Article

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Message Formats, Numeracy, Risk Perceptions of Alcohol-Attributable Cancer, and Intentions for Binge Drinking Among College Students

Yixin Chen[1] and Z. Janet Yang[2]

Abstract

We conducted an experiment to examine whether risk perceptions of alcohol-attributable cancer influence college students' binge-drinking intention and to explore how message formats (text, table, and graph) and numeracy influence risk perceptions of alcohol-attributable cancer. We found that a majority of participants (87%) perceive some risks of alcohol-attributable cancer. Risk messages in tabular and graphic formats are more effective in elevating risk perceptions, but there is no significant difference between these two formats. Numeracy and its interaction with message formats, however, do not predict risk perceptions. We recommend risk messages should be delivered using tabular or graphic formats to enhance risk perceptions. We also advocate the *less-is-more* principle in presenting risk information.

Keywords

binge drinking, college students, message formats, numeracy, risk perception

[1]Department of Communication Studies, Sam Houston State University, Huntsville, TX, USA
[2]Department of Communication, University at Buffalo, The State University of New York, Buffalo, NY, USA

Corresponding Author:
Yixin Chen, Department of Communication Studies, Sam Houston State University, Huntsville, TX 77341–2299, USA.
Email: cindychen@shsu.edu

College students' binge drinking raises a serious public health concern (Wechsler et al., 2002) because it often creates health and behavioral problems for drinkers themselves and for others on campus. Binge drinking refers to having five or more drinks for men and having four or more drinks for women in about 2 hours (Campo & Cameron, 2006). Based on statistics from *Monitoring the Future*, a national survey on drug use, the 2010 rate for binge drinking among college students was 37%, which had largely remained unchanged since 1993 (Johnston, O'Malley, Bachman, & Schulenberg, 2011). An important factor that accounts for binge drinking is college students' low risk perceptions of alcohol-related problems—that is, perceived risk of negative consequences following alcohol consumption (Bazargan-Hejazi, Gaines, Duan, & Cherpitel, 2007; Strano, Cuomo, & Venable, 2004). In particular, risk perception related to each negative consequence should be examined separately, as risk perception of alcohol-attributable cancer is likely different from that of death or injury due to drunk driving, or that of unplanned sex because of binge drinking.

In this study, we focus on risk perception of alcohol-attributable cancer. A considerable proportion of cancer cases (e.g., cancer of the upper aerodigestive tract, liver cancer, colorectal cancer, and female breast cancer) can be attributed to alcohol consumption (Schütze et al., 2011). However, because cancer is more likely to strike older people (National Institute on Aging, 2013), college students might not be aware of this association because they are less likely to view cancer as relevant to them. Previous researchers have examined college students' perceptions of risk from experiencing alcohol-related problems such as having a hangover, nausea, or vomiting; experiencing blackouts (Bujarski, Klanecky, & McChargue, 2010); drunk driving (McCarthy, Pedersen, & Leuty, 2005); and unplanned sex (Klein, Geaghan, & MacDonald, 2007). However, college students' risk perception of alcohol-attributable cancer has yet to be explored. Our first goal in the current study is to explore whether elevating college students' perceived risk of alcohol-attributable cancer can reduce their intentions to binge drink. Our second goal is to examine how message formats (texts, tables, and graphs) and numeracy influence college students' perceived risk of alcohol-attributable cancer. Here, numeracy refers to an individual's ability to understand and use numbers in daily life (Bernhardt & Cameron, 2003).

Theoretical Framework

This study is inspired by a recent review of literature related to the effects of numeracy on cognition, health behaviors, and medical outcomes (Reyna, Nelson, Han, & Dieckmann, 2009). Reyna et al. (2009) proposed a causal framework arguing that the interplay between message formats and numeracy affects cognition, which, in turn, influences health and medical decision making. In particular, risk messages presented in varying formats may have different

effects on individuals' risk perceptions, and such effects may be moderated by their numerate skills. Applying this framework to the current research context, risk perceptions of alcohol-attributable cancer might affect binge-drinking intentions, which could be considered as one type of behavioral decisions after being exposed to risk messages. Moreover, based on Reyna et al.'s (2009) framework, it is speculated that varying formats of risk messages may have an impact on college students' risk perceptions of alcohol-attributable cancer, and this impact may be contingent on their levels of numeracy. Next, empirical studies for these speculations are reviewed.

Risk Perception and Behavioral Intention

Risk perception is essential to risk-related decision making. Floyd, Prentice-Dunn, and Rogers (2000), in their meta-analysis of research on protection motivation theory, demonstrated that increases in perceived severity and vulnerability (two components of risk perception) are predictive of higher intention to take protective actions, and the effect sizes are in the moderate range. Researchers in recent studies also showed that risk messages could augment individuals' perception of negative consequences and, accordingly, lead them to adopt preventive behaviors to decrease the risks. For example, McMath and Prentice-Dunn (2005) found that undergraduate participants exposed to a high-threat message reported higher perceived severity of skin cancer and greater perceived vulnerability to skin cancer, which led to increased intentions to take precautionary measures against skin cancer. Also, De Wit, Das, and Vet (2008) showed that risk perception of infection with the hepatitis B virus mediated the effects of different types of persuasive evidence (narrative evidence and statistical evidence) on individuals' intention to obtain the hepatitis B virus vaccine. Even though the link between risk perception of alcohol-attributable cancer and intention for binge drinking has not been studied, based on existing research on the impact of risk perception on behavioral intention, the following hypothesis is posed:

H1: Risk perception of alcohol-attributable cancer is negatively related to intention for binge drinking.

Message Format and Risk Perception

Risk messages can successfully modify individuals' risk perceptions related to binge drinking (Ayers & Myers, 2012). Public health campaigns intending to reduce binge drinking among college students have consistently focused on the immediate negative consequences of binge drinking, including alcohol-related injury, death, or unprotected sex (DeJong, 2002). One problem of

these messages is that college students may ignore them due to message fatigue, a phenomenon that happens among individuals receiving long-term and repetitive public health messages (O'Neill, McBride, Alford, & Kaphingst, 2010). In comparison, emphasizing the *alcohol–cancer association* might be a novel strategy to elevate college students' risk perceptions related to binge drinking. In addition, such messages should be presented in formats that facilitate understanding, so that college students can perceive their risks correctly and take appropriate actions to reduce their risks (Waters, Sullivan, Nelson, & Hesse, 2009).

There is empirical evidence that risk messages presented in texts, tables, or pictographs have different effects on cognitive responses. Smerecnik et al. (2010) found that health-related risk messages presented in graphs resulted in better comprehension than those presented in texts or tables, but tabular and textual messages did not lead to different levels of comprehension. Tait, Voepel-Lewis, Zikmund-Fisher, and Fagerlin (2010) reported that messages in pictographs were associated with more accurate risk perceptions of clinical research than those in texts and tables, but there was no significant difference between textual and tabular messages. These findings suggest that graphs have advantages over tables and texts in aiding individuals to form appropriate risk perceptions. Thus, the following hypothesis is advanced:

> H2: Exposure to risk messages in graph format is associated with higher risk perception of alcohol-attributable cancer than exposure to those in table format (H2a) and text format (H2b).

Numeracy and Risk Perception

An important feature of risk messages is that they often contain numbers, statistics, or other numerical information. Individuals need a certain level of numeracy to comprehend these messages. One might expect college students to have sufficient numeracy, which is essential for risk assessments and decision making (Reyna et al., 2009), but this is not the case for all American college students. Based on a recent study on math achievement, American college students performed poorly in solving math problems, such as comparing the magnitude of two fractions (Richland, Stigler, & Holyoak, 2012). Thus, it is important to explore whether numeracy influences college students' risk perception of alcohol-attributable cancer. Previous researchers have shown that lower numeracy is associated with less understanding of medical information, worse risk comprehension or assessment, lower self-efficacy in managing health, and poorer decision making (Chen & Feeley, 2014; Miron-Shatz, Hanoch, Graef, & Sagi, 2009; Tanius, Wood, Hanoch, & Rice, 2009; Wright, Whitwell, Takeichi,

Hankins, & Marteau, 2009). Although the relationship between numeracy and risk perceptions of alcohol-attributable cancer is unclear, based on existing research, the following hypothesis is posed:

> H3: Numeracy is positively related to risk perception of alcohol-attributable cancer.

The Moderating Role of Numeracy

Reyna et al. (2009) pointed out that individuals with lower numeracy are more susceptible to how risk messages are presented. In other words, numeracy may moderate the effects of message formats on risk perception. Some researchers have found that adding visual aids to numerical information reduces the gap in risk comprehension and risk perceptions between individuals with low and high numeracy (Garcia-Retamero & Galesic, 2010; Keller, Siegrist, & Visschers, 2009). Other researchers, however, suggest that graphical risk messages promote better comprehension and more accurate risk perceptions than tabular or textual ones, regardless of individual differences in numeracy (Smerecnik et al., 2010; Tait et al., 2010). In addition, there is empirical evidence that not everyone benefits from visual displays (Galesic & Garcia-Retamero, 2011), and graphs may create more difficulty in risk comprehension for individuals with low numeracy (Hess, Visschers, Siegrist, & Keller, 2011). In light of the inconsistency of these findings, the following research question (RQ) is posed:

> RQ: Does numeracy moderate the relationship between message formats and risk perception of alcohol-attributable cancer?

Figure 1 shows a conceptual model illustrating the hypothesized relationships.

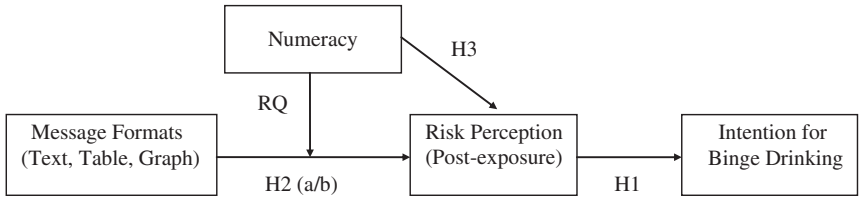


Figure 1. Hypothesized model illustrating the relationships among major variables.
RQ = research question.

Method

Survey and Experimental Design

We used an online experimental survey to test the hypotheses and address the RQ. At the beginning of the survey, participants were given the following instruction as to what *a drink* refers to:

> Throughout these questions, by "a drink" we mean a can or a bottle of beer, a glass of wine or a wine cooler, a shot of liquor, or a mixed drink with liquor in it. We are not asking about the times when you only had a sip or two from a drink.

Participants were also instructed that "binge drinking refers to 5 or more drinks on a single occasion for men or 4 or more drinks on a single occasion for women, generally within about 2 hours." Then, we inquired participants' demographic information and past alcohol consumption and assessed their numeracy. After that, participants were randomly assigned to one of the message conditions (text, table, and graph). In the remaining survey, we measured participants' risk perceptions after message exposure and intentions for binge drinking in the next month.

Participants

Participants were 127 undergraduates who completed the online experimental survey. Data were collected from undergraduate courses in the Department of Communication and the Department of Mathematics at a large public university in the northeast of the United States. The decision to include students taking communication courses and those taking mathematics courses allowed for a sample with diversified numeracy, as students taking math courses are likely to have higher numeracy than those taking communication courses.

Participants ranged from 19 to 28 years of age ($M = 20.65$, $SD = 1.85$). Among them, 88 (69.3%) were men and 39 (30.7%) were women; 95 (74.8%) were White and 32 (25.2%) were non-White; 50 (39.4%) were humanity/social science majors; 77 (60.6%) were natural science/engineering majors. Years at college ranged from 1 to 7 years ($M = 2.17$, $SD = 1.18$). Their self-rated health status ranged from $1 = poor$ to $5 = excellent$ ($M = 3.77$, $SD = 0.83$).

Stimuli

The messages about the causal relationship between alcohol use and cancer incidence were adapted from an article entitled "Alcohol attributable burden of incidence of cancer in eight European countries based on results from prospective cohort study," published in the *British Medical Journal* (Schütze et al., 2011). The real percentages of alcohol-attributable cancers reported in this

article were used to ensure the ecological validity of the study. Appendix shows the stimuli in three different formats (text, table, and graph). The number of participants assigned to text, table, and graph condition were 42, 49, and 36, respectively.

Measures

Individual characteristics. Individual characteristics including age, gender, ethnicity, major, self-rated health status, and years at college were measured. In addition, participants' past drinking behavior was assessed by asking participants, in the past month (30 days): (a) On average, how many drinks did you have each time you drank? (b) What is the maximum number of drinks you had at any one time? These two items have been used to examine drinking patterns among female college students (a sorority-only sample; Huchting, Lac, & LaBrie, 2008). The average number of drinks they had each time they drank in the past month ranged from 0 to 50 ($M = 4.76$, $SD = 6.53$). The maximum number of drinks they had at any one time in the past month ranged from 0 to 50 ($M = 6.58$, $SD = 7.10$).

Risk perceptions. The measure of risk perceptions in this study consisted of perceived susceptibility and perceived severity. These two subscales were multiplied to create a product term representing risk perceptions. Perceived susceptibility was assessed by a single item, which was adapted from a measure of perceived probability of health risks (Yang et al., 2010): "How likely are you to get cancer in the future from binge drinking? Please use a scale from 0 to 100, where 0 means absolutely unlikely and 100 means absolutely likely." Perceived severity was assessed by a single item, which was adapted from a measure of perceived severity of health risks (Yang et al., 2010): "If you were to get cancer from binge drinking, how serious do you think it would be? Please use a scale from 0 to 100, where 0 means not serious at all and 100 means extremely serious."

Participants' risk perceptions ranged from 0 to 7,990 ($M = 1{,}547$, $SD = 1{,}744$). The histogram of risk perceptions showed that this variable was positively skewed (Skewness = 1.531, Kurtosis = 2.332). Thus, a natural-log data transformation (ln[1 + risk perception]) was performed, and the transformed risk perception showed an improved normality (Skewness = −1.255, Kurtosis = 0.384). The histogram of ln(1 + risk perception) showed that this transformed variable consisted of a spike representing participants who scored zero for risk perception and a separate normal curve representing those who scored larger than zero for risk perception. Based on Weinstein's (2000) reasoning and analyses, cases with nonzero risk perceptions should be studied separately from those with zero risk perception. Thus, participants who scored zero for risk perception (i.e., ln[1 + risk perception] = 0; 16 participants, 12.6%) were excluded from subsequent analyses to facilitate data analysis, resulting in a final

sample size of 111. This procedure further improved the normality of ln(1 + risk perception) (Skewness = −0.969, Kurtosis = 0.415) with a mean value of 6.79 ($SD = 1.47$).

Numeracy. Numeracy was measured by four items from the subjective numeracy scale (SNS; Fagerlin et al., 2007), which has been validated in risk communication research and has good reliability (Zikmund-Fisher, Smith, Ubel, & Fagerlin, 2007). The SNS, rather than the objective numeracy measure (Lipkus, Samsa, & Rimer, 2001), was used in the present study to reduce the cognitive burden of participants. The SNS assesses individuals' self-perceived ability to perform various mathematical tasks (Fagerlin et al., 2007). The SNS items include the following: (a) How good are you at working with fractions? (b) How good are you at working with percentages? (c) How good are you at calculating a 15% tip? (d) How good are you at figuring out how much a shirt will cost if it is 25% off? The response options ranged from 1 = *Not at all good* to 6 = *Extremely good*. Upon reliability check ($\alpha = .92$), these items were averaged to create a measure for numeracy ($M = 4.47$, $SD = 1.19$).

Binge-drinking intention. Binge-drinking intention was measured by three items: (a) I intend to binge drink in the next month, (b) I plan to binge drink in the next month, and (c) I will binge drink in the next month. The response options ranged from 1 = *Strongly disagree* to 5 = *Strongly agree*. Upon reliability check ($\alpha = .97$), these items were averaged to create a measure for intention for binge drinking ($M = 3.10$, $SD = 1.14$).

Analysis Plan

We conducted path analyses to test the hypotheses and address the RQ. Path analyses allow us to simultaneously examine whether changes in risk perception, as a function of the intervention of risk messages, modified binge-drinking intentions. As message condition is a categorical variable, we conducted separate path analyses, with each message condition included as a dummy variable to test the interaction between numeracy and each message condition.

Results

Table 1 shows the zero-order correlation matrix of study variables. Results of the first path analysis (Text = 1; Table and Graph = 0) showed the model had a decent fit: $\chi^2(3) = 3.84$, $p = .28$, root mean square error approximation (RMSEA) = .053. The association between risk perception and intention for binge drinking was not significant ($b = -.056$, $p = .475$). The association between the text condition and risk perceptions was significant ($b = -.501$, $p = .029$), indicating that textual messages were related to lower risk perceptions than

Table 1. Zero-Order Correlation Matrix of Study Variables.

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Gender (*Male* = 1; *Female* = 2)	—	.078	−.119	−.299**	.184	−.221*	−.127	−.261**	−.344**	−.167	−.219*
2. Age		—	−.128	−.413**	.724**	.107	.014	.029	−.129	−.012	−.117
3. Ethnicity (1 = *Non-White*; 2 = *White*)			—	.021	−.081	.227*	.146	.229*	.198*	.092	.216*
4. Major (1 = *Humanity/Social Science*; 2 = *Natural Science/Engineering*)				—	−.556**	−.117	−.062	−.075	.453**	.023	.033
5. Number of years in college					—	−.046	.096	.074	−.280**	−.117	−.273**
6. Health status						—	.058	.144	.179	.068	.180
7. Average number of drinks at one time							—	.533**	−.085	−.027	.223*
8. Maximum number of drinks at one time								—	.083	.088	.322**
9. Subjective numeracy									—	.126	.122
10. Risk perception										—	−.065
11. Intention											—

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

both graphic and tabular ones. The association between numeracy and risk perception was not significant ($b = .003$, $p = .985$). The interaction effect (text condition × numeracy) on risk perception was not significant ($b = .251$, $p = .119$).

Results of the second path analysis (Table = 1; Text and Graph = 0) showed the model had a decent fit: $\chi^2(3) = 2.17$, $p = .54$, RMSEA = .000. The association between risk perceptions and intentions for binge drinking was not significant ($b = -.056$, $p = .475$). The association between the table condition and risk perception was not significant ($b = .119$, $p = .429$), indicating that tabular messages did not differ from the other two conditions in influencing risk perception. The association between numeracy and risk perception was not significant ($b = .094$, $p = .490$). The interaction effect (table condition × numeracy) on risk perception was not significant ($b = .051$, $p = .574$).

Lastly, results of the third path analysis (Graph = 1; Text and Table = 0) showed the model had a decent fit: $\chi^2(3) = 3.37$, $p = .34$, RMSEA = .035. The association between risk perceptions and intentions for binge drinking was not significant ($b = -.056$, $p = .475$). The association between the graph condition and risk perceptions was not significant ($b = .012$, $p = .906$), indicating that graphical message did not differ from the other two conditions in influencing risk perceptions. The association between numeracy and risk perceptions was not significant ($b = .077$, $p = .555$). The interaction effect (graph condition × numeracy) on risk perceptions was not significant ($b = .072$, $p = .248$).

Based on the earlier analyses, across different message conditions, risk perceptions were not significantly related to binge-drinking intentions; thus, H1 was not supported. Graphical risk messages were not associated with higher risk perceptions than tabular ones; thus, H2a was not supported. However, graphical risk messages were associated with higher risk perceptions than textual one; thus, H2b was supported. Numeracy was not significantly related to risk perceptions; thus, H3 was not supported. To address the RQ, numeracy also did not moderate the effect of message conditions on risk perceptions.

Discussion

In this study, we examined the association between risk perceptions of alcohol-attributable cancer and college students' intentions for binge drinking. We also explored how message formats (text, table, and graph) and numeracy influence risk perceptions. We found that, among participants who perceive some risks of alcohol-attributable cancer, higher risk perceptions were not significantly associated with lower intentions for binge drinking. We demonstrated that risk messages in both table and graph format were more effective in increasing risk perceptions than those in text format, but there was no significant difference between risk messages in graph format and those in table format; numeracy and its interaction with message formats also did not influence risk perceptions. The implications of these findings are discussed later.

Considering that binge drinking is prevalent on college campuses, it is probably unrealistic to persuade students not to drink at all. The present study represents a first attempt to explore whether perceived risks of alcohol-attributable cancer influence college students' intentions for binge drinking. Although cancer is a preventable disease, it claims more than a half million lives each year in the United States alone (National Cancer Institute, 2007). Many risk factors associated with cancer incidence have been identified, such as unhealthy diet, physical inactivity, and tobacco use (National Cancer Institute, 2007), but the causal link between alcohol consumption and cancer incidence is a recent research finding (Schütze et al., 2011), which is probably less known to the general public, including the college student population. Thus, we consider risk messages specifying this causal link (e.g., the ones used in the current study) possess novelty, which might combat message fatigue among college students. Based on our findings, a majority of college students (87%) did perceive some risks of alcohol-attributable cancer. Unfortunately, we did not find a significant relationship between risk perceptions of alcohol-attributable cancer and intentions for binge drinking.

Two reasons may explain the nonsignificant relationship between risk perceptions and intentions for binge drinking. The first is that risk perception has small effects on intention, according to a meta-analysis of experimental studies (Sheeran, Harris, & Epton, 2014). Such small effects require a larger sample size for detection, which is not the case in the current study. The second is that participants reported their risk perceptions of alcohol-attributable cancer shortly after exposure to the risk messages. As typical college students, some participants might not have read and thought carefully about the risk messages, and thus failing to relate what they read to the estimation of their personal risks for alcohol-related cancer incidence. Future research should take into account the way in which participants process the risk messages presented in different formats. Taken together, a larger sample size and a more personalized approach to encourage participants to actively process the risk messages might result in a greater impact on risk perceptions.

With the above being said, we contribute to the literature by addressing two issues in risk perception measurement in previous studies. One issue is that previous researchers often used measures of risk for people in general instead of personal risk (Brewer et al., 2007). Findings from these studies are likely to lead to biased estimates, as individuals have a tendency to rate the risk for others as greater than their personal risks (Karlsson, 2008). A second issue is that previous researchers often did not specify a behavior in their measures when assessing personal risk (Brewer et al., 2007). As a result, participants' estimates of personal risks were not based on the same reference point (Karlsson, 2008). In this study, we were mindful of these two issues, as we focused on perceptions of personal cancer risks related to a specific behavior—binge drinking.

The finding that there is no significant difference in risk perceptions between risk messages in table format and those in graph format suggests that tables may be an effective alternative to graphs in delivering risk messages. The finding that compared with text, graph is a more effective format to communicate risk is in line with previous studies (Smerecnik et al., 2010; Tait et al., 2010). This finding shows the advantages of graphs over texts in delivering risk information to college students, regardless of their numeracy levels. Graphs probably attract and hold more attention because they present numerical information in a vivid manner (Smerecnik et al., 2010). Also, graphs show a pattern of change in magnitudes, so they may demand less cognitive effort and accordingly facilitate the comprehension of risk (Smerecnik et al., 2010). It is likely that individuals would have more accurate risk perceptions if they were more attentive to graphical risk information and were required to use less effort in processing such information. Another possible explanation is that graphs can facilitate meaningful risk comprehension through features that enhance visual perception abilities and semiotic convention (Severtson & Henriques, 2009).

The finding that tabular risk messages have advantages over textual ones is inconsistent with previous studies that failed to detect the differences between these two formats (Smerecnik et al., 2010; Tait et al., 2010). It is possible that tables demand less effort in information processing, as they eliminate redundant information and make the overall information more organized. More concise and organized information may facilitate both heuristic and systematic information processing, and thus generating in-depth understanding of risk information (Chaiken, 1980). Therefore, risk messages in table format are potentially more comprehensible, and thus helping individuals form accurate risk perceptions. There is empirical evidence that deleting unnecessary information and sequencing information could promote better understanding among both low-numerate and high-numerate individuals (Peters et al., 2007). Our finding seems consistent with this research and supports the *less-is-more* principle in presenting risk information.

Contrary to Reyna et al.'s work, numeracy was not predictive of risk perceptions. One possible reason is that, in the current sample, there were a high percentage of science, technology, engineering, and mathematics (STEM) students, which might have inflated the scores of the numeracy measure (mode is 6 on a 1–6 scale, representing 20% of participants). Another possible reason is that some participants might have overrated their numerate skills because of social desirability or overconfidence. A third reason is that risk messages in the current study were relatively easy to understand and thus might require less numerate skills to comprehend, rendering a nonsignificant effect of numeracy on risk perception. Based on this result, future research should assess objective numeracy (Lipkus et al., 2001) rather than subjective numeracy (Fagerlin et al., 2007) when exploring its impact on risk perceptions.

Practical Implications

The present findings suggest that effects of message formats on risk perceptions are consistent for both low-numerate and high-numerate individuals. Some scholars have consistently argued "problems with understanding numerical information often do not reside in people's minds, but in the representation of the problem" (e.g., Garcia-Retamero & Galesic, 2010, p. 1019). Our findings appear to be in line with this argument. Perhaps individuals' difficulties in understanding numerical information are associated with the presentation formats of risk information, rather than with insufficient numeracy. In other words, if misperception of risk information occurs, perhaps poor presentation format is to blame, not low numeracy.

In practice, we provide guidance for effective risk message design for health interventions dedicated to increasing risk perceptions of alcohol use. Although college students are probably not too concerned about cancer themselves, they may have family members who are suffering from or battling with cancer, or they may have experienced the loss of a loved one due to cancer. Exposure to alcohol-attributable cancer risk messages may prompt some deep thoughts and reflections in college students regarding possible long-term consequences of binge drinking, such as cancer incidence. Health educators implementing drug and alcohol education programs may want to incorporate alcohol-attributable cancer risk messages and present these messages in graphical or tabular formats to facilitate comprehension of risk information.

Limitations

Several limitations of this study should be considered when interpreting findings. First, the present findings apply only to students who at least perceive some sort of risks of alcohol-attributable cancer. Although these students constituted a majority (87%) of the sample, there was a small group of students who did not perceive any risk of alcohol-attributable cancer. For this small group, other social cognitive factors might be more important in motivating behavioral change. Second, we had a relatively small sample size, which probably accounts for the nonsignificant association between risk perceptions and intentions for binge drinking. Also related to our sample, 63% of participants were Natural Science/Engineering majors, and the rest of them were Humanity/Social Science majors. Nationally, about 14% of all undergraduates in U.S. postsecondary institutions were STEM majors (U.S. Department of Education, 2009). Our sample consisted of a high percentage of STEM students and thus did not represent the U.S. undergraduate student population, which limits the generalizability of our findings. Third, there was no true control condition in this experimental study. Fourth, we examined risk perceptions only as the direct outcome after message exposure and as the antecedent to intentions for binge

drinking. Individuals' emotional states, such as the level of worry or anxiety, can also change after exposure to risk messages and may serve as predictors of intentions for binge drinking.

Conclusion

Despite the limitations mentioned earlier, this study represents an initial effort to examine the association between risk perceptions of alcohol-attributable cancer and college students' intentions for binge drinking. We also explored whether textual, tabular, and graphical formats of risk information have different impacts on risk perception related to alcohol-attributable cancer. Results from this study contribute to the drug or alcohol education literature by assessing risk perceptions of alcohol-attributable cancer as a potential targeting cognitive construct for health interventions designed to reduce binge drinking on American college campuses. Our findings are important, as we found support that risk messages should be delivered using tabular or graphic formats rather than textual formats and demonstrated that tables and graphs may be equally effective in enhancing risk perceptions of alcohol-attributable cancer. Future research should explore more effective message design to motivate participants to pay attention to alcohol-attributable cancer risks and examine the impacts of possible emotional factors on young adults' intentions for binge drinking.

Appendix. Messages in Three Different Formats

Scientists in epidemiology, drug addiction, cancer prevention, and public health have found that an important proportion of cases of cancer can be attributable to alcohol consumption, especially consumption higher than the recommended upper limits. Their findings, published in the *British Medical Journal*, reported the percentages of the incidence of different types of cancer that were attributable to alcohol consumption as follows:

Condition 1 (Message in text):

Among men with cancer of upper aerodigestive tract, 44 out of 100 cases were attributable to alcohol consumption.

Among women with cancer of upper aerodigestive tract, 25 out of 100 cases were attributable to alcohol consumption.

Among men with liver cancer, 33 out of 100 cases were attributable to alcohol consumption.

Among women with liver cancer, 18 out of 100 cases were attributable to alcohol consumption.

Among men with colorectal cancer, 17 out of 100 cases were attributable to alcohol consumption.

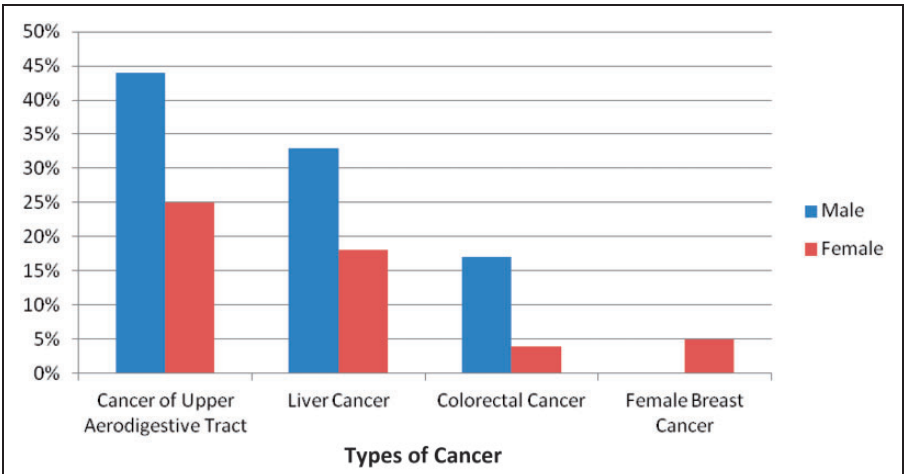
Among women with colorectal cancer, 4 out of 100 cases were attributable to alcohol consumption.

Among women with breast cancer, 5 out of 100 cases were attributable to alcohol consumption.

Condition 2 (Message in table):

	Percentage of cancer incidence attributable to alcohol consumption	
Type of cancer	Male (%)	Female (%)
Cancer of upper aerodigestive tract	44	25
Liver cancer	33	18
Colorectal cancer	17	4
Female breast cancer		5

Condition 3 (Message in bar graph):
Percentage of cancer incidence attributable to alcohol consumption



Note: Figure is available in full colour in the online version at dre.sagepub.com

Author Note

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Author Biographies

Yixin Chen, PhD in Communication, 2014, is an Assistant professor in the Department of Communication Studies at Sam Houston State University.

Z. Janet Yang, PhD in Communication, 2009, is an Associate professor in the Department of Communication at the University at Buffalo, The State University of New York.