The Impact of Item Order on Ratings of Cancer Risk Perception[1]

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Abstract

Although perceived risk is central to most theories of health behavior, there is little consensus on its measurement with regard to item wording, response set, or the number of items to include. In a methodological assessment of perceived risk, we assessed the impact of changing the order of three commonly used perceived risk items: quantitative personal risk, quantitative population risk, and comparative risk. Participants were 432 men and women enrolled in an ancillary study of the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial. Three groups of consecutively enrolled participants responded to the three items in one of three question orders. Results indicated that item order was related to the perceived risk ratings of both ovarian ($P < 0.05$) and colorectal ($P < 0.05$) cancers. Perceptions of risk were significantly lower when the comparative rating was made first. The findings suggest that compelling participants to consider their own risk relative to the risk of others results in lower ratings of perceived risk. Although the use of multiple items may provide more information than when only a single method is used, different conclusions may be reached depending on the context in which an item is assessed.

Introduction

Perceived risk for developing illness is central to most theories of health behavior (1–3) and in particular, it has been identified as an important predictor of cancer screening adherence (4–6). The majority of studies assessing the association between perceived risk and screening adherence have found that perceived risk was positively associated with screening adherence (7–12). However, a few studies have found a curvilinear relationship, such that only moderate levels of perceived risk were associated with improved adherence, (13–15) and other studies have found no relationship (16) or a negative relationship in certain subsamples (17).

The most common measures of perceived risk include: (*a*) a comparative measure using a five-point Likert scale with anchors at either end point [*e.g.*, (1) I am at much less risk than others to (5) I am at much greater risk than others]; (*b*) a percentage rating from 0% to 100%; or (*c*) a visual analogue scale, in which the anchors are numeric (0–100) and/or descriptive. Because of its role in adherence to cancer screening, the measurement of perceived risk has received a great deal of research attention, but it is still considered inexact (18–20). For example, Woloshin *et al.* (21) reported recently that level of perceived risk depended on the type of perceived risk measure used, such that overestimation of risk was more likely when using numeric ratings, and accurate risk perception was more common when using comparative measures.

There have been recent recommendations regarding the measurement of perceived risk. Weinstein (22) concluded that because single items cannot give an accurate estimate of a person's understanding of risk, multiple items should be used to improve the measurement of perceived risk. These items should include the severity of the potential harm, the likelihood of the potential harm, and the possibility of reducing the harm (22). Similarly, in a study of breast cancer risk perceptions, Lipkus *et al.* (23) recommended that both absolute and comparative risk perceptions should be assessed. Finally, Fischhoff (24) recommended using numeric scales (0% to 100%) over comparative scales for the assessment of beliefs about the likelihood of the occurrence of a particular event, because of the improved ease of interpretation of numeric scales. Fischhoff described verbal anchors (*e.g.*, 'likely' or 'rarely') as too vague and open to different interpretation by individuals and in different situations. He concluded that although it may be more difficult for people to respond in a numeric fashion, the improved interpretability of numeric responses outweighs this negative aspect.

In the present paper, we assessed perceived risk for cancer as part of an ancillary study to the PLCO[3] Cancer Screening Trial (25). We included three commonly used perceived risk questions: (*a*) a quantitative rating of personal risk (0–100%); (*b*) a quantitative rating of the risk of the general population (0–100%); and (*c*) a five-point comparative rating of personal risk (much less risk than others to much greater risk than others). In a quasi-experimental design, we assessed the impact of varying the order of these three questions on perceived risk ratings of the participants.

The initial order of the three items was as they are listed above. After administering the items to a series of participants, it became apparent that some participants did not comprehend the questions, as evidenced by their inconsistent responses across the three questions. After observing the inconsistent responses, we speculated that moving the comparative question from last to first in the order would improve comprehension. We then administered the questions in this order to the next set of consecutively enrolled participants. Although comprehension appeared to improve with this modification, we changed

Received 5/25/01; revised 4/1/02; accepted 4/21/02.

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[1] This work was supported by the National Cancer Institute (K07 CA 72645 and N01-CN-25522).

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[3] The abbreviations used are: PLCO, Prostate, Lung, Colorectal, and Ovarian; QOL, Quality of Life.

the order once more, because we further speculated that asking participants about population risk before personal risk would improve comprehension by allowing participants to more easily put their own risk in the context of the risk of the population. Thus, subjects were not randomly assigned to a question order, as the impact of question order on ratings of perceived risk was an unanticipated finding that became apparent while conducting the initial interviews.

Materials and Methods

Overview of the PLCO Cancer Screening Trial

We conducted this study with a subsample of participants in the PLCO Cancer Screening Trial of the National Cancer Institute (25). The PLCO is a large, ongoing study designed to examine whether screening tests for prostate, lung, colorectal, and ovarian cancer reduce disease-related mortality. Participants include men and women who are 55–74 years of age with no history of these four cancers. Members of the intervention group receive screening examinations for 6 years, and the participants in the control group are asked to follow their normal health care routine. Health and screening information is gathered annually for both groups for up to 14 years.

Participants in the QOL Ancillary Study

Participants in the QOL study were recruited from the PLCO subject pool between May and December of 1998 at the Georgetown University site. Eligibility criteria for the QOL study included the ability to speak English and willingness to complete a series of interviews (only the baseline assessment is presented here). Along with the informational packet, 483 PLCO participants were mailed a QOL introductory letter and a consent form. Of these 483, ineligible participants included: 5 participants who were unable to speak English, 14 who dropped out of the PLCO, and 1 person who died before the first interview. Of the remaining 463 eligible participants, 432 (93.3%) completed the baseline interview ($n = 215$ screening, $n = 217$ control). Of the 31 not participating, 7 (22.6%) had completed the baseline screening examinations before being contacted for the QOL study, 13 (41.9%) were unreachable and 11 (35.5%) declined. Those who declined the QOL study gave responses of "too busy" ($n = 6$) and "not interested in the topic" ($n = 5$).

Measures

Perceptions of Risk Susceptibility. We assessed perceived lifetime risk of prostate, colorectal, and ovarian cancer using three items that have been used in previous studies of high risk cancer populations (26, 27) and have been associated with screening adherence among women in the general population (9). Perceived risk for lung cancer was not included in these analyses because of its overwhelming association with smoking history.

The three items were worded as follows: (*a*) quantitative personal risk ("On a scale from 0% to 100%, on which 0 means you definitely will not be diagnosed with cancer and 100 means you definitely will be diagnosed with cancer, what would you estimate to be your chance of being diagnosed with ________ cancer in your lifetime?"); (*b*) quantitative population risk ("On a scale from 0% to 100%, what percentage of men/women your age in the general population do you think will be diagnosed with ________ cancer in their lifetime?"); and (*c*) comparative risk ["Compared to other men/women your age, what do you think your chances of being diagnosed with ________ cancer during your lifetime are?" (five-point Likert scale, 1 = I am at much less risk than others to 5 = I am at much higher risk than others)].

Responses were considered inconsistent when responses to the three items were contradictory (*i.e.*, not internally consistent). For example, if a participant indicated that the general population risk for colorectal cancer was 20% and that he/she was at lower risk on the comparative rating of personal risk (*e.g.*, at much less risk than others), then a quantitative rating of personal risk of ≥20% would be considered inconsistent, whereas a quantitative personal rating of <20% would be considered consistent.

Psychological Variables. We assessed cancer worry using a single-item: How frequently do you worry about developing cancer? The response format was 1 = never/rarely to 4 = frequently (28). We used the intrusion subscale of the Impact of Events Scale to assess cancer-specific distress (29). To reduce respondent burden, we limited the scale to four of the original seven items of the subscale, based on data demonstrating the four items with the highest item-total correlations (30). The response format was 0 = not at all, 1 = rarely, 3 = sometimes, and 5 = often. Internal consistency of the four items was 0.85.

Demographic and Medical Information. Demographic information included date of birth, marital status, number of years of education, ethnicity, and employment status. Participants indicated their own personal history of cancer, as well as whether any of their blood relatives had been diagnosed with cancer, which blood relatives had been diagnosed, and what type of cancer the relative had. We have included information on the percentage of participants with a first and/or second degree relative with prostate, ovarian, or colorectal cancer.

Procedure for the QOL Study

A letter and consent form describing the QOL study design, purpose, and time requirements were included in PLCO informational packets. Subsequently, trained interviewers attempted to contact all persons by telephone, and those who agreed to participate completed a 15-min baseline telephone interview. Signed consent forms were returned by mail. Potential participants who were not reached after 10 call attempts were considered unreachable.

Perceived lifetime risk for prostate, colorectal, and ovarian cancer was assessed using the three items described above. Three groups of consecutively enrolled subjects were each asked the three questions in a set order. Thus, subjects were not randomly assigned to a particular question order, but instead, the first 105 subjects enrolled were asked the three risk perception items in the following order: quantitative personal risk, quantitative population risk, and comparative risk. The following 77 subjects enrolled were asked the questions in this order: comparative risk, quantitative personal risk, and quantitative population risk; and the final 250 subjects were asked the questions in this order: comparative risk, quantitative population risk, and quantitative personal risk. The sample sizes of the three groups differ as the primary goal of modifying the question order was to improve comprehension of the questions, and we were attempting to find the best question order for the largest proportion of our sample.

Data Analyses

The analyses were conducted in four steps. First, descriptive statistics were used to describe the demographic characteristics of the sample. Second, we conducted bivariate analyses (χ^2, *F*

Table 1 Demographic and medical variables stratified by question order

	Order 1 (n = 105)	Order 2 (n = 77)	Order 3 (n = 250)
Gender[a]			
Males	48.6% (n = 51)	31.2% (n = 24)	52.0% (n = 130)
Females	51.4% (n = 54)	68.8% (n = 53)	48.0% (n = 120)
Age[a]			
55–64	59.0% (n = 62)	50.6% (n = 39)	42.0% (n = 105)
65–74	41.0% (n = 43)	49.4% (n = 38)	58.0% (n = 145)
Education			
High school/some college	39.0% (n = 41)	32.9% (n = 25)	37.2% (n = 93)
College degree	26.7% (n = 28)	28.9% (n = 22)	30.0% (n = 75)
Graduate degree	34.3% (n = 36)	38.2% (n = 29)	32.8% (n = 82)
Married	69.5% (n = 73)	57.9% (n = 44)	68.4% (n = 171)
Caucasian	86.7% (n = 91)	88.2% (n = 67)	88.0% (n = 220)
Employed	51.4% (n = 54)	55.8% (n = 43)	47.6% (n = 119)
Personal history of cancer	14.3% (n = 15)	13.0% (n = 10)	14.4% (n = 36)
Family history of any cancer	81.9% (n = 86)	84.4% (n = 65)	77.1% (n = 192)
FDR/SDR[b] with:			
Prostate cancer[c,d]	22% (n = 11/50)	0.0% (n = 0/21)	10.2% (n = 13/127)
Ovarian cancer[e]	6.4% (n = 3/47)	11.6% (n = 5/43)	8.0% (n = 8/100)
Colorectal cancer	20.6% (n = 21/102)	14.9% (n = 11/74)	17.7% (n = 43/243)

[a] $P \leq 0.01$.
[b] FDR, first degree relative; SDR, second degree relative.
[c] The percentages indicate the percent of male participants within each order who had a FDR or SDR with prostate cancer.
[d] $P \leq 0.05$.
[e] The percentages indicate the percent of female participants (with ovaries) within each order who had a FDR or SDR with ovarian cancer.

tests, and *t* tests) to determine the associations between demographic variables, the independent variable (item order), and the dependent variables (perceived risk). Third, for each of the three cancer sites, we conducted a 2 (Family history) × 3 (Question order) ANOVA in which the dependent variable was the quantitative personal risk rating. The comparative rating and the population risk rating could not be used to test the impact of question order on perceived risk ratings because they did not occupy each of the three possible positions in the ordering. Family history (of the particular cancer) was included as an independent variable to assess the association between perceived risk and family history. Fourth, we developed a measure of participants' consistency of responses across the three items to assess whether consistency improved as a function of question order. In addition, we conducted χ^2 analyses to: (*a*) assess whether those who responded inconsistently differed from those who responded consistently in terms of demographic and psychological characteristics; and (*b*) assess the relationship between item order and characteristics of consistent *versus* inconsistent subjects. Because data collection occurred before the screening participants' baseline screening exams, we did not expect to find group differences on any variables and, thus, combined screening and control participants. Our analyses confirmed this, as there were no group differences on demographic variables, question order, or risk perception.

Results

Table 1 presents the descriptive information for the sample stratified by question order. Age [χ^2 (2, n = 432) = 8.941; $P <$ 0.01], gender [χ^2 (2, n = 432) = 10.31; $P < 0.01$], and having a family history of prostate cancer (among men) were each related to question order. These associations were because of chance groupings of consecutive subjects in which there was a greater proportion of older participants in order #3, a greater proportion of women in order #2, and no men with a family history of prostate cancer in order #2. We included age and sex as covariates in the multivariate analyses.

Table 2 Unadjusted means (and SDs) of the quantitative personal risk ratings

Order	Tumor Site		
	Ovarian	Colorectal	Prostate
1	25.2 (21.6)	26.5 (21.0)	39.8 (27.8)
2	28.0 (21.4)	25.6 (16.7)	34.4 (18.6)
3	18.3 (17.3)	21.7 (18.4)	30.9 (24.9)

Regarding sex differences, men had completed more education than women [M = 16.9 years (SD = 3.3) and M = 15.9 years (SD = 2.7), respectively; $P < 0.001$], and men were more likely to be married ($P < 0.001$). Women were more likely to have a personal history of cancer ($P < 0.001$) and to have a relative with cancer ($P < 0.001$).

Bivariate Analyses. To identify potential cofounder variables, we assessed the associations between age, sex, education level, and personal history of cancer with the dependent (the quantitative perceived risk item) and the independent (the order of the perceived risk items) variables. Education was negatively associated with the quantitative personal risk rating for both ovarian [F (2,189) = 6.82; P = 0.001] and colorectal cancers [F (2,418) = 9.47; $P < 0.001$]. Because of these significant bivariate associations and findings in the literature regarding variables that impact perceived risk ratings (31–32), we included age and education (and sex in the colorectal analyses) as covariates in each of the analyses described below.

Does the Order of the Perceived Risk Items Affect Risk Perception? Table 2 presents the means and SDs of the quantitative rating of personal perceived risk for each of the three disease sites across each of the three item orders.

Using the quantitative rating of personal perceived risk as the outcome, we found that question order was associated with

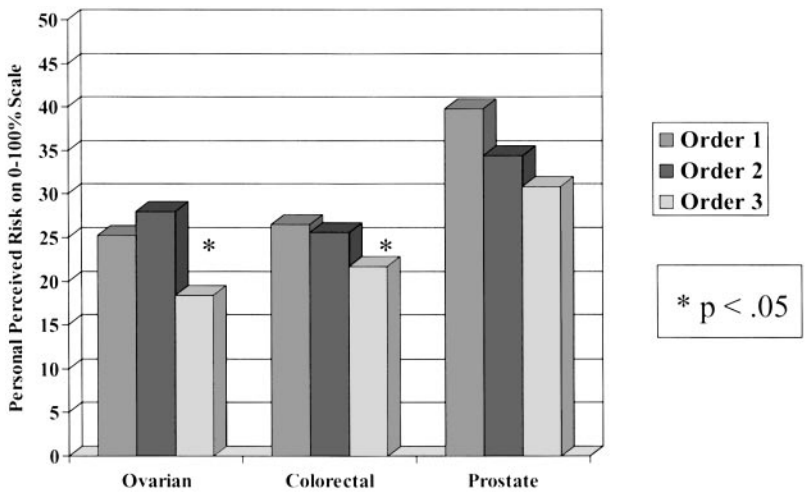

Fig. 1. Quantitative personal perceived risk as a function of item order. Means presented in the figure are unadjusted.

perceived risk for both ovarian [F (2,182) = 3.87; $P < 0.05$] and colorectal [F (2,410) = 3.27; $P < 0.05$] cancers. Because we were not interested in the difference between orders #1 and #2, but only in whether order #3 differed overall from the first two orders, we conducted a post hoc comparison that assessed the difference between orders #1 and #2 combined *versus* order #3. The quantitative perceived risk rating was significantly lower in order #3 for both ovarian [t (188) = 2.9; $P < 0.01$] and colorectal [t (417) = 2.4; $P < 0.05$]. As seen in Fig. 1, perceived risk ratings (unadjusted) were lowest for order #3 (comparative, quantitative population, and quantitative personal risk), relative to orders #1 (quantitative personal, quantitative population, and comparative risk) and #2 (comparative, quantitative personal, and quantitative population risk). Unfortunately, we could not conduct an identical analysis for prostate cancer (*i.e.,* a model which included family history as a factor) because there were no men with a positive family history in order #2. However, we did conduct a one-way ANOVA without family history in the model and did not find a significant effect for question order [F (2,193) = 2.04; P = 0.13]. Despite the linear trend, one explanation for the absence of a significant finding is a lack of power, in that fewer participants were available in order #2 relative to the analyses on ovarian and colorectal perceived risk. We have included the means for perceived risk for prostate cancer in Fig. 1 for illustrative purposes.

Fig. 1 also suggests that participants were overestimating their risk on each of the cancers, regardless of question order. For example, the mean perceived risk rating for lifetime colorectal cancer risk ranged from 22% to 26%, depending on item order. However, for a 60-year-old Caucasian person, Surveillance, Epidemiology, and End Results data indicate that lifetime risk for colorectal cancer is 5.6% (33). And among Caucasian first-degree relatives of colorectal cancer patients, the lifetime risk has been estimated to be 1.8 times the risk of persons without a family history (34). Together, these estimates translate into a 10% lifetime risk of colorectal cancer for Caucasians with a family history. Therefore, even accounting for our sample's older age, race, and that 17% had a family history of colorectal cancer, their perceived risk ratings appear to be substantially higher than their actual risk. Similarly, participants greatly overestimated the population's risk on each of the cancers (prostate: M = 36.2%, SD = 21.0; ovarian: M = 25.0%, SD = 16.9; and colorectal: M = 26.3%, SD = 16.3). Thus, participants rated everyone's risk (self and others) as higher than what is actually observed.

Not surprisingly, we also found that individuals with a family history of a particular cancer reported greater perceived risk for that cancer type [prostate: F (1,192) = 16.1, $P < 0.001$; ovarian: F (1,182) = 6.4, $P < 0.01$; and colorectal: F (1,410) = 11.3, $P < 0.001$]. These results were also found using the comparative measure (data not shown).

Does the Order of Perceived Risk Items Affect the Consistency of Responses to the Three Items?[4] We assessed whether participants' consistency of responses to the three items improved as a function of question order and found that consistency did improve for prostate [χ^2 (2, n = 188) = 10.8, $P < 0.01$] and colorectal cancer [χ^2 (2, n = 396) = 7.4, $P < 0.05$] but not for ovarian cancer [χ^2 (2, n = 168) = 2.4, $P > 0.20$].

Next, we assessed whether those who responded inconsistently differed from those who responded consistently, in terms of demographic and psychological characteristics. To conduct these analyses, we collapsed across the three orders and included all of the subjects. For colorectal cancer, persons with lower education [χ^2 (2, n = 396) = 21.4; $P < 0.0001$], greater cancer-related distress [χ^2 (1, n = 396) = 6.5; $P < 0.01$], as well as nonwhite participants [χ^2 (1, n = 396) = 12.4; $P < 0.001$] and women [χ^2 (1, n = 396) = 3.8; P = 0.052], were significantly less consistent than each of their respective counterparts. Regarding ovarian cancer, nonwhite participants [χ^2 (1, n = 168) = 3.94; $P < 0.05$] and persons with greater cancer worry [χ^2 (1, n = 168) = 5.18; $P < 0.05$] were less likely to respond in a consistent fashion compared with their respective counterparts. No demographic or psychological variables were significantly related to consistency for prostate cancer (all Ps > 0.20).

Finally, we assessed the relationship between item order and characteristics of consistent *versus* inconsistent subjects. We conducted a series of χ^2 analyses between demographic and psychological variables, and the consistency variable for Order #1 and Order #3 for each of the three disease sites. We excluded Order #2 to reduce the number of tests conducted.

We found very similar results to the findings reported

[4] We thank an anonymous reviewer for suggesting these analyses.

above when we collapsed across the three item orders. For ovarian cancer, those with greater cancer worry [χ^2 (1, n = 93) = 4.2; $P < 0.05$] were less consistent across items for Order #3. For colorectal cancer, lower education was marginally associated with less consistency [χ^2 (2, n = 97) = 4.5; P = 0.10] for Order #1, and for Order #3, lower education [χ^2 (2, n = 235) = 10.7l $P < 0.01$], nonwhite race [χ^2 (1, n = 235) = 12.3; $P < 0.001$], and cancer-related distress [χ^2 (1, n = 235) = 3.9; $P < 0.05$] were associated with less consistency across items. For prostate cancer, lower education [χ^2 (2, n = 47) = 6.4; $P < 0.05$] was associated with less consistency across measures for Order #1.

Overall, we found that consistency across items was related to item order for prostate and colorectal cancer, such that consistency improved with each change in item order. Additionally, we found that persons with less education, cancer-related distress/worry, and nonwhites were less consistent than their respective counterparts. Finally, it appeared that Order #1 and Order #3 were associated with similar demographic and psychological characteristics; *i.e.*, changing item order did not appear to modify the association between consistency and demographic or psychological characteristics.

Discussion

The goal of this study was to demonstrate that varying the order of perceived risk items can result in different perceived risk ratings. Importantly, our goal was not to improve accuracy of perceived risk (although this occurred to some extent) but rather to demonstrate that responses are dependent on the context in which they are assessed. The results suggest that it is possible to influence the quantitative ratings of perceived risk as a function of the order in which the items are presented. In particular, when participants considered their risk in comparative terms and the risk of the general population first, their subsequent quantitative personal risk ratings were lower (and therefore somewhat more realistic) than when the quantitative personal risk item appeared first. The results suggested that participants were more likely to rate their own risk closer to their rating of the population's risk with each modification in item order, and particularly in order #3, when the comparative and quantitative population ratings were made before the quantitative personal ratings.

It is possible that participants were attempting to match their numerical rating to their comparative rating, which resulted in the lower numerical ratings of perceived risk. There is some evidence for this, as we found that consistent responses across the three items improved with changes in item order. Importantly, inconsistent responses were most prevalent among certain subgroups, including persons with lower education, higher cancer worry, and nonwhites. These are groups that are often focused on in an effort to increase cancer screening (28, 35). To the extent that perceived risk is used to predict and explain cancer screening in these subgroups, the current findings have particular relevance for researchers when they are selecting measures to assess perceived risk in future studies. Furthermore, these findings provide evidence for the role of innumeracy in participants' ratings of perceived risk (31), particularly among those with less education.

These findings are interesting in light of results reported by Woloshin *et al.*, (21) who found that the comparative measure of perceived risk provided a more accurate reflection of actual risk than did the quantitative measure. As the order of the items in that study was the quantitative item followed by the comparative item, an interesting follow-up question to this study would be whether the same results would be found if the question order were reversed. The results from the current study would suggest that if the comparative item preceded the quantitative item, the quantitative item would provide results that were closer to the comparative item and to the actual risk estimates.

In the related research area of psychological uncertainty, Windschitl and Wells (36) found that a comparative measure was a better predictor of preferences and intentions when compared with a quantitative measure. These authors concluded that despite the preference for numeric methods in the psychological literature, verbal measures are a potentially more informative method of assessment, particularly for constructs such as perceived risk for disease. Certainly, evidence from the risk communication literature demonstrates that certain subgroups of people prefer to receive risk related information in comparative rather than numeric formats and that this preference is associated with choice of medical treatment (37). Similarly, Diefenbach *et al.* (38) reported that college students preferred verbal ratings to numeric ratings of perceived risk, as they believed they were easier to use and more accurately reflected their feelings. Unfortunately, we were unable to test the direct impact of question order on the comparative perceived risk item, as this item was not ever placed second in the ordering.

The effect of question order on perceived risk ratings can be interpreted in terms of whether or not participants considered their own risk in the context of others' risk. That is, when the comparative rating and the population risk ratings were made first, participants were required to consider their own risk relative to that of others, but when the quantitative personal risk question was asked first, they were not compelled to consider their own risk in relation to others' risk. Our results are consistent with studies conducted by Weinstein (39, 40) in which subjects became more accurate in their estimation of their own risk when they were forced to consider the risk status of others. Importantly, the participants in the Weinstein studies were initially underestimating their risk, whereas the participants in the current study overestimated their risk. Thus, regardless of the initial direction of the inaccuracy, forcing individuals to consider their risk relative to that of others may lead to more accurate risk perception. Although the goal of the current study was not to increase the accuracy of perceived risk, it appears that increased accuracy was a side effect of modifying item order.

The limitations of this study include the lack of random assignment to question order and the fact that a complete Latin-square design in which each measure appeared in each of the three positions was not used. Experimental research in which participants are randomly assigned to all of the possible item orders and all of the item orders are tested is needed to fully address the impact of item order on participant ratings. In addition, further research is needed to determine which of the perceived risk measures most accurately predicts behavior.

In summary, although using multiple methods to assess perceived risk might provide more information than when only a single method is used, different conclusions may be reached depending on the context in which an item is assessed. Previous research has demonstrated that differing results may be obtained depending on how perceived risk questions are assessed (21). Results from the present study additionally suggest that item order or the context in which an item is asked is also important in the assessment of perceived risk.

Psychometrically sound, multi-item assessments are needed to accurately assess perceived risk. However, our reading of the literature suggests that although some perceived risk researchers may be discussing the importance of perceived risk scales (22), single items are currently the norm for assessing perceived risk. Thus, the results of the current paper are relevant to researchers who are designing and executing studies before the availability of psychometrically sound scales. And indeed, the results of the current study may hasten the shift away from single-item assessments, by demonstrating their lack of reliability and dependence on the context in which they are assessed.

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