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The Roles of Prevention Messages, Risk Perception, and Benefit Perception in Predicting Binge Drinking among College Students

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ABSTRACT

To account for the effect of prevention-message exposure on binge drinking among college students, I hypothesized a conceptual model outlining potential mechanisms including perceived probability of negative consequences (PPNC), perceived severity of negative consequences (PSNC), perceived probability of positive consequences (PPPC), and perceived beneficiality of positive consequences (PBPC) from binge drinking, based on the two-step process model. I conducted an online survey at a public university in the US (N = 278). Findings suggested only PBPC was significantly related to binge drinking and the relationship was positive; prevention-message exposure was not directly associated with binge drinking, but was positively associated with PPNC, PSNC, PPPC, and PBPC; none of the mediational paths was significant; higher risk perception (interaction between PPNC and PSNC) was significantly related to less binge drinking, while benefit perception (interaction between PPPC and PBPC) was not predictive of binge drinking. Implications of findings were discussed.

Alcohol consumption is pervasive and epidemic on college campuses. What is especially worrisome is binge drinking in college students, which has been considered a serious public health problem for more than a decade (Wechsler et al., 2002). Binge drinking refers to having five or more drinks for males and having four or more drinks for females in about two hours (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2004). Binge drinking among college students is typically associated with a number of negative outcomes (e.g., poor academic performance, violent behavior) and a series of health and psychological problems (Hingson, Heeren, Winter, & Wechsler, 2005). There have been tremendous public education efforts in delivering alcohol-prevention messages to the college-student population, but these efforts have not been very successful: in a recent national survey on drug use, 37% of college students reported binge drinking in 2010—an alarming percentage, nearly the same as that reported in 1993 (Johnston, O'Malley, Bachman, & Schulenberg, 2011). Therefore, more research is needed on college binge drinking to provide guidance to alcohol-prevention programs targeting this population.

Risk perception is one of the important cognitive beliefs that may account for the effect of prevention messages on binge drinking (Karlsson, 2008). However, existing literature presents mixed findings regarding the impact of risk perception on binge drinking (e.g., Boyle & Boekeloo, 2009; Quick & Bates, 2010). Studies involving risk perception of binge drinking have often left out relevant benefit perception, although the latter should also be part of the decision-making process (Goldberg & Fischhoff, 2000). Moreover, it appears that researchers have conceptualized and operationalized risk perception and benefit perception in various ways, adding to the confusion of findings and making their interpretation even more challenging.

The present study has three main goals. The first is to conceptualize risk perception and benefit perception based on the classical model of risk (Kasperson et al., 1988). The second is to systematically investigate the unique impacts of risk perception and benefit perception on binge drinking. The third is to explore whether risk perception/benefit perception serves as a psychological mechanism translating the effect of prevention messages to binge-drinking behavior. Next, I review the two-step process model (Karlsson, 2008) and related empirical studies, and then I propose a conceptual model to guide my data collection procedure.

Theoretical Framework: The Two-Step Process Model

Scholars from different disciplines have proposed different models/frameworks to explain how communication variables influence health/risk behaviors. One of these models/frameworks is the two-step process model (Karlsson, 2008). The two-step process model suggests that communication processes (e.g., media exposure) change individuals' behaviors through a two-step process. In the first step, intervention approaches target a mediating variable (e.g., a cognitive belief) and (ideally) change it; in the second step, the modified cognitive belief produces behavioral effects on individuals (Karlsson, 2008). There are two indispensable conditions for this process to succeed. First, the mediating variable must be associated with the behavior; second, intervention approaches

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must be able to influence the mediating variable associated with the behavior (Karlsson, 2008). Relying on the two-step process model, I propose that media exposure affects binge-drinking behavior through its influences on cognitive beliefs (e.g., risk perception, benefit perception).

Risk Perception and Binge Drinking

The term *risk* itself often implies two meanings: (1) chance/probability of loss or injury; (2) something that generates or implies a threat (Merriam-Webster, 2014). As such, the definitions of risk and risk perception also vary in the literature. Formal models of risk define it as a joint function of the probability of occurrence of a threat (i.e., harm, hazard) and the severity of that threat (Kasperson et al., 1988). That is, risk is the product of these two factors, and can be computed by the formula Risk = Probability × Severity. As such, risk perception can be understood as a two-dimensional construct: the product of perceived probability of a negative event and perceived severity of that event. Perceived severity is also called perceived seriousness, while perceived probability is also called perceived risk, perceived likelihood, perceived susceptibility, or perceived vulnerability (Weinstein, 2000). In the health behavior literature, the term *risk perception* is less precise than the one mentioned above. It is often considered as a one-dimensional construct and used interchangeably with perceived risk(s) or perception of risk(s), which can refer to (1) the product term; (2) the overall riskiness; or (3) the perceived probability of contracting a disease or getting into a dangerous situation (Aiken, Gerend, & Jackson, 2001).

I consider risk perception as given by the formula Risk Perception = PPNC × PSNC, where PPNC is the *perceived probability* of *negative consequences* and PSNC is the *perceived severity* of *negative consequences*. There are three reasons for this. First, treating risk perception as a product term reflects the intrinsic nature of risk defined by Kasperson et al. (1988). Second, based on theoretical reasoning, it seems evident that perceived probability and perceived severity do not function independently on protective-behavior motivation (Weinstein, 2000). Third, there is empirical data supporting an interaction between probability and severity, although this interaction is difficult to detect (Weinstein, 2000). Thus, I treat risk perception as a product term in the current study.

Perceived risk of alcohol use has been assessed by a variety of different measures in studies involving college students' alcohol consumption (Boyle & Boekeloo, 2009; Crawford, Moore, & Ahl, 2004; Kelley, Fukushima, Spivak, & Payne, 2009; Klein, Geaghan, & MacDonald, 2007; LaChance, Feldstein Ewing, Bryan, & Hutchison, 2009; Quick & Bates, 2010). Findings from these studies are mixed, with negative, null, and even counterintuitively positive relationships reported between perceived risk and alcohol-consumption intention/behavior. An example of such negative relationship is that perceived risk (i.e., perceived probability) of contracting three diseases resulting from drinking alcohol was found to be positively associated with intentions to drink *less* in college students (Quick & Bates, 2010). A positive relationship was observed in a prospective study that reported that college freshmen with higher perceived risk—measured by perceived probability of undesirable outcomes following alcohol use—consumed *more* alcohol 4 months later (Klein et al., 2007). In contrast, some studies failed to find any significant relationship between perceived risk and alcohol consumption (Boyle & Boekeloo, 2009; Crawford et al., 2004; LaChance et al., 2009). In those studies, perceived risk had been measured by the overall riskiness of events resulting from alcohol or other drug use (Crawford et al., 2004), alcohol-involved behaviors' riskiness (LaChance et al., 2009), and the product of the likelihood of negative drinking outcomes and the seriousness of those outcomes (Boyle & Boekeloo, 2009).

Compared to the volume of studies focusing on the perceived risk–alcohol consumption association, there is a paucity of research that has explored how perceived severity influences alcohol consumption in college students. One study found that there is a negative relationship between perceived personal severity of impaired well-being and alcohol consumption (Crawford et al., 2004). Another study reported that perceived severity of punishment resulting from an alcohol-policy violation has no significant effect on students' intentions for future policy violations (Kelley et al., 2009).

Most extant studies on alcohol use examined only one component of risk: either probability alone (e.g., Klein et al., 2007; Quick & Bates, 2010) or severity alone (e.g., Kelley et al., 2009). There is a dearth of studies examining the association between risk perception as a product term and binge drinking among college students (e.g., Boyle & Boekeloo, 2009). Additionally, some studies measured perceived risk by asking participants to rate the overall riskiness (e.g., least risk to highest risk; not at all risky to very risky) of alcohol-related events/behaviors (e.g., Crawford et al., 2004; LaChance et al., 2009). A question like this might be confusing: some participants might consider this to be a question about severity, while others might interpret it as being about *both* probability and severity.

To fill the gaps in the literature, I propose to further investigate the unique predictive capacity of each of the two components of risk perception (i.e., PPNC and PSNC) on binge drinking in college students and to explore whether these two components have an interaction (i.e., multiplication) effect on binge drinking—that is, if risk perception as a product term influences binge drinking. In doing so, this study promises to reveal the theoretical mechanisms by which the probability and the severity components of risk perception influence risky behaviors. When both components of risk perception are taken into account, the model testing is more likely to present unbiased findings of the roles of these two components. Examining risk perception as a product term reflects an application of the classical model of risk (Kasperson et al., 1988). Furthermore, measuring the probability and severity components of risk perception separately can minimize participants' misunderstanding of alcohol-related risk perception and accordingly enhance the validity of the risk-perception measure. The following research hypotheses and questions are posed:

H1: (a) Higher PPNC or (b) higher PSNC of binge drinking is related to less binge drinking.

RQ1: Is there an interaction between PPNC and PSNC, such that higher risk perception (PPNC × PSNC) is related to less binge drinking?

Benefit Perception and Binge Drinking

Benefit perception is often used interchangeably with perceived benefit(s) or perception of benefit(s) (e.g., Chen & Yang, 2017; Coskunpinar & Cyders, 2012). Benefit perception (i.e., perceived benefit or perception of benefit) is conceptualized as "the perception of the positive consequences that are caused by a specific action" (Leung, 2013, p. 1450). In the context of alcohol consumption, perceived benefit has been operationalized as *either* perceived probability of positive outcomes from drinking alcohol (e.g., Goldberg, Halpern-Felsher, & Millstein, 2002) *or* perceived beneficiality—perceived extent of pleasure/other positive outcomes derived from alcohol consumption (e.g., Chao, Szrek, Leite, Peltzer, & Ramlagan, 2015; Hampson, Severson, Burns, Slovic, & Fisher, 2001). It appears that *no* study has ever considered this construct as a product term similar to risk perception.

In the health/risk behavior literature, attitude stands out as a construct that overlaps with risk perception or benefit perception. Attitude is conceptualized as "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Ajzen, 1991, p. 188). If the evaluation of the behavior is more favorable, then the individual holds a more positive attitude about that behavior, that is, perceives more benefits and less risks of performing that behavior. If the evaluation of the behavior is more unfavorable, then the individual holds a more negative attitude about that behavior, that is, perceives more risks and less benefits of performing that behavior. In other words, the attitude construct reflects the sum of perceived benefits (with a positive sign) and perceived risks (with a negative sign). In the drinking literature, attitude has been operationalized as the perceived degree of positive outcomes vs. negative outcomes (i.e., benefits vs. risks; e.g., Elliott & Ainsworth, 2012) or the perceived degree of *only* positive outcomes (i.e., benefits; Chen & Feeley, 2015) derived from alcohol consumption. Those operationalizations have not taken the probability of positive/negative outcomes into account.

I propose examining benefit perception, rather than attitude, together with risk perception, as benefit perception conceptually is a counterpart of risk perception, representing the other end of the assessment scale, while attitude is a combination of both benefit perception and risk perception. Separately examining benefit perception and risk perception of binge drinking helps understand how perceived benefits prompt individuals to engage in binge drinking compared with how perceived risks prevent this behavior. Such understanding cannot be gained by looking at attitude, which treats benefit perception and risk perception as a single construct in the model.

Similar to the cognitive assessment of risk, when evaluating the positive consequences derived from a specific behavior, individuals are likely to assess both the probability and beneficiality of such consequences. To be consistent with the conceptualization and operationalization of risk perception in the current study, I define benefit perception by the formula Benefit Perception = PPPC × PBPC, where PPPC is the *perceived probability* of *positive consequences* and PBPC is the *perceived beneficiality* of *positive consequences*. As with risk perception, treating benefit perception as either PPPC or PBPC in the model—that is, excluding one of these components from the model—the model testing is likely to result in an inaccurate estimation of the effect magnitude of the other component.

Some researchers have claimed that the perceived benefits of risky behaviors (e.g., heavy alcohol use) have received substantially less attention (Goldberg & Fischhoff, 2000; Goldberg et al., 2002) in scholarly inquiries. They argued that studies applying health-behavior models, including the theory of planned behavior (TPB; Ajzen, 1991) and the health belief model (HBM; Janz & Becker, 1984), tend to focus on perceived risks of a risky behavior, perceived benefits of stopping the risky behavior, and/or perceived benefits of performing a protective behavior, while omitting perceived benefits of *the risky behavior itself*. This is no longer the case: in recent years, *perceived benefits* or *perceived benefits vs. risks* (as a single construct) of risky behaviors such as binge drinking have been examined extensively in studies using the TPB model. Both of these constructs were named *attitude toward binge drinking* (e.g., Chen & Feeley, 2015; Elliott & Ainsworth, 2012). Those studies found that attitude is a strong and positive predictor of binge-drinking behaviors among college students. An issue with those studies is that either they only explored perceived benefit (represented by the attitude construct) but left out perceived risk of drinking (e.g., Chen & Feeley, 2015), or they were not able to reveal the unique impact of perceived benefits relative to perceived risks, because they were measured as a single attitude construct (e.g., Elliott & Ainsworth, 2012).

There is a tendency among studies on binge drinking to address only risk perception (e.g., Chen & Yang, 2015), only benefit perception (e.g., Chen & Feeley, 2015), or benefit vs. risk perception (e.g., Elliott & Ainsworth, 2012) of binge drinking. Few studies have examined both risk perception and benefit perception as two separate constructs, although both of them should be part of the decision-making equation (Goldberg et al., 2002). For example, one study reported that, in adolescents, increased risk perceptions (i.e., perceived risks) and decreased benefit perceptions (i.e., perceived benefits) from drinking alcohol were significantly related to a decreased likelihood of drinking 6 months later (Goldberg et al., 2002). Another study showed that, among participants (a sample of South Africans who went for HIV tests), perceived pleasure of drinking heavily was positively related to problem drinking, while the perceived riskiness of drinking heavily was unrelated to problem drinking (Chao et al., 2015). Additionally, one study was unable to determine the *unique* effects on alcohol consumption of risk perception and benefit perception because they were examined not in a single model, but in two separate models (Coskunpinar & Cyders, 2012).

The dearth of drinking research examining risk perception and benefit perception in conjunction, as well as the limited findings, warrants additional studies. Also, it appears studies involving benefit perception have treated this construct as either perceived beneficiality (Chao et al., 2015) or perceived probability (Goldberg et al., 2002) of positive outcomes from drinking alcohol. It remains unknown if the two components of benefit perception generate unique impacts on binge drinking. Moreover, to the knowledge of the present author, no study has examined whether benefit perception as a product term influences binge drinking. The following research hypotheses and questions are posed:

H2: (a) Higher PPPC or (b) higher PBPC of binge drinking is related to more binge drinking.

RQ2: Is there an interaction between PPPC and PBPC, such that higher benefit perception (PPPC × PBPC) is related to more binge drinking?

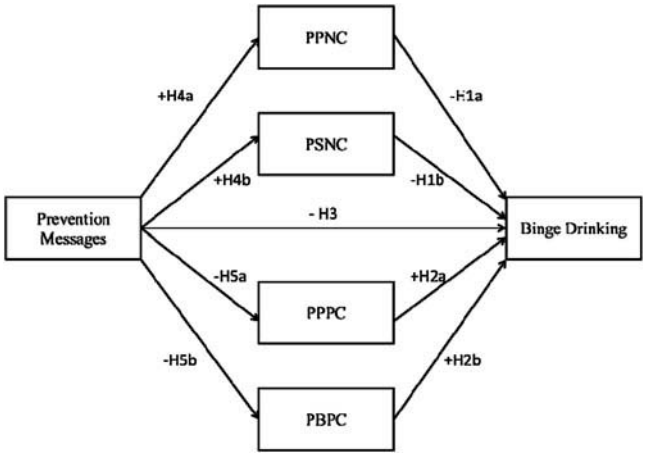

Figure 1. Hypothesized model illustrating the relationships among major variables.

Note. PPNC: perceived probability of negative consequences; PSNC: perceived severity of negative consequences; PPPC: perceived probability of positive consequences; PBPC: perceived beneficiality of positive consequences. To improve the visibility of the model, the correlations between PPNC and PSNC, between PPPC and PBPC, between PPNC and PPPC, and between PSNC and PBPC are not depicted in the figure.

The Role of Prevention Messages

A systematic review of the health mass-media campaign literature from 1996 to 2005 concluded that targeted, well-executed health mass-media campaigns in general can exert small-to-moderate impacts on health knowledge, beliefs, attitudes, and behaviors (Noar, 2006). Moreover, based on a series of studies on message interventions, media messages can successfully enhance people's risk perceptions related to alcohol use and, ultimately, reduce their alcohol consumption (Ayers & Myers, 2012; Hedman & Akagi, 2008; Schuckit, Kalmijn, Smith, Saunders, & Fromme, 2012). For example, an anti-drinking video clip was successful in increasing risk perceptions toward alcohol-related accidents among young regular drinkers (Ayers & Myers, 2012). Also, personalized alcohol-prevention programs online appeared to be effective in reducing alcohol consumption among drinking college students (Hedman & Akagi, 2008; Schuckit et al., 2012).

The present study aims to explore alcohol-prevention messages that college students might be exposed to inside and outside school as, in today's media-rich society, their risk perception and benefit perception of binge drinking are likely to be influenced by multiple sources of information. Based on the two-step process model (Karlsson, 2008), it is possible that college students who have higher exposure to alcohol-prevention messages will have higher risk perception and lower benefit perception, and thus are less likely to binge drink. It remains unknown whether prevention-message exposure can change each of the two components of risk/benefit perception, and whether each potentially modified component can, in turn, change the binge-drinking behavior. As such, the following research hypotheses and questions are posed:

H3: Higher prevention-message exposure is related to less binge drinking.

H4: Higher prevention-message exposure is related to (a) higher PPNC or (b) higher PSNC.

H5: Higher prevention-message exposure is related to (a) lower PPPC or (b) lower PBPC.

RQ3: Is the relationship between higher prevention-message exposure and less binge drinking mediated by (a) higher PPNC, (b) higher PSNC, (c) lower PPPC, and (d) lower PBPC?

Figure 1 shows a conceptual model illustrating the hypothesized relationships among major variables.

Method

Survey Design

I conducted an online survey measuring all predictors, drinking behavior in the last 2 weeks, and individual characteristics. At the beginning of the survey, participants were provided the definition of "a drink."[1] Participants were also informed of the definition of binge drinking provided by the NIAAA (2004).

Participants

Undergraduate students taking an introductory communication class at a public university in the US participated in this study. I made an announcement in class to solicit participation, and the instructor of the class posted the link to the survey on the class website. Students were given 48 hours to complete the survey. The following section describes measures for variables. Sample characteristics and descriptive statistics are reported in the Results section.

Measures

Individual characteristics including gender, age, ethnicity, number of months in college, and health status were measured. Health status was assessed by a single question: How would you describe your health status? The response scales ranged from 1 = *poor* to 5 = *excellent*.

Binge Drinking Behavior

Participants were asked the question "During the past 2 weeks, on how many days did you have # or more drinks on the same occasion?" twice with the "#" rotating from 4 to 5. This measure was developed based on the definition of binge drinking by NIAAA (2004). For a female participant, the number of binge-drinking days was calculated as the number of days that she had *four or more* drinks on the same occasion; for a male participant, the number of binge-drinking days was calculated as the number of days that he had *five or more* drinks on the same occasion.

Risk Perception

Risk perception was measured by two questions adapted from Yang et al. (2010), which separately assessed **PPNC** and **PSNC** associated with binge drinking. The item assessing **PPNC** was "If you binge drink, how likely is it that you will get sick, get hurt, or get into trouble? Please use a scale from 0 to 100, where 0 means absolutely unlikely and 100 means absolutely likely." The item assessing **PSNC** was "If you got sick, got hurt, or got into trouble 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." These two items were centered at their means and then multiplied to create a measure of risk perception.

Benefit Perception

Benefit perception was also measured by two questions adapted from Yang et al. (2010), with **PPPC** and **PBPC** assessed separately. The item assessing **PPPC** was "If you binge drink, how likely is it that you will obtain psychological and social benefits (relaxation, pleasure, fun, being liked, etc.)? Please use a scale from 0 to 100, where 0 means absolutely unlikely and 100 means absolutely likely." The item assessing **PBPC** was "If you obtained psychological and social benefits (relaxation, pleasure, fun, being liked, etc.) from binge drinking, how beneficial do you think it would be? Please use a scale from 0 to 100, where 0 means not beneficial at all and 100 means extremely beneficial." These two items were centered at their means and then multiplied to create a measure of benefit perception.

Prevention-Message Exposure

Prevention-message exposure was measured by one stem question—"During the past 2 weeks, how often have you seen or heard alcohol prevention messages…" followed by five items: (1) at school, such as an on-campus health campaign? (2) in newspapers or magazines? (3) on radio, TV, or movies? (4) on the Internet (excluding social media)? (5) on Facebook or other social media? The response scales ranged from 1 = *Never* to 7 = *Very Often*. Those items were adapted from items assessing people's use of and attention to different media in the 2007 Health Information National Trends Survey (HINTS) (visit http://hints.cancer.gov/). The responses to these items were added to create a measure representing frequency of prevention-message exposure. Higher values indicate a higher frequency of exposure.

Analysis Plan

I conducted path analyses to test the hypothesized model using AMOS software (version 20.0) and maximum likelihood estimation. In addition to Chi-square, I used several alternative fit indices to evaluate model fit, including the comparative fit index (CFI), the Tucker–Lewis index (TLI), and the root mean square error of approximation (RMSEA).[2]

I used bootstrapping procedures to test the significance of mediational paths. The advantage of bootstrapping is that it does not impose distributional assumptions (Shrout & Bolger, 2002). I performed bootstrapping procedures using AMOS with the number of bootstrap samples set to 1000. After that, I obtained the bias-corrected 95% confidence intervals for each mediational path and made statistical inferences based on those confidence intervals (Preacher & Hayes, 2008).

Results

Sample Characteristics, Descriptive Statistics, and Correlations

After data cleaning, I determined that a total of 278 participants were valid cases for data analyses.[3] Their ages ranged from 18 to 29 years (M = 19.77, SD = 1.75). Among the participants, 132 (47.5%) were males; 167 (60.1%) were White, 64 (23%) were Asian or Pacific Islander, 20 (7.2%) were Black, 8 (2.9%) were Hispanic, 1 (0.4%) was American Indian or Alaska Native, and 18 (6.5%) were "Other Ethnicities." The number of months that participants had been in college ranged from 2 to 60 (M = 15.89, SD = 12.15). Their health status ranged from 2 to 5 (M = 3.77, SD = .82), indicating that their average health status was close to "very good." Number of binge-drinking days in the past 2 weeks ranged from 0 to 8 (M = .84, SD = 1.43). Table 1 presents descriptive statistics including ranges, means, and standard deviations. Table 2 presents the zero-order correlation matrix of major study variables.

Table 1. Descriptive statistics of major variables.

Variables	Minimum	Maximum	Mean	*SD*
Prevention Messages	5	35	16.73	7.63
PPNC	0	100	31.49	31.70
PSNC	0	100	36.54	33.77
PPPC	0	100	51.37	33.24
PBPC	0	100	40.70	30.45
No. of Binge-Drinking Days	0	8	0.84	1.43

Note. PPNC: perceived probability of negative consequences
PSNC: perceived severity of negative consequences
PPPC: perceived probability of positive consequences
PBPC: perceived beneficiality of positive consequences

Table 2. Zero-order correlation matrix of major variables.

Variable	1	2	3	4	5	6
1. Prevention messages	—	.151*	.198**	.131*	.120*	.001
2. PPNC		—	.531**	.132*	.063	−.077
3. PSNC			—	.117	.127*	−.058
4. PPPC				—	.574**	.251**
5. PBPC					—	.291**
6. No. of binge-drinking days						—

Note. PPNC: perceived probability of negative consequences
PSNC: perceived severity of negative consequences
PPPC: perceived probability of positive consequences
PBPC: perceived beneficiality of positive consequences
*$p < .05$. **$p < .01$.

Model Testing

Results of path analyses indicated that the hypothesized model provided an excellent fit to the data.[4] Chi-square was not significant at $\chi^2(2) = 2.48$, $p = .289$, and $\chi^2/df = 1.24$; CFI = .999, TLI = .991, and RMSEA = .030. Overall, the hypothesized model accounted for approximately 10.3% of the variance in number of binge-drinking days ($R^2 = .103$). The standardized path coefficients of direct effects are presented in Figure 2.

Neither PPNC (β = −.069, $p = .309$) nor PSNC (β = −.058, $p = .393$) was significantly related to number of binge-drinking days. PPPC (β = .083, $p = .360$) was *not*, while PBPC (β = .239, $p = .008$) *was* significantly related to number of binge-drinking days. Thus, H1a, H1b, and H2a were not supported, while H2b was supported.

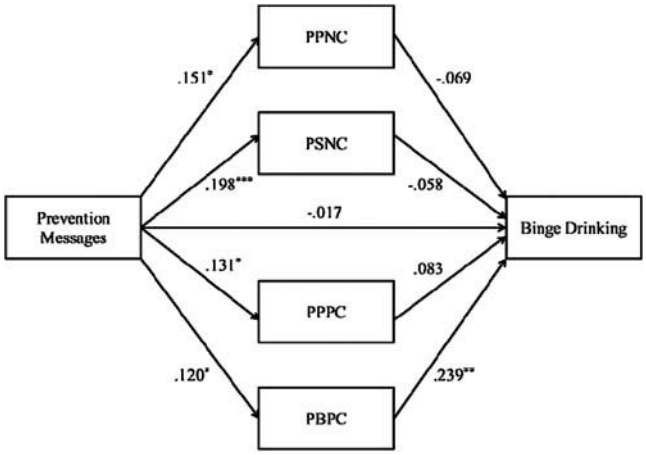

Figure 2. Standardized path coefficients from path analysis.

Note. PPNC: perceived probability of negative consequences; PSNC: perceived severity of negative consequences; PPPC: perceived probability of positive consequences; PBPC: perceived beneficiality of positive consequences; *$p < .05$, **$p < .01$, ***$p < .001$.

Prevention-message exposure (β = −.017, $p = .771$) was not significantly related to number of binge-drinking days; thus, H3 was not supported. Prevention-message exposure was significantly and positively related to both PPNC (β = .151, $p = .011$) and PSNC (β = .198, $p < .001$); thus H4a and H4b were supported. Prevention-message exposure was significantly and *positively* related to both PPPC (β = .131, $p = .028$) and PBPC (β = .120, $p = .044$). The relationship between prevention-message exposure and PPPC/PBPC was opposite to what was hypothesized; thus, H5a and H5b were not supported.

RQ1 asked if there is an interaction between PPNC and PSNC, and RQ2 asked if there is an interaction between PPPC and PBPC. I tested the effects of these two interaction terms on binge drinking by a hierarchical regression with number of binge-drinking days as the outcome variable. Table 3 shows the results of the hierarchical regression. There was a significant interaction between PPNC and PSNC, such that higher risk perception (PPNC × PSNC) was related to the number of binge-drinking days (β = −.132, $p = .032$); there was no significant interaction between PPPC and PBPC, such that benefit perception (PPPC × PBPC) was not related to the number of binge-drinking days (β = .010, $p = .870$).

RQ3 asked if the relationship between higher prevention-message exposure and less binge drinking is mediated by (a) higher PPNC, (b) higher PSNC, (c) lower PPPC, and (d) lower PBPC. Results of bootstrapping indicate that none of the mediational paths is significant. Thus, none of PPNC, PSNC, PPPC, and PBPC mediates the effect of prevention-message exposure on number of binge-drinking days.

Discussion

In this study, I hypothesized a conceptual model outlining four potential mechanisms that might account for the effect of prevention-message exposure on binge-drinking behavior among college students, based on the two-step process model. Specifically, I assumed that higher prevention-message exposure might lead to higher PPNC, higher PSNC, lower PPPC, and lower PBPC, each of which might subsequently result in less binge drinking. I also assumed that there was an interaction effect between PPNC and PSNC and an interaction effect between PPPC and PBPC on binge-drinking

Table 3. Hierarchical regression of predictors on number of binge-drinking days.

	Outcome variable = Number of binge-drinking days											
	Model 1				Model 2				Model 3			
Predictor	*B*	*SE(B)*	β	*p*	*B*	*SE(B)*	β	*p*	*B*	*SE(B)*	β	*p*
Gender (0 = Male; 1 = Female)	−.214	.173	−.075	.217	−.218	.173	−.077	.209	−.225	.173	−.079	.196
Age	−.053	.057	−.065	.359	−.052	.057	−.063	.369	−.038	.058	−.047	.504
Ethnicity (0 = None-White; 1 = White)	.674	.172	.232	.000	.681	.173	.234	.000	.600	.177	.206	**.001**
Months	.005	.008	.041	.555	.005	.008	.043	.541	.003	.008	.029	.678
Health status	−.162	.104	−.093	.120	−.162	.104	−.093	.121	−.167	.104	−.096	.109
Prevention messages					.005	.011	.024	.684	.005	.011	.027	.650
Risk perception = PPNC × PSNC									.000	.000	−.132	**.032**
Benefit perception = PPPC × PBPC									.000	.000	.010	.870

behavior. Findings from path analyses suggested only PBPC was a significant predictor of binge drinking and the effect was positive; prevention-message exposure was not significantly related to binge drinking, but was significantly and positively related to PPNC, PSNC, PPPC, and PBPC; none of the mediational paths was significant. Results from the hierarchical regression suggested higher risk perception (PPNC × PSNC) was significantly related to less binge drinking, while benefit perception (PPPC × PBPC) was not predictive of binge drinking. Implications of these findings are discussed below.

I found when the probability and severity components of risk perception are considered together with the probability and beneficiality components of benefit perception, only the beneficiality component of benefit perception (i.e., PBPC) stands out as a significant predictor of binge drinking. This finding is consistent with studies on college binge drinking using the TPB model, which suggest that attitude is the most prominent predictor of binge drinking (e.g., Chen & Feeley, 2015). The attitude construct in those studies and the PBPC construct in the current study perhaps provide similar cognitive evaluations of binge drinking, as a more favorable attitude toward binge drinking can be considered a higher beneficiality assessment of positive outcomes associated with binge drinking.

That PBPC is the only significant predictor of binge drinking is also in line with Chao et al.'s (2015) study, which showed that the amount of pleasure derived from heavy drinking was a positive predictor of problem drinking, while the level of riskiness was not a predictor. However, this finding is inconsistent with Goldberg et al.'s (2002) study, which suggested that the probability component of risk perception had a negative impact on drinking behavior, while the probability component of benefit perception had a positive impact. One possible reason is that Goldberg et al. (2002) did not include the severity component of risk perception, nor did they include the beneficiality component of benefit perception; if the severity and beneficiality components were included in their study, the impacts of the two probability components on binge drinking might show a different pattern.

Unlike previous studies, which often assessed only one of the two components of risk perception (e.g., Kelley et al., 2009; Klein et al., 2007) or benefit perception (e.g., Chao et al., 2015; Goldberg et al., 2002), I tested the effects on binge drinking of both risk perception and benefit perception as interaction terms. One novel finding is that, although PPNC and PSNC do not have an additive effect on binge drinking, they do have a multiplicative effect. Perhaps perceptions of negative consequences of binge drinking depend on various contexts: assessment of associated risks requires sizing up both the probability for negative consequences to occur and the severity of those consequences, if they did occur. In other words, only the product of these two is able to influence binge-drinking behavior. This finding suggests that individuals would not change a potentially risky behavior, if either perceived probability or perceived severity is very small. This is manifested in other risk-taking activities. For example, most people would perceive a plane crash as very severe, but they continue to fly because they perceive a crash as a small-probability event. Many drivers exceed the speed limit, even if they believe there is a high chance of getting a ticket, as they do not perceive this as a very severe consequence.

Although risk perception as an interaction term has been examined by some previous researchers on college drinking, they often failed to find a significant effect of this interaction term on problem drinking behaviors (e.g., Boyle & Boekeloo, 2009; Chen & Yang, 2015). One possible reason may be the small sample size (e.g., 111 in Chen & Yang, 2015), which does not have sufficient power to detect the interaction effect. Another possible reason is that the probability and severity components of risk perception were not measured with enough precision. For example, Boyle and Boekeloo (2009) asked college-student participants to rate both the likelihood that each negative drinking outcome would occur and the seriousness of the outcome on *five point* scales. Such scales gave participants limited room to rate the risks: their numerical ratings of the risks were constrained to integers from 1 to 5 (inclusive). As such, their reported scores of risk perception might lack variability, accordingly exhibiting a null effect on problem drinking behaviors. Taken together, since the effect of risk perception as an interaction term on behavioral outcomes is a higher-order effect, it may require a larger sample size and a more refined measure to detect it.

Another novel finding is that PPPC and PBPC do not engender a multiplicative effect on binge drinking. This is probably because the chance to obtain pleasure, fun, and other good feelings has an almost 100% certainty for many college students, and thus the interaction term is nearly equal to the perceived beneficiality. In other words, it is likely that many college students are nearly certain about getting psychosocial benefits from binge drinking, and thus only rely upon the beneficiality evaluation when it comes to their decisions about binge drinking.

Prevention messages increase college students' PPNC and PSNC associated with binge drinking, as hypothesized. However, contrary to hypotheses, such messages also boost their PPPC and PBPC. These findings demonstrate that prevention messages can have the opposite of their intended effect, such as increasing message recipients' benefit perceptions associated with binge drinking. Such unintended effects are not very surprising, as repetitive prevention messages intending to persuade individuals to perform a protective behavior or stop a risky behavior may engender psychological reactance, and a subsequent boomerang effect: individuals feel their freedom or autonomy is threatened, and therefore adopt an opposing position instead (Brehm & Brehm, 1981). Contrary to hypothesis, prevention-message exposure does not produce any significant direct or indirect effect on binge-drinking behavior. One possible explanation is that it is much more difficult for prevention messages to change a behavioral outcome than a cognitive belief. In social cognition models, prevention messages are social factors, which are considered distal factors in influencing behaviors, compared to cognitive beliefs (e.g., risk/benefit perception), which are considered proximal factors (Sutton, 2004). Another possible reason is that prevention-message exposure in this study was measured as a composite score

—the sum of exposures to various message sources. Perhaps a categorization of exposure based on different message sources can help detect the potential significant effects of some message-source exposures.

Theoretical Implications

This study has two important implications for advancing theories on health/risk behaviors. One theoretical implication is that theoretical models (e.g., the two-step process model, Karlsson, 2008; the TPB, Ajzen, 1991) that attempt to account for health/risk behaviors need to incorporate both risk perception and benefit perception of the behavior itself as key predictors of the decision-making process. Specifically, both risk perception and benefit perception play an important role in determining a health/risk behavior; leaving out either of them from the decision-making equation can lead to biased results. Another theoretical implication is that the probability and severity components of risk perception do not function independently: their influences on risky behaviors (e.g., binge drinking) are likely to be contingent on each other, and only their product has the ability to create a behavioral change. Thus, risk perception in those theoretical models should be treated as a product term, rather than a one-dimensional variable, in order to successfully detect its impact on a health/risk behavior.

Practical Implications

This study has three important practical implications for binge-drinking interventions targeting college students. First, this study challenges the assumption that young adults like college students consider themselves invulnerable to negative outcomes from risky behaviors and disregard potential risks of those behaviors (Weinstein, 1984). Based on my findings, risk perception does play a role in college students' decision-making regarding binge drinking, and it can serve as a protective factor discouraging binge drinking.

Second, this study questions the reasoning that young adults like college students tend to make irrational choices and have less judgmental wisdom than older people (Tentori, Osherson, Hasher, & May, 2001). Based on that reasoning, young adults would proceed with risky behaviors regardless of their perceptions of potential risks associated with those behaviors. My data provides a different explanation: young adults make decisions on binge drinking by weighing the potential risks and benefits; the fact that benefits outweigh risks is an important factor driving them to engage in binge drinking.

Third, similar to a medical treatment, this study suggests that, as the dose of a treatment (e.g., message intervention) is increased, at some point, the desired effects can reach a plateau, while adverse effects can keep increasing. Thus, "more is not necessarily better" can serve as a guiding principle for implementations of alcohol-prevention programs. It is an ongoing challenge to design alcohol-prevention messages that can successfully augment risk perception while minimizing boomerang effects among college students. More creative and novel messages, accompanied by more personalized prevention programs (Schuckit et al., 2012), may be more likely to see success in binge-drinking reductions in college students.

Limitations

This study has several limitations that should be noted when interpreting findings. First, I identified prevention-message exposure, risk perception, and benefit perception as key predictors, but I did not examine subjective norm and perceived control, which are potential predictors of binge drinking (Chen & Feeley, 2015; Elliott & Ainsworth, 2012). Including subjective norm and perceived control in this study may increase the variance explained by the hypothesized model. However, results of SEM analyses found that the proposed model provided an excellent fit to the data, indicating that the model is already good enough (i.e., the predictors in the model are sufficient) to explain the outcome variable. Thus, for the sake of parsimony, it appears more appropriate to exclude subjective norm and perceived control in model testing. Second, I used a cross-sectional design, which constrains the causality inferences between predictors and the outcome variable. Third, the assessment of binge-drinking behavior was based on self-report. Thus, poor recall or social desirability might incur underreporting of drinking behaviors in some participants. Fourth, the assessments for risk perception and benefit perception were single-item measures, which are more likely to incur measurement error, despite their advantages in easy administration and reducing participants' fatigue (Chen & Feeley, 2014; Chen & Yang, 2017). However, the single-item measures in this study have been used by previous researchers and suggested with good validity (e.g., Yang et al., 2010). Using such single-item measures, rather than multiple-item measures, will not change theoretical tests and empirical findings (Bergkvist & Rossiter, 2007). Finally, my findings may have limited generalizability, because analyses were based on a convenience sample, which may not be representative of the US college-student population.

Conclusion

Despite the limitations mentioned above, this study represents a first effort to comprehensively examine how the probability and severity components of risk perception, together with the probability and beneficiality components of benefit perception, jointly influence binge-drinking behavior among college students, and to test whether these components serve as psychological mechanisms accounting for the effect of prevention messages on binge drinking. My findings are enlightening for health communication research and practice, as I demonstrate that both risk perception and benefit perception are parts of the decision-making equation, that risk perception as a product term carries a significant influence on binge drinking, and that prevention-message exposure can not only augment risk perception (a desired effect), but also *increase* benefit perception (a boomerang effect). Future researchers might want to include other potential predictors of binge drinking (e.g., perceived control) in the hypothesized model, employ a longitudinal design, and/or use a national sample to improve the predictive capacity of the model, make the study's causality claims stronger, and increase the generalizability of findings.

Notes

1 "Throughout these questions, by 'a drink' we mean a can or 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 times when you only had a sip or two from a drink. By 'on the same occasion,' we mean within a 2-hour period" (National Survey on Drug Use and Health [NSDUH] series, visit https://www.icpsr.umich.edu/icpsrweb/ICPSR/series/64).

2 The CFI and the TLI values larger than .90 and .95 are considered an acceptable and an excellent fit, respectively (Kline, 1998). The RMSEA values smaller than .05 and .08 are considered a close and a reasonable fit, respectively (McDonald & Ho, 2002).

3 A total of 288 cases were collected for the survey. Among them, six were incomplete cases and were removed from data analyses. Four participants' responses to the question "During the past 2 weeks, on how many days did you have 4 or more drinks on the same occasion" were greater than 14, and they were considered outliers and were excluded from data analyses as well. These two procedures resulted in a total of 278 cases for final data analyses.

4 Preliminary examinations showed that all assumptions of structural equation modeling (linearity, multivariate normality, homoscedasticity) were met.

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