



Published in final edited form as:

J Behav Med. 2016 February ; 39(1): 65–74. doi:10.1007/s10865-015-9667-9.

Deliberative and intuitive risk perceptions as predictors of colorectal cancer screening over time

Jennifer L. Hay, Ph.D.¹, Marcel Ramos, B.A.¹, Yuelin Li, Ph.D.¹, Susan Holland, M.A.¹, Debra Brennessel, M.D.², and M. Margaret Kemeny, M.D.²

¹Department of Psychiatry & Behavioral Sciences, Memorial Sloan Kettering Cancer Center

²Mount Sinai Medical Center, Queens Hospital Center

Abstract

Cancer risk perceptions may involve intuitions – including both affect as well as gut-level thoughts about risk – and deliberative risk magnitudes. Yet, little research has examined the potentially diverse relations between risk perceptions and behavior across time. A highly diverse primary care sample (N=544, aged 50) was utilized to compare how deliberative and intuitive perceptions of risk relate to chart-confirmed colorectal cancer screening at cross-sectional and prospective time points. At baseline, deliberative and intuitive risk perceptions were negatively associated with chart-confirmed colorectal cancer screening adherence in bivariable but not multivariable analyses. Among those who were non-adherent with colorectal cancer screening at baseline, deliberative and intuitive risk perceptions were positively associated with prospective uptake of chart-confirmed colorectal cancer screening adherence at 12-months in bivariable analyses; only deliberative risk perceptions remained significant in the multivariable model. This study indicates that diverse risk perceptions are differentially important for screening at different time points.

Keywords

cancer risk perceptions; colorectal cancer screening; primary care; diverse populations

Cancer risk perceptions are key components of decisions regarding both screening and preventive behavior (Slovic et al., 2005). This assertion is consistent with most individual-level theories of health behavior change (Conner & Norman, 2005), and with extensive empirical research (Watts et al., 2003; Woloshin et al., 2000). While risk perceptions are often better predictors of health actions than objective risk status (Aiken et al., 1995; Lipkus et al., 2000), risk perceptions do not predict subsequent behavior adoption with as much strength and consistency as might be predicted from theory (Conner & Norman, 2005; Waters et al., 2013; Weinstein & Nicolich, 1993) for a number of potential reasons.

First, design issues are likely at play. A large proportion of the research has confounded prediction with accuracy by measuring risk perceptions and behavior at one time point only

(Brewer et al., 2004; Gerrard et al., 1996). This research design is not fully interpretable because some people may base their risk judgments on their current protective behavior whereas others may or may not engage in a behavior based on the basis of their risk perceptions; the overall cross-sectional effect size would thus include these two subsamples. While prospective designs more clearly reveal the motivational influence of risk perceptions on behavior, even in prospective studies, the effect of risk perception on behavior may not only be direct, but may also include mediating and moderating effects (McQueen et al., 2010). Second, measurement issues have plagued risk perception research. Risk perceptions have been measured in diverse ways – including comparative, absolute verbal, quantitative likelihood, as well as worry items – which may be differently interpreted with some assessments influenced more by education or numeracy levels than others. Optimistic bias is quite common as well, and any underestimation of risk status influences some measures, such as comparative risk, more than others, such as absolute likelihood assessments (Weinstein & Klein, 1995). Third, risk perception measures have also not consistently directed participants to consider their prior or current behavior in making their risk assessments (Weinstein, 2007), which adds response heterogeneity. Finally, it may be that risk perceptions have a greater influence at the early changes of the risk perception process (Weinstein & Sandman, 1992). Risk perceptions may have a larger effect on upstream attitudes such as active deliberation about behavior change rather than behavior adoption *per se* (Sheeran et al., 2014).

An additional reason why risk perceptions may be inconsistently related to behavior is that the only perceptions of risk considered by these theories and investigations involve perceived likelihood (that is probability) of cancer, which is in line with a view of health behavior as the outcome of a deliberative analysis of statistical risks. These cancer risk perceptions are typically measured using one or more face-valid questions (Diefenbach et al., 1993; Lipkus & Hollands, 1999; Weinstein, 1980, 1982). Implicitly equating risk perceptions solely with magnitude judgments for likelihood and severity is based on the assumption that people respond to cancer risk in an exclusively rational, rule-based manner. More recently, however, intuitive elements of the risk perception process – such as gut-level feelings – have also been found to be important predictors of health behavior (Dillard et al., 2012; Weinstein et al., 2007). For example, Janssen et al. (2014) examined the role of deliberative as well as affect-laden risk beliefs (i.e., how people report feeling about their risk, worry, and anticipated regret) in predicting subsequent sunscreen use and tobacco quit attempts, and found that overall, affect-laden risk beliefs were more important and uniquely predictive than were the deliberative likelihood risks. These findings are consistent with theoretical work highlighting the important role of affect in the risk perception process. For example, Cameron and Leventhal (2003) outlined the Self-Regulation Model based on the processing of health information, both through rational, deliberative processes as well as affective processes. Others have identified the importance of emotion in the rapid, automatic formulation of cancer risk judgments and other decisions as the affect heuristic (Finucane et al., 2000; Peters et al., 2006; Slovic et al., 2005, 2002). The Risk-as-Feelings hypothesis (Loewenstein et al., 2001) proposes that both feelings generated while risk information is being processed and feelings associated with the hazard itself are important to risk assessment. These theories highlight the key role emotion, specifically, in the rapid,

automatic formulation of cancer risk judgments that represent short-cuts used to avoid the time and cost of rational analysis.

However, intuitive risk perceptions may involve gut-level thoughts as well as feelings. Orom and colleagues (2014) found an explicit tendency to employ wishful thinking and hopefulness in evaluating personal cancer risk in an African-American sample. In a similar vein, Hay, Baser, et al. (2014) found that the belief that thinking about cancer risk could encourage cancer development is prevalent across diverse participant samples. Yet the health behavioral outcomes of intuitive cognitions about risk have not been studied. Superstitious thinking surrounding risk assessments has been examined in the social psychological literature (Pronin et al., 2006; Risen & Gilovich, 2008; Subbotsky & Quinteros, 2002; Wegner & Wheatley, 1999), but not in the health context.

In the current study, we examined the role of multiple measures of deliberative and intuitive risk perceptions in promoting colorectal cancer (CRC) screening behavior in a diverse, inner city, primary care population. The association between risk perception and behavior may differ in direction and/or magnitude when both are measured concurrently, compared to when behavioral uptake is measured subsequent to risk perception. Thus, we propose and examine unique theory-driven hypotheses for both the cross-sectional and prospective relationships between risk perceptions and CRC screening. Accordingly we hypothesize (H_1) that the relations between both deliberative and intuitive risk perceptions and CRC screening adherence will be *negative* at the cross-sectional time point. This is consistent with an accuracy hypothesis (Brewer et al., 2004); those who are already adherent to CRC screening will have lower deliberative and intuitive risk perceptions than those who are non-adherent to screening. Indeed, the reduction of risk perception, or at least the belief that one has taken appropriate steps to manage risk, is one potential motivator of adopting health behavior. Additionally, CRC screening via colonoscopy and sigmoidoscopy can reduce objective risk by polyp removal (Brenner et al., 2012).

In contrast, the behavior motivation hypothesis (Brewer et al., 2004) proposes that risk perceptions would predict prospective uptake of CRC screening. This is consistent with an extensive body of work substantiating that risk perceptions motivate health protective behavior (Conner & Norman, 2005). Accordingly we hypothesize (H_2) that the relation between both deliberative and intuitive risk perceptions and CRC screening adherence will be *positive* at 12-month prospective follow-up.

This expanded study of the risk appraisal process – both thoughts and feelings about risk and outcomes at multiple time points – may improve our understanding of how behavior influences risk perceptions, may improve current interventions that seek to raise CRC risk awareness, and finally may suggest new strategies to motivate and encourage maintenance of cancer screening and cancer risk reduction behaviors, particularly in diverse populations where standard, risk-based CRC screening interventions have been universally useful (Vernon et al., 2011).

Methods

Study Participants

Primary care patients were approached and offered study participation between 2009 and 2011 by trained research study assistants at the Queens Hospital Center (QHC) ambulatory care clinic. Queens Hospital Center is a member of the New York City Health and Hospitals Corporation, the public safety net healthcare system of New York City, and serves central and southeastern Queens, communities with a large proportion of New Americans. Standard care at QHC involved physician recommendation for colorectal cancer screening for those patients aged 50 and older.

As part of a larger study of risk perceptions in diverse populations aged 18 and older, patients in this clinic were eligible and recruited if they did not have a personal history of colorectal cancer and were English-language fluent. Among those 2466 persons initially approached, 799 (32%) consented to study participation while 1667 refused (68%). Reasons for refusal included 'not being interested' (60%), 'not having time' (27%), 'not feeling well' (5%), beliefs that 'cancer is too sensitive to discuss' (5%), or 'other reasons' (3%). Of those aged 50 and older, 95% had complete baseline data and were evaluable for the current study (N=544). The study was approved by the Institutional Review Board of Memorial Sloan Kettering Cancer Center and QHC.

Procedure

Study participation involved completion of a baseline survey assessing CRC risk perceptions and demographics, and consent for chart review of CRC screening status. Adherence to CRC screening was evaluated through chart review of the QHC Electronic Medical Record. Research assistants were trained by Dr. Debra Brennessel, QHC Ambulatory Care Clinic Director, in conducting the chart reviews. The reviews were performed within two weeks of baseline survey administration. National Cancer Institute (NCI) information about CRC screening was provided to all participants after baseline assessment. All participants received a \$15 New York City Transportation MetroCard in thanks for study participation. A subsequent 12-month follow-up chart review was also conducted for only those participants who were non-adherent with CRC screening by chart review at baseline to evaluate whether they had received screening since the baseline assessment.

Measures

Colorectal cancer risk perceptions. Deliberative and intuitive risk perceptions were assessed. Deliberative risk perceptions included numerical and comparative risk likelihood (Weinstein, 1980, 1982). The perceived percent chance of colorectal cancer risk was measured using an 11-level item from 0 to 100 by 10 percent intervals. Two comparative risk items were used. The first item asked, "Compared to the average person of your age and gender, what is the chance that you will develop colorectal cancer in the future?" The second comparative risk item asked, "Compared to the average patient at the Queens Hospital Center, what is the chance that you will develop colorectal cancer in the future?" Possible responses for both items ranged from "well below average" to "well above

average” on a 5-level scale. The comparative items were highly reliable ($\alpha = 0.82$) and were thus combined for further analyses.

Intuitive risk perceptions included affective and cognitive variables. Affective risk perception included two items (Weinstein et al., 2007). The first item asked the level of agreement with the statement, “I feel that I’m going to get colorectal cancer someday.” The 4-level response scale ranged from “disagree strongly” to “agree strongly.” The second item asked for the level of agreement on the same scale to the statement, “I feel very vulnerable to developing colorectal cancer someday...” These items had high reliability ($\alpha = 0.80$) and were combined for further analyses. Cancer worry was assessed with the following item, “Are you worried about getting colorectal cancer some day?” derived from Lerman et al. (1991). The 5-level response scale included levels of worry as “not at all”, “rarely”, “sometimes”, “often” and “almost all the time.” Negative affect in risk (six-item scale) involves negative feelings generated during the risk perception process, and included items such as “I get frightened when I think I could get cancer” and “Thinking about getting cancer makes me afraid” (Hay, Baser, et al., 2014).

Three validated scales were used to assess cognitive aspects of intuitive risk perceptions (Hay, Baser, et al., 2014). Cognitive causation (10-item scale) involves intuitive beliefs that thinking about risk can influence disease risk, including items such as, “If I think too hard about the possibility of getting cancer, I could get it” and “Too much thought about cancer risk could encourage the disease.” Preventability of Cancer (five-item scale) involves beliefs about whether cancer is controllable, including items such as, “There isn't much anyone can do to control whether they get cancer or not.” Finally, Unpredictability of Cancer (five-item scale) involves beliefs about irreducible uncertainties about getting cancer, such as, “You never know who is going to get cancer.” Each of these scales used 4-level response options indicating level of agreement, from “strongly disagree” to “strongly agree”.

Demographics. Age, gender, Hispanic ethnicity, racial group identity, religious affiliation, United States nativity, marital status, education, and income were assessed. Familial history of cancer and colorectal cancer were also included as demographic items of interest.

Colorectal Cancer Screening Adherence. Colorectal cancer screening status was assessed using chart-reviews using the CRC screening recommendations set forth by the U.S. Preventive Services Task Force (2008). The CRC screening tests considered in this study are the Fecal Occult Blood Test (FOBT), the flexible sigmoidoscopy, and the colonoscopy. The recommended testing intervals are as follows: once a year for an FOBT, once every 5 years for a flexible sigmoidoscopy, and once every 10 years for a colonoscopy. Participants are reported as being current or not current within the guidelines in any of these three tests at baseline and again at the 12-month follow-up among those who were non-adherent at baseline.

Statistical Approach

Cronbach's alpha statistics were sought to describe the internal consistency of risk perception items. Pearson correlation coefficients were used for describing associations in general, and for the consideration of covariate inclusion in multivariable analyses. Logistic

regression was used to model bivariable relationships between baseline characteristics and colorectal cancer screening adherence. Multicollinearity diagnostics as described in Fox and Monette (1992) were performed and no issues with highly correlated variables were evident.

Results

Table 1 reports the demographic characteristics of the QHC sample (N=544). The sample was highly diverse. Participants, on average, were age 61 (SD=7.3), 55% female, and largely (92%) non-Hispanic. One-third (31%) were of African American descent, 21% reported being Caribbean black, 24% of participants reported being of mixed race or of another race, and 14% were Asian or Pacific Islander identity. About half (47%) were married or living with a partner. A vast majority of participants (77%) reported being born outside of the United States. The most frequent religion endorsed was Christianity (62%) followed by Hinduism and Islam (20% and 8%, respectively). About 42% had less than a high school education or equivalent. Thirty-two percent of participants' incomes were less than \$10,000 dollars, 30% had an income between \$10,000 and \$30,000 dollars and 16% had an income greater than \$30,000. One third (30%) had a family history of cancer and 6% a family history of colorectal cancer.

Adherence with CRC screening

Of the 544 total eligible participants, 18 chart reviews were not able to be completed due to inaccessible charts; thus, 526 participants had information on their current colorectal cancer screening status. At baseline, 59% of participants were adherent within the USPSTF guidelines (U.S. Preventive Services Task Force, 2008). Accordingly, 215 (41%) participants who were non-adherent at baseline underwent an additional chart review after 12 months. Of those who were followed up at 12 months, 6 chart reviews were not able to be completed due to inaccessible charts; therefore, 209 participants were included in the follow-up analyses. At follow-up, 38% of the previously non-adherent sample had undergone CRC screening by the end of the study.

We examined the association of the demographic variables with baseline and follow-up screening. At baseline, age was the only demographic variable found to be significantly related to colorectal cancer screening adherence. For every 10 year increase in age, participants were at 1.38 times the odds of being adherent with CRC screening (95% CI: 1.08 – 1.76; $p = 0.01$). At follow-up, no significant relationships were found between demographic characteristics and 12-month CRC screening adherence with all p -values equal to or greater than 0.163. Cross-sectional associations between risk perceptions and CRC screening (H_1)

Table 2 shows a correlation matrix of baseline risk perception, CRC screening variables, and Cronbach's alpha reliabilities for diverse risk perception subscales. In general, the perceived risk variables are moderately correlated and have moderate to strong measurement reliability ranging from 0.49 to 0.85. The perceived percent chance of developing CRC, affective risk perception, CRC worry, negative affect in risk, and cognitive causation are all negatively related to CRC screening at the 0.1 level. Bivariable and multivariable logistic regressions were performed using these five variables as well as significant demographic predictors of

screening (Table 3). Consistent with H₁, we found negative relationships between risk perceptions and CRC screening at baseline; we did not find evidence that any specific risk perception measurement approach was uniquely or more strongly related to baseline CRC screening. Prospective relationships between risk perceptions and CRC screening at 12 months (H₂)

Table 4 shows a series of correlations between baseline risk perceptions and subsequent CRC screening adherence status at 12 months. Consistent with H₂, risk perceptions were positively related with CRC screening at 12 months. In particular, deliberative magnitude judgments (percent chance of developing CRC but not comparative risk) and affective risk perceptions were significantly and positively associated with subsequent CRC screening in the bivariable model; preventability was negatively related to CRC screening uptake. Only percent chance of developing CRC remained significantly predictive of CRC screening uptake in the multivariable model. Using a variable selection criterion of a lower than 0.1 alpha-level, Table 5 shows the bivariable and multivariable logistic regressions along with the means for each adherence group in the 12-month follow-up screening variable. Among participants who were not current at baseline (n = 209), there was a 1.15 OR increase in becoming adherent to CRC screening for every ten percent increase in perceived percent chance of developing CRC when controlling for affective risk perception and preventability of cancer ($p = 0.052$).

Discussion

In this study we examine the role of deliberative and intuitive risk perceptions and both concurrent CRC screening status (the cross-sectional relationship), as well as subsequent CRC screening uptake (the prospective relationship), proposing distinct hypotheses based on theory and prior empirical findings using chart-confirmed CRC screening in an inner city, primary care, highly diverse population. In recent years, it has become clear that cross-sectional relationships between risk perceptions and screening assess distinct yet important relationships from what can be evaluated in prospective designs (Brewer et al., 2004; Glenn et al., 2011; Hay et al., 2007), where risk perceptions are assessed as motivators of subsequent behavior uptake. It has also become increasingly clear in recent years that the risk perception process involves deliberative and intuitive elements (Dillard et al., 2012; Janssen et al., 2014; Weinstein et al., 2007), but intuitive thoughts and feelings about risk have not been well-examined to date. By definition, intuitive risks involve the gut-level thoughts and feelings generated during the risk perception process. Findings from the current study indicate that deliberative and intuitive risk perceptions are both significantly associated with concurrent CRC screening status, as well as uptake of CRC screening by 12 months.

At baseline, consistent with our hypothesis (H₁) that the relations between deliberative and intuitive risk perceptions and CRC screening adherence would be *negative* at the cross-sectional time point (Brewer et al., 2004), we found consistent negative relationships between risk perceptions and CRC screening at the bivariable level. Deliberative risk perceptions (percent chance but not comparative risk of developing CRC) were negatively related to CRC screening adherence. Intuitive risk perceptions (affective risk perceptions,

negative affect in risk, cognitive causation, but not unpredictability of cancer or preventability of cancer), were negatively related to CRC screening adherence. As such, those who were adherent with CRC screening had *lower* deliberative and intuitive risk perceptions than those who were non-adherent. This may be because CRC screening leads to reductions in perceptions of risk likelihood among those who have already been screened (Glenn et al., 2011). The current study extends this to intuitive perceptions of risk. Those who complete screening believe they are at somewhat less risk of developing CRC, and feel less vulnerable to CRC, report that thinking about cancer risk raises less emotion, and feel less superstitious about cancer in general.

We further hypothesized (H₂) that the relations between deliberative and intuitive risk perceptions and CRC screening adherence would be *positive* at 12-month follow-up (Brewer et al., 2004). Importantly, after the baseline assessment we provided all participants with standard NCI information about screening guidelines, which may have prompted screening in some participants who were screening non-adherent at baseline. Consistent with this, we found that risk perceptions predicted subsequent CRC screening adoption. Specifically, percent chance of developing CRC and affective risk perceptions predicted screening uptake. In contrast with cross-sectional analyses, negative affect in risk, cognitive causation, and unpredictability of cancer were unrelated to screening uptake. Also in contrast with cross-sectional analyses, beliefs about the preventability of cancer in general were negatively related to screening uptake, such that those who thought cancer was more preventable were less likely to be adherent with CRC screening by 12 months. Further, we found that the only deliberative risk was retained in the multivariable equation; percent chance of developing CRC.

It is important to note that we conducted our research in a specific setting, a New York City Health and Hospitals Corporation public safety net healthcare system of New York City, where CRC screening recommendations are universally provided regardless of ability to pay, making screening uptake relatively straightforward and the influence of demographic variables potentially less important given the reduction of critical systemic barriers to screening – such as physician recommendation or insurance coverage for CRC screening. Indeed, despite the fact that our sample was a highly diverse inner-city sample, the baseline CRC screening rate found here (59%) was consistent with national screening rates (Shapiro et al., 2012). The only demographic variable related to baseline CRC screening was, predictably, age; and even this variable was not related to subsequent screening at 12 months. Despite this, deliberative risk perceptions (perceived percent chance of developing CRC) were related to screening uptake at 12 months, attesting to the importance of risk perceptions even in this ideal setting.

At the same time, this unique setting may have contributed to the more modest effects of risk perceptions on screening than has been reported in other work, especially the lack of effect of comparative risk perceptions on CRC screening adherence found here, which is in contrast to other studies (e.g., (Hay et al., 2006). There is coalescing evidence that risk perceptions have significant but modest effects on CRC screening (Atkinson et al., 2015), and this may be particularly true in the current sample since cost and physician recommendation were not issues in this primary care, inner city population where CRC

screening had been prioritized. Accordingly we cannot generalize these findings to other situations where patients may need to be more activated to request and schedule CRC screening; these may be situations where perceived risks, including both deliberative and intuitive risks, may be quite important. As well, numeracy levels may be quite diverse in this population, as education levels were very diverse, and so it may not be surprising that deliberative risk assessments might be poorer predictors of CRC screening than in more numerate, educated samples.

What are intervention implications of this research? To intervene on intuitive risk perceptions, narrative interventions may be useful to resolve or dispelling of superstitious thinking about risk, as well as negative affect in the risk context, via modeling stories about other people that address and identify risk intuitions. One interesting outcome of this research is that intuitive risks may be more important at the cross sectional time point than the prospective time point. Those who have not screened may be more superstitious about their risk, and potentially then less amenable to continued efforts to get them to appreciate their risk, and thus this group may require enhanced intervention, or intervention that target constructs other than risk, to manage or work around their risk-related intuitions such as superstitious thinking.

Yet we do not propose that interventionists should be particularly impressed by the significant prospective relations between risk perceptions and CRC screening per se, but rather that the use of strong designs in diverse populations and contexts is required to disentangle the intriguing and potentially important complexity in the risk perception-behavior relation. As such we advocate for further investigating the role of multiple risk perceptions (deliberative, intuitive) and CRC screening in prospective as well as cross-sectional studies. Further work is also required to better understand how intuitive risk perceptions may contribute to deliberative risk judgements, as well. Further research should identify subpopulations and contexts where perceived risk may be a useful motivator of screening, and those where environmental supports may preclude the need for this.

Study limitations include the fact that chart-confirmed screening could have underreported CRC screening status if patients had been screened elsewhere. There was very good concordance (77%) between self-reported and chart-confirmed CRC screening with screening adherence by self-report only slightly higher than chart-reviewed adherence (64% versus 59%, respectively), yet to be conservative we chose to use chart-confirmed screening as our primary outcome variable. We also did not counterbalance risk perception items, which may have influenced study findings. Study strengths include the use of chart-confirmed screening as our outcome, the large, diverse study sample employed, as well as the opportunity to examine this study population over time.

In conclusion, our findings attest the importance of measuring the associations of risk perceptions – both deliberative and intuitive – at multiple time points, and specifying specific hypotheses for specific time points. Conducting risk perception research with diverse populations is a critical step in understanding the diverse range of ways that deliberative and intuitive risk perceptions function in and across diverse cultures, that has the potential to shed light on how people manage uncertainty in general (Hofstede, 2001),

and the health risk perception process in particular, probably differ across cultures (Francois et al., 2009; Huerta & Macario, 1999; Joseph et al., 2009; Lee, 2010; Pasick et al., 2009). We are currently conducting work validating Spanish and Haitian translations of intuitive risk perception measures (Hay, Brennessel, et al., 2014) and examining risk perception and patient activation across diverse language groups (Hay et al., 2015). Consistent with Weinstein et al. (2007), understanding the specific behavioral context – such as whether behaviors that influence risk have been performed previously or not - may influence deliberative or intuitive risk perceptions, and should be considered in interventions developed to encourage adoption or maintenance of that behavior. The positive prospective relations between baseline deliberative and intuitive risk perceptions and subsequent uptake of CRC screening by 12 months is consistent with most health behavior theories (Conner & Norman, 2005), confirms the importance of continuing to explore the understudied issue of intuitive risk perceptions and behavior (Janssen et al., 2014), and confirms the importance of deliberative risk perceptions in motivating behavior adoption.

Acknowledgements

We acknowledge the support of NIH grants CA098106 and CA133376 to Jennifer Hay PhD, and Shoshana Shiloh PhD for her contributions to study interpretation. We thank Linda Bulone RN, as well as Ollie Ganz MPH and Kate Hariton BFA for their aid in completing the study. We also thank and our study participants for their time and efforts.

References

- Aiken LS, Fenaughty AM, West SG, Johnson JJ, Lockett TL. Perceived determinants of risk for breast cancer and the relations among objective risk, perceived risk, and screening behavior over time. *Womens Health*. 1995; 1(1):27–50. [PubMed: 9373372]
- Atkinson T, Salz T, Hay J. Does colorectal cancer risk perception predict screening behavior? A systematic review and meta-analysis. *Journal of Behavioral Medicine*. 2015 Under Review.
- Brenner H, Chang-Claude J, Rickert A, Seiler CM, Hoffmeister M. Risk of colorectal cancer after detection and removal of adenomas at colonoscopy: population-based case-control study. *Journal of Clinical Oncology*. 2012; 30(24):2969–2976. doi: 10.1200/jco.2011.41.3377. [PubMed: 22826281]
- Brewer NT, Weinstein ND, Cuite CL, Herrington JE. Risk perceptions and their relation to risk behavior. *Annals Behavioral Medicine*. 2004; 27(2):125–130. doi: 10.1207/s15324796abm2702_7.
- Cameron, LD.; Leventhal, H. *The self-regulation of health and illness behaviour*. Routledge; London ; New York: 2003.
- Conner, M.; Norman, P., editors. *Predicting health behaviour: Research and practice with social cognition models*. 2nd edition. Open University Press; Buckingham: 2005.
- Diefenbach MA, Weinstein ND, O'Reilly J. Scales for assessing perceptions of health hazard susceptibility. *Health Education Research*. 1993; 8(2):181–192. [PubMed: 10148827]
- Dillard AJ, Ferrer RA, Ubel PA, Fagerlin A. Risk perception measures' associations with behavior intentions, affect, and cognition following colon cancer screening messages. *Health Psychology*. 2012; 31(1):106–113. doi: 10.1037/a0024787. [PubMed: 21806302]
- Finucane ML, Alhakami A, Slovic P, Johnson SM. The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*. 2000; 13(1):1–17. doi: 10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S.
- Fox J, Monette G. Generalized Collinearity Diagnostics. *Journal of the American Statistical Association*. 1992; 87(417):178–183.
- Francois F, Elysee G, Shah S, Gany F. Colon cancer knowledge and attitudes in an immigrant Haitian community. *Journal of Immigrant and Minority Health / Center for Minority Public Health*. 2009; 11(4):319–325. doi: 10.1007/s10903-008-9126-6. [PubMed: 18322798]

- Gerrard M, Gibbons FX, Bushman BJ. Relation between perceived vulnerability to HIV and precautionary sexual behavior. *Psychological Bulletin*. 1996; 119(3):390–409. [PubMed: 8668745]
- Glenn BA, Herrmann AK, Crespi CM, Mojica CM, Chang LC, Maxwell AE, Bastani R. Changes in risk perceptions in relation to self-reported colorectal cancer screening among first-degree relatives of colorectal cancer cases enrolled in a randomized trial. *Health Psychology*. 2011; 30(4): 481–491. doi: 10.1037/a0024288. [PubMed: 21744967]
- Hay, JL.; Baser, R.; Weinstein, ND.; Li, Y.; Primavera, LH.; Kemeny, MM. Examining intuitive risk perceptions for cancer in diverse populations.; *Health Risk and Society*. 2014. p. 1-16. doi: <http://dx.doi.org/10.1080/13698575.2014.911822>
- Hay JL, Brennessel D, Kemeny MM, Lubetkin EI. Examining Intuitive Cancer Risk Perceptions in Haitian-Creole and Spanish-Speaking Populations. *Journal of Transcultural Nursing*. 2014 doi: 10.1177/1043659614561679.
- Hay JL, Coups E, Ford J. Predictors of perceived risk for colon cancer in a national probability sample in the United States. *Journal of Health Communication*. 2006; 11(Suppl 1):71–92. doi: 10.1080/10810730600637376. [PubMed: 16641075]
- Hay JL, Ostroff J, Burkhalter J, Li Y, Quiles Z, Moadel A. Changes in cancer-related risk perception and smoking across time in newly-diagnosed cancer patients. *Journal of Behavioral Medicine*. 2007; 30(2):131–142. doi: 10.1007/s10865-007-9094-7. [PubMed: 17334916]
- Hay JL, Zabor EC, Kumar J, Brennessel D, Kemeny MM, Lubetkin EI. Cancer Beliefs and Patient Activation in Diverse, Multi-lingual Primary Care. 2015 Manuscript in preparation.
- Hofstede, G. *Culture's consequences: Comparing values, behaviors, institutions, and organizations across nations*. Sage Publications; Thousand Oaks, CA: 2001.
- Huerta EE, Macario E. Communicating health risk to ethnic groups: reaching Hispanics as a case study. *Journal of the National Cancer Institute Monographs*. 1999; (25):23–26. [PubMed: 10854453]
- Janssen E, Waters EA, van Osch L, Lechner L, de Vries H. The importance of affectively-laden beliefs about health risks: the case of tobacco use and sun protection. *Journal of Behavioral Medicine*. 2014; 37(1):11–21. doi: 10.1007/s10865-012-9462-9. [PubMed: 23073599]
- Joseph G, Burke NJ, Tuason N, Barker JC, Pasick RJ. Perceived susceptibility to illness and perceived benefits of preventive care: an exploration of behavioral theory constructs in a transcultural context. *Health Education & Behavior*. 2009; 36(5 Suppl):71s–90s. doi: 10.1177/1090198109338915. [PubMed: 19805792]
- Lee SJ. Uncertain Futures: Individual Risk and Social Context in Decision-Making in Cancer Screening. *Health, Risk & Society*. 2010; 12(2):101–117. doi: 10.1080/13698571003637048.
- Lerman C, Trock B, Rimer BK, Jepson C, Brody D, Boyce A. Psychological side effects of breast cancer screening. *Health Psychology*. 1991; 10(4):259–267. [PubMed: 1915212]
- Lipkus IM, Hollands JG. The visual communication of risk. *Journal of the National Cancer Institute Monographs*. 1999; (25):149–163. [PubMed: 10854471]
- Lipkus IM, Kuchibhatla M, McBride CM, Bosworth HB, Pollak KI, Siegler IC, Rimer BK. Relationships among breast cancer perceived absolute risk, comparative risk, and worries. *Cancer Epidemiology, Biomarkers & Prevention*. 2000; 9(9):973–975.
- Loewenstein GF, Weber EU, Hsee CK, Welch N. Risk as feelings. *Psychological Bulletin*. 2001; 127(2):267–286. [PubMed: 11316014]
- McQueen A, Vernon SW, Rothman AJ, Norman GJ, Myers RE, Tilley BC. Examining the role of perceived susceptibility on colorectal cancer screening intention and behavior. *Annals Behavioral Medicine*. 2010; 40(2):205–217. doi: 10.1007/s12160-010-9215-3.
- Orom H, O'Quin KE, Reilly S, Kiviniemi MT. Perceived cancer risk and risk attributions among African-American residents of a low-income, predominantly African-American neighborhood. *Ethnicity & Health*. 2014:1–14. doi: 10.1080/13557858.2014.950197.
- Pasick RJ, Burke NJ, Barker JC, Joseph G, Bird JA, Otero-Sabogal R, Guerra C. Behavioral theory in a diverse society: like a compass on Mars. *Health Education & Behavior*. 2009; 36(5 Suppl):11s–35s. doi: 10.1177/1090198109338917. [PubMed: 19805789]

- Peters E, McCaul KD, Stefanek M, Nelson W. A heuristics approach to understanding cancer risk perception: contributions from judgment and decision-making research. *Annals of Behavioral Medicine*. 2006; 31(1):45–52. doi: 10.1207/s15324796abm3101_8. [PubMed: 16472038]
- Pronin E, Wegner DM, McCarthy K, Rodriguez S. Everyday magical powers: the role of apparent mental causation in the overestimation of personal influence. *Journal of Personality and Social Psychology*. 2006; 91(2):218–231. doi: 10.1037/0022-3514.91.2.218. [PubMed: 16881760]
- Risen JL, Gilovich T. Why people are reluctant to tempt fate. *Journal of Personality and Social Psychology*. 2008; 95(2):293–307. doi: 10.1037/0022-3514.95.2.293. [PubMed: 18665703]
- Shapiro JA, Klabunde CN, Thompson TD, Nadel MR, Seeff LC, White A. Patterns of colorectal cancer test use, including CT colonography, in the 2010 National Health Interview Survey. *Cancer Epidemiology, Biomarkers & Prevention*. 2012; 21(6):895–904. doi: 10.1158/1055-9965.epi-12-0192.
- Sheeran P, Harris PR, Epton T. Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychological Bulletin*. 2014; 140(2):511–543. doi: 10.1037/a0033065. [PubMed: 23731175]
- Slovic P, Peters E, Finucane ML, Macgregor DG. Affect, risk, and decision making. *Health Psychology*. 2005; 24(4 Suppl):S35–40. doi: 10.1037/0278-6133.24.4.s35. [PubMed: 16045417]
- Slovic, P.; Peters, E.; Finucane, ML.; Macgregor, DG., editors. *The affect heuristic*. Cambridge University Press; Cambridge, England: 2002.
- Subbotsky E, Quinteros G. Do cultural factors affect causal beliefs? Rational and magical thinking in Britain and Mexico. *British Journal of Psychology*. 2002; 93(Pt 4):519–543. [PubMed: 12519532]
- U.S. Preventive Services Task Force. Colorectal Cancer Screening Recommendation Summary. 2008. from <http://www.uspreventiveservicestaskforce.org/Page/Topic/recommendation-summary/colorectal-cancer-screening>
- Vernon SW, Bartholomew LK, McQueen A, Bettencourt JL, Greisinger A, Coan SP, Myers RE. A randomized controlled trial of a tailored interactive computer-delivered intervention to promote colorectal cancer screening: sometimes more is just the same. *Annals of Behavioral Medicine*. 2011; 41(3):284–299. doi: 10.1007/s12160-010-9258-5. [PubMed: 21271365]
- Waters, E.; McQueen, A.; Cameron, L. Perceived risk and its relationship to health-related decisions and behavior. In: Martin, LR.; DiMatteo, MR., editors. *The Oxford handbook of health communication, behavior change, and treatment adherence*. Oxford University Press; New York, New York: 2013. p. 193-213.p. 519
- Watts BG, Vernon SW, Myers RE, Tilley BC. Intention to be screened over time for colorectal cancer in male automotive workers. *Cancer Epidemiology, Biomarkers & Prevention*. 2003; 12(4):339–349.
- Wegner DM, Wheatley T. Apparent mental causation. Sources of the experience of will. *American Psychologist*. 1999; 54(7):480–492. [PubMed: 10424155]
- Weinstein N. Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*. 1980; 39(5):806–820. doi: 10.1037/0022-3514.39.5.806.
- Weinstein N. Unrealistic optimism about susceptibility to health problems. *Journal of Behavioral Medicine*. 1982; 5(4):441–460. [PubMed: 7154065]
- Weinstein N. Misleading tests of health behavior theories. *Annals of Behavioral Medicine*. 2007; 33(1):1–10. doi: 10.1207/s15324796abm3301_1. [PubMed: 17291165]
- Weinstein N, Klein W. Resistance of personal risk perceptions to debiasing interventions. *Health Psychology*. 1995; 14(2):132–140. [PubMed: 7789348]
- Weinstein N, Kwitel A, McCaul KD, Magnan RE, Gerrard M, Gibbons FX. Risk perceptions: assessment and relationship to influenza vaccination. *Health Psychology*. 2007; 26(2):146–151. doi: 10.1037/0278-6133.26.2.146. [PubMed: 17385965]
- Weinstein N, Nicolich M. Correct and incorrect interpretations of correlations between risk perceptions and risk behaviors. *Health Psychology*. 1993; 12(3):235–245. [PubMed: 8500454]
- Weinstein N, Sandman PM. A model of the precaution adoption process: evidence from home radon testing. *Health Psychology*. 1992; 11(3):170–180. [PubMed: 1618171]

Woloshin S, Schwartz LM, Byram S, Fischhoff B, Welch HG. A new scale for assessing perceptions of chance: a validation study. *Medical Decision Making*. 2000; 20(3):298–307. [PubMed: 10929852]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 1

Demographic characteristics of eligible QHC participants (n=544)

Variables	n (%)
Age in years M (SD)	60.9 (7.3)
Median (Range)	60 (50 - 87)
Female	301 (55.3)
Hispanic	46 (8.4)
Race	
Asian/Pacific Islander	78 (14.3)
African American	166 (30.5)
Caribbean Black	115 (21.1)
Mixed Race/Other	132 (24.3)
White	32 (5.9)
Foreign born	417 (76.7)
Religion	
Christianity	338 (62.1)
Hinduism	111 (20.4)
Islam	42 (7.7)
Other/None	45 (8.3)
Marital status	
Married/Living with partner	256 (47.1)
Single	118 (21.7)
Divorced/Separated	106 (19.5)
Widowed	57 (10.5)
Educational Attainment	
Less than 7th grade	141 (25.9)
Junior HS/Some HS	85 (15.6)
HS Graduate/GED	140 (25.7)
Some college	145 (26.7)
College degree	23 (4.2)
Family history of cancer	162 (29.8)
Family history of CRC	33 (6.1)
Income category	
< \$10,000	176 (32.4)
\$10,000 to \$29,999	165 (30.3)
> \$30,000	89 (16.4)
Missing	114 (21.0)

Note. QHC = Queens Hospital Center, CRC = Colorectal Cancer

Table 2
 Pearson's Correlation Coefficient Matrix of Risk Perception and Baseline Colorectal Cancer Screening (N=544)

Variables	M (SD)	Scale Range	α	1	2	3	4	5	6	7	8	9
1. Chance of Developing CRC [‡]	25.9 (23.6)	0-100	-	-								
2. Comparative Risk Perception	2.48 (0.91)	1-5	0.82	0.458 ^d	-							
3. Affective Risk Perception	1.84 (0.87)	1-4	0.80	0.473 ^d	0.358 ^d	-						
4. CRC Worry	2.04 (1.14)	1-5	-	0.431 ^d	0.328 ^d	0.463 ^d	-					
5. Negative Affect in Risk	2.84 (0.85)	1-4	0.85	0.205 ^d	0.139 ^c	0.224 ^d	0.303 ^d	-				
6. Cognitive Causation	2.15 (0.69)	1-4	0.82	0.001	-0.046	0.187 ^d	0.081 ^a	0.319 ^d	-			
7. Unpredictability of Cancer	3.29 (0.57)	1-4	0.57	0.141 ^c	0.140 ^c	0.144 ^c	0.117 ^c	0.044	0.300 ^d	-		
8. Preventability of Cancer	2.77 (0.61)	1-4	0.49	-0.045	-0.099 ^b	-0.128 ^c	-0.032	-0.178 ^d	-0.127 ^c	-0.272 ^d	-	
9. Screening Adherence [‡]	-	-	-	-0.080 ^a	-0.048	-0.101 ^b	-0.073 ^a	-0.098 ^b	-0.083 ^a	-0.051	-0.020	-

Note. CRC = Colorectal Cancer, QHC = Queens Hospital Center. α = Cronbach's alpha; alpha could not be calculated for single items. *p*-values:

^a < 0.10

^b < 0.05

^c < 0.01

^d < 0.001.

[‡] Chance is measured in percents as an 11-level item with a range from 0 to 100 by 10% increments.

[‡] Point-biserial correlations were used for Screening Adherence and *n* = 526 due to missing data on screening.

Table 3
 Bivariable and Multivariable Predictors of Adherence to Screening at Baseline (N=526)

Variables	Not Current (n=215) M (SD)	Current (n=311) M (SD)	Unadjusted Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio	95% Confidence Interval	Wald's χ^2
Chance of Developing CRC [‡]	28.3 (25.2)	24.4 (22.6)	0.934 ^a	(0.86 - 1.01)	0.946	(0.86 - 1.04)	1.255
Affective Risk Perception	1.94 (0.95)	1.77 (0.80)	0.790 ^b	(0.65 - 0.97)	0.923	(0.70 - 1.21)	0.335
CRC Worry	2.13 (1.20)	1.96 (1.08)	0.878 ^a	(0.75 - 1.02)	0.998	(0.81 - 1.23)	0.000
Negative Affect in Risk	2.93 (0.84)	2.78 (0.86)	0.818 ^a	(0.66 - 1.01)	0.877	(0.68 - 1.12)	1.071
Cognitive Causation	2.23 (0.73)	2.09 (0.65)	0.748 ^b	(0.58 - 0.97)	0.782	(0.58 - 1.05)	2.649
Age [‡]	59.9 (7.11)	61.6 (7.51)	1.378 ^b	(1.08 - 1.76)	1.284	(0.98 - 1.69)	3.220 ^d

Note. CRC = Colorectal Cancer.

c < 0.01

[‡]Chance is measured in percents as an 11-level item with a range from 0 to 100 by 10% increments. *p*-values:

^a < 0.10

^b < 0.05

^d < 0.001.

[‡]Odds ratios reflect a 10-year increase in age.

Table 4

Point-biserial Correlation Coefficients between Risk Perception and Colorectal Cancer Screening Adherence at 12-month Follow-Up (n=209)

Variables	12-month Follow-up Screening Adherence
Chance of Developing CRC [‡]	0.187 ^b
Comparative Risk Perception	0.068
Affective Risk Perception	0.122 ^a
CRC Worry	0.100
Negative Affect in Risk	0.000
Cognitive Causation	0.034
Unpredictability of Cancer	-0.019
Preventability of Cancer	-0.123 ^a

Note. CRC = Colorectal Cancer, QHC=Queens Hospital Center. *p*-values:

^c < 0.01

^d < 0.001.

^a < 0.10

^b < 0.05

[‡]Chance is measured in percents as an 11-level item with a range from 0 to 100 by 10% increments.

Table 5
 Multivariable Predictors of Adherence to Screening at 12-month Follow-up (n=209)

Variables	Not Current (n=129) M (SD)	Newly Current (n=80) M (SD)	Unadjusted Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio	95% Confidence Interval	Wald's χ^2
Chance of Developing CRC [‡]	24.3 (23.1)	33.9 (26.7)	1.169 ^b	(1.04 - 1.32)	1.150	(1.00 - 1.32)	3.772 ^a
Affective Risk Perception	1.84 (0.87)	2.08 (1.03)	1.305 ^a	(0.97 - 1.76)	0.997	(0.68 - 1.47)	0.000
Preventability of Cancer	2.84 (0.64)	2.69 (0.57)	0.657 ^a	(0.41 - 1.05)	0.690	(0.41 - 1.16)	1.957

Note. CRC = Colorectal Cancer.

c < 0.01

d < 0.001.

[‡] Chance is measured in percents as an 11-level item with a range from 0 to 100 by 10% increments. *p*-values:

^a < 0.10

^b < 0.05