
   No one  Everyone

6. Out of 100 people your age, how many would say it is sometimes OK …
   … to use your fists to resolve a conflict?

   0  10  20  30  40  50  60  70  80  90  100
   No one  Everyone
7. Out of 100 people your age, how many would say it is sometimes OK …
   … to drink and drive?
   
   0 10 20 30 40 50 60 70 80 90 100
   No one Everyone

8. Out of 100 people your age, how many would say it is sometimes OK …
   … to yell and argue to solve a conflict?
   
   0 10 20 30 40 50 60 70 80 90 100
   No one Everyone

9. Out of 100 people your age, how many would say it is sometimes OK …
   … not to hold the door open for people?
   
   0 10 20 30 40 50 60 70 80 90 100
   No one Everyone

10. Out of 100 people your age, how many would say it is sometimes OK …
    … not to tell the police when you witness a crime?
    
    0 10 20 30 40 50 60 70 80 90 100
    No one Everyone

11. Out of 100 people your age, how many would say it is sometimes OK …
    … not to give directions to someone who is lost?
    
    0 10 20 30 40 50 60 70 80 90 100
    No one Everyone

12. Out of 100 people your age, how many would say it is sometimes OK …
    … not to be on time for appointments?
    
    0 10 20 30 40 50 60 70 80 90 100
    No one Everyone

13. Out of 100 people your age, how many would say it is sometimes OK …
    … not to return something you borrowed?
    
    0 10 20 30 40 50 60 70 80 90 100
    No one Everyone
14. Out of 100 people your age, how many would say it is sometimes OK …
… not to keep secrets that a friend told you?

0 10 20 30 40 50 60 70 80 90 100
No one Everyone

15. Out of 100 people your age, how many would say it is sometimes OK …
… not to return phone calls right away?

0 10 20 30 40 50 60 70 80 90 100
No one Everyone

16. Out of 100 people your age, how many would say it is sometimes OK …
… not to spend time with friends in need?

0 10 20 30 40 50 60 70 80 90 100
No one Everyone