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# Dispositional Optimism and Perceived Risk Interact to Predict Intentions to Learn Genome Sequencing Results

**Jennifer M. Taber**, **William M. P. Klein**, **Rebecca A. Ferrer**, **Katie L. Lewis**, **Leslie G. Biesecker**, and **Barbara B. Biesecker**

National Institutes of Health

## Abstract

**Objective—**Dispositional optimism and risk perceptions are each associated with health-related behaviors and decisions and other outcomes, but little research has examined how these constructs interact, particularly in consequential health contexts. The predictive validity of risk perceptions for health-related information seeking and intentions may be improved by examining dispositional optimism as a moderator, and by testing alternate types of risk perceptions, such as comparative and experiential risk.

**Method—**Participants ($n$ = 496) had their genomes sequenced as part of a National Institutes of Health pilot cohort study (ClinSeq®). Participants completed a cross-sectional baseline survey of various types of risk perceptions and intentions to learn genome sequencing results for differing disease risks (e.g., medically actionable, nonmedically actionable, carrier status) and to use this information to change their lifestyle/health behaviors.

**Results—**Risk perceptions (absolute, comparative, and experiential) were largely unassociated with intentions to learn sequencing results. Dispositional optimism and comparative risk perceptions interacted, however, such that individuals higher in optimism reported greater intentions to learn all 3 types of sequencing results when comparative risk was perceived to be higher than when it was perceived to be lower. This interaction was inconsistent for experiential risk and absent for absolute risk. Independent of perceived risk, participants high in dispositional optimism reported greater interest in learning risks for nonmedically actionable disease and carrier status, and greater intentions to use genome information to change their lifestyle/health behaviors.

**Conclusions—**The relationship between risk perceptions and intentions may depend on how risk perceptions are assessed and on degree of optimism.

### Keywords

dispositional optimism; perceived risk; genetics; genomics; comparative risk



Correspondence concerning this article should be addressed to Jennifer M. Taber, National Cancer Institute, 9609 Medical Center Drive, Room 3E642, Bethesda, MD 20892-9761. jennifer.taber@nih.gov.

Jennifer M. Taber, William M. P. Klein, and Rebecca A. Ferrer, National Cancer Institute, National Institutes of Health; Katie L. Lewis, Leslie G. Biesecker, and Barbara B. Biesecker, National Human Genome Research Institute, National Institutes of Health.

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Dispositional optimism and risk perceptions (single-event optimism) both assess a type of optimism, but are conceptually distinct and not highly correlated (e.g., Radcliffe & Klein, 2002). Risk perceptions may interact with dispositional optimism to influence health-related intentions, behaviors, and information seeking, although little research has examined interactions among multiple types of optimism (Klein & Zajac, 2009). We examined the interaction of dispositional optimism and risk perceptions in the context of deciding to receive genome sequencing feedback.

Dispositional optimism is a personality trait indicating the degree to which individuals have positive expectations about their future (Carver & Scheier, 2002). Greater dispositional optimism is typically associated with beneficial health outcomes (Carver & Scheier, 2014; Nes & Segerstrom, 2006; Rasmussen, Scheier, & Greenhouse, 2009). These beneficial outcomes may occur because optimists exert more effort and are more persistent when striving toward goals and use more active than avoidant coping strategies (Aspinwall & Taylor, 1992; Carver & Scheier, 2014; Nes & Segerstrom, 2006; Taylor et al., 1992). Optimists also may be more receptive to threatening information (Aspinwall & Brunhart, 1996) and responsive to the utility and personal relevance of health information (Aspinwall, Richter, & Hoffman, 2001), suggesting that they may be more likely to seek out information to make informed decisions.

People also can be optimistic, or have positive expectations, about a single event. In the context of health, these expectations can be measured by assessing perceived risk (Klein & Zajac, 2009). People can be said to display optimistic risk perceptions when they rate their risk of disease as being relatively low, regardless of how accurate their perceptions are. Perceived risk is a component of many health behavior theories (Rosenstock, 1990; Witte, 1992), and perceiving greater disease risk is posited to motivate behaviors intended to mitigate risk. However, in practice, risk perceptions are often only weakly or moderately associated with intentions and behavior (Brewer et al., 2007; McCaul, Branstetter, Schroeder, & Glasgow, 1996), although moderating factors may strengthen the association (Sheeran, Harris, & Epton, 2014).

An important health behavior is opting to learn potentially threatening, health-relevant information such as genome sequencing results indicating disease risk. Genome sequencing is a rapidly emerging technology for early risk identification (Bick & Dimmock, 2011). Research is needed to determine how people make decisions about and respond to genome information (Berg, Khoury, & Evans, 2011; Collins, Green, Guttmacher, & Guyer, 2003). Just as greater perceived risk tends to promote greater health behaviors to reduce risk (albeit weakly); it also tends to promote health information seeking. This occurs because risk information is more likely to be health relevant and important when disease risk is high (Sweeny, Melnyk, Miller, & Shepperd, 2010; Wiebe & Black, 1997). However, because risk information conferring elevated risk is more likely to obligate unwanted action or to result in negative emotion, greater perceived risk can also be associated with avoiding health information (Persoskie, Ferrer, & Klein, 2014; Sweeny et al., 2010). That greater perceived risk promotes both information seeking and avoidance is consistent with evidence that perceived risk inconsistently predicts genetic testing uptake (Sweeny, Ghane, Legg, Huynh, & Andrews, 2014).

We tested the interactive effects of dispositional optimism and perceived risk among adults who reported intentions to learn their actual genome sequencing results and to change their lifestyle and health behaviors in response. For participants with high perceived risk of learning negative information from their sequencing results, optimism may be necessary to promote willingness to learn information and to take action to mitigate risks. This effect may occur for two reasons: (1) Dispositional optimism prompts attention to the utility of information, such as when disease risk is high (Aspinwall et al., 2001); and (2) personal psychological resources can reduce information avoidance (Howell, Crosier, & Shepperd, 2014; Taber, Klein, Ferrer, Lewis, et al., 2014).

Two studies have tested interactive effects of dispositional optimism and risk perceptions on health-related outcomes. Among dispositionally optimistic undergraduates, those with higher perceived comparative risk increased exercise more and retained relatively more information about coronary heart disease than those with lower perceived risk (Davidson & Prkachin, 1997), and when given false feedback indicating high risk for dental health problems, participants reported greater perceived credibility and importance of the feedback and dental hygiene information, respectively (Geers, Wellman, & Fowler, 2013). In both studies, perceived comparative risk was unassociated with outcomes for those low in dispositional optimism. Neither study examined the interaction of dispositional optimism with other types of risk perceptions.

In the present study, we assessed three distinct types of risk perceptions. Absolute perceived risk is the subjective likelihood of developing disease, independent of context. Comparative perceived risk is the likelihood of developing disease compared to the likelihood of people with similar characteristics, such as gender and age. Experiential perceived risk (also known as “feelings of risk”) is the extent to which individuals feel at risk for disease (e.g., “I feel that I am vulnerable to cancer”) and is thought to be based on intuitive assessments and the experience of risk (Slovic, Peters, Finucane, & MacGregor, 2005; Weinstein et al., 2007).

These different risk perception measures likely capture different constructs, as they are reported to be only moderately correlated (Dillard, Ferrer, Ubel, & Fagerlin, 2012; Lipkus, Klein, Skinner, & Rimer, 2005; Zajac, Klein, & McCaul, 2006). Comparative (Portnoy, Kaufman, Klein, Doyle, & de Groot, 2014) and experiential risk perceptions (Dillard et al., 2012; Janssen, Waters, van Osch, Lechner, & de Vries, 2014; Weinstein et al., 2007) are often more predictive of behavior than absolute risk. Because individuals attend greatly to comparative information (Suls & Wheeler, 2012), comparative risk perceptions may better reflect how individuals evaluate risk (Klein, 2003; Radcliffe & Klein, 2002). Experiential risk perceptions also may reflect how individuals evaluate risk because such perceptions encompass affect, which is a major influence on decision making (Loewenstein, Weber, Hsee, & Welch, 2001). Further, absolute risk perceptions may have lower predictive validity due to general difficulty interpreting numerical information (Nelson, Reyna, Fagerlin, Lipkus, & Peters, 2008).

We tested several hypotheses. First, we predicted that greater perceived experiential risk would be more associated with intentions to learn genome information than absolute or comparative risk. Second, we predicted that greater dispositional optimism would be

associated with greater intentions to learn genome information and to use this information to change lifestyle/health behaviors given optimists' greater attention to threatening health information and employment of active coping strategies (Aspinwall & Brunhart, 1996; Aspinwall et al., 2001). Third, we expected that optimism and risk perceptions would interact to predict intentions to learn sequencing results—particularly for medically actionable disease—such that higher risk perceptions would be linked to greater intentions to receive results only for individuals high in dispositional optimism. We had no a priori predictions as to whether the three types of risk perceptions would interact differently with optimism to influence outcomes.

## Method

### Participants and Procedure

Participants aged 45 to 65 years were recruited from the greater Bethesda, Maryland community for a study piloting the use of genome sequencing that was designed to identify variants related to heart disease (ClinSeq®; Biesecker et al., 2009). The National Human Genome Research Institute's institutional review board approved the study. Of the 998 participants who were enrolled in ClinSeq®, the 962 participants who had been enrolled for at least 1 month (up to 7 years) and not received sequencing results were invited to complete a survey prior to receiving any results (Lewis et al., 2014). A primary purpose of this survey was to assess predictors of intentions to learn results among people actually facing potential receipt of this information. Of these, 551 completed the survey (57.3% response rate). All provided informed consent before enrolling in the parent study and again before completing the survey. The former informed consent stated that possible benefits included "free clinical testing for cholesterol and other lipids, diabetes, and so forth" and a free CAT scan. Participants also were informed that gene variants important to their health and/or the health of their relatives may be identified, but it was stated that, "It is possible that you may not learn anything from the genome sequencing part of the study." Prior research has shown that altruism and personal health benefits were about equally endorsed motivators for participation in a subset of ClinSeq enrollees, with few endorsing both (Facio et al., 2011). The baseline survey included a battery of items assessing attitudes and individual difference measures potentially related to genome sequencing. Different hypotheses concerning predictors of intentions to learn sequencing results have been tested and reported elsewhere (Ferrer et al., 2014; Taber, Klein, Ferrer, Han, et al., 2014, Taber, Klein, Ferrer, Lewis, et al., 2014). Descriptive statistics can be found in Lewis et al. (2014). We report only a subset of items that were pertinent to the present study and include data only from 496 participants who completed them (51.6% completion rate). As shown in Table 1, these 496 respondents did not differ significantly from the 466 survey noncompleters on age or coronary artery disease (CAD) risk. Survey completers were more likely to be White (92.3 vs. 82.6%), $\chi^2(1) = 18.36$, $p < .001$; have an income greater than $100,000 (78.2 vs. 60.3%), $\chi^2(1) = 7.13$, $p = .008$; be a college graduate or higher (89.3 vs. 75.1%), $\chi^2(1) = 7.88$, $p = .005$; and be female (57.1 vs. 46.8%) $\chi^2(1) = 10.17$, $p < .001$.

## Measures

Intentions to receive sequencing results were measured by two items assessing intentions to learn ("I intend to learn such a result" based on a scale ranging from 1 = *definitely no* to 5 = *definitely yes*) and likelihood of learning ("How likely is it that you will choose to learn about such a result?" based on a scale ranging from 1 = *extremely unlikely* to 7 = *extremely likely*). These two items were each asked about three types of results: (1) medically actionable (learning about "a gene variant that *predisposes you to a disease that can be prevented or treated*"; $r = .260$, $p < .001$), (2) nonmedically actionable (learning about "a gene variant that *predisposes you to a disease that cannot be prevented or treated*"; $r = .728$, $p < .001$), and (3) carrier status for recessive condition (learning about "a gene variant that *does not affect your health, but that may be important to the health of other relatives, such as your children*"; $r = .502$, $p < .001$). Less than 5% of respondents gave discrepant responses to the two items assessing intentions to learn results for medically actionable disease (e.g., above the midpoint on one item but below the midpoint on the other), suggesting that the low correlation among these items was due to skew and restriction of range. Items were standardized and then averaged to form independent scales for medically actionable disease, non-medically actionable disease, and carrier status. To normalize the distribution, log transformations were used (medically actionable: original kurtosis = 2.74 and skew = −1.72, transformed kurtosis = −0.13 and skew = 1.11; nonmedically actionable: original kurtosis = 1.84 and skew = −1.54; transformed kurtosis = −0.63 and skew = 0.87; carrier status: original kurtosis = 3.78 and skew = −1.86, transformed kurtosis = −0.04 and skew = −1.02). Responses were reverse-scored following transformation.

Intentions to use sequencing results to change health behaviors were assessed by two items indicating intentions to use (based on a scale ranging from 1 = *definitely no* to 5 = *definitely yes*) and likelihood of using (based on a scale ranging from 1 = *extremely unlikely* to 5 = *extremely likely*) three types of results (medically actionable disease, nonmedically actionable disease, and carrier status) to "change your lifestyle/health behavior (diet, exercise, stress management)." Each item was standardized and then the two items were averaged to form independent scales for medically actionable disease, nonmedically actionable disease, and carrier status. A square root transformation was applied to normalize the distribution of intentions to use medically actionable results (original skew = −1.33, kurtosis = 1.89; transformed skew = 0.86, kurtosis = −0.07). Responses were reverse-scored after transformation.

Absolute perceived risk was assessed as the average of three items ($\alpha = .765$) preceded by the introduction, "Rate how likely is it that you will learn the following from your sequence results." Participants were then asked, "I believe my sequence results will tell me that my risk for a common chronic disease is …" from 1 (*extremely unlikely*) to 7 (*extremely likely*). Two additional items substituted "heart disease" and "cancer" for "a common chronic disease."

Comparative perceived risk was assessed as the average of three items ($\alpha = .831$) immediately after absolute risk and preceded by, "Now, answer the same questions about how likely you are to learn the following information from your sequence results *when*

*compared with other people your age and sex*." Participants then completed the item, "That you are at increased risk for developing a common chronic disease" with response options ranging from 1 (*much less likely than the average person*) to 7 (*much more likely than the average person*). Two additional items substituted "heart disease" and "cancer" for "a common chronic disease."

Experiential perceived risk was assessed as agreement with the statement "I feel like my genes put me at high risk for developing a common chronic disease such as cancer or heart disease" from 1 (*strongly disagree*) to 7 (*strongly agree*).

Dispositional optimism was assessed by three items ($\alpha$ = .850) from the Life Orientation Test-Revised (Scheier, Carver, & Bridges, 1994): "In uncertain times, I usually expect the best," "I'm always optimistic about my future," and "Overall, I expect more good things to happen to me than bad," from 1 (*strongly disagree*) to 5 (*strongly agree*). Dispositional pessimism was not assessed.

Participants reported age, gender, race/ethnicity (coded as White vs. non-White), educational level, average household income, and health concerns. Framingham scores (D'Agostino et al., 2008) were used to categorize participants by risk of developing CAD in the next 10 years (1 = *less than 5% risk*, 2 = *5% to 10% risk*, 3 = *greater than 10% risk*, 4 = *history of CAD*).

## Results

### Descriptives and Zero-Order Correlations

Table 1 presents demographic characteristics of the 496 respondents included in data analysis in the present study and survey nonrespondents, and comparisons between these groups. Participants were on average 61.5 years old (*SD* = 5.53; range = 46 to 70). Only 11% reported a personal history of cancer. Table 2 presents means and standard deviations of risk perceptions and dispositional optimism. Correlations among the types of risk assessments were low to moderate (*r*s from .32 to .46; Table 2). As shown in Table 2, the hypothesis that experiential perceived risk would be most strongly related to intentions was not supported. None of the risk beliefs was systematically related to intentions to learn sequencing results or to use results to change lifestyle/health behaviors. Dispositional optimism was not significantly associated with intentions to learn results for medically actionable disease, but was significantly associated with greater intentions to receive nonmedically actionable and carrier results and was positively associated with intentions to use all three types of results to change lifestyle/health behaviors.

### Optimism as a Moderator of the Influence of Perceived Risk on Intentions to Learn Results

**Overview of regression analyses—**We conducted hierarchical linear regressions with risk perceptions and dispositional optimism predicting intentions to learn sequencing results, with main effects entered before interactions. For each of the three types of risk beliefs (absolute, comparative, and experiential) we tested whether the interaction of each risk belief measure with dispositional optimism significantly predicted intentions to learn each type of sequencing result (medically actionable disease, nonmedically actionable disease,

and carrier status). Each analysis controlled for the other types of risk beliefs but only included the interaction of one risk belief with optimism (the pattern of results did not change when the other risk beliefs were not included as covariates, with one exception noted later). All regression analyses controlled for income, age, gender, race, education, and CAD risk. The pattern of significant effects remained the same when these sociodemographic and health status covariates were not included. Predictor variables were centered at the mean.

Regression analysis results are presented in Table 3 and summarized here. Across analyses, participants higher in dispositional optimism consistently reported greater intentions to learn results for nonmedically actionable disease risk and carrier status, but optimism was not significantly associated with intentions to receive results for medically actionable disease risk.

**Absolute risk—**Controlling for experiential and comparative risk, absolute risk did not significantly predict intentions to receive any type of sequencing result, nor did absolute risk interact with dispositional optimism to predict interest in learning any type of sequencing result. When the main effects of comparative and experiential risk were not included as predictors in the three regression analyses examining the interaction of absolute risk with dispositional optimism, absolute risk was associated with greater intentions to learn all three types of results at $p < .10$.

**Comparative risk—**Comparative risk did not significantly predict intentions to receive any type of sequencing result. More important, and as predicted, the effect of comparative risk on intentions was conditional on dispositional optimism. The patterns (Figures 1A–C) were similar across intentions to learn the three types of disease results. Simple slopes tests were conducted (Hayes, 2013) to test the association of comparative risk perceptions with intentions for individuals with dispositional optimism scores one standard deviation above and below the mean. For intentions to learn risk for medically actionable disease, perceived comparative risk was not associated with intentions for individuals either high (β = .015, *SE* = .009, 95% CI [−.004, .033], $p = .117$) or low in dispositional optimism (β = −.013, *SE* = .011, 95% CI [−.033, .008], $p = .232$). For intentions to learn risk for nonmedically actionable disease, greater perceived comparative risk was also not significantly associated with higher intentions for individuals high (β = .019, *SE* = .011, 95% CI [−.003, .040], $p = .088$) or low in optimism (β = −.015, *SE* = .012, 95% CI [−.039, .010], $p = .233$). For carrier status, greater perceived comparative risk was significantly associated with greater intentions for individuals high (β = .020, *SE* = .010, 95% CI [−.0002, .039], $p = .031$) but not low in optimism (β = −.008, *SE* =≥.011, 95% CI [−.029, .013], $p = .450$).

**Experiential risk—**Controlling for absolute and comparative risk, experiential risk did not significantly predict intentions to learn any type of sequencing result. As shown in Figure 1D, there was a significant interaction of experiential risk and dispositional optimism predicting intentions to learn medically actionable results consistent with the findings for comparative risk. Greater perceived experiential risk was significantly associated with greater intentions to learn medically actionable results for individuals high (β = .014, *SE* = .007, 95% CI [.001, .027], $p = .048$), but not low in optimism (β = −.011, *SE* = .008, 95% CI [−.026 to .004], $p = .151$).

### Intentions to Use Results to Change Lifestyle/Health Behaviors

The earlier analyses were repeated with the outcome of intentions to use each of the three types of sequencing results to change lifestyle/health behaviors, for a total of nine analyses. Results are shown in the right half of Table 3. Consistent with predictions, participants higher in optimism reported greater intentions to use results to change lifestyle/health behaviors across all analyses, with stronger associations seen for nonmedically actionable and carrier status results than for medically actionable results. Participants with greater perceived absolute risk reported greater intentions to use carrier results to change lifestyle/health behaviors. Perceived comparative and experiential risk perceptions were not significantly associated with intentions to use results to change lifestyle/health behaviors. In contrast to the results seen for intentions to receive sequencing results, dispositional optimism did not interact with any risk perception measure to influence intentions to use results to change lifestyle/health behaviors.

## Discussion

Participants' degree of dispositional optimism moderated the effect of both comparative and experiential risk perceptions, but not absolute risk perceptions, on intentions to learn actual genome sequencing results. For participants high in dispositional optimism, the relationship between comparative risk perceptions and intentions was as expected—comparative risk perceptions and intentions to receive results were positively associated. This positive association was not apparent for individuals low in dispositional optimism. The present study is the first of which we are aware to examine how dispositional optimism and perceived risk interact to influence the specific behavior of intentions to learn health information. The present results are consistent with the results of two laboratory studies of college students that tested the interaction of dispositional and comparative optimism (Davidson & Prkachin, 1997; Geers et al., 2013).

Whether dispositional optimism and risk perceptions interacted to influence intentions to learn genome sequencing results depended on both the type of risk assessment and type of results. This may be the first study to examine how not only comparative risk perceptions, but also other types of risk perceptions, interact with dispositional optimism to influence health-relevant outcomes. Experiential risk was not more strongly associated than comparative or absolute risk with intentions. However, dispositional optimism interacted with both comparative and experiential risk, but not absolute risk, to influence intentions, perhaps because comparative and experiential risk perceptions are often better predictors of behavior (Dillard et al., 2012; Janssen et al., 2014; Portnoy et al., 2014). Of note, this interaction was more consistent and reliable for comparative perceived risk than for experiential risk. Although we did not predict that the effect would differ by type of risk belief a priori, one explanation is that because comparative risk beliefs tend to be biased and defensively held, dispositional optimism may help people to behave proactively (i.e., learn their sequencing results) rather than defensively when they think they are more likely to learn negative or threatening information than other people.

The interaction effect of dispositional optimism and risk perceptions also differed according to the type of disease result. Experiential risk perceptions significantly interacted with

dispositional optimism to predict intentions to learn results for medically actionable disease, whereas the effect was absent for intentions to learn nonmedically actionable disease and carrier status. This is consistent with predictions that dispositional optimism should be more predictive of greater intentions when action can be taken or information is personally relevant (Aspinwall et al., 2001). It is unclear why this pattern of influencing intentions to learn medically actionable disease results occurred for experiential but not comparative risk. Nevertheless, we can confidently state that comparative risk was more reliable than either experiential or absolute risk in terms of the moderating effects of dispositional optimism.

As just noted, dispositional optimism was directly associated with greater interest in learning sequencing results for both non-medically actionable disease and carrier status, for which effective preventive action cannot be taken. Threatening health information often evokes attempts to minimize the threat or avoid the information altogether (Jemmott, Ditto, & Croyle, 1986; Sweeny et al., 2010). Typically, opting to receive information is a more active response than avoiding information, although not necessarily a beneficial response if the information ultimately confers no medical or psychological benefit. Therefore, optimists' greater interest in receiving nonmedically actionable disease and carrier status results is consistent with research showing that optimists employ more active coping strategies than those low in optimism (Nes & Segerstrom, 2006). Optimism may have been unassociated with intentions to learn medically actionable disease results in bivariate analyses if this information was not perceived as threatening, and therefore optimistic resources were not employed. Optimists were also pragmatic in that they reported higher intentions to receive sequencing results only when they expected that these results would reveal information with health implications; that is, when they perceived their risk to be high. These results are also consistent with research testing terror management theory which demonstrates that optimism is engaged as a resource only under conditions of sufficient threat, such as when individuals' mortality is made salient (Arndt et al., 2006), or in the present study, when perceived risk is high.

Optimists did not adjust their plans to change lifestyle and health behaviors in response to the likely medical utility of the genome risk information—they reported greater intentions to change their behaviors when the disease was described as both medically and nonmedically actionable. Whereas genetic information about medically actionable diseases has clear potential to benefit health, it is less clear whether information about unpreventable disease would have benefits. On one hand, people who received genetic test results for unpreventable diseases such as Huntington or Alzheimer disease reported benefits of improved knowledge, life planning, and hope (Chao et al., 2008; Williams et al., 2010). On the other hand, expecting genome information for unpreventable disease to provide opportunities to act may be unrealistically positive. Indeed, holding positive expectations (event-specific optimism) that are subsequently disconfirmed can lead to negative affect and disappointment (Sweeny & Shepperd, 2010). If participants with greater dispositional optimism overestimate the usefulness of genome information and their options to act on it, this could lead to disillusionment with the medical promise of genome sequencing, suggesting a potential downside of optimism.

Two points concerning optimists' intentions to change their behavior in response to information about nonmedically actionable disease and carrier testing are worth mentioning. First, "lifestyle" and "health" behaviors were combined in the item wording such that we do not know which behaviors optimists planned to change. Changing health behaviors to prevent disease that cannot be prevented may be misguided (although potentially still beneficial for overall health, if participants planned to increase rather than decrease health behaviors). However, changing lifestyle factors—for example, preparing for illness or even death, preparing family members, or adjusting life priorities—may represent beneficial, active responses. Learning of risk for disease that is not "medically actionable" should not necessarily preclude engagement in non-medical behaviors. Second, optimistic beliefs about genetic information may be associated with perceiving this information as changing or uncertain (Biesecker et al., 2014). Optimists may expect future medical research to identify modifiable risk factors for currently unpreventable diseases, which may explain the link between optimism and greater intentions to change behavior. Further research is needed to explore how both optimists and pessimists plan to and do respond to learning of high risk for nonmedically actionable disease.

## Implications for Understanding Genetic and Genomic Testing

As the availability of genetic tests continues to increase, it is important to understand factors that predict interest in genetic information. It is largely unknown whether research results concerning predictors of interest in and uptake of genetic testing for single high-penetrance mutations such as *BRCA1/2* can be extrapolated to predictors of genome sequencing results such as those featured here. Greater perceived disease risk is often an important predictor of interest in single, high-penetrance gene mutations (Cameron & Reeve, 2006; Gooding, Organista, Burack, & Biesecker, 2006; Kasparian, Meiser, Butow, Simpson, & Mann, 2009; but see Sweeny et al., 2014). It is surprising that in the present study, participants' expectations of whether they would learn about increased risk for disease based on their genome sequencing results were largely unassociated with their intentions to learn this information. Perceived risk may be more salient in the context of genetic testing, in which individuals are likely aware of family history of disease or more likely to have had personal experience with the disease, than in the context of genome sequencing. Importantly, we did not assess perceived risk of disease per se, but instead perceived likelihood that one's genetics confer elevated disease risk. These are slightly different questions: the latter is comparable to asking *BRCA1/2* test recipients whether they expect to have the mutation, which could differ from their perceived risk of breast cancer. As it is largely unknown whether expectations about carrying genetic risk predict either genetic testing uptake or receipt of genome sequencing information, researchers should examine both perceived disease risk and perceived likelihood of carrying genetic risk as predictors of uptake. The relatively older age of the sample also may have contributed to the lack of associations among risk perceptions and intentions, as older adults are more likely to make decisions using an affective mode of thinking, compared to using deliberative processes that might incorporate information such as risk perceptions (Peters, Hess, Västfjäll, & Auman, 2007).

Little research has examined whether optimism predicts genetic testing uptake. In one study, members of the general population high in dispositional optimism perceived higher benefits

and expressed greater intentions to undergo genetic testing than those low in optimism (Yanushka Bunn, Bosompra, Ashikaga, Flynn, & Worden, 2002). The present results similarly suggest that optimistic individuals will be more likely to learn genome sequencing results.

## Limitations

Important limitations of the study were its cross-sectional nature that precluded a determination of causality, and assessing intentions rather than uptake as the outcome measure. Because intentions to receive genetic testing may be higher than uptake (Sanderson, O'Neill, Bastian, Bepler, & McBride, 2010), it is unknown whether optimism would lead to behavioral action. Another limitation is that the sample was primarily White and high in both education and income. However, participants were recruited from an area with a high cost of living and more inflated salaries; for example, government jobs in the Washington, DC area receive a pay increase of 24.22% compared to other locations (Office of Personnel Management, 2014). Further, although this sample is not generalizable to the U.S. population, it is similar to samples in other studies of genetic testing in high-risk settings (McBride, Koehly, Sanderson, & Kaphingst, 2010). Racial differences in genetic testing uptake and participation in genetic testing research exist (Armstrong, Micco, Carney, Stopfer, & Putt, 2005; Aspinwall, Taber, Kohlmann, & Leachman, 2013), and these data suggest that future research on genome sequencing may examine whether health cognitions and personality factors function similarly among people lower in socioeconomic status and who are not White.

Participants were also slightly older than those receiving various genetic test results (mean age ranged from 35–58 years across studies; Sweeny et al., 2014), and age may have influenced participants' decision making. Generalizability also may be limited because receipt of genetic results was a possible benefit of participation, and participants may have been particularly motivated to learn results. We also did not correct for multiple comparisons in the regression analyses. When a very conservative Bonferroni correction for Type I error is used for each set of regression analyses ($p < .006$, $\alpha = .05 \div 9$ comparisons), the interaction effects do not meet the statistical significance criterion, but the majority of optimism main effects do. Thus, the strength of the interaction effects is moderate, but because the patterns matched our predictions, Type I error is less of a concern.

## Research Implications

These data suggest important research implications. First, researchers should continue to examine risk perceptions as a predictor of consequential behavior, but give greater attention to moderators. Second, these findings can also help to address a long-held issue concerning what types of risk beliefs are most important to measure and intervene on. Finally, researchers should be careful to distinguish among different types of optimism—dispositional optimism is distinct from comparative optimism, and can in fact moderate the effects of comparative optimism.

## Conclusions

In the present study, dispositional optimism was associated with the positive health outcome of greater intentions to learn potentially threatening health information. The results also tentatively suggest that optimists may have unrealistically positive expectations about the utility of genome information, although more research is needed to explore this finding. We expanded on prior research showing that the predictive validity of (comparative) risk perceptions can be improved by examining moderators such as dispositional optimism, and that there is utility in examining alternate types of risk perceptions such as comparative and experiential risk.

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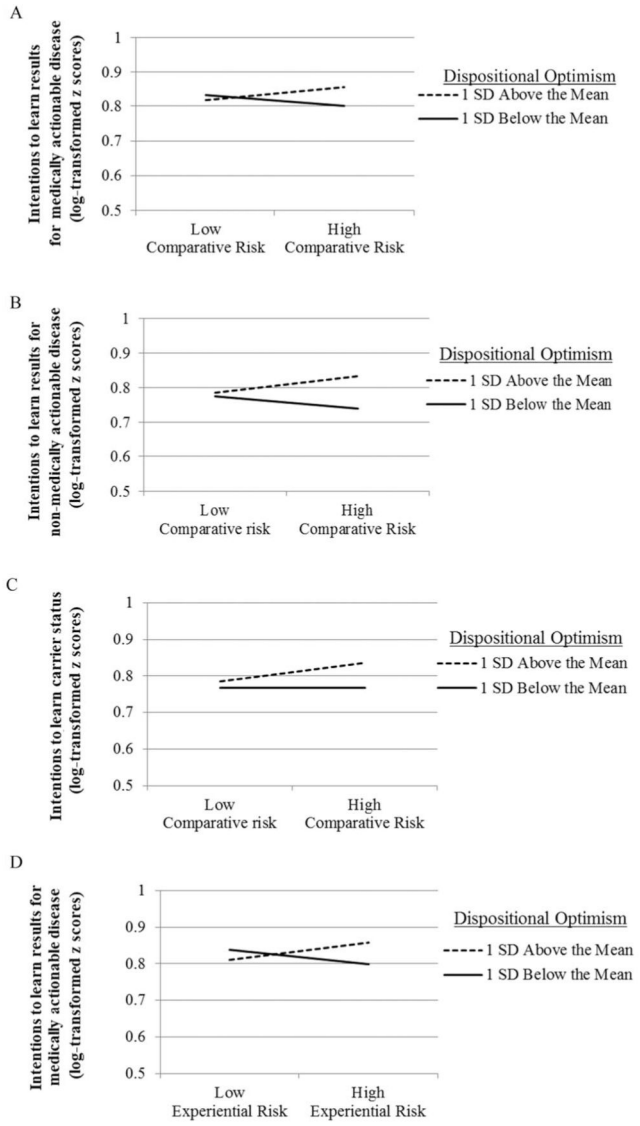


**Figure 1.**

Interactive effects of dispositional optimism and risk perceptions on intentions to learn genome sequencing results.

**Table 1**

Demographic Characteristics of Baseline Survey Completers Analyzed in the Present Study and Survey Noncompleters, and Comparisons Between These Participants

| | Survey completers (*n* = 496) | | Survey noncompleters (*n* = 466) | | |
|---|---|---|---|---|---|
| **Demographic characteristics** | ***n*** | **%** | ***n*** | **%** | **$\chi^2$ and *p* value[a]** |
| Ethnicity/race | | | | | |
| White | 458 | 92.3 | 385 | 82.6 | $\chi^2(1) = 18.36$, $p < .001$ |
| Not white | 38 | 7.7 | 77 | 16.5 | |
| Missing | 0 | 0 | 4 | .009 | |
| Age in years at time of survey | | | | | |
| 45–49 | 19 | 3.8 | 25 | 5.4 | $\chi^2(5) = 6.77$, $p < .239$ |
| 50–54 | 72 | 14.5 | 64 | 13.7 | |
| 55–59 | 109 | 22.0 | 112 | 24.0 | |
| 60–64 | 164 | 33.1 | 141 | 30.3 | |
| 65–69 | 127 | 25.6 | 111 | 23.8 | |
| 70+ | 5 | 1.0 | 13 | 2.8 | |
| Heart disease risk[b] | | | | | |
| 1–3 | 396 | 79.8 | 366 | 78.5 | $\chi^2(1) = 0.25$, $p < .620$ |
| 4 | 100 | 20.2 | 100 | 21.5 | |
| Education | | | | | |
| College graduate and higher | 443 | 89.3 | 350 | 75.1 | $\chi^2(1) = 7.88$, $p < .005$ |
| Less than college graduate | 53 | 10.7 | 72 | 15.5 | |
| Missing | 0 | 0 | 44 | 9.4 | |
| Income | | | | | |
| More than $100,000 | 388 | 78.2 | 281 | 60.3 | $\chi^2(1) = 7.13$, $p < .008$ |
| $100,000 or less | 108 | 21.8 | 118 | 25.3 | |
| Missing | 0 | 0 | 67 | 14.4 | |
| Gender | | | | | |
| Male | 283 | 57.1 | 218 | 46.8 | $\chi^2(1) = 10.17$, $p < .001$ |
| Female | 213 | 42.9 | 248 | 53.2 | |

*Note*. Chi-square values were calculated excluding cells with missing data. All factors reported in this table were included as covariates in the primary regression analyses.

[a] Based on comparisons between survey completers versus noncompleters.

[b] Values are based on Framingham risk scores for developing coronary artery disease in the next 10 years (1 = *less than 5% risk*, 2 = *5% to 10% risk*, 3 = *greater than 10% risk*, 4 = *history of coronary artery disease*).



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## Table 2

Correlations Among Risk Perceptions and Dispositional Optimism, and Associations of Risk Perceptions and Dispositional Optimism With Intentions to Learn Genome Sequencing Results

| | Absolute risk perceptions | Comparative risk perceptions | Experiential risk perceptions | Dispositional optimism |
|---|---|---|---|---|
| Absolute risk perceptions | | .395** | .315** | −.009 |
| Comparative risk perceptions | | | .470** | −.114* |
| Experiential risk perceptions | | | | −.175** |
| Intentions to learn genome sequencing results | | | | |
| Medically actionable disease | .071 | .044 | .043 | .050 |
| Nonmedically actionable disease | .081† | .033 | −.040 | .120** |
| Carrier status | .093* | .075† | .031 | .136** |
| Intentions to use genome sequencing results to change lifestyle/health behaviors | | | | |
| Intentions to use medically actionable disease results | .010 | −.034 | −.026 | .145** |
| Intentions to use nonmedically actionable disease results | .044 | −.051 | −.063 | .147** |
| Intentions to use carrier status results | .098* | −.040 | −.009 | .123** |
| *M* (*SD*) | 4.50 (1.02) | 4.28 (1.27) | 4.01 (1.74) | 3.79 (0.74) |

† $p < .10$.

* $p < .05$.

** $p < .01$.

**Table 3**

Unstandardized Beta Weights and Standard Errors for Regression Analyses of Risk Perceptions, Dispositional Optimism, and Their Interaction Predicting Intentions to Receive Genome Sequencing Results for Medically Actionable Disease, Nonmedically Actionable Disease, and Carrier Status, and Intentions to Use Sequencing Results to Change Lifestyle/Health Behaviors

| | Intentions to learn sequencing results | | | | | | Intentions to use sequencing results to change lifestyle/health behaviors | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Medically actionable disease | | Nonmedically actionable disease | | Carrier status | | Medically actionable disease | | Nonmedically actionable disease | | Carrier status | |
| **Predictors** | **β** | ***SE*** | **β** | ***SE*** | **β** | ***SE*** | **β** | ***SE*** | **β** | ***SE*** | **β** | ***SE*** |
| Absolute risk perceptions | | | | | | | | | | | | |
| Experiential risk | .003 | .006 | −.008 | .007 | .000 | .006 | .006 | .010 | −.014 | .030 | .009 | .030 |
| Absolute risk | .012 | .009 | .017 | .011 | .012 | .009 | .015 | .016 | .054 | .048 | .092 | .047 |
| Comparative risk | .003 | .008 | .005 | .009 | .008 | .008 | .001 | .014 | −.028 | .040 | −.055 | .040 |
| Dispositional optimism | .014 | .012 | .036** | .014 | .037** | .012 | .063** | .020 | .178** | .060 | .161** | .059 |
| Absolute Risk × Dispositional Optimism | .008 | .012 | .010 | .014 | .007 | .012 | −.013 | .020 | −.028 | .060 | .024 | .060 |
| Comparative risk perceptions | | | | | | | | | | | | |
| Experiential risk | .003 | .006 | −.008 | .007 | −.001 | .006 | .006 | .010 | −.014 | .030 | .011 | .030 |
| Absolute risk | .012 | .009 | .016 | .011 | .011 | .009 | .015 | .016 | .056 | .047 | .098* | .047 |
| Comparative risk | .001 | .008 | .002 | .009 | .006 | .008 | .003 | .014 | −.021 | .041 | −.050 | .040 |
| Dispositional optimism | .013 | .011 | .035* | .014 | .036** | .012 | .064** | .020 | .182** | .059 | .162** | .059 |
| Comparative Risk × Dispositional Optimism | .018* | .008 | .022* | .010 | .019* | .008 | −.020 | .014 | −.056 | .042 | −.034 | .042 |
| Experiential risk perceptions | | | | | | | | | | | | |
| Experiential risk | .001 | .006 | −.008 | .007 | .000 | .006 | .005 | .010 | −.015 | .030 | .012 | .030 |
| Absolute risk | .011 | .009 | .016 | .011 | .012 | .009 | .013 | .016 | .051 | .047 | .099* | .047 |
| Comparative risk | .003 | .008 | .004 | .009 | .008 | .008 | .000 | .014 | −.029 | .040 | −.053 | .040 |
| Dispositional optimism | .010 | .012 | .032* | .014 | .035** | .012 | .063** | .020 | .179** | .060 | .167** | .059 |
| Experiential Risk × Dispositional Optimism | .017** | .006 | .013† | .007 | .006 | .006 | .003 | .011 | −.004 | .033 | −.026 | .033 |

*Note*. All analyses controlled for income, age, gender, race, education, and coronary artery disease risk.

† $p < .10$.

* $p < .05$.

$^{**}p < .01$.