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Effects of Communicating Social Comparison Information on Risk Perceptions for Colorectal Cancer

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People typically believe their health risks are lower than those of others (i.e., optimistic bias). We sought to increase perceptions of colorectal cancer (CRC) risk among adults aged 50–75 who were nonadherent to fecal occult screening (FOBT). 160 participants were randomized to receive information about the following: (1) general CRC risk factors (control), (2) general and tailored CRC risk factor feedback (absolute risk group), or (3) absolute CRC risk factor feedback plus CRC feedback as to how their total number of risk factors compared with that of others (absolute plus comparative risk group). Primary outcomes were perceived absolute and comparative risks, attitudinal ambivalence toward FOBT, and screening intentions; the secondary outcome was return of a completed FOBT. Participants who were told that they had more than the average number of risk factors believed their comparative CRC risk was higher than that of controls and of participants informed that they did not have more than the average number of risk factors. Perceived absolute risk did not vary by group. Participants who received social comparison risk factor feedback expressed greater intentions to screen via a FOBT than participants who received absolute risk feedback and controls; they also expressed less ambivalence about FOBT screening than controls. Although not statistically significant, participants informed they were at lower comparative risk had the highest proportion of completing an FOBT than any other group. These results suggest that providing social comparison CRC risk factor feedback can effectively reduce optimistic comparative risk perceptions. Contrary to findings of models of health behavior change, being informed that one does not have more than the average number of CRC risk factors, while resulting in lower evaluations of perceived comparative risk, did not result in higher ambivalence toward and lower intentions to screen using FOBT or the lowest rate of screening.

Colorectal cancer (CRC) is the second leading cause of cancer death in the United States, with 148,610 new cases and 55,170 deaths projected for 2006 (American Cancer Society, 2006). CRC mortality rates can be reduced substantially through

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screening via FOBT and sigmoidoscopy (SIG; for review, see Walsh & Terdiman, 2003). The 2002 Behavioral Risk Factor Surveillance System (Centers for Disease Control, 2004), a national survey of noninstitutionalized individuals ages 18 and older, found that 44.8% of men and women 50 and older ever had an FOBT; among these, 48.7% had the test within the last year. Similarly, 48.1% ever had a SIG or colonoscopy, of which 36.6% were completed within a year of the survey. These less-than-optimal rates suggest continuing efforts to identify critical constructs that can affect the motivation to screen.

One important construct central to most theories of health behavior change is perceived risk. Consistent with health behavior change theories (Janz & Becker, 1984; Rogers, 1983; Weinstein, 1988, 1993) is the finding that individuals who report greater perceived CRC risk are more likely to screen for CRC than those with lower perceived risk, although consistency of these relations varies by screening modality (for reviews, see Vernon, 1997, 1999). One method of attempting to increase people's risk perceptions is to provide them with information about their own total number of CRC risk factors (Emmons, Puleo, Weinstein, Fletcher, & Colditz, 2004; Lipkus et al., 2005; Weinstein et al., 2004). In theory, individuals informed they have a high number of risk factors should perceive themselves at greater CRC risk, express stronger intentions to screen, and actually get screened. This straightforward approach of communicating CRC risk factor, however, has a drawback in that individuals lack a benchmark to judge whether their total number of risk factors is sufficiently threatening to motivate action. For example, individuals told they have two versus four risk factors may arrive at similar levels of perceived risk because they have no standard to evaluate whether their number of risk factors is sufficiently above average to cause concern.

Providing individuals with information as to how their total number of risk factors compares with similar others may provide a useful criterion to judge their CRC risk. The provision of social comparison may reduce sources of ambiguity about one's risk (Emmons et al., 2004; Klein, 1997; Klein & Weinstein, 1997); when something is less ambiguous, people are typically less worried about it and less likely to be defensive (see discussion below; Ritov & Baron, 1990). Those informed they are at higher risk than others may take advantage of this clearer message and reduce the threat by getting screened. Those informed they are not at higher comparative risk may screen due to a lack of fear of finding cancer; the result of screening can reinforce perceptions of being at lower risk. In this study we tested how providing a standard to judge one's total number of risk factors, specifically how one's number of risk factors compared with similar peers (i.e., provision of social comparison information), affected perceived absolute and comparative risks and worry. We expected participants provided with information informing them they have more than the average number of risk factors compared to others would report the highest levels of absolute and comparative risks, while those informed they did not have more than the average number of risk factors would interpret this information optimistically and report the lowest levels of absolute and comparative risks.

The possibility exists that the provision of social comparison information may backfire in modifying perceptions of CRC risks. Specifically, the provision of social comparison information that informs people they have more CRC risk factors than others directly confronts people's propensity to think they are less vulnerable than others (e.g., are optimistically biased; Klein & Weinstein, 1997; Weinstein, 1980). Optimistic beliefs may hinder attentiveness to and processing of information about

CRC risk and acceptance that certain CRC risk factors apply to them (Kreuter & Strecher, 1995; Weinstein & Klein, 1995; Weinstein et al., 2004). Consequently, being informed that one has more risk factors than others, if viewed as threatening, may instigate changes in how people process the information to reduce the perceived threat (i.e., fear control; for reviews, see Croyle, Yi-Chun, & Hart, 1997; Witte, 1998), and constitutes a reason why provision of CRC risk factors in general along with social comparison feedback may not increase CRC risk perceptions.

Actions to reduce the perceived threat of being told one has more risk factor than others (i.e., high social comparison risk feedback) can take several forms (Croyle et al., 1997). These include viewing the information as not credible or accurate or both. Alternatively, participants who get such comparative feedback may reduce the perceived strength of the causal association between a specific risk factor and getting CRC (e.g., ''I really don't think age is strongly related to getting CRC''), view a specific risk factor as common in the population and as such less threatening, or view CRC as less severe of a disease, compared with those who do not get comparative feedback. In this study we tested whether individuals presented with potential threatening social comparative risk feedback engage in any of the mechanisms discussed above. To the best of our knowledge, no study has ever explored looking at several defensive strategies in the context of providing comparative CRC risk factor information.

Design Overview and Hypotheses

We randomized participants ages 50 to 75 who were off-schedule for having an FOBT into one of three conditions: (1) control, (2) absolute risk condition only, and (3) absolute plus comparative risk condition. Controls received general information about CRC, CRC screening methods, and CRC risk factors. Those in the absolute risk condition received the same information as controls plus received tailored CRC risk factor information. Those in the absolute plus comparative risk condition received the same information as participants in the latter group; in addition, they were informed that their total number of CRC risk factors (based on a previous study cohort of 100 people) was greater than the average or was not greater than average, thus forming two groups within this condition. We examined how our manipulations affected absolute and comparative CRC risks, worry about getting CRC, and defensive reactions to the information. Further, we examined how our manipulations affected ambivalence and intention to screen using a FOBT, and as a secondary outcome, actual FOBT screening rates. We tested the following hypotheses:

> ***H1***: Participants informed they have more than the average number of risk factors will have the highest mean absolute and comparative risk and worry compared to the other groups. To create a corollary to this hypothesis, we examined whether participants informed they have more than the average number of risk factors would engage in more threat reduction mechanism (e.g., view the information as not very credible/ accurate) than any other group.
>
> ***H2***: Participants informed they have more than the average number of risk factors will express the strongest intentions and feel the least ambivalent about screening; they are also predicted to have the highest response rate of returning a FOBT than any other group.

Methods

Participants and Procedure

Participants were recruited by local newspaper advertisements in the Orange, Durham, and Wake Counties of North Carolina. The advertisement asked men and women aged 50 and older to participate in a study on health issues. Men and women interested in participating were asked to call the Duke University Medical Center's Risk Communication Lab (RCL). During this initial baseline call, callers were told that the purpose of the study was to gain insights into people's reactions to health education materials designed to educate the public about CRC and CRC screening. Callers were told they needed to come to the RCL to review the materials, and that they would be paid $40.00 for their help. Participants were eligible if they were between the ages of 50 to 75, never had CRC, never had a colonoscopy or sigmoidoscopy or both for CRC screening, and had not had an FOBT within the last 2 years. We selected the latter criteria for three reasons. First, we eliminated individuals who ever had colonoscopy/sigmoidoscopy for screening purposes because not finding any polyps and especially the removal of polyps through these procedures affect actual risk; thus, outcomes related to these procedures may affect perceptions of risk and worry more so than our experimental manipulations. Second, based on recommendations from major health organizations and review panels (e.g., American Cancer Society, National Cancer Institute, Preventive Services Task Force), all participants would be off-schedule for having an FOBT. Thus, we could examine how our manipulations affected screening intentions and behaviors prospectively for a behavior relevant to all participants. Third, we selected FOBT because it is a common screening test for CRC among average risk individuals, and it is easily accessible (Ransohoff & Sandler, 2002).

Callers who met our eligibility criteria and agreed to participate completed a 15-minute baseline telephone survey, which assessed demographics and several psychosocial constructs (see measures below). Callers were then scheduled to come to the RCL, usually within a week or two of the call. Overall, out of 806 individuals who inquired about the study, 182 (22.5%) met eligibility and completed the baseline survey; 160 (88%) completed the laboratory portion.[1] Demographic characteristics of those who completed the laboratory portion are presented in Table 1. These characteristics did not differ by experimental condition.

Procedure

When participants arrived at the RCL, a research assistant reviewed the purpose and study procedures and obtained written consent. Participants were first stratified into two groups on the number of CRC risk factors they had as obtained from the baseline survey: less than four risk factors or four or more risk factors—deemed the lower and higher risk factor groups, respectively. This divided the sample in half based on collected unpublished data using the same measures from an earlier study on modifying CRC risk perceptions in a similar population where the median and mean

[1]One person randomized to the social comparison above-average group inadvertently received comparative risk information for the lower risk group. Data from this individual were excluded from the analyses. Further, one participant after going through the intervention realized she had an FOBT within a 2-year period. Data from this person were used for all the analyses except those involving intentions and ambivalence to screening and actual screening.

Table 1. Demographic characteristics by experimental condition

Characteristic	Control ($n=43$)	Abs. risk only ($n=40$)	Abs. + comp. risk: Low ($n=38$)	Abs. + comp. risk: High ($n=39$)
Mean age	55.7	54.8	57.6	56.4
% women	63	62	58	79
Race (%)				
White	77	65	76	67
African American	21	30	18	26
Other	2	5	5	8
Education (%)				
≤High school	12	15	10	20
Some college	28	30	24	18
College graduate	60	55	66	62

Note. Due to rounding, percentages may not always sum to exactly 100%.
Abs. = absolute.
Comp. = comparative.

number of risk factors was three. The lower and higher risk factor group participants then were randomized to one of three conditions: (1) general CRC risk factors control group, (2) absolute risk only, and (3) absolute plus comparative risk—the latter consisted of a high and low comparative risk group. After obtaining the materials appropriate to their experimental condition, participants completed the same baseline measures with a few additional questions and were provided with a FOBT to complete with instructions to mail it back within a month to Duke University Medical Center's Gastroenterology Laboratory. All returned kits tested negative. At the end of the laboratory sessions, participants were debriefed, thanked, and paid $40.00 for their help. Discussion of the experimental groups is provided below, beginning with what all participants received in common.

Educational Materials Provided to All Groups

Participants read a booklet that varied in length based on the experimental condition. Participants read about facts common to all conditions, (1) the function of the colon and rectum, (2) basic facts about CRC (e.g., most people [75%] who have CRC never had symptoms; most people over 50 are not being screened; CRC is most preventable when found early, etc.), (3) symptoms of CRC (e.g., change in stool habits, rectal bleeding), and (4) different screening tests (FOBT and SIG), and their efficacy for reducing mortality from CRC.

Participants were told that CRC is the third most common cancer in the United States and the second leading cause of cancer death, and were informed of the lifetime risk of getting CRC in the general population (i.e., 6% or 1 in 18 people). The incidence of CRC was presented in a table and compared with other cancers listed in a sex-specific hierarchy from most to least common (Parker, Tong, Bolden, & Wingo, 1997). For women, the 10 cancers listed from most to least common follow: breast, lung, colorectal, uterine, ovarian, non-Hodgkin's lymphoma, urinary/bladder, melanoma, cervical, and pancreatic cancer. For men, the 10 cancers listed

from most to least common were: prostate, lung, colorectal, urinary/bladder, non-Hodgkin's lymphoma, melanoma, cancer of the oral cavity and pharynx, leukemia, stomach, kidney, and renal pelvis. Colorectal cancer was highlighted in bold. The goal was to show that CRC is relatively common by visually emphasizing it as being one of the top three cancers, with seven cancers below it (Lipkus et al., 1999; Lipkus, Green, & Marcus, 2003).

Control Group

These participants received only the information provided above.

Absolute Risk Only Group

This group received the same information as the controls. Further, based on their responses to the baseline survey, they received a tailored message specific to their risk factors. The header for this section was, "What Affects MY Chances of Getting CRC?" This was followed by, "Based on the answers you gave us on the phone, listed below are risk factors that *may* INCREASE YOUR risk for getting colorectal cancer."

Participants received tailored messages about lifestyle risk factors if they did the following: (1) ate less than five servings of fruits or vegetables per day, (2) ate more than three servings of red meat a week, (3) smoked, (4) had more than one alcoholic drink per day, and/or (5) engaged in less than 30 minutes of moderate to intense exercise every day most days of the week. In addition, they all received tailored feedback as to their age as a risk factor, family history of CRC, and ever having or never having been checked for polyps. The research assistant reviewed the information with participants, emphasizing those risk factors that applied specifically to them.

Absolute Plus Comparative Risk Group

This group received the same materials as those in the absolute risk only group, along with information as to how their total number of risk factors compared with 100 men/women in an earlier CRC study. Participants were told the following:

> You've just read about *YOUR* risk factors for colorectal cancer. Again, these are things about you that may put you at *higher* risk. You may also want to know how the total number of risk factors compares with that of other women/men from Central North Carolina. In another similar study, we interviewed 100 women/men between the ages of 50 to 75, and, like you, they were asked about their colorectal cancer risk factors. We took the average number of total risk factors they had and compared it with the total number of the risk factors you have. Compared with these 100 women/men from central North Carolina, **[you have more/do not have more]** than the average number of risk factors (items in bold were in red in the text).

The research assistant reviewed the information with participants, emphasizing those risk factors that applied specifically to them as well as how their total number of risk factors compared with others (i.e., either above average or not above average).

Measures

Unless otherwise mentioned, the following measures were assessed each time.

Perceptions of Absolute Risk. Participants were asked what they thought was their chance of getting CRC in their lifetime. Response options were no chance, very unlikely, unlikely, likely, very likely, and certain to happen (scored 1–6, respectively).

Perceptions of Comparative Risk. Participants were asked to compare their lifetime risk with that of other people of their same sex, age, and race. Response options follow: much below average, below average, same average risk as a woman/man your age and race, above average, and much above average (scored 1 to 5, respectively).

Negative Emotions About Getting CRC (Worry). Participants were asked how worried, fearful, and anxious they felt about getting CRC in their lifetime (1 = not at all to 5 = extremely). Items were summed to create an index of overall negative emotions about getting CRC, which we heretofore call worry. Cronbach's alphas were .87 and .90 for baseline and lab, respectively.

Perceived Severity of CRC. Participants were asked to what extent CRC is a serious, dangerous, and life-threatening illness (1 = not at all to 7 = extremely). The three items were summed to create an overall score of perceived severity. Cronbach's alphas were .77 and .91 for baseline and lab, respectively.

Basic and Lifestyle Risk Factors. At baseline only, in addition to age, participants were asked if they had one or more first-degree relatives ever diagnosed with CRC (no/yes) and whether they have ever been told they had one or more polyps (no/yes, description of polyp provided).

Questions about lifestyle risk factors consisted of current smoking status (no/yes); number of servings of alcohol on average per day (a serving was defined as a can or bottle of beer, a four-ounce glass of wine, or one cocktail containing one ounce of liquor); whether on average they got at least 30 minutes or more of moderate physical activity most days of the week, including work-related physical activity (no/yes; examples, taking brisk walks, swimming, cycling, home care such as general cleaning); and daily vegetable and fruit consumption. The latter was assessed by a 7-item food frequency index designed after a similar measure used by the Centers for Disease Control in their Behavioral Risk Factors Surveillance System and validated subsequently by Serdula and colleagues (1993). Responses to these questions were used to tailor the CRC risk feedback among participants in the absolute risk and absolute plus comparative risk conditions.

Strength of Association Between Basic and Lifestyle Risk Factors and CRC. Participants were asked whether the following risk factors increased, decreased, or did not affect CRC risk: (1) being $\geq$50, (2) having a family history of CRC, (3) having a polyp, (4) stress (filler item), (5) eating more than three servings of red meat a week, (6) engaging in at least 30 minutes of moderate/heavy physical activity most days of the week (examples of moderate and heavy physical activity were provided), (7) eating less than five servings of fruits and vegetables a day, (8) smoking, and (9) drinking more than one serving of alcohol each day. A response other than "did not affect CRC risk" was followed by how much they felt that specific risk factor increased or decreased CRC risk from very little to a great deal. Scoring was such that a response of "did not affect CRC risk" was assigned a value of 0. A score of 1 (very little) to 5 (a great deal) was assigned to responses associated with the perception of a risk factor increasing risk; a score of -1 (very little) to -5 (a great deal) was assigned to

responses associated with the perception of a risk factor decreasing risk. Thus, scores for strength of association ranged from 5 to −5. The strength of the association was assessed after measuring risk perceptions.

Distribution of Risk Factors in the Population. Participants were told, " I want to get your impressions as to how many women/men your age and race selected at random from the population in Central North Carolina engage in different lifestyle habits or have certain medical conditions." This was followed by asking out of 100 men/women, how many: (1) have a family history of CRC; (2) eat more than three servings of red meat a week where a serving is 2 to 3 ounces or the size of a deck of cards; (3) eat fewer than five serving of vegetables and fruits a day; (4) engage in at less than 30 minutes of moderate to intense physical activity every day, most days of the week (examples of moderate physical activity are taking brisk walks, swimming, cycling, and doing housework such as general cleaning; examples of vigorous activity are jogging, running, and weight lifting); (5) smoke cigarettes; (6) drink more than one serving of alcohol a day, where one serving is a can of beer, a glass of wine, or a shot of hard liquor; and (7) have at least one polyp of any size. Higher scores were interpreted as the risk factor being more common in the population.

Additional Measures Assessed During the Laboratory Session

Manipulation Check of Comparative Risk Feedback and Understanding of Risk Factors Information. Participants in the absolute plus comparative risk condition were asked to report whether they did or did not have more than the average number of risk factors compared with 100 other men/women in the previous CRC study. To further verify understanding, participants in the absolute plus comparative risk and in the absolute risk only conditions were asked, based on the feedback, to list which risk factors applied specifically to them. These items were tallied and a total mean score created. All participants were asked to specify the total number of risk factors they had and to estimate the total number of risk factors of others their age, sex, and race who were selected at random from North Carolina.

Evaluation of the Risk Factors Information. All participants rated on seven-point Likert scales the extent to which the risk factor information they received was: (1) useful, (2) informative, (3) credible, (4) trustworthy, (5) accurate, (6) persuasive, and (7) relevant to them. Items were summed, such that higher scores represented a more favorable evaluation. Scale alpha was .91.

Barriers to Screening. Participants were asked how well the following reasons would keep them from getting screened for CRC: (1) doctor did not recommend, (2) have no symptoms, (3) exam is embarrassing, (4) exam is unpleasant/disgusting, (5) not enough time, and (6) afraid of finding cancer. Response options follow yes, no, and not sure. A response of yes or not sure received a score of 1, otherwise 0. Items then were summed to create an index of overall number of barriers.

Attitudinal Ambivalence. Participants indicated their agreement with three Likert-style items stating that they had "mixed feelings," felt "torn," and had "conflicting thoughts" about whether to get screened for CRC using an FOBT. Response options follow strongly disagree, disagree, slightly disagree, slight agree, agree, and strongly agree (scored 1 to 6, respectively). Items were summed to create a total score of attitudinal ambivalence toward FOBT screening. Scale alpha was .89.

Screening Intentions. Participants were asked to what extent they intended to complete the FOBT kit that would be given to them within the next month. Response anchors on a seven-point Likert scale were "definitely will complete the test" to "definitely will not complete the test" (scored 1 to 7).

Statistical Methods

The primary hypotheses were tested using ANCOVAs covarying baseline values, when available, of the same outcome variable (e.g., risk perceptions) using experimental group as the main independent variable. In all instances, the covariate was significantly related to the outcome. Associations among constructs (e.g., perceptions of risk and screening intentions) were tested using Pearson correlations. Logistic regression analyses were used to predict the return of a completed FOBT (no/yes). Outcomes were considered statistically significant at $p < .05$. In general, none of the demographic characteristics affected appreciably the main findings, and will not be discussed further.

Results

Manipulation Check of the Social Comparison Feedback

Among participants in the absolute plus comparative risk condition who were informed they had more than the average number of risk factors, 81% correctly checked that they had more than the average number of risk factors; among those who were informed they did not have more than the average number of risk factors, 95% correctly checked that they did not have more than the average risk factors ($\chi^2_{(1)} = 44.0$, $p < .0001$). Thus, overall, participants understood correctly the social comparison feedback, though this was more true in the condition where they were given favorable feedback. Unless otherwise indicated, results did not differ significantly when data from the few participants who failed to answer the comparative risk manipulation check question correctly were excluded from the analyses.

Distribution of and Perceptions of CRC Risk Factors

Table 2 presents the distribution of baseline CRC risk factors by experimental condition; how many CRC risk factors participants thought they and other individuals had in general; and among those in the absolute risk only and absolute plus comparative risk conditions, based on the feedback they received, how many risk factors they listed (e.g., see numbers in parentheses). As testament that the stratification and randomization process worked, the total number of risk factors did not differ between the control and absolute risk only conditions (Ms = 3.56 and 3.50, respectively); as expected, though, the mean number of risk factors in the above average comparative risk condition was significantly higher than any other group ($M = 4.50$), while the mean number of risk factors in the not above average comparative risk condition was lower than any other group ($M = 2.72$)—contrasts significant at $p < .05$ based on Tukey's post-hoc tests.

The total number of risk factors reported for self varied by experimental condition. Those informed they had more than average compared with others reported a higher mean number of risk factors ($M = 4.21$) than any other group. Perceptions of

Table 2. Distribution of CRC risk factors by experimental condition

Risk factor	Control	Abs. risk only	Abs. + comp. risk High	Abs. + comp. risk Low
Age	43	40 (39)	38 (38)	40 (40)
Family history	2	2 (7)	4 (7)	2 (9)
Never checked for polyps	43	40 (37)	38 (7)	40 (39)
History of polyp	0	0 (0)	1 (0)	0 (0)
<5 serving of F&V/day	27	35 (36)	33 (33)	19 (22)
>3 servings of red meat/week	9	5 (8)	21 (23)	2 (8)
>1 alcoholic drink/day	4	2 (8)	5 (9)	1 (9)
<30 min. of physical activity/day				
Most days of the week	18	10 (17)	21 (22)	5 (11)
Smokes cigarettes	7	6 (10)	9 (12)	1 (9)
Mean number of risk factors	3.56_a	3.50_a	4.50_b	2.7_c
Mean number of risk factors				
Listed as part of feedback	—	4.07_a	4.76_b	3.59_a
Perceptions of risk factors				
Mean total reported for self	2.79_a	3.60_a	4.21_b	2.79_{ac}
Mean total reported for other	5.18_a	7.15_a	4.64_a	4.13_a

Note. Numbers in parentheses represent the number of participants in the absolute risk only and absolute plus comparative risk condition who mentioned they received a specific risk factor as part of the risk factor feedback. For example, among the 38 participants who were informed that their age was a risk factor for CRC, all 38 mentioned that age may increase their CRC risk. Means with different lettered subscripts within rows differ by $p < .05$ based on Tukey's post-hoc test

Abs. = absolute.

Comp. = comparative.

the number of risk factors others had did not vary by experimental condition. Participants perceived others as having approximately two more CRC risk factors than themselves ($M_{(\text{diff})} = 1.97$, paired $t_{(157)} = 3.57$, $p < .005$], however, and this was unaffected by experimental condition.

Perceptions of Absolute and Comparative Risk and Worry

It was predicted that participants informed they had more than the average number of risk factors would have the highest mean absolute and comparative risk and worry compared with the other groups. Conversely, it was expected that participants informed they did not have more than the average number of risk factors compared with other groups would have the lowest mean absolute and comparative risk and worry compared with the other groups. There was limited support for these hypotheses. (See Table 3.) Perceptions of absolute risk and worry did not vary significantly by group, although the trends were in the predicted directions. Perceived comparative risk did vary by group. Participants informed that they had more than the average number of risk factors compared with others had higher mean comparative risk estimates than participants in the control and in the lower comparative risk feedback groups. We reran the above analyses deleting data from participants in the comparative risk feedback groups who incorrectly

Table 3. Mean perceived risks and worry during the laboratory session by experimental condition

			Abs. + comp; risk		
Outcome	Control	Abs. risk only	Low	High	F value
Absolute risk (range 1 to 7)					
Adjusted for baseline	3.25_a	3.22_a	3.02_a	3.44_a	1.83
Unadjusted for baseline	3.28	3.17	3.50	2.97	
Baseline mean	3.14	2.95	3.21	2.94	
Comparative risk (range 1 to 5)					
Adjusted for baseline	2.43_a	2.52_{ab}	2.25_a	2.86_b	4.05*
Unadjusted for baseline	2.44	2.50	2.18	2.95	
Baseline mean	2.51	2.45	2.34	2.65	
Worry (range 3 to 15)					
Adjusted for baseline	6.06_a	6.28_a	5.60_a	6.38_a	1.50
Unadjusted for baseline	5.93	6.10	6.55	6.77	
Baseline	5.77	5.70	6.18	6.18	

Note. Higher means represent greater perceived risk or worry. Means with different lettered subscripts within rows differ by $p < .05$ based on Tukey's post-hoc test.
Abs. = absolute.
Comp. = comparative.
*$p < .009$.

responded to the manipulation check question ($n = 31$ and $n = 37$ for comparative risk high and low conditions, respectively). The results did not change for absolute risk and worry, but they did change for perceived comparative risk. Overall, the same results were found as before, except that now perceived comparative risk was significantly higher among those informed they had more risk factors than others relative to those who received absolute risk feedback only (least square means, 2.94 vs. 2.54, $F(3,146) = 4.30$, $p < .007$).

We explored further how the total number of CRC risk factors participants reported they had in general and the total number they listed correlated with perceived risks and worry. Participants who thought they had more CRC risk factors reported greater perceived absolute and comparative risks (rs = .42, ps < .0001), and worry ($r = .28$, $p < .0004$). Among participants who received tailored feedback, those listing more risk factors, whether accurate or not, reported greater perceived absolute and comparative risks ($r = .22$ and $r = .23$, respectively, ps < .05), and worry ($r = .24$, $p < .01$).

Defensive Reactions to Risk Information

We wondered whether participants who were informed that they had more than the average number of risk factors compared with others would (1) evaluate risk factor information more negatively (e.g., less accurate, useful, etc.); (2) perceive CRC as less severe; (3) perceive a weaker causal relationship between CRC risk factors and getting CRC, especially for risk factors they said put them at higher risk based on tailored feedback; (4) view CRC risk factors are more common in the population, especially for risk factors they said put them at higher risk based on the tailored

Table 4. Mean ambivalence and intentions to screen and FOBT screening rates

			Abs. + comp. risk		
Outcome	Control	Abs. risk only	Low	High	F value
Ambivalence (range 3–21)	9.61_a	6.65_b	5.92_b	5.71_b	10.4*
Intentions (range 1–7)	2.21_a	3.65_b	6.43_c	6.65_c	132.7*
% returning an FOBT	38	42	47	64	–

Note. Higher numbers represent greater ambivalence and intentions to screen. Means with different lettered subscripts within rows are statistically significantly different by Tukey's post-hoc test.

Abs. = absolute.

Comp. = comparative.

feedback; or all of these. No differences emerged, with very minor exceptions—data are not shown but are available from the first author upon request. For the consumption of red meat, participants informed they had more than the average number of risk factors compared with others perceived a weaker association between eating more than three servings of red meat a week and getting CRC than those in the control group only ($M = 2.92$ vs. $M = 3.67$; $F(3,147) = 3.21$, $p < .05$). Further, among those who got tailored feedback, participants who said lack of exercise put them at higher risk viewed a stronger association between exercise and getting CRC than those who did not mention exercise as a risk factor ($M = 2.21$ vs. $M = 1.20$, $t_{(112)} = -2.00$, $p < .05$).[2] Overall, there was little evidence that participants responded defensively to the social comparison information.

Screening Intentions and Ambivalence

We hypothesized that participants informed they had more than the average number of risk factors compared with others would express the strongest intentions and feel the least ambivalence to screening using an FOBT. This hypothesis received partial support (see Table 4). Consistent with the prediction, participants informed they had more than the average number of risk factors had higher mean intentions to screen than participants in the control and absolute risk only groups; they did not have higher mean scores than participants informed that they did not have more than the average number of risk factors. The latter group also had higher mean intentions to screen than participants in the control and absolute risk only groups. With respect to ambivalence, participants in the control group expressed stronger ambivalence towards screening than any other group.

We explored how perceived absolute and comparative risk and worry, total number of CRC risk factors participants reported they had in general, and the number listed specific to the feedback correlated with ambivalence and screening intentions. Neither perceived absolute or comparative risks nor worry were related

[2]We examined whether there were changes between baseline and the lab in the weighing of CRC risk factors. With the exception of family history, all CRC risk factors were given a stronger association during the laboratory visit relative to baseline; hence, across experimental groups, the CRC risk factors became more salient. These data are available from the first author upon request.

significantly with ambivalence ($-.04 < rs < .04$) or intentions ($.05 < rs < .11$). Participants who reported having more CRC risk factors had stronger intentions to screen only ($r = .22$, $p < .005$). The number of risk factors they listed based on the tailored risk feedback, however, was not associated with either intentions ($r = .11$, NS) or with ambivalence ($r = -.10$, NS).

Predicting Screening

We examined whether the experimental manipulations, perceptions of risks and worry, barriers to screening, ambivalence, and screening intentions predicted the receipt of a FOBT. Overall, 47% returned a completed FOBT. The proportion of participants who returned an FOBT by experimental group is shown at the bottom of Table 4.

Preliminary analyses predicting return of a FOBT revealed that participants who expressed more ambivalence (OR = .82, 95% CI .74 to .90. $p < .0001$) and barriers to screening (OR = .81, 95% CI .69 to .95. $p < .02$, $M = 2.2$) were less likely to have returned a FOBT; conversely, those with stronger intentions to screen were more likely to have returned the FOBT (OR = 1.16, 95% CI 1.01 to 1.34, $p < .05$). When data from participants who incorrectly responded to the comparative risk manipulation question were removed, intentions no longer predicted the return of a FOBT ($p < .06$). In a multivariate logistic regression analysis, only ambivalence and barriers continued to predict significantly a lower likelihood of returning a FOBT (Wald's $\chi^2 = 21.5$, $p < .0001$; OR = .81, 95% CI .74 to .90, $p < .0001$ for ambivalence, OR = .80, 95% CI .67 to .95, $p < .02$ for barriers).

We contrasted screening rates between controls (reference group), the absolute risk condition, and the absolute plus comparative risk condition with the high and low groups combined as well as separated. In general, participants who received social comparison information were more likely to have returned a completed FOBT (overall, 56%), although this failed to achieve conventional levels of significance ($p < .15$).[3]

Discussion

To our knowledge, this is the first study to collectively test in unison how the provision of tailored absolute plus comparative CRC risk factors information affects individuals' risk perceptions, worry, defensive reactions to feedback, screening intentions, and, as a secondary outcome, screening, compared with people who receive tailored or nontailored absolute CRC risk factor information. Our study differs slightly from others that have used computerized algorithms (i.e., Harvard Risk Index) to provide numerical or verbal estimates of the *magnitude* of relative risk based on a person's risk factors; our study did not quantify the magnitude of risk but simply informed participants as to their standing on the total number of risk factors. In sum, we found the following: (1) we could effectively increase perceived comparative risk among those who were informed that they had more than the average number of risk factors compared with controls and those informed they did not have

[3]We tested whether there was a pattern of greater completion of a FOBT in relation to participants being supplied with more risk information (i.e., controls < absolute risk only < absolute plus comparative risk). The test of a linear trend failed to achieve significance (Mantel-Haenszel $X_{(1)}^2$=3.77, p=.052).

more than the average number of risk factors; (2) reactions that can be construed as defensive did not differ among groups; (3) the provision of comparative risk feedback reduced ambivalence and increased screening intentions, but actual perceptions of risk did not correlate with these outcomes or screening; and (4) perceived ambivalence strongly predicted the return of FOBTs. We discuss several of these issues and their implication for CRC risk communication and motivating screening.

Our ability to effectively modify perceptions of comparative risk by simply informing individuals whether they have more or no more than the average number of CRC risk factors compared with 100 other men or women is encouraging and yet disheartening. As a group, individuals informed they had more than an average number risk factors viewed their risk as slightly below average compared with others (adjusted $M = 2.86$). Even when data from participants who responded incorrectly to the manipulation check question were removed, the mean remained below three (adjusted $M = 2.96$). Based strictly on the data they were given, it would have been expected that the mean score would have been higher than the absolute scale value of three, corresponding to the same "average" risk.

The above results cannot be attributed strongly to participants' misinterpretation of the data. The majority (81%) correctly interpreted the information and listed a greater number of risk factors relative to individuals informed they did not have more than the average number of risk factors, and those in the absolute risk only condition. Nor did they engage in any defensive reaction explored in this study. A close inspection revealed, however, that as with individuals in the other groups, these participants were engaging in optimistic appraisals of their risk factors; they viewed their total number of CRC risk factors as slightly less than others ($M = 4.21$ vs. $M = 4.64$). Thus, despite the feedback, as a whole they continued to believe their total risk factors were somewhat less than those of others. Similarly, the group informed they did not have more than the average number of risk factors interpreted the findings perhaps overly optimistically, as evidenced by having the lowest mean perceived risks and worry than any other group—admittedly, they did not even differ from controls. It appears that these individuals were interpreting the comparative information as indicating they were at lower risk, even though the feedback did not state this explicitly.

At the same time, the results are encouraging. When data from participants who responded incorrectly to the manipulation check question were removed from the analyses, those informed they had more risk factors than others reported higher comparative risk than participants in all conditions. Thus, among those who understood the information, informing these participants that they had more than the average number of risk factors, if anything, prevented them from becoming more optimistically biased. The extant literature on trying to overcome the optimistic bias using approaches such as ours generally has met with failure. For example, Weinstein and Klein (1995) asked participants to list factors that increased or decreased their risk of heart disease, and found that whereas the "decrease" condition exhibited an enhanced optimistic bias (relative to controls), the "increase" condition made no adjustment to their risk perceptions.

We were encouraged by findings that individuals provided with social comparison information had the highest intentions to screen, had the least amount of ambivalence, and had the highest screening rates. Of import, contrary to models of health behavior change, these are the first findings to show that being informed that one does not have more than the average number of CRC risk factors, while

resulting in lower evaluations of perceived comparative risk, did not result in higher ambivalence toward screening and lower intentions to screen and with actual screening. Indeed, this group had the highest screening rate (64%). Perhaps these individuals, based on the feedback they received, expected a negative test result. Replicating these findings in a larger representative sample and testing mechanisms for this possible outcome is warranted.

Although our manipulations were somewhat successful at modifying comparative risk perceptions, risk perceptions were not related significantly with screening intentions, ambivalence, or actual screening. Rather, our manipulations consistently affected intentions to screen and ambivalence. What is novel is that the provision of social comparison feedback significantly reduced feelings of ambivalence; in turn, feeling less ambivalent was a strong predictor of returning an FOBT, even after controlling for screening intentions and barriers. These results should not be interpreted within a mediational framework because none of our experimental groups differentially predicted screening. Nonetheless, these data are the first to suggest that risk communications may affect not only perceptions of risk, but also feelings of ambivalence. We have found that ambivalence is a strong predictor of mammography screening (Rimer et al., 2002) and the desire among young smokers to quit smoking (Lipkus, Green, Feaganes, & Sedikides, 2001; Lipkus et al., 2005), even after taking into consideration positive and negative beliefs as measured by decisional balance scales. Testing other ways of lowering ambivalence and how it motivates screening merits further investigation.

The results should be interpreted in light of some methodological weaknesses. First, the sample may not be representative of the larger population, especially given that our sample was more highly educated than the general population. Second, improvements are warranted in how patients are interpreting CRC risk factor feedback. As shown in Table 2, several participants mentioned having a risk factor that was never provided as part of the tailored materials. Some may have misinterpreted the question—although we were careful in explaining what this question asked for—or based their responses on the education section that reviewed general CRC risk factors as well as the tailored materials. From a communications perspective, when the main emphasis is on tailoring CRC risk factors, the provision of general risk factors information could possibly be avoided to enhance clarity. Third, we assessed risk perceptions in terms of likelihoods; perhaps the sensitivity of assessing risk perceptions would have increased if they were measured as attitudes (e.g., How strongly do you agree that you will get CRC in your lifetime?). We assessed a limited number of defensive reactions. For example, in hindsight, we did not ask participants how many others may have received the same social comparison risk feedback. Those in the higher risk group may have viewed this feedback as more common than those in the lower risk group, attenuating the perceived threat. Finally, we did not test what factors (e.g., self-efficacy) may moderate defensive reactions. Rather, due to previous research showing that affecting perceptions of comparative risk is difficult, our attempt was to first examine if we could modify these perceptions experimentally within the realm of CRC.

Our results suggest areas of future investigation. The social comparison manipulation used base rates of 100 people. Would have perceptions of risk differed if base rates were larger (e.g., 200, 500) or smaller (e.g., 50)? As the literature suggests, people often are insensitive to base rates, and this may have happened in this study (for reviews see Bar-Hillel, 1990; Koehler, 1996). Other work suggests that a very

specific social comparison target might be more impactful than aggregated comparison information in terms of influencing cancer risk perceptions (Dillard, McCaul, Kelso, & Klein, in press). Further, we did not provide as part of the social comparison feedback what constituted the average number of risk factors among the 100 men/women; we decided not to provide this number so that we could assess its effects on biased perceptions of risk factors information and risk. Would providing this number have made any difference to perceptions of risk? Would the comparative risk feedback have been more effective with a graphical display? Further, how is it that our manipulations actually affected ambivalence toward screening? As our results and these areas of future research suggest, much more work is needed to understand how to maximize the potency of providing CRC risk factors information to affect risk perceptions and screening. Gaining insights into these mechanisms can be useful not only for reducing mortality and morbidity from CRC, but from other cancers and diseases as well.

References

American Cancer Society. (2006). www.cancer.org/downloads/STT/CAFF2006PWSecured. Retrieved April 24, 2006.

Bar-Hillel, M. (1990). In Robin M. Hogarth (Ed.), *Insights in decision making: A tribute to Hillel J. Einhorn* (pp. 200–216). Chicago, IL: University of Chicago Press.

Centers For Disease Control Behavioral Risk Factor Surveillance System. (2004). *Prevalence data all states—2002.* Retrieved from April 29, 2004, http://www.CDC.gov/Brfss/

Croyle, R. T., Yi-Chun, S., & Hart, M. (1997). In K. J. Petrie & J. A. Weinman (Eds.), *Processing risk factor information: Defensive biases in health-related cognitions. Perceptions of health and illness: Current research and applications* (pp. 267–90). Netherlands: Harwood Academic Publisher.

Dillard, A. J., McCaul, K. D., Kelso, P. D., & Klein, W. M. P. (In press). Resisting good news: Reactions to breast cancer risk information. *Journal of Health Communication.*

Emmons, K. M., Wong, M., Puleo, E., Weinstein, N., Fletcher, R., & Colditz, G. (2004). Tailored computer-based cancer risk communication: Correcting colorectal cancer risk perception. *Journal of Health Communication*, *9*, 127–141.

Janz, N. K. & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly*, *11*, 1–47.

Klein, W. M. (1997). Objective standards are not enough: Affective, self-evaluative, and behavioral responses to social comparison information. *Journal of Personality & Social Psychology*, *72*, 763–774.

Klein, W. M. & Weinstein, N. D. (1997). Social comparison and unrealistic optimistic about personal risk. In B. P. Buunk & F. X. Gibbons (Eds.), *Social comparison and unrealistic optimism about personal risk: Health, coping, and well-being: Perspectives from social comparison theory* (pp. 25–61). Hillsdale, NJ: Lawrence Erlbaum.

Koehler, J. J. (1996). The base rate fallacy reconsidered: Descriptive, normative, and methodological challenges. *Behavioral & Brain Sciences*, *19*, 1–53.

Kreuter, M. W. & Strecher, V. J. (1995). Changing inaccurate perceptions of health risk: Results from a randomized trial. *Health Psychology*, *14*, 56–63.

Lipkus, I. M., Crawford, Y., Fenn, K., Biradavolu, M., Binder, R. A., Marcus, A., & Mason, M. (1999). Testing different formats for communicating colorectal cancer risk. *Journal of Health Communication*, *4*, 311–324.

Lipkus, I. M., Green, J. D., Feaganes, J. R., & Sedikides, C. (2001). The relationship between attitudinal ambivalence and desire to quit among college smokers. *Journal of Applied Social Psychology*, *31*, 113–133.

Lipkus, I. M., Green, S. L., & Marcus, L. (2003). Manipulating perceptions of colorectal cancer threat: Implications for screening intentions and behaviors. *Journal of Health Communication*, *8*, 213–228.

Lipkus, I. M., Pollak, K. I., McBride, C. M., Schwartz-Bloom, R., Lyna, P., & Bloom, P. (2005). Assessing attitudinal ambivalence towards smoking and its association with desire to quit among teen smokers. *Psychology and Health, 20*, 373–387.

Lipkus, I. M., Skinner, C. S., Dement, J., Pompeii, L., Moser, B., Samsa, G., & Ransohoff, D. (2005). Increasing colorectal cancer screening among individuals in the carpentry trade: Test of risk communication interventions. *Preventive Medicine*, *40*, 489–501.

Parker, S. L., Tong, T., Bolden, S., & Wingo, P. A. (1997). Cancer statistics, 1997. *CA, Cancer Journal of Clinicians*, *47*, 5–28.

Ransohoff, D. F. & Sandler, R. S. (2002). Screening for colorectal cancer. *The New England Journal of Medicine*, *346*, 40–44.

Rimer, B. K., Halabi, S., Skinner, C. S., Lipkus, I. M., Strigo, T. S., Kaplan, E. B., & Samsa, G. P. (2002). Effects of a mammography decision-making intervention at 12 and 24 months. *American Journal of Preventive Medicine*, *22*, 247–257.

Ritov, I. &Baron, J. (1990). Reluctance to vaccinate: Omission bias and ambiguity. *Journal of Behavioral Decision Making*, *3*, 263–277.

Rogers, R. W. (1983). Cognitive and physiological processes in fear appeals and attitude change. A revised theory of protection motivation. In J. T. Cacioppo & R. E. Petty (Eds.), *Social psychophysiology: A sourcebook* (pp. 153–176). New York: Guilford Press.

Serdula, M., Coates, R., Byers, T., Mokdad, A., Jewell, S., Chavelz, N., Mares-Perlman, J., Newcomb, P., Ritenbaugh, C., Trieber, F., & Block, G. (1993). Evaluation of a brief questionnaire to estimate fruit and vegetable consumption in diverse study population. *Epidemiology*, *4*, 455–463.

Vernon, S. W. (1997). Participation in colorectal cancer screening: A review. *Journal of the National Cancer Institution*, *89*, 1406–1422.

Vernon, S. W. (1999). Risk perception and risk communication for cancer screening behaviors: A review. *Monographs of the National Cancer Institute*, *25*, 101–119.

Walsh, J. M. & Terdiman, J. P. (2003). Colorectal cancer screening: Scientific review. *Journal of the American Medical Association*, *289*, 1288–1296.

Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, *39*, 806–820.

Weinstein, N. D. (1988). The precaution adoption process. *Health Psychology*, *7*, 355–386.

Weinstein, N. D. (1993). Testing four competing theories of health-protective behavior. *Health Psychology*, *12*, 324–333.

Weinstein, N. D., Atwood, K., Puleo, E., Fletcher, R., Colditz, G., & Emmons, K. M. (2004). Colon cancer: Risk perceptions and risk communication. *Journal of Health Communication*, *9*, 53–65.

Weinstein, N. D. & Klein, W. M. (1995). Resistance to debiasing interventions. *Health Psychology*, *14*, 132–140.

Witte, K. (1998). Fear a motivator, fear as inhibitor: Using the extended parallel process model of explain fear appeal success and failures. In P. A. Anderson & L. K. Guerrero (Eds.), *Handbook of communication and emotion: Research, theory, applications, and contexts* (pp. 424–451). San Diego, CA: Academic Press.