OPTIMISTICALLY BIASED COLON CANCER RISKS: MOTIVATIONAL CAUSES AND CONSEQUENCES

by

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ABSTRACT OF THE DISSERTATION

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Colon cancer is the third leading type of cancer, accounting for 10% of cancer deaths for both men and women (ACS, 2005). Because colon cancer is caused by behavioral factors as well as environmental ones, this hazard represents an important opportunity for psychological investigation. This dissertation examined the influence of risk perceptions (and risk perception biases) on intentions for preventive behaviors. Specifically, this dissertation compared group-level and individual-level optimistic biases and also examined risk attribution biases and their effects on future intentions. A study of undergraduates at Rutgers University ($N = 342$) found that although participants believed their risk to be significantly below average (i.e. a group-level optimistic bias), participants actually overestimated their objective risk (i.e. an individual-level pessimistic bias). While risk perceptions were associated with intentions, the degree of optimistic bias was generally unrelated to intentions. Finally, participants generally underweighted the impact of many of the actual risk factors for colon cancer (e.g., alcohol, red meat, etc.) while overweighting many irrelevant factors (e.g., affect). The types of attributions participants made were also related to their future intentions. These results suggest that people engage in a variety of biases when formulating their risk judgments and that some

of these biases may have implications for future behavioral intentions.

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Cancer currently accounts for 25% of total deaths in the United States (American Cancer Society, 2005). It is second only to heart disease among causes of death, and current trajectories suggest that cancer will eventually surpass heart disease in rates of mortality.

Colon cancer accounts for 10% of the cancer deaths for both men and women, which ranks third for both sexes (lung and prostate are first and second, respectively for men; lung and breast are first and second, respectively for women; ACS, 2005). Despite its frequency, colon cancer's survival rate of 64% lags well behind many other cancers (ACS, 2005). The high frequency and modest survival rates for colon cancer make this health hazard an extremely important target for research. Given the number of behavioral risk factors for colon cancer, it is an ideal candidate for psychological investigation.

Though behavioral risk factors such as diet and exercise have a great deal of influence on the development of colon cancer, evidence suggests the an alarming number of Americans fall short of health guidelines. For example, less than 24% of Americans eat the recommended number of fruits and vegetables for optimal cancer prevention (ACS, 2005). Understanding the decision-making processes involved in the performance of preventive behaviors could inform interventions that have the potential of significantly reducing the rate of colon cancer.

It should be noted that although screening behaviors for colon cancer (e.g. FOBT, flexible sigmoidoscopy, colonoscopy) are perhaps more important to investigate than prevention behaviors from a public health perspective, they are only relevant for certain ages (i.e. over 50 years old; ACS, 2005). Many other behaviors (both risky and

preventive) are important determinants of colon cancer for all age groups and this study has focused on these behaviors.

One of the more important factors in predicting whether someone will perform a given preventive action is their perception of risk or susceptibility. Several health behavior models (health belief model, Leventhal, Hochbaum, & Rosenstock, 1960; Becker, 1974; Janz & Becker, 1984; subjective expected utility theory, Edwards, 1954; Ronis, 1992; protection motivation theory, Maddux & Rogers, 1983; theory of reasoned action; Ajzen & Fishbein, 1980) have included some form of this construct. Indeed, various reviews and meta-analyses have uncovered a consistent relationship between perceived risk and future behavioral actions (for reviews see Conner & Norman, 1995; Weinstein, 1993). An understanding of participants' risk perceptions for colon cancer enhances the likelihood that future interventions will become more successful at increasing the frequency of preventive behaviors.

This dissertation will not only focus on perceived risk for colon cancer, but also the degree of inaccuracy of perceived risk. People tend to believe they are less at risk than the average person for a variety of negative health outcomes, and more likely to be the recipient of positive outcomes. On an individual level, this response pattern can certainly be accurate. A person who exercises regularly, eats properly, and has no family history of high blood pressure or high cholesterol might be correct to think that his or her risk for cardiovascular disease is less than average. Yet, when the majority of a large group reports being less at risk than average, assuming a random sample and a normal distribution, this effect is known as the optimistic bias. Clearly, not everyone can be better than average. This phenomenon has been demonstrated in a wide range of hazards,

including auto accidents (McKenna, Warburton, & Winwood, 1993), heart attacks (Radcliffe & Klein, 2002), lung cancer (Kreuter & Strecher, 1995), HIV status (Taylor et al., 1992), unplanned pregnancy (Burger & Burns, 1988), and alcohol problems (Weinstein, 1984, 1987).

In addition to the numerous replications of the optimistic bias, in a variety of contexts, several factors have been identified that influence both the size and direction of these biased risk estimates (for a review see Helweg-Larsen & Shepperd, 2001). These moderators include mood (Abele & Hermer, 1993; Salovey & Birnbaum, 1989), dysphoria (Alloy & Ahren, 1987), event severity (Heine & Lehman, 1995), perceived control (Harris, 1996), and prior experience (Weinstein, 1980), among others. Although this work has been invaluable in learning more about what conditions reduce or exacerbate this effect, considerably less work has been conducted to directly determine the causes and consequences of the optimistic bias.

This dissertation will investigate four aspects to cancer risk perception biases. First, a new methodology for identifying unrealistic optimism (which compares participants' perceived risk to their objective risk) will be applied to the cancer domain and examined alongside the traditional methodology (which compares participants' perceived risk to their perception of the average participants' risk). Second, psychological causes and correlates of unrealistically optimistic biases will be examined. Third, the consequences of unrealistically optimistic biases will be investigated (specifically, whether these biases influence people's future behavioral intentions). Fourth, this dissertation will explore what factors participants believe causes colon cancer and how these factors are weighted when estimating their risk.

Unrealistic optimism terminology and methodology

Before reviewing the existing literature related to these research questions, it is necessary to define the terminology associated with optimistic bias to avoid possible confusion (see Table 1 for definitions). A person who reports that his or her risk is lower than average for a negative health outcome is demonstrating "comparative optimism" (Radcliffe & Klein, 2002). However, if this same person is falsely reporting his or her risk as lower than average, then he or she is exhibiting an "optimistic bias" (Weinstein, 1980). The term optimistic bias is synonymous with "unrealistic optimism" (Weinstein, 1980; Radcliffe & Klein, 2002). However, as also stated previously, it is important to point out that just because a person reports his or her risk as lower than average for a negative event (i.e. "comparative optimism") that is not necessarily the manifestation of an "optimistic bias" (or, "unrealistic optimism"). Quite logically, there are many people who could accurately characterize themselves as having below average risk because of personal characteristics or behaviors. Another consideration is that even if a person reports his or her risk as above average, they may still be exhibiting an optimistic bias. For example, a heavy smoker may believe her risk for lung cancer is a little above average, whereas in reality it is well above average.

Therefore, to truly identify a bias, one of two methodologies should be used (Radcliffe & Klein, 2002). The first is to have an objective measure of a person's risk. Comparing someone's reported risk to their actual risk will yield an indication of the presence and strength of any bias. Although this may represent the purest form of identifying an optimistic bias (since, by definition, an optimistic bias represents the

underestimation of risk), to objectively determine risk, especially for a real health hazard with multiple risk factors, is an extremely involved task, and consequently, few studies have utilized this approach (though see Radcliffe & Klein, 2002).

A more common way to assess the optimistic bias is at the group level. Conceding that it may be impossible to determine if a specific person is biased or not, it is not nearly as difficult to determine if there is bias within a group. In this methodology, each person is asked to compare their risk of experiencing a certain outcome to the average person in their population of the same age and gender (i.e. comparative risk judgments). This can either be done with a single-item comparison (direct method; "compared to the average person of your age and gender, what is the likelihood that you will develop liver cancer?") or through creating a difference score of the person's perception of their individual risk and the person's perception of the average risk (indirect method; "what is the likelihood that you will develop liver cancer?"; "what is the likelihood that the average person of your age and gender will develop liver cancer?"). A detailed comparison of these two methods is beyond the scope of this introduction, though there are clear differences between them (see Helweg-Larsen & Shepperd, 2001).

Assuming there is a normal distribution and that those responding are representative of the sample they were asked to compare to, the mean comparative risk (established either directly or indirectly) should be equivalent to the "average" risk (either the midpoint of a single-item scale with direct method, or a difference score of zero with the two-item indirect method). That is, some people may report being higher than average, some may report being lower, but normatively speaking, the mean of the group should be equivalent to the "average". This would indicate that the mean reported risk

distribution matches the mean of the actual risk distribution. Any statistically significant deviation between the mean risk and the average risk could be categorized as a bias, either optimistic (if reported risk is significantly lower for a negative outcome) or pessimistic (if reported risk is significantly higher for a negative outcome).

Causes of the optimistic bias

As referenced earlier, a large body of work has been conducted on the group-level optimistic bias. Yet, only a small subset of studies has investigated its causes, and most of these studies have substantial methodological flaws (DiBonaventura, 2006a). Therefore, this dissertation originally proposed to experimentally test two of the most commonly hypothesized causes for unrealistic optimism: self-esteem and hazard-specific anxiety. Unfortunately, even after several different methodologies, no successful manipulation was discovered for these two constructs (see Appendix A for a detailed explanation). Therefore, because the main hypotheses surrounding this issue were unable to be tested, only a very brief overview of the literature for this research question will be presented here. For a more thorough discussion of the causes of the optimistic biases, please see the dissertation proposal (DiBonaventura, 2006b).

Self-enhancement literature

There has been a large body of work demonstrating that people assume that their traits and abilities (and risk judgments) are superior to those around them ("better-than-average effect", e.g. Alicke, 1985, 2000,; Alicke, Klotz, Breitenbecher, Yurak, & Vredenburg, 1995; Perloff & Fetzer, 1986; Weinstein, 1980). The ubiquity of these

favorable comparisons is thought to include the optimistic bias. From this perspective, the fact that the bias occurs in the context of a health hazard or involves risk judgments is irrelevant. Rather, the inherent motivation to appear better than average is merely extended into the domain of risk. Furthermore, it is argued that these favorable comparisons subsequently lead to increased self-esteem (or a maintenance of high self-esteem), which is the greater psychological purpose for the optimistic bias.

In other words, from a self-enhancement perspective, unrealistic optimism occurs when self-esteem is decreased as a result of being confronted with a health hazard. By biasing risk judgments, self-esteem is subsequently increased. Unfortunately, this causal pathway has not been explicitly tested, though a few experimental studies have provided evidence that social comparison information increases self-esteem-related constructs (e.g. Diener & Fujita, 1997; Hagerty, 2000; Smith, Diener, & Weddell , 1989; Strack, Schwartz, Chassein, Kern, & Wanger, 1990). Though there is preliminary evidence of a causal mechanism between favorable comparison and satisfaction/positive affect, far more work needs to be done to ascertain whether social comparisons, especially for health risks, lead to increased self-esteem. Furthermore, work needs to be done to determine whether this need for self-enhancement is what drives the manifestation of the bias.

Anxiety-reduction literature

For decades, researchers have argued that to reduce anxiety, people will engage in a distortion of reality in a psychologically defensive manner (e.g Kirscht, Haefner, Kegeles, & Rosenstock, 1966). Work specific to the optimistic bias has also offered a

similar explanation as to why the bias occurs (Weinstein, 1980; Weinstein & Klein, 1996). These studies claim that a negative health hazard produces anxiety, and distorting one's level of risk alleviates the anxiety related to the hazard.

Associations between anxiety and the optimistic bias have largely focused on state or trait anxiety. It is worth noting, however, that, in general, more anxious people demonstrate less bias (Butler & Mathews, 1987; Eysenck & Derakshan, 1997; Myers & Brewin, 1996; Welkenhuysen, Myriam, Evers-Kiebooms, Decruyenaere & Van Den Berghe, 1996). Despite this correlational evidence, these studies fail to test the anxiety-reduction hypothesis. This motivational account makes no claims in regard to global anxiety, only to anxiety generated from the hazard (i.e. "hazard-related anxiety").

The anxiety-reduction perspective describes a fairly sophisticated pathway of anxiety presence (resulting from a confrontation with a health hazard), followed by the biasing of risk, which is then followed by anxiety reduction. Clearly, any correlational research is unfit to test this account. Rarely have any studies truly tested this anxiety-reduction perspective. However, Klein (1997) found that participants would be less disturbed if they found their risk for developing a pancreatic disorder was below average. Participants were also happier in their driving abilities if they found their risk for causing an automobile accident to be below average. Additionally, a recent study indicated that having lower risk for a variety of health hazards decreased feelings of worry (Klein, 2003). However, these findings should be viewed cautiously, as these scenarios were hypothetical, thus limiting the external validity of the results. Additionally, the variables measured (disturbance, happiness, and worry) may be tapping into constructs other than hazard-related anxiety.

Summary of causes research

Although a fair number of studies have attempted to provide support for the causes of unrealistic optimism, too many have relied on correlational designs. Therefore, this dissertation attempted to investigate whether self-enhancement and anxiety-reduction may play a role in producing the optimistic bias. Unfortunately, after several iterations, no successful manipulation of these constructs was found, therefore these hypotheses remain untested. Nevertheless, the same constructs identified as potential causes (anxiety and self-esteem, among others) will be investigated as correlates of unrealistic optimism.

Consequences of unrealistic optimism

Another major research question is to determine the consequences of unrealistic optimism. This research question has thus far evaded empirical scrutiny. Primarily, this is due to the fact that the vast majority of the research studies investigating the optimistic bias has relied upon the group-level methodology. As discussed previously, the group-level methodology involves assessing perceptions of risk and perceptions of "average" risk for each person in a particular sample. Using this methodology, an optimistic bias can only be obtained for a group. Therefore, it would be impossible to correlate bias on an individual level with intention or behavior in order to investigate prospective consequences of the optimistic bias.

Because of this limitation, virtually no studies have examined the effect of the optimistic bias on future preventive intentions and behaviors. One notable exception was a study that utilized a comprehensive design to establish an individual-level measure of

risk (Radcliffe & Klein, 2002). The authors used an instrument known as the Health Risk Appraisal (HRA), which predicts a 10-year mortality risk for heart disease with impressive accuracy. Therefore, by comparing perceived risk to this objective risk, an individual-level measure of optimistic bias could be obtained. Results indicated that participants who were classified as optimistically biased were at higher objective risk, worried less about their risk, and were more likely to believe that their standing on risk factors reduced their risk. Additionally, these participants who were optimistically biased also knew less about risk factors for an MI, and retained less when asked to read about risk factors for an MI (Radcliffe & Klein, 2002). These results provide preliminary support that a "defensive denial" approach is being used by people who report optimistically biased risk perceptions. Participants who are reporting unrealistically optimistic risks fit a profile of those who are at high at risk, yet less worried and knowledgeable about the hazard they are at risk for.

However, when investigating this research question, it is imperative to remove the effects of perceived risk from the effects of optimistic bias (potentially a delicate task). Several health behavior models (health belief model, Leventhal, Hochbaum, & Rosenstock, 1960; Becker, 1974; Janz & Becker, 1984; subjective expected utility theory, Edwards, 1954; Ronis, 1992; protection motivation theory, Maddux & Rogers, 1983; theory of reasoned action; Ajzen & Fishbein, 1980) and a wealth of research has indicated that perceived risk/susceptibility has a relationship between intentions and behavior (for reviews see Conner & Norman, 1996; Weinstein, 1993). Therefore, the effect of perceived risk must be taken into account. For example, a person who believes their risk for colon cancer is extremely low (e.g. 5%) may not intend to change their

behavioral risk factors, regardless of the level of accuracy of this perception. However, this proposal aims to establish that the degree of bias is associated with intentions for positive behavior change even after accounting for the effect of perceived risk. Previous research using this methodology (Radcliffe & Klein, 2002) has not clearly separated out the effects of perceived risk from the effect of bias.

Essentially, it is hypothesized that a person has a general conception of their perceived risk. However, under certain circumstances this general conception can be shifted to suit psychological needs (e.g. to reduce anxiety by underestimating risk). Those who are unrealistically optimistic (by "shifting" their risk downward) may be doing so in a defensive fashion. This reliance on defensive denial strategies may be associated with lowered intentions to change behaviors.

Summary of consequences research

Although the traditional methodology for assessing an optimistic bias (at the group level) is easy to implement, it is severely limiting in that a measure of bias is not obtained on an individual level. Because of this, few studies have investigated the relationship between bias and future intentions, though there is preliminary support that there may be an inverse association between these variables. Therefore, this proposal seeks to extend this pre-existing work by using an individual-level measure of bias and determining the relationship between the optimistic bias and future intentions.

Risk attribution research

People are generally motivated to identify causes for events. A large body of

research in social psychology has found that negative, highly-salient events in situations of uncertainty are more likely to produce causal attributions (Turnquist, Harvery, & Anderson, 1988; Sensky, 1997; Weiner, 1986). Given these findings, it is not surprising that people make attributions for their illnesses (since illnesses are negative, salient, and often occur with some form of uncertainty stemming from treatment and/or outcomes). Indeed, an overwhelming number of patients make a specific attribution for the cause of their illness (e.g. Taylor, Lichtman, & Wood, 1984; Turnquist et al., 1988).

There is evidence that the type of attribution made can have an impact on health outcomes, both behavioral and psychological. For example, several studies, which focused on causal attributions and cancer, have found a relationship between the type of causal attribution and both distress (Costanzo, Lutgendorf, Bradley, Rose, & Anderson, 2005; Faller, Schilling & Lang, 1995) and the malignancy of the cancer (Anagnostopoulos & Spanea, 2005).

Rather than exclusively examining the causal attributions patients make after they have been diagnosed, it is relevant to investigate the causal attributions healthy people make. Just as type of causal attribution influences treatment outcome for the diagnosed (e.g. Anagnostopoulous & Spanea, 2005; Costanzo et al., 2005; Faller et al., 1995), the type of causal attributions also influences preventive behaviors for the healthy (e.g. Lipkus et al., 2004). However, much less work has been conducted on causal attributions of the healthy, especially in the cancer domain. Addressing this gap in research is particularly worthwhile as inaccurate attributions may have profound implications on preventive behaviors and, subsequently, colon cancer rates.

The examination of causal attributions in tandem with risk perceptions also

provides a unique opportunity to determine the objective accuracy of participants' beliefs. Although past research has been able to identify the types of attributions made, this study will be able to provide a comparison between the attributions participants make and the attributions participants normatively should make. In other words, since objective risk and risk factor information will be available, this dissertation will be able to estimate how much each risk factor contributes to a person's objective risk and compare that with how people actually weight those same risk factors.

In sum, this proposal seeks to establish the causal attributions for colon cancer made by participants. Since no clear theoretical framework has been used to organize cancer attributions, this study will rely on an exploratory approach to identify clusters of attributions. These clusters will then be examined to determine which set of attributions influences behavior and future intentions. Furthermore, this study will examine the accuracy of these risk attributions by comparing how much each risk factor is weighted by participants to how much each risk factor objectively should be weighted.

General summary

There are four general aims to this dissertation. The first aim is to descriptively compare unrealistic optimism at the individual-level (the difference between perceived risk and objective risk) to unrealistic optimism at the group-level (the difference between perceived risk and perception of the average person's risk). The second aim is to replicate known correlates of group-level unrealistic optimism and investigate whether these same correlates are related to individual-level unrealistic optimism. The third aim is to focus on the consequences of unrealistic optimism. Previous research has relied on the

restrictive group-level methodology for investigating biases, thus the effects of these unrealistic judgments have not yet been empirically tested. The final aim of this dissertation is to explore related risk perception biases. Specifically, the personal algorithms participants use to formulate their risk estimates will be examined.

Hypotheses

Again, as mentioned previously, even after several iterations of pilot testing, no experimental manipulation of either self-esteem or anxiety was successful. In fact, the experimental conditions did not differ on any of the variables used in this study (see preliminary results for a more thorough explanation). Therefore, though one of the main research questions for this dissertation was to investigate the causes of unrealistic optimism, none of the hypotheses relating to this research question will be discussed here (see the dissertation proposal to review these hypotheses). Instead, only correlational hypotheses relating to perceived risk, unrealistic optimism, intentions, and risk attributions will be discussed.

Perceived risk and unrealistic optimism

Participants will believe their conditional risk for colon cancer (assuming no behavior change) is higher than their conditional risk (assuming behavior change). When risk perception is investigated cross-sectionally, the effects of risk on intentions and behaviors can easily be misinterpreted (Brewer, Weinstein, Cuite & Harrington, 2004). Some participants may factor in how their behaviors will change in the future when they report their level of risk, while other participants may not. To clarify the relationship between

perceived risk and intention/behavior, the use of conditional risk estimates is recommended (Brewer et al., 2004). Perceived risk conditional on no behavior change is likely to be positively related to future intentions, while perceived risk conditional on behavior change is likely to be inversely related to future intentions. Without assessing conditional risk, it is unclear how participants interpret risk perception (Brewer et al., 2004).

This preliminary hypothesis states that participants should perceive that they have behavioral control over their risk for colon cancer. By reporting a higher conditional risk assuming no behavior change than a conditional risk assuming behavior change, participants are acknowledging that improving their behavior can lower their risk.

Participants will exhibit a group-level optimistic bias, such that the mean conditional risk (assuming no behavior change) will be significantly lower than mean perception of the average student's risk. As an overwhelming amount of previous literature has demonstrated, participants should exhibit a traditional optimistic bias.

Participants will exhibit an individual-level pessimistic bias, such that they will perceive their risk as significantly higher than their actual risk. Contrary to implicit conclusions drawn from the optimistic bias literature, it is expected that participants will actually overestimate their perceived risk relative to their objective risk. In other words, it is expected that participants will report a lower perceived risk (conditional on no behavior change) than perceived average risk (see previous hypothesis), but participants' risk perception will be higher than their objective risk. This is in-line with preliminary

studies conducted by the author.

Unrealistic optimism will be positively related to self-esteem, self-efficacy, and perceived cancer control, but inversely related to cancer affect and cancer seriousness. Previous literature has uncovered several factors related to a group-level optimistic bias (perceived control, self-esteem, self-efficacy, affect, and seriousness). I predicted that the results from this previous literature would be replicated when using both a group-level and an individual-level measure of optimistic bias.

Behavioral consequences of risk perceptions and unrealistic optimism

There will be an inverse relationship between the level of unrealistic optimism and intentions for positive behavior change. It is expected that individual-level optimistic bias will be inversely related to intentions for future change of healthy behaviors (increase in vegetable and multivitamin consumption and exercise) and positively related to intentions for future change of unhealthy behaviors (increase in red meat and alcohol consumption). This relationship is expected to be stronger than the relationship between perceived risk and future intentions.

Perceived risk, conditional on no behavior change, will be positively related to intentions for positive behavior change. Previous literature has recommended using conditional risk estimates to clarify the relationship between perceived risk and intention/behavior (Brewer et al., 2004). Based on past research, conditional risk, assuming no behavior change, is expected to be positively associated with future intentions for healthy

behaviors and inversely associated with future intentions for unhealthy behaviors ("motivational hypothesis"; Brewer et al., 2004).

Perceived risk, conditional on behavior change, will be inversely related to intentions for positive behavior change. Based on previous research, conditional risk, assuming behavior change, is expected to be inversely associated with future intentions for healthy behaviors and positively associated with future intentions for unhealthy behaviors ("risk reappraisal hypothesis"; Brewer et al., 2004).

There will be an interaction of anxiety and self-efficacy in predicting intentions. Though not directly related to unrealistic optimism, it is hypothesized that colon-cancer anxiety would be positively related to future intentions for healthy behaviors (and inversely related for unhealthy behaviors), but only when self-efficacy is high.

Risk attribution hypotheses

Do people inaccurately weight the effect of risk factors? As an exploratory hypothesis, it is anticipated that people will inaccurately weight risk factor information when formulating their risk judgments. A variety of risk factors (e.g. red meat consumption, alcohol, exercise) determine someone's objective risk. By regressing objective risk onto participants' scores on these risk factors, a linear weight can be calculated for each risk factor. It is hypothesized that participants' linear weights (determined by regressing perceived risk onto these same risk factors) will be significantly different (i.e. inaccurate). Another words, participants will weight risk factor information differently

than the objective risk calculator.

What factors do people attribute to their colon cancer risk? As a follow-up to the previous hypothesis, it is expected that people will use non-risk factor information when formulating their risk judgments. In other words, participants will attribute their risk to a variety of factors that, in reality, have no bearing on their actual colon cancer risk.

What are risk attributions associated with? As a final exploratory hypothesis, it is expected that the types of risk attributions made will be associated with cancer beliefs and intentions. However, no specific pattern is expected.

Methods

Participants

Three-hundred and forty three undergraduate Psychology students participated in this study in exchange for course credit. One participant did not complete the last page of the questionnaire, which contained crucial demographic information for obtaining objective risk. This participant was eliminated from all analyses, leaving $N = 342$.

Procedure

For clarity, only the final procedure, which was used for all participants in these analyses, is described here (see Figure 1 for diagram of experimental procedures and Appendix A for procedures used during the pilot-testing phase). Participants were randomly assigned to one of three conditions: the high self-esteem, the low self-esteem,

or the control condition. Participants assigned to the high self-esteem condition were told they would be participating in two short studies, which in actuality were merely two parts of the same study. The experimenter explained that the "first study" involves pilot testing for a gender knowledge test for a future experiment. This "first study" was actually the self-esteem manipulation (a version of the self-esteem manipulation used in Experiment 2 of Rudman & Fairchild, 2004). Participants were seated at a computer and completed a masculine gender knowledge test. Regardless of their responses, participants were told that they scored in the 95th percentile. Previous research (and preliminary pilot testing; see Appendix A) indicated that participants who completed the masculine test and were told they scored in the 95th percentile demonstrate a boost in self-esteem. After this gender knowledge test, participants completed a paper questionnaire, which included a manipulation check along with all other variables assessed in this study.

Participants assigned to the low self-esteem condition were treated identically as participants in the high self-esteem condition, except they completed a feminine gender knowledge test instead of a masculine one. Regardless of their responses, participants were told that they scored in the 95th percentile. Previous research (and preliminary pilot testing; see Appendix A) indicated that participants who completed the feminine test and were told they scored in the 95th percentile demonstrate a drop in self-esteem. After this gender knowledge test, participants completed a paper questionnaire, which included a manipulation check along with all other variables assessed in this study. Participants in the control condition did not complete either of these gender knowledge tests. These participants were only given the paper questionnaire.

Measures (see Appendix B for full questionnaire[1])

Self-esteem. The State Self-Esteem Scale (SSES; Heatherton & Polivy, 1991) was used to assess self-esteem. This 14-item scale contains two subscales: performance self-esteem (e.g. "*I feel confident in my abilities*") and social self-esteem (e.g. "*I am feel inferior to others at this moment*"). Both subscales demonstrated good reliability individually (Cronbach's $\alpha = .80$ and $\alpha = .88$, respectively). However, the combined items (from both scales) also demonstrated very good reliability (Cronbach's $\alpha = .88$), therefore these items were combined to form a single self-esteem score.

Objective risk. Objective colon cancer risk was calculated by entering several risk factor items (including age, gender, ethnicity, height, weight, medical history, family history, diet, and exercise behavior) into a computer algorithm (Harvard Center for Cancer Prevention, 2006). The output of this algorithm was in a comparative format. Specifically, the output compared the participants' risk to someone of the same age and gender in the United States (from "much below average" to "much above average").

Perceived risk. Four items were used to assess perceived risk. The first was a perceived risk item (*"Compared to the average person in the United States of your age and gender, what is the risk that you will develop colon cancer?"*; a five-point scale from "much below average" to "much above average"). Although the response scale is in a comparative format, this item is considered "perceived risk" for the purposes of this study

[1] In accordance with APA guidelines, previously published scales will not be included in the Appendix.

(rather than "comparative risk"). This response scale was used so that it would match the response scale of the objective risk item (which has already been set in a comparative format by the Harvard Center for Cancer Prevention). Because an individual-level measure of bias is calculated as perceived risk minus objective risk, these response scales need to be identical. The second item assessed perceived risk conditional on no behavior change (*"What is your risk for developing colon cancer, assuming you do not change any of your current behaviors?*"), while the third item assessed perceived risk condition on changing behavior as intended (*"What is your risk for developing colon cancer, assuming you change your behavior as you currently intend?")*. The fourth item assesses perceived risk of the average Introduction to Psychology student ("*What is the risk for the average Introduction to Psychology student of your age and gender for developing colon cancer?*"). These last three items all had a seven-point response scale from "extremely low" to "extremely high".

Optimistic bias. The optimistic bias was calculated using two methods (individual level and group level). On an individual level, objective risk was subtracted from perceived risk (though the response scale was in a comparative format to match the objective risk output). In other words, people with negative values for this item are underestimating their risk, while those with positive values are overestimating their risk. On a group level, perceived average risk was subtracted from perceived risk (conditional on no behavior change). This difference score represents comparative optimism, but across the sample, it represents a measure of optimistic bias (a negative group mean would indicate a presence of an optimistic bias).

Colon cancer beliefs. Affective aspects to colon cancer were assessed with three items: "*How anxious does colon cancer make you feel?*", "*How worried does colon cancer make you feel?*", "*How afraid does colon cancer make you feel?*". All three items had five-point response scales, from "not at all anxious/worried/afraid" to "extremely anxious/worried/afraid". Colon cancer related negative affect (worry, anxiety, and fear) demonstrated very good reliability (Cronbach's $\alpha = 0.88$) and, as a result, these three items were combined to form a single cancer affect score. In addition to the affective elements of colon cancer, seriousness and controllability measures were also included ("*How serious do you think colon cancer is?*"; "*How much control over colon cancer do you think you have?*"). Both of these items had five-point response scales, from "not at all serious"/"no control" to "extremely serious"/"full control".

Risk factors. Several risk factors were assessed, including the number of servings of vegetables ("0", "1", "2", "3", "4 or more") and fruit ("0", "1", "2", "3", "4 or more" eaten per day, and the number of servings of red meat ("0-1", "2-3", "4-5", or "6 or more") and fish ("0-1", "2-3", "4-5", or "6 or more") eaten per week. History of Crohn's disease, previous cancer diagnoses, and family history for colon cancer were also assessed ("yes"/"no"). History of taking a daily aspirin ("yes"/"no"), birth control pills ("never", "less than 5 years", or "5 years or more"), alcohol consumption per day ("0 drinks", "1 drink", "2 drinks", or "3 drinks or more"), exercise behavior per week ("0 hours", "1-2 hours", "3-4 hours", "5-6 hours", or "7 or more hours"), and consumption of multivitamins per week ("never", "1-2 days", "3-4 days", "5-6 days", or "every day")

were also measured.

Risk attributions. Factors that participants think contributes to colon cancer risk were also assessed. Participants rated sixteen factors on their importance in determining whether someone will get colon cancer (a five point scale from "not at all important" to "extremely important"). These sixteen factors were chosen by selecting actual colon cancer risk factors as well as risk attributions used from current literature in the causal attribution domain (e.g. Costanzo et al., 2005; Faller et al., 1995; Moss-Morris et al., 2002; Mumma & McCorkle, 1983). These factors include: negative thoughts, environmental toxins, food toxins, bad luck, stress, lack of eating fruits, lack of eating vegetables, eating red meat, lack of vitamins, lack of exercise, genetics, alcohol, tobacco, gender, ethnicity, and God.

Self-efficacy. Self-efficacy was assessed using the 10-item General Perceived Self-Efficacy Scale (GSE; Schwarzer & Jerusalem, 1995). Items include "*I can always manage to solve difficult problems if I try hard enough*", "*When I am confronted with a problem, I am usually find several solutions*", etc. Each of the ten items was rated on a four-point agreement scale (from "strongly disagree" to "strongly agree"). These ten items exhibited good reliability (Cronbach's $\alpha = 0.80$) and therefore were combined to form a single self-efficacy score.

Intentions for positive behavior change. Intentions to change the behavioral risk factors was assessed by requesting participants to report how much they intend to change how

much they eat (of vegetables, fruit, red meat, fish, multivitamins), drink alcohol, and exercise in the next ten years. Intentions to change were assessed for each behavior on a five-point scale from "much less" to "much more".

Demographics. Gender, age, height, weight and race were all assessed.

Results

Missing data

Less than 0.2% of all responses were missing. Of the 78 total variables, 53 had fully complete data (68%) and, of the 25 variables with some missing data, no variable had more than 3 missing responses[2]. Because there were so few missing responses, all missing responses were replaced with the item mean. Though mean replacement has well-known limitations (for a review, see Little & Rubin, 1987), it is unlikely that any alternative form of imputation would affect the results and subsequent interpretation. One exception to mean replacement was for missing values for the weight variable (n = 3). Because there is a strong relationship between a participant's height and weight (and the fact that height information was available for all participants), the mean weight for each participant's given height was imputed.

Demographics and descriptive statistics

As expected, participants were young (M = 18.6 SD = 1.5) and mostly female (56.7%, n = 194). The racial breakdown of participants was as follows: 43.9 % White (n

[2] This excludes an item on the birth control pill. The majority of male participants did not answer this item, though they were subsequently coded as answering "never". No female participant left this item missing.

= 150), 30.4% Asian-American (n = 104), 8.8% African-American (n = 30), 8.2% Latino (n = 28), 3.2% Pacific Islander (n = 11), 5.6% other (n = 19). See Tables 2 and 3 for descriptive statistics for all variables.

Manipulation check

In order to explore potential causal mechanisms for both group-level and individual-level unrealistic optimism, it is imperative to have a successful manipulation of self-esteem and anxiety. Unfortunately, no successful manipulation of anxiety was discovered. Preliminary pilot testing (based on the methodology of previous literature) showed that completing a masculine gender knowledge test and receiving subsequent laudatory performance feedback increases self-esteem, while completing a feminine gender knowledge test and receiving subsequent laudatory performance feedback decreases self-esteem. However, surprisingly, there was no main effect of condition on self-esteem ($F(2, 339) = 0.53$, $p = .59$; $M_{high} = -14.8$, $M_{low} = -14.5$, $M_{control} = -15.7$). Though it is possible that self-esteem was affected, but not expressed through changes in this state self-esteem measure, this explanation appears unlikely. None of the variables used in this study differed by condition (Wilks' $\lambda = 0.78$, $F(86, 594) = 0.91$, $p = .70$).

Because the self-esteem manipulation had no effect on any variables used in this study (most notably self-esteem), these conditions were collapsed for subsequent analyses. Furthermore, the proposed hypotheses that involved the self-esteem conditions will be not be discussed. Instead, the focus will be on the correlational hypotheses, along with subsequent exploratory hypotheses.

Perceived risk and unrealistic optimism

Participants will believe their conditional risk for colon cancer (assuming no behavior change) is higher than their conditional risk (assuming behavior change). Not surprisingly, participants reported their conditional risk for colon cancer, assuming no behavior change, as significantly higher than their conditional risk, assuming behavior change, (M = 2.86 vs. M = 2.56, t(341) = 4.83, p < .0001). In essence, participants believed that they could reduce their risk if they changed their behavior as they intended.

Participants will exhibit a group-level optimistic bias, such that the mean conditional risk (assuming no behavior change) will be significantly lower than mean perception of the average student's risk. Replicating past research, there was a pronounced group-level optimistic bias, in that participants' reported risk for colon cancer, assuming no behavior change, was significantly less than their perception of the average Introduction to Psychology student's risk (M = 2.86 vs. M = 3.17, t(341) = -5.53, p < .0001). Though 50.9% of participants (n = 174) reported their risk to be the same as the average Introduction to Psychology student, 35.0% of participants (n = 120) reported their risk as below the average student (the remaining 14.0% reported their risk as higher than the average student) (see Table 4).

Participants will exhibit an individual-level pessimistic bias, such that they will perceive their perceived risk as significantly higher than their objective risk. As hypothesized, there was also a pronounced pessimistic bias on the individual level. In other words, participants' perceived risk was significantly higher than their objective risk (M = 2.20

vs. *M* = 1.79, t(341) = 6.89, p < .0001). In fact, 49.7% of participants (n = 121) overestimated their risk, while 29.5% of participants were accurate (n = 101) and 20.8% of participants (n = 71) underestimated their risk. These two measures of bias (individual level and group level) were significantly associated with one another (r = 0.27, p < .0001).

In sum, participants overestimated their actual risk, but still believed their risk was lower than the average peer. In other words, contrary to the conclusions drawn from much of the optimistic bias literature, participants misjudge their risk, but pessimistically, not optimistically. It appears that the reason the optimistic bias phenomenon occurs is due to wildly overestimating the average person's risk, rather than underestimating one's own risk.

Unrealistic optimism will be positively related to self-esteem, self-efficacy, and perceived cancer control, but inversely related to cancer affect and cancer seriousness. Next, correlates of both the individual-level measure of bias and the group-level measure were examined. Specifically, self-esteem, self-efficacy, cancer affect (the composite score of colon cancer anxiety, worry, and fear), colon cancer seriousness, perceived colon cancer control, and demographics were investigated (see Tables 5 and 6 for results).

Surprisingly, few associations were uncovered. Self-esteem was only slightly related to the individual-level measure of bias[3] (r = -0.11, p = .04) and marginally related to the group-level measure (r = -0.10, p = .06). Though this association is much weaker than expected, it should be noted that it is in the direction of past literature. In addition,

[3] Note that both bias measures were coded the same way. Negative values indicate optimistically biased judgments (either less than objective risk or less than the average person's risk).

gender was related to the individual-level measure of bias ($t(337.901^4) = 2.28$, $p = .02$), such that men overestimated their risk significantly more than women. Neither self-efficacy ($r = 0.05$, $p = .33$; $r = -0.10$, $p = .06$), seriousness ($r = 0.01$, $p = .93$; $r = 0.07$, $p = .21$), perceived control ($r = 0.03$, $p = .57$; $r = -0.06$, $p = .24$), nor any other demographic variable was significantly associated with either the individual-level measure or the group-level measure, respectively. The lack of significant for perceived control is particularly surprising, given its reputation as one of the most reliable correlates of the optimistic bias (e.g. Harris, 1996).

However, affect was a noticeably strong correlate of both the individual-level and group-level measures ($r = 0.29$, $p < .0001$; $r = 0.18$, $p = .001$, respectively). The more worried, anxious, and afraid a participant was about colon cancer, the less optimistically biased they were regarding their risk (both in relation to their objective risk and in relation to comparing themselves to "average"). Though conceptually this result may not be surprising, it does add to the growing literature that suggests the importance of affect in formulating risk perceptions. Furthermore, it is interesting that the relationship between the individual-level measure and affect is larger than the relationship between the group-level measure and affect.

Behavioral consequences of risk perceptions and unrealistic optimism

There will be an inverse relationship between the level of unrealistic optimism and intentions for positive behavior change. Though there was modest evidence for the relationship between individual-level unrealistic optimism and future intentions, it was in

[4] Because of a significant inequality of variance test ($F(1) = 5.19$, $p = .02$), a degrees-of-freedom correction was made.

the opposite than expected direction (see Table 7). Specifically, individual-level unrealistic optimism was associated with increased intentions to consume multivitamins ($r = -0.12$, $p = .02$)[5] and decreased intentions to drink alcohol ($r = 0.17$, $p = .002$). Unrealistic optimism was unrelated to intentions to eat vegetables, red meat, or to exercise in the future. In addition, group-level unrealistic optimism was unrelated to any future intentions.

Although this evidence may suggest that individual-level unrealistic optimism is actually beneficial because it relates to future preventive actions (albeit modestly), there are strong alternative explanations to consider. By examining the correlation matrix in Table 8, it can be seen that there is a consistent relationship between current behavior and objective risk (this is not surprising, as objective risk is calculated, in part, based on current behaviors). There is also a consistent relationship between current behavior and intentions to change. This, too, may not be surprising (though it was unanticipated at the time of the proposal). Participants who are performing behaviors at unhealthy levels are more apt to intend to positively change their behavior than participants who are already performing behaviors at healthy levels. Putting all these correlations together, a convincing alternative account remains. Unhealthy participants will have higher objective risk which, in turn, will make it more likely for them to be optimistically biased since objective risk is strongly related to unrealistic optimism ($r = 0.64$, $p < .0001$). Unhealthy participants (who happen to be unrealistically optimistic) will also have higher intentions for change, as they are more likely to want to positively change their behavioral patterns. This is likely the cause of the relationship between unrealistic

[5] Again, it is important to note that unrealistic optimism is a negative value (i.e. perceived risk minus objective risk), so an association with increasing intentions is a negative correlation and decreasing intentions is a positive correlation.

optimism and future intentions.

To statistically account for the consistent inverse relationship between current behavior and future intentions, partial correlations were conducted controlling for current behavior. In other words, individual-level unrealistic optimism was used to predict future intentions, controlling for current behavior (see bottom two rows of Table 7). Interestingly, the relationship between unrealistic optimism and future intentions for vitamin consumption, vegetable consumption and exercise behavior, which all had positive trends, were reversed when controlling for current behavior (though nowhere close to significance). However, the relationship between individual-level unrealistic optimism and future intentions for red meat and alcohol consumption were left unchanged when controlling for current behavior (since current behavior was not related to future intentions for these behaviors).

In summary, by attempting to statistically eliminate the confound of the current behavior-future intention relationship, only one significant association between unrealistic optimism remains: future intentions to consume alcohol. As stated previously, this significant result is in the opposite direction than expected. The more unrealistically optimistic participants were on the individual-level, the less they intended to increase their alcohol consumption.

Perceived risk, conditional on no behavior change, will be positively related to intentions for positive behavior change. Little evidence was found for the relationships between conditional risk estimates and future intentions; however, all correlations were in the expected direction (risk-reducing behaviors had a positive correlation while risk-

increasing behaviors had a negative correlation; see Table 7). The relationship between perceived risk and exercise intention was the lone significant one ($r = .13$, $p = .02$). The modest relationships are not entirely surprising as there is not one clear behavior that participants would view as reducing their risk for colon cancer. In fact, some participants may not have viewed any of these behaviors as risk-reducing, thus, even if they perceived their risk to be high, that would not necessarily have a positive relationship with future intentions.

Perceived risk, conditional on behavior change, will be inversely related to intentions for positive behavior change. The evidence for the relationship between conditional (on behavior change) risk estimates and future intentions was consistent (though, again, modest; see Table 7). As expected, risk perceptions (conditional on behavior change) were negatively associated with future intentions for vegetable consumption ($r = -.12$, $p = .03$) and exercise behavior ($r = -.12$, $p = .03$), and positively associated with future intentions for red meat consumption ($r = .11$, $p = .04$) and alcohol consumption ($r = .12$, $p = .03$). The association between conditional risk and vitamins was not significant, though in the expected direction (i.e. negative). The consistent pattern suggests that participants reappraise their risk if they were to change their behavior as they intended. In other words, participants reported their risk as lower if they intended to eat more vegetables and eat less red meat, consume less alcohol and exercise more. Again, the modest relationships suggest that some participants do not view these particular behaviors as risk reducing. So, even though they may intend to perform more healthy behaviors and less unhealthy ones, they may not reappraise their colon cancer risk.

Exploratory Analyses

The primary hypotheses derived from psychology theory in this dissertation surrounded unrealistic optimism, both its causes and consequences. However, there were also several other related areas of interest that were investigated.

Predicting intentions

There will be an interaction of anxiety and self-efficacy in predicting intentions. It was hypothesized that anxiety would motivate behavior change, but only if self-efficacy is sufficiently high. To test this hypothesis, a series of linear regressions was run with cancer affect (composite score of anxiety, worry, and fear), self-efficacy, and the interaction term as predictors of behavioral intentions. Prior to their inclusion in the regression model as predictors, both cancer affect and self-efficacy were centered to reduce non-essential multicollinearity (Cohen, Cohen, West & Aiken, 2003).

Interestingly, cancer-related affect predicted both vegetable consumption (β = 0.14, t = 2.53, p = .012) and alcohol consumption (β = -0.19, t = -3.59, p < .0001). Self-efficacy only predicted alcohol consumption (β = 0.15, t = 2.84, p = .005), however, it was in the opposite than expected direction. Higher levels of self-efficacy were associated with intentions to consume more alcohol in the future (as opposed to less). The interaction between affect and self-efficacy was only marginally significant for alcohol consumption (β = 0.10, t = 1.92, p = .056) and not significant for any other behavior. By further examining this interaction, the pattern indicates that there is an inverse relationship between affect and intention to change behavior (as expected), but that this

relationship is actually stronger (marginally so) for those with low self-efficacy (see Figure 2).

Personal risk algorithms

Do people inaccurately weight the effect of risk factors? To determine what risk factors participants are using to mentally calculate their risk estimates, two regression models were conducted. The first model used all risk factor information to predict objective risk. In essence, this is a confirmation of the online risk calculator, as only the risk factor items that were needed to calculate objective risk were included in this study.

As expected, the overall model was significant ($F(18, 323) = 28.5$, $p < .0001$, $R^2 = 0.61$). In particular, family history of colon cancer, daily aspirin, vegetable consumption, red meat consumption, alcohol consumption, exercise behavior, multivitamins, gender, and weight were all significantly associated with objective risk (see Table 9). Naturally, the other risk factors are likely important for objective risk (since they are included in the risk calculator), but not necessarily for this age group.

However, interestingly, a much different pattern emerged for predicting perceived risk from these very same risk factors. The overall model was significant ($F(18, 323) = 2.46$, $p = .001$, $R^2 = 0.12$). In particular, family history of colon cancer, vegetable consumption, weight, and being Latino were all significantly associated with perceived risk (see Table 9). Specifically, Latino participants perceived their risk for colon cancer to be higher than other participants ($M = 2.54$ vs. $M = 2.17$) despite the fact that their objective risk was the same.

A side-by-side comparison of these two models is informative for determining

how risk perceptions are formulated. In particular, it is clear that the correct risk factors are underweighted and, in some cases, not used at all when participants formulate their risk for colon cancer. More generally, it is interesting to note that only 12% of the variance in perceived risk can be accounted for by these factors.

One post-hoc hypotheses was that cancer affect would contribute to explaining extra variance in perceived risk. Indeed, when introducing cancer affect, cancer seriousness, and perceived cancer control to the previous linear regression, the overall model dramatically increases its predictive ability ($F(21, 320) = 4.50$, $p < .0001$, $R^2 = 0.23$; $\Delta F(3, 320) = 14.88$, $p < .0001$, $\Delta R^2 = 0.11$). However, only affect ($\beta = 0.35$, $t = 6.57$, $p < .0001$) contributed to predicting perceived risk above and beyond the risk factor predictors. Neither seriousness ($\beta = -0.06$, $t = -1.04$, $p = .30$) nor control ($\beta = 0.00$, $t = 0.02$, $p = .99$) were significant. What is particularly interesting is how strong the association was between affect and perceived risk, even after controlling for risk factors. Participants' affective reaction to colon cancer appears to influence their risk judgments far more than the actual risk factors.

What factors do people attribute to their colon cancer risk? In addition to using the correct risk factors to predict risk perceptions, risk attributions were also analyzed to determine what general factors participants believe contributes to their risk. First, an exploratory factor analysis (EFA) was conducted to reduce the sixteen risk attribution items to a more meaningful set of factors. To extract the factors, an unweighted least squares (ULS) extraction method with a promax rotation was used. To identify the number of factors to extract, a parallel analysis (PA) was performed. Parallel analysis

has been found to be a far more accurate method for determining the number of underlying factors in EFA compared to K1 and scree-plot methods (e.g. Hayton, Allen, & Scarpello, 2004).

The results indicated a four-factor solution ($\chi^2(41) = 297.47$, $p < .0001$, CFI = 0.88, GFI = 0.99, AGFI = 0.98), which explained 66.1% of the variance. However, two risk attribution variables (luck and God) were removed from the final analysis due to insufficient loadings (i.e. < 0.30) on any of the factors (see Table 10 for factor loadings). Factor 1 ("genetics"; $\alpha = .81$) includes genetics, gender, and ethnicity. Factor 2 ("smoking/alcohol"; $\alpha = 0.95$) includes smoking and drinking alcohol. Factor 3 ("diet and exercise"; $\alpha = .80$) includes fruit, vegetable, red meat, and multivitamin consumption along with exercise behavior. Factor 4 ("personality and environment"; $\alpha = 0.81$) includes negative thoughts, stress, environmental toxins, and food toxins.

What are risk attributions associated with? The four extracted risk-attribution factors (along with the importance of God and luck variables, which did not sufficiently load) were included in several correlation matrices to determine correlates. First, relationships between these variables and demographic variables were examined. No significant associations emerged between risk attributions and gender and age. However, there were significant differences among racial groups. A MANOVA, with race as a predictor, revealed significant differences among the risk attribution variables (Wilks' $\lambda = 0.80$, $F(30, 1326) = 2.56$, $p < .0001$). Follow-up ANOVAs indicated that there were racial differences on three risk attribution factors: smoking/alcohol, personality/environment, and God. Tukey's HSD revealed that Whites reported significantly less importance to

smoking and alcohol than Asian-Americans (M = -0.21 vs. M = 0.16) and African-Americans (M = -0.21 vs. M = 0.38). In addition, Whites also reported significantly less importance to environmental/personality factors than Asian-Americans (M = -0.17 vs. M = 0.31). Finally, African-Americans reported significantly more importance to God than Asian-Americans (M = 2.8 vs. M = 1.9) and Whites (M = 2.8 vs. M = 1.8).

Next, a correlation matrix was created to investigate the association between risk-attribution factors and perceived risk, cancer beliefs, cancer affect, self-esteem and self-efficacy (see Table 11). A few expected patterns emerge. For example, the higher the level of perceived cancer control, the higher the importance of smoking/alcohol, diet and exercise, and personality/ environment. Naturally, if one believes colon cancer is highly controllable, it is logical that they would also attribute controllable causes as highly important for determining one's cancer risk. Furthermore, there was also an association between diet/exercise and personality/environment attributions and conditional (no behavior change) risk. Conversely, there was an association between luck attribution and conditional (behavior change) risk. Expectedly, participants who attribute risk to controllable factors (diet, exercise, toxins, stress), report their risk as higher, assuming they don't change their behaviors. On the other hand, participants who attribute their risk to luck, report their risk as higher even if they change their behaviors (since they believe changing their behavior can reduce risk only so much).

In addition to the generally-expected associations above, there were also a few intriguing relationships. For example, cancer seriousness was associated with genetics ($r = 0.13$, $p < .05$). The more colon cancer was attributed to intrinsic characteristics (gender, ethnicity, genetics), the more serious it was reported to be. Interestingly, self-

esteem was correlated with controllable attributions but not correlated with uncontrollable attributions.

Also, interestingly, the higher participants perceived the importance of behavioral attributions (with the exception of smoking/alcohol), the higher their perceived risk for the average person (but not their own perceived risk). This particular finding complements the original hypothesis that the group-level optimistic bias is the result of participants' overestimating the average person's risk. Many health hazards (colon cancer included) have behavioral risk factors. The belief in the importance of behavioral risk factors in determining risk appears to be associated with adjusting upward the risk for the average person but not adjusting for the self. That is, the group-level optimistic bias (comparing one's risk to average), is exacerbated when behavioral factors are believed to be important. Since the belief that behavioral factors are important does not affect one's own risk, this attribution does not influence the individual-level optimistic bias. Therefore, attributing risk to behavioral factors may be one way which causes the distinction between the group-level and individual-level optimistic bias measures.

Finally, associations between attribution factors and behavior and intentions were examined. No significant associations existed between risk attributions and current behavior. However, a few associations were found between attribution factors and future intentions (see Table 12). As expected, attributing risk to uncontrollable factors (genetics, God, and luck) was not associated with any future intentions. Also, as expected, attributing risk to controllable factors (smoking/acohol, diet and exercise, and personality/environment) was associated with positive behavior change intentions, though the associations were surprisingly modest.

Discussion

This dissertation had four general aims. The first aim was to compare the tradition group-level optimistic bias with the newer individual-level optimistic bias. The second aim was to replicate known correlates of group-level unrealistic optimism and investigate whether these same correlates are related to individual-level unrealistic optimism. The third aim was to focus on the consequences of unrealistic optimism, a previously unanswered research question. Previous research has relied on the restrictive group-level methodology for investigating optimistic biases, thus the effects of these unrealistic judgments have not yet been empirically tested. The final aim of this dissertation was to explore related risk perception biases. Specifically, the personal algorithms participants use to formulate their risk estimates were examined.

Interestingly, there was a substantial discrepancy between the group-level and individual-level optimistic bias methodologies. Consistent with previous literature, the majority of participants perceived their risk to be "below average". As mentioned previously, this finding has often been misinterpreted as evidence that people underestimate their risk. In fact, the opposite is true. Participants actually overestimated their risk, relative to an objective standard. Taken together, these results suggest that the reason the traditional group-level optimistic bias occurs is due to a substantial overestimation of the average person's risk, rather than an underestimation of one's own risk (since one's own risk is overestimated, too). This has important implications to this field of research. Although current interventions may be attempting to "de-bias" participants by increasing their risk (to eliminate the group-level bias), this may, in fact,

be exacerbating the problem by causing participants to overestimate their objective risk even further.

The roots of unrealistic optimism were not able to be examined experimentally, thus only cross-sectional predictors were investigated. However, the examination of these predictors yielded an unexpected pattern. Only self-esteem and affect were associated with either unrealistic optimism measure. Though both of these variables have well-documented relationships with unrealistic optimism (e.g. Helweg-Larsen & Shepperd, 2001), it is important to note the strong association between affect and bias. This particular finding adds to the growing literature focusing on affect's role in perceived susceptibility to health hazards (e.g. Loewenstein, Weber, Hsee, & Welch, 2001).

Surprisingly, many traditional predictors of unrealistic optimism assessed in this study (e.g. self-efficacy, seriousness, and perceived control) showed no significant associations. Although previous literature is more equivocal regarding the impact of self-efficacy and seriousness on risk perceptions and bias (Helweg-Larsen & Shepperd, 2001), the lack of an effect with perceived control is particularly puzzling. This null result is not only at odds with past reviews (e.g. Harris, 1996), but even with preliminary research conducted by the author using the same methodology, hazard, and sample.

A final point should be made on the nature of these associations. Because both the group and individual-level measures of unrealistic optimism are differences scores, it is imperative to determine the relationship between the proposed correlates and the components of each of these difference scores. Interestingly, it appears that these correlates of unrealistic optimism are really just correlates of perceived risk. In other

words, self-efficacy and affect are not associated with bias per se, but rather with risk perceptions (and because risk perceptions comprise the measures of bias there is also an association between self-efficacy and affect and unrealistic optimism).

The pattern of relationships regarding risk perceptions and behavioral intentions was also somewhat surprising. Although there was the expected pattern between both types of conditional risk estimates and intentions ("motivational" and "risk reappraisal" hypotheses; Brewer et al., 2004), these associations were quite modest. One explanation may be that participants did not correctly perceive the behaviors assessed as affecting their risk. In other words, for example, the "motivational" hypothesis states that participants will intend to perform risk-reducing behaviors if they perceive their risk to be high. However, if some participants do not believe that the behaviors assessed in this study (alcohol, red meat, vegetable consumption, exercise, etc.) will reduce their risk (likely, given the risk attribution results) then the correlations should be modest. This further corroborates the exploratory hypotheses demonstrating the participants generally do not have an accurate sense of what risk factors influence a person's colon cancer risk.

The relationship between unrealistic optimism and future intentions was in the opposite-than-expected direction. Unfortunately, as explained previously, there was an inherent relationship between current behavior and objective risk (and, subsequently unrealistic optimism) and between current behavior and future intentions. This confound created a spurious relationship between unrealistic optimism and future intentions. Statistically controlling for current behavior was a post-hoc solution to more accurately investigate this research question. Yet, unrealistic optimism was only related to future alcohol consumption, though in the reverse direction than hypothesized. It is unclear

why this result occurred. One possibility is that alcohol consumption is seen as a positive behavior, which is plausible since the modal response among participants was no alcohol consumption. Furthermore, self-efficacy was positively associated with intentions to increase alcohol consumption (generally, self-efficacy was related to positive behavior changes, not negative ones). However, based on the factor analysis of risk attributions, alcohol and smoking load together which indicates that they are likely both seen as negative behaviors. So, there is no clear reason for why the relationship between unrealistic optimism and intentions to change alcohol use are significant in this direction.

Though controlling for current behavior was one way to adequately test these hypotheses, for future research, perhaps behaviors should be assessed that do not influence current objective risk. For example, screening intentions and behaviors may be more appropriate outcome variables. Objective risk, and subsequently unrealistic optimism, would not be strongly related to current screening behaviors, therefore these outcomes might be a better set of variables for testing the consequences of unrealistic optimism. Naturally, assessing these behaviors in a college-age sample would not be particularly informative because of the extremely low frequency of performing screening behaviors. Therefore, this research question might be better tested in an older population, which would be more externally valid anyway.

Lastly, the exploratory risk perception hypotheses provided some interesting findings relating to how participants conceptualize risk. As expected, participants inaccurately weight risk factor information when formulating their risk judgments. Participants accurately weight the influence of family history and vegetable consumption when formulating their risk perceptions, but they underweight all other risk factors. In

fact, besides family history and vegetable consumption only body weight correctly factors in at all when formulating risk judgments (though it is underweighted relative to its actual influence).

In addition to underweighting actual risk factors, participants also overweight irrelevant factors. For example, Latinos incorrectly weight their ethnicity has contributing to their risk, when it should not. Perhaps most interestingly, though, is the substantial role affect has in contributing to risk judgments. It appears participants use affective information (specifically anxiety, worry, and fear) substantially more than risk factor information when formulating their risk for colon cancer. This finding supports the "risk-as-feelings" hypothesis (Loewenstein et al., 2001). In other words, participants' beliefs and behavior are guided less by cognitive factors than by their affective reaction to colon cancer.

Finally, the factor analysis of risk attribution factors revealed a very statistically and theoretically clear series of attribution categories (genetics, personality/environment, diet/exercise, smoking/alcohol). Though very exploratory, the types of factors one attributes their risk to appears to modestly influence their beliefs about colon cancer. Subsequent studies should further investigate the impact these risk attributions have on risk perceptions and behavior.

In closing, this dissertation has introduced a new methodology for examining unrealistic optimism, with some intriguing results. Contrary to the conclusions drawn from the optimistic bias literature, participants generally overestimate their risk. The clear implication is that the optimistic bias occurs because participants overweight the average person's risk far more than they overestimate their own risk. Future research

should test this hypothesis.

Unfortunately, due to methodological constraints, causal hypotheses relating to unrealistic optimism were unable to be tested. Though correlation associations between the two different forms of unrealistic optimism might give evidence on potential constructs to manipulate, the associations were unexpectedly modest (though it should be noted that the strongest correlations were between the two constructs that were originally proposed to be manipulated: self-esteem and anxiety). Furthermore, the associations were driven by perceived risk and not the discrepancy between perceived risk and objective/average risk. Certainly, much more experimental work must be done to test causal hypotheses surrounding unrealistic optimism, but care must be taken to make certain whatever manipulation is used is influencing the amount of bias and not just perceived risk.

Lastly, this dissertation has been one of the first studies of its kind to systematically compare how people conceptualize their risk with how their risk should be normatively conceptualized. Perhaps not surprisingly, vast differences emerge between personal algorithms and objective ones. However, this study has identified specific factors that are underweighted and overweighted. Perhaps, these factors represent targets in future interventions to increase accuracy of perceived risk.

In closing, colon cancer remains one of the most common cancers caused by behavioral factors. Because of these attributes, it provides an important opportunity for psychological research. Through the investigation of risk perception biases, we can begin to understand important points of intervention to ensure the proper behavioral action is taken by those at risk for this deadly health hazard.

Table 1

Definitions of common terms in the optimistic bias literature.

Measure	Definition
Conditional risk	A participants' perception of the likelihood of getting cancer assuming they do, or do not, change their behaviors as they intend
Perceived risk[a]	A participant's perception of the likelihood of getting cancer
Average risk	A participant's perception of the likelihood of getting cancer for the average person
Comparative risk	The comparison of a participant's risk to the average person in the population (i.e. Intro Psychology students); a difference score of conditional risk (assuming no behavior change) minus average risk
Comparative optimism (pessimism)	A participant's belief that his or her risk is below (above) the average person
Group-level optimistic (pessimistic) bias	The mean comparative risk for a sample; the mean perceived risk minus the mean perceived average risk; for an optimistic (pessimistic) bias to exist, this must be a negative (positive) value significantly different from zero
Individual-level optimistic (pessimistic) bias	Perceived risk minus objective risk; for an optimistic (pessimistic) bias to exist, this must be a negative (positive) value

[a]In this study, the perceived risk item actually had a comparative response scale (i.e. "much below average" to "much above average"). This was done to match the response scale for the objective risk item. Because the individual-level measure of optimistic bias is calculated as perceived risk minus objective risk, it is imperative that these response scales match.

Table 2

Means and standard deviations for all continuous variables (N = 342).

Variable	*M*	*SD*
Perceived risk		
Perceived risk	2.2	0.9
Conditional risk (no behavior change)	2.9	1.2
Conditional risk (behavior change)	2.6	1.1
Average risk	3.2	1.0
Objective risk	1.8	0.8
Cancer beliefs		
Cancer worry	1.9	0.9
Cancer anxiety	1.6	0.8
Cancer fear	1.9	1.0
Cancer seriousness	3.9	0.8
Cancer control	2.6	0.9
Risk factors		
Vegetable consumption	2.6	0.9
Fruit consumption	2.6	1.0
Red meat consumption	2.1	1.0
Fish consumption	1.4	0.6
Alcohol consumption	1.3	0.6
Vitamin consumption	2.0	1.5
Exercise behavior	2.6	1.1
Risk attributions		
Negative thoughts	1.9	1.1
Environmental toxins	3.3	1.0
Food toxins	3.7	0.9
Luck	1.5	1.0
Stress	2.9	1.0
Lack of fruits	3.3	0.9
Lack of vegetable	3.3	0.9
Red meat	3.0	1.0
Lack of vitamins	3.4	0.9
Lack of exercise	3.3	1.1
Genetics	4.0	0.9
Alcohol	3.3	1.1
Tobacco	3.2	1.1
Gender	2.8	1.1
Ethnicity	2.3	1.1
God	2.0	1.4

Table 2 (continued)

Variable	*M*	*SD*
Self-esteem		
I feel confident about my abilities	3.8	0.7
I feel frustrated about my performance	2.4	0.9
I feel that I am having trouble understanding things that I read	2.1	1.0
I feel as smart as others	3.5	0.9
I feel confident that I understand things	3.7	0.8
I feel I have less scholastic ability right now than others	2.1	1.0
I feel like I am not doing well	2.3	1.1
I am worried about whether I am regarded as a success or a failure	2.7	1.4
I am worried about looking foolish	2.7	1.2
I feel displeased with myself	1.9	0.9
I feel self-conscious	2.6	1.1
I feel concerned about the impression I am making	2.8	1.1
I am worried about what other people think of me	2.7	1.1
I feel inferior to others at this moment	1.6	0.9
Self-efficacy		
I can always manage to solve difficult problems if I try hard enough	3.2	0.6
If someone opposes me, I can find the means and the ways to get what I want	2.7	0.6
It is easy to stick to my aims and accomplish my goals	2.8	0.6
I am confident that I could deal efficiently with unexpected events	3.0	0.6
Thanks to my resourcefulness, I know how to handle unforeseen situations	2.9	0.6
I can solve most problems if I invest the necessary effort	3.3	0.5
I can remain calm when facing difficulties because I can rely on my coping abilities	2.9	0.7
When I am confronted with a problem, I can usually find several solutions	2.9	0.6
If I am in trouble, I can usually think of a solution	3.1	0.5
I can usually handle whatever comes my way	3.0	0.5
Intentions for behavior change		
Vegetable consumption	4.2	0.6
Fruit consumption	4.2	0.6
Red meat consumption	2.8	0.7
Fish consumption	3.4	0.8
Vitamin consumption	4.0	0.8
Alcohol consumption	2.8	1.0
Exercise change	4.2	0.7
Demographics		
Age	18.6	1.5
Weight	144.1	33.0
Height (in inches)	66.3	3.9

Table 3

Percentages for all categorical variables (N = 342).

Variable	**No**	**Yes**	
History of Crohn's disease	99.4%	0.6%	
History of cancer	98.5%	1.5%	
Family history of colon cancer	98.5%	1.5%	
Daily aspirin consumption	99.7%	0.3%	
Variable	**Never**	**< 5 years**	**5^{+} years**
Birth control pills	68.8%	29.8%	1.5%

Table 4

Trichotomization of group-level and individual-level measures of unrealistic optimism (r = .27, p = < .0001).

	Above average	**Average**	**Below average**
Group-level	14.0%	50.9%	35.0%
	Pessimistic	**Accurate**	**Optimistic**
Individual-level	49.7%	29.5%	20.8%

Table 5

Correlates of individual-level and group-level unrealistic optimism and their components.

	Self-esteem	Affect	Self- efficacy	Seriousness	Perceived Control	Age
Individual-level	-0.11*	0.29**	0.05	-0.00	0.03	0.03
Perceived risk	-0.14*	0.35**	-0.03	0.06	0.02	0.07
Objective risk	0.00	-0.03	-0.10	0.06	-0.02	0.03
Group-level	-0.10	0.18**	-0.10	0.07	-0.06	-0.02
Conditional risk (no behavior change)	-0.16*	-0.22**	-0.01	0.05	0.12*	0.14*
Average risk	-0.05	0.28**	0.04	0.03	0.06	0.09

*p < .05
**p < .01

Table 6

Means and standard deviations of the individual-level and group-level unrealistic optimism measures by race and gender. Negative means indicate an optimistic bias and positive means indicate a pessimistic bias (relative to their objective risk or to the average person).

	Individual-level measure		**Group-level measure**	
	M	***SD***	***M***	***SD***
Gender				
Men	0.57*	0.98	-0.28	1.0
Women	0.30*	1.20	-0.34	1.1
Race				
White	0.49	1.05	-0.20	1.02
Asian-American	0.51	1.09	-0.43	1.12
African-American	-0.07	1.23	-0.60	0.81
Latino	0.43	1.37	-0.14	1.04
Pacific Islander	0.27	1.19	-0.00	1.00
Other	0.16	1.01	-0.53	1.12

*These groups are significantly different ($p < .05$).

Table 7

Correlations between future behavioral intentions to change and perceived risk measures.

	Future Intentions to Change				
	Vegetable	**Red meat**	**Vitamin**	**Alcohol**	**Exercise**
Individual-level	-0.02	0.05	-0.12*	0.16**	-0.10
Group-level	0.05	-0.01	0.09	-0.04	0.08
Conditional risk: no behavior change	0.08	-0.01	0.07	-0.03	0.13*
Conditional risk: behavior change	-0.12*	0.11*	-0.02	0.12*	-0.12*
Individual-level[a]	0.00	0.05	0.00	0.16**	0.06
Group-level[a]	0.03	-0.01	0.08	-0.04	0.05

[a]Partial correlations that control for current behavior.
*$p < .05$
**$p < .01$

Table 8

Correlation matrix for current behaviors with future intentions and objective risk.

	Current Behavior				
	Vegetable	**Red meat**	**Vitamin**	**Alcohol**	**Exercise**
Future intentions	-0.30**	0.08	-0.37**	-0.07	-0.48**
Objective risk	-0.20*	0.15*	-0.48**	0.19*	-0.43**

*p < .05
**p < .01

Table 9

Regression weights for colon cancer risk factors when predicting both objective and perceived colon cancer risk.

	Predicting Objective risk		Predicting Perceived risk	
Variable	**β**	**SE β**	**β**	**SE β**
Medical History				
Crohn's disease	-0.02	0.04	-0.01	0.05
Family history	0.22**	0.04	0.16**	0.05
Prior cancer	0.01	0.04	0.01	0.05
Health behaviors				
Birth control	0.01	0.04	0.01	0.06
Daily aspirin	-0.08*	0.04	0.00	0.05
Vegetable	-0.10**	0.04	-0.11*	0.05
Red meat	0.16**	0.04	0.07	0.06
Alcohol	0.20**	0.04	0.04	0.06
Exercise	-0.41**	0.04	-0.02	0.06
Multivitamin	-0.40**	0.04	-0.01	0.05
Personal Characteristics				
Gender	-0.34**	0.06	0.08	0.09
Age	0.01	0.04	0.04	0.06
Weight	0.37**	0.05	0.15*	0.07
Height	0.10	0.06	-0.12	0.09
Asian (dummy coded)	-0.05	0.06	0.16	0.09
Black (dummy coded)	-0.05	0.05	-0.06	0.07
Latino (dummy coded)	0.01	0.05	0.18*	0.07
White (dummy coded)	-0.02	0.07	0.19	0.10

*$p < .05$
**$p < .01$

Table 10

Factor loadings for exploratory factor analysis (EFA) of risk attribution items. The two attribution variables that assessed the importance of God and luck were removed prior to this analysis due to insufficient loadings on a preliminary factor model.

	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**
Personality/environment				
Negative thoughts	0.036	0.1	-0.014	**0.487**
Environmental toxins	-0.033	-0.067	-0.092	**0.904**
Food toxins	-0.111	-0.045	0.225	**0.628**
Stress	0.266	0.077	0.064	**0.407**
Diet and exercise				
Fruit	-0.008	-0.051	**0.937**	-0.003
Vegetables	0.026	-0.093	**1.008**	-0.057
Red meat	0.012	0.008	**0.659**	0.001
Multivitamin	0.005	0.119	**0.633**	0.000
Exercise	0.034	0.228	**0.399**	0.170
Smoking/Alcohol				
Alcohol	-0.095	**0.824**	0.135	-0.108
Smoking	0.044	**0.803**	-0.130	0.074
Genetics				
Genetics	**0.319**	-0.055	0.044	0.103
Gender	**0.740**	0.009	0.073	-0.122
Ethnicity	**0.872**	-0.023	-0.049	0.017

Table 11

Associations between risk attribution factors and risk perception items.

Variable	Perceived risk	Conditional risk (no change)	Conditional risk (change)	Average risk	Seriousness	Perceived control	Affect	Self-efficacy	Self-esteeem
Genetics	0.00	-0.03	-0.01	-0.02	0.13*	0.00	-0.05	0.14**	-0.08
Smoking/alcohol	-0.02	-0.02	-0.07	0.01	0.08	0.17**	0.09	0.05	-0.14**
Diet and exercise	0.09	0.17**	-0.06	0.18**	0.05	0.21**	0.04	0.08	-0.17**
Personality/ environment	0.14*	0.16**	-0.07	0.13*	0.10	0.14*	0.19**	0.12*	-0.14**
God	0.09	0.06	0.13*	-0.04	0.08	-0.07	0.05	0.01	0.00
Luck	0.02	0.06	0.05	0.03	0.05	-0.17**	0.07	0.07	-0.01

*p < .05
**p < .01

Table 12

Associations between risk attribution factors and future behavioral intentions.

Variable	Future Intentions				
	Vegetable	**Red meat**	**Vitamin**	**Alcohol**	**Exercise**
Genetics	0.01	-0.05	0.07	0.00	-0.03
Smoking/alcohol	0.18**	-0.14*	0.07	-0.13*	0.05
Diet and exercise	0.16**	-0.07	0.10	-0.08	0.09
Personality/ environment	0.11*	-0.08	0.05	-0.14*	0.12*
God	-0.08	-0.03	0.05	-0.02	-0.07
Luck	0.00	-0.07	0.01	-0.08	0.02

*p < .05
**p < .01

Figure 1. Diagram of experimental procedures.

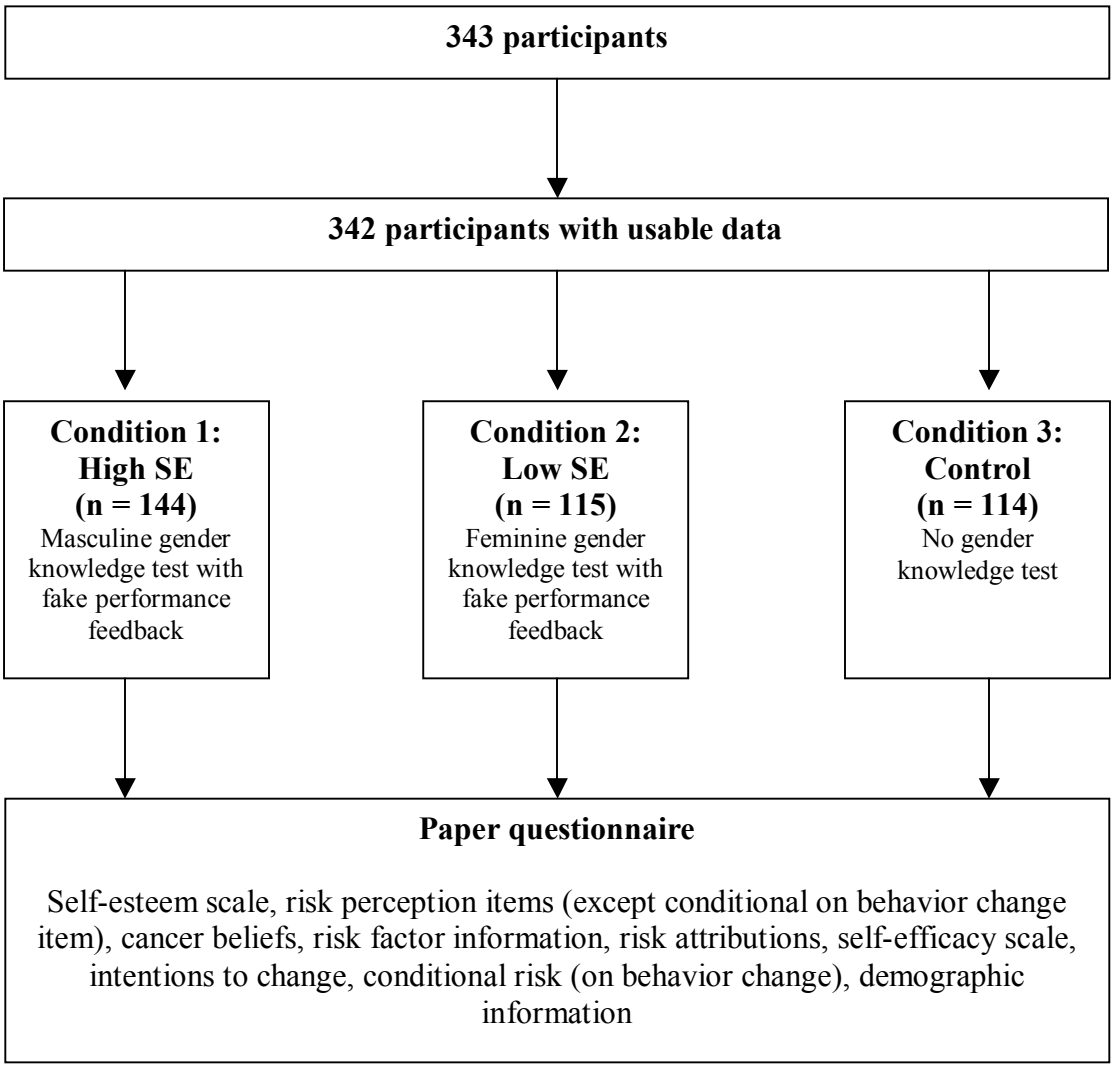
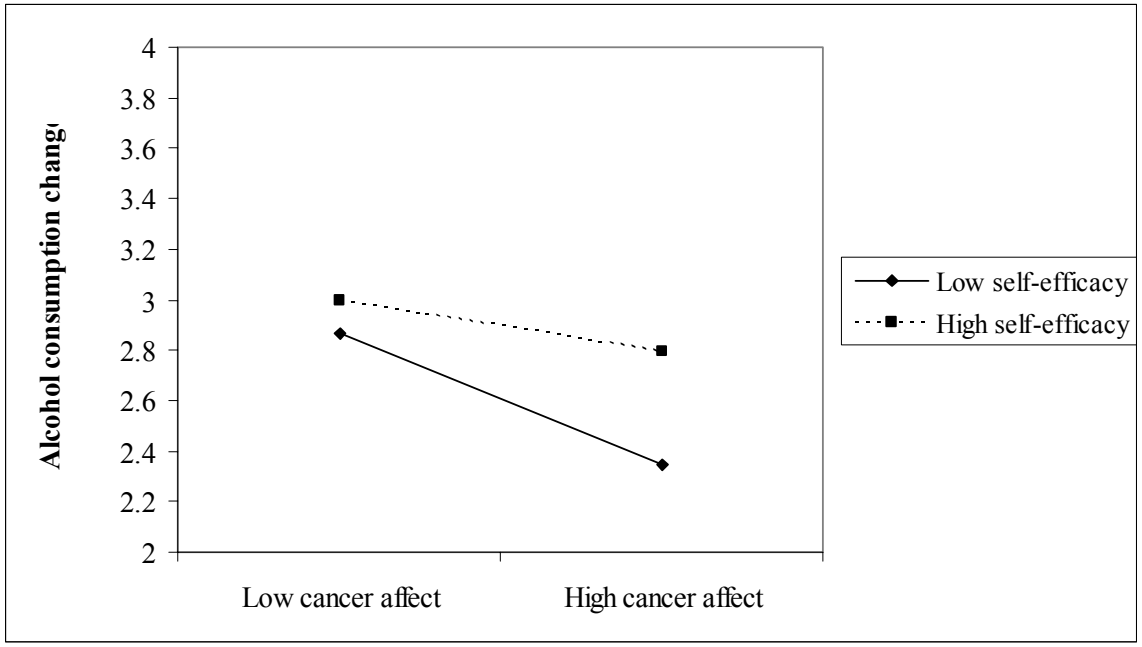


Figure 2. The interaction between cancer affect and self-efficacy in predicting intentions to consume alcohol in the future.



Appendix A: Pilot testing procedures and results

Self-esteem manipulation: Version 1

Procedure. Participants (N = 16) entered the lab and were told they would be participating in two short studies. In actuality, the first "study" was the self-esteem manipulation and the other was the manipulation check. Participants were seated at a computer and randomly assigned to either a self-esteem increasing condition or a self-esteem decreasing condition. Regardless of the condition, all participants were told that they would be pilot testing a computerized personality questionnaire that had already been tested extensively at Rutgers University. Students then completed the questionnaire and at the end were told what factors have been shown to be associated with their personality profiles. These factors, which were exactly the same within each self-esteem condition, served as the self-esteem manipulation. In the self-esteem increasing condition, participants were told that their personality profile was associated with future job success, relationship success, and life satisfaction. In the self-esteem decreasing condition, participants were told that their personality profile was associated with future job trouble, relationship trouble, and life dissatisfaction. Participants were then told by the experimenter to complete the next "study," which was a paper questionnaire containing the self-esteem measure along with risk perception questions.

Results and Discussion. Interestingly, there was a main effect of condition on self-esteem, but it was in the opposite than expected direction ($t(14) = 2.31$, $p = .04$). Participants in the self-esteem decreasing condition (M = -9.3) had a higher level of self-esteem than those in the self-esteem increasing condition (M = -16.0). Recent literature

suggests this pattern is not entirely uncommon in self-esteem research (Rudman, 2006). Nevertheless, this particular manipulation procedure was abandoned.

Self-esteem manipulation: Version 2

Procedure. Participants (N = 21) entered the lab and were told they would be participating in two short studies. In actuality, the first "study" was the self-esteem manipulation (used in Rudman & Fairchild, 2004) and the other was the manipulation check. Participants were seated at a computer and randomly assigned to complete either a masculine gender knowledge test or a feminine gender knowledge test. Participants were told that this computerized questionnaire was being pilot tested for a future study. Regardless of the answers they gave, participants were told that they scored in the 95th percentile. Participants were then told by the experimenter to complete the next "study," which was a paper questionnaire containing the self-esteem measure along with risk perception questions.

Results and Discussion. As shown in previous research, there was a trend for participants in the self-esteem increasing condition to have higher self-esteem than participants in the self-esteem decreasing condition (M = -13.7 vs. M = -19.1; t(19) = 1.45, p = 0.16). Given the seemingly moderately-sized effect of the manipulation, and the support of this procedure in previous research, this manipulation was used in the current study.

Anxiety manipulation: Version 1

Procedure. Participants (N = 21) entered the lab and were seated at a computer. They

were told that they would be provided computerized instructions and would then be asked to complete a short paper questionnaire about colon cancer. The instructions informed participants that, since some people may not be familiar with colon cancer, a few pages of information would be provided before they filled out the questionnaire. These informational pages served as the anxiety manipulation. In the low-anxiety condition, a brief description of colon cancer was given along with illustrations of a diseased colon, polyps, and a stoma. In the high-anxiety condition, the same description of colon cancer was given; however, medical photographs were used instead of illustrations. Participants then filled out the questionnaire, which assessed participants' worry, anxiety, and fear towards colon cancer as well as risk perception items.

Results and Discussion: Interestingly, participants in the high-anxiety condition actually exhibited a trend toward less worry (M = 2.1 vs. M = 2.55; t(19) = -1.06, p = .30), anxiety (M = 1.9 vs. M = 2.1; t(19) = -0.39, p = .70), and fear (M = 2.10 vs. M = 2.45; t(19) = -0.76, p = .46) than participants in the low-anxiety condition. It was hypothesized post-hoc that the medical photographs did not provoke anxiety because it was not immediately clear what they were displaying. A subsequent manipulation (see Version 2) gave a context for the medical photographs by including them along with the illustrations used in the low-anxiety condition.

Anxiety manipulation: Version 2

Procedure. The procedure for the second version of the anxiety manipulation was nearly identical to the previous version (N = 40). The only difference was that the informational

pages were slightly changed. In the low-anxiety condition, a brief description of colon cancer was given along with illustrations of a diseased colon, polyps, and a stoma. The high-anxiety condition included the same description and illustrations, but also included the medical photographs that were used in the previous version of the manipulation. Participants then filled out the paper questionnaire, which included items assesssing participants' worry, anxiety, and fear towards colon cancer as well as risk perception items.

Results and Discussion. Though there was no significant effect of condition on worry ($t(38) = -0.20$, $p = .84$) or fear ($t(38) = -0.91$, $p = .37$), there was a general trend in the expected direction for anxiety ($t(38) = 1.02$, $p = .31$). Participants in the high-anxiety condition reported more anxiety ($M = 2.7$) than participants in the low-anxiety condition ($M = 2.4$). Because this effect was quite small, and because worry and fear exhibited the opposite pattern, a stronger manipulation was tested.

Anxiety manipulation: Version 3

Procedure. The procedure for the third version of the anxiety manipulation was nearly identical to the previous version ($N = 28$). The only difference was that the informational pages were slightly changed again. In the low-anxiety manipulation, a brief description of colon cancer was given along with illustrations of a diseased colon, polyps, and a stoma. In addition, excerpts from a fictitious memoir were included describing a young woman's experience with colon cancer leading up to her death. The high-anxiety condition included the same description and illustrations, but also medical photographs

and memoir excerpts that were more affectively-laden. Participants then filled out the paper questionnaire, which included items assessing participants' worry, anxiety, and fear towards colon cancer as well as risk perception items.

Results and Discussion. There was no significant effect of condition on worry ($t(26) = -0.72$, $p = .48$), anxiety ($t(26) = -0.27$, $p = .79$), or fear ($t(26) = 0.24$, $p = .82$). Interestingly, both worry ($M = 2.36$ vs. $M = 2.64$) and fear were ($M = 1.43$ vs. $M = 1.50$) higher in the low-anxiety condition. Only fear ($M = 2.64$ vs. $M = 2.57$) demonstrated the expected pattern of means. Because no consistent, moderately-sized effect was shown in any of these manipulations, the anxiety conditions were removed from this dissertation.

Appendix B: Questionnaire items

Personality and Cancer Beliefs

[Self-esteem scale placed here]

We are interested in how people estimate various health risks. To help us learn the best way to pose questions like this, we are going to ask you to estimate your risk for some health events using several different question formats.

This first question uses a relative risk format, where you compare your risk to that of the average person of your age and gender in the United States. Even if you are not sure about the answer to this question give your best guess.

1. Colon cancer occurs when cells of the colon (upper large intestine) grow out of control. Compared to the average person of your age and gender, what is your risk for colon cancer assuming you do not change any of your current behaviors?

1	**2**	**3**	**4**	**5**
much below average	below average	average	above average	much above average

This next set of questions uses an absolute risk format. You won't compare yourself to an average person; you'll judge your risk on an absolute scale. Some of the items ask about the probability that certain health hazards will happen to you, and some questions ask about the probability that the health hazards will happen to the average Introduction to Psychology student at Rutgers of your age and gender.

2. What is your risk for developing colon cancer, assuming you **do not change** any of your current behaviors?

❒	❒	❒	❒	❒	❒	❒
extremely low	very low	low	neither high nor low	high	very high	extremely high

3. What is the risk of the average Introduction to Psychology student of your age and gender for developing colon cancer?

❒	❒	❒	❒	❒	❒	❒
extremely low	very low	low	neither high nor low	high	very high	extremely high

4. How worried does colon cancer make you feel?

1	2	3	4	5
not at all worried	a little worried	somewhat worried	very worried	extremely worried

5. How anxious does colon cancer make you feel?

1	2	3	4	5
not at all anxious	a little anxious	somewhat anxious	very anxious	extremely anxious

6. How afraid does colon cancer make you feel?

1	2	3	4	5
not at all afraid	a little afraid	somewhat afraid	very afraid	extremely afraid

7. How serious do you think colon cancer is?

1	2	3	4	5
not at all serious	a little serious	somewhat serious	very serious	extremely serious

8. How much control over colon cancer do you think you have?

1	2	3	4	5
no control	a little control	some control	a lot of control	full control

The following questions ask how much you eat certain foods <u>per day</u>.

	Number of servings eaten <u>per day</u>				
	0	**1**	**2**	**3**	**4 or more**
9. Servings of vegetables (1 serving = 1 cup leafy vegetables = ½ cup all other vegetables)	❒	❒	❒	❒	❒
10. Servings of fruit (1 serving = ½ cup canned/chopped fruit = ¾ cup fruit juice)?	❒	❒	❒	❒	❒

11. If you are female, what is the <u>total amount of time</u> you've ever taken birth control pills?

Never *Less than 5 years* *5 years or more*

The following questions ask about you and your family's medical history.

	No	Yes
12. Have you been diagnosed with chronic inflammatory bowel disease, Crohn's disease, or ulcerative colitis for more than 10 years?	❒	❒
13. Has your brother, sister, or parent ever had colon cancer?	❒	❒
14. Have you taken aspirin every day for 15 or more years?	❒	❒
15. Have you been previously diagnosed with any type of cancer (except for non-melanoma skin cancer)?	❒	❒

The following questions ask how much you eat certain foods <u>per week</u>.

	Number of servings eaten <u>per week</u>			
	0-1	2-3	4-5	6 or more
16. Servings of red meat (1 serving = ¼ lb)	❒	❒	❒	❒
17. Servings of fish (1 serving = ¼ lb)	❒	❒	❒	❒

18. On average, how many servings of alcohol do you have <u>per day</u>?

❒ 0 drinks ❒ 1 drink ❒ 2 drinks ❒ 3 drinks or more

19. On average, how many hours do you exercise <u>per week</u>?

❒ 0 hours ❒ 1-2 hours ❒ 3-4 hours ❒ 5-6 hours ❒ 7 or more hours

20. On average, how many days per week do you take a multivitamin?

❒ I don't take a multivitamin	❒ one or two days	❒ three or four days	❒ five or six days	❒ every day

~~~~~~

This next section of questions asks about what factors you think contribute to someone's colon cancer risk. Rate each factor on how important it is in determining whether someone will get colon cancer.

	not at all important	a little important	somewhat important	very important	extremely important
21. Having negative thoughts	❒	❒	❒	❒	❒
22. Environmental toxins	❒	❒	❒	❒	❒
23. Food toxins	❒	❒	❒	❒	❒
24. Bad luck	❒	❒	❒	❒	❒
25. Stress	❒	❒	❒	❒	❒
26. Lack of eating fruits	❒	❒	❒	❒	❒
27. Lacking of eating vegetables	❒	❒	❒	❒	❒
28. Eating red meat	❒	❒	❒	❒	❒
29. Lack of vitamins	❒	❒	❒	❒	❒
30. Lack of exercise	❒	❒	❒	❒	❒
31. Genetics	❒	❒	❒	❒	❒
32. Alcohol	❒	❒	❒	❒	❒
33. Tobacco	❒	❒	❒	❒	❒
34. Being a certain gender	❒	❒	❒	❒	❒
35. Being a certain ethnicity	❒	❒	❒	❒	❒
36. God	❒	❒	❒	❒	❒

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[Self-efficacy scale placed here]

This next section of questions asks about your intentions to change certain behaviors over the next 10 years or so.

In the next ten years or so, how do you intend to change the amount you eat of the following foods?

	much less	a little less	the same amount	a little more	much more
37. Vegetables	❒	❒	❒	❒	❒
38. Fruit	❒	❒	❒	❒	❒
39. Red meat	❒	❒	❒	❒	❒
40. Fish	❒	❒	❒	❒	❒
41. Multivitamins	❒	❒	❒	❒	❒

42. In the next ten years or so, how do you intend to change the amount of alcohol you consume?

❒	❒	❒	❒	❒
drink much less	drink a little less	drink the same amount	drink a little more	drink much more

43. In the next ten years or so, how do you intend to change the amount of exercise you perform?

❒	❒	❒	❒	❒
exercise much less	exercise a little less	exercise the same amount	exercise a little more	exercise much more

44. What is your risk for developing colon cancer, assuming you **change** your behavior as you currently intend?

❒	❒	❒	❒	❒	❒	❒
extremely low	very low	low	neither high nor low	high	very high	extremely high

45. What is your gender?

Female **Male**

46. What is your age? _____

47. What is your height (in feet and inches)? _____

48. What is your weight (in pounds)? _____

49. What category best describes your race?

❒	❒	❒	❒	❒	❒	❒
Asian American	African American	Native American	Pacific Islander	Hispanic/ Latino	White	Other

Thank you for your answers!

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