Effects of a Personalized Anti-Drinking Mobile Game on College Students’ Responses to Binge Drinking: Mediating Roles of Self-Referencing Effects and Flow

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This study suggests that a personalized anti-drinking mobile game can be effective in addressing college students’ binge drinking perceptions, as it can generate higher levels of self-referencing effect and flow. This study conducted a post-test only experiment with the personalized mobile game condition by using a participant’s selfie and name and the control condition by using a default game character. This study found that (1) the personalized mobile game generated a higher level of self-referencing effect than the default mobile game; (2) the self-referencing mediated the positive effect of the personalized mobile game on attitudes toward the game and the negative effect of it on attitudes toward binge drinking; and (3) the personalized mobile game generated higher levels of self-referencing effect and flow than the default mobile game, which in turn resulted in more positive attitudes toward the game. The implications of these results are discussed.

Keywords: Personalized Mobile Game, Anti-Drinking Game, College Binge Drinking

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Introduction

Binge drinking, which refers to more than four drinks per drinking occasion for women and more than five drinks per drinking occasion for men (Laghi, Baiocco, Liga, Lonigro, & Baumgartner, 2014), has been one of the most problematic issues among college students (CDC, 2013; Crosnoe, Kendig, & Benner, 2017; Larimer & Cronce, 2007), resulting in unintentional injuries (e.g., vehicle crashes), alcohol poisoning, and violence. According to the Centers for Disease Control and Prevention (CDC, 2013), among all age periods, the college period (18 to 24 years old) is the critical time when binge drinking frequently occurs. In this respect, the importance of developing health communication strategies, such as anti-binge drinking public service announcements (PSAs), to reduce binge drinking behaviors among college students has received much attention.

Despite various intervention efforts to address the problem of college binge drinking, such as posters and newspaper ads, significant changes in binge drinking behaviors have not been observed among college students (Wechsler et al., 2002; White & Hingson, 2013). To address less successful previous intervention efforts, this study focuses on the strategic use of mobile phone, which is the most popular medium among college students (Klasnja & Pratt, 2012; Pew Research, 2014). In particular, this study seeks to investigate the effects of a personalized anti-drinking mobile game among college students on their attitudinal responses to binge drinking. In addition, in order to better understand the process by which a personalized anti-drinking mobile game produces positive attitudinal effects, this study tests the mediating roles of self-referencing effect (Rogers, Kuiper, & Kirker, 1977) and perceived flow (Csíkszentmihályi, 1990). Playing an anti-binge drinking mobile game with personalized cues (e.g., individuals’ own photos and names on the game character) would help individuals feel more immersed in the game experience, resulting in more positive attitudinal responses (Faiola, Newlon, Pfaff, & Smyslova, 2013).

In doing so, this research will help health communication scholars better understand the strategic use of mobile phones as a tool to reduce binge drinking and other risky behaviors. In addition, this study will help communication
professionals and health practitioners develop effective anti-binge drinking intervention strategies targeting college students by using mobile phones.

**Literature review**

**College Students’ Binge Drinking and Mobile Health Intervention Strategies**

College students’ binge drinking may have many undesirable consequences for individuals and communities, such as academic difficulties, unwanted sexual experiences, fighting, and vandalism (CDC, 2013; Crosnoe et al., 2017). Consequently, communication scholars and health practitioners have put an emphasis on the importance of effective intervention strategies to prevent college binge drinking (Wechsler et al., 2002). For example, Kim, Kim, and Lee (2014) found that college students showed more positive responses to anti-binge drinking PSAs emphasizing the benefits of not engaging in binge drinking (e.g., good academic performance) than they did to PSAs highlighting the costs of engaging in binge drinking (e.g., car accident).

Mobile phones are the most frequently used medium among college students in their daily lives. According to the Pew Research (2014), 98 percent of young adults (18 to 29 years old) have mobile phones, and among mobile phone users, 83 percent of young adults have smartphones. Among various mobile phone apps, game apps are the most popular paid apps among young adults (BuzzMedia, 2012). Considering the popularity of mobile phone games, the strategic use of mobile phones and games in developing health intervention strategies targeting college students need to be considered as a way to reduce their risky binge drinking (Carrà et al., 2016; Gajecki, Berman, Sinadinovic, Rosendahl, & Andersson, 2014; Suffoletto et al., 2016).

Young adults tend to positively respond to games incorporating health messages (Peng, 2009). Especially, personalized mobile games can help individuals be more involved in the game situation (Kim et al., 2015). Prior research on self-referencing effects (Burnkrant & Unnava, 1995) suggests the possibility of personalized mobile games generating better attitudinal outcomes, which will be
discussed in the following section.

**Self-Referencing Effects on Personalized Mobile Game**

The self-referencing effect posits that people tend to prefer messages tailored with self-related cues (e.g., one’s own photos, first- or second-person words, and one’s own personal experiences) to messages with other-related cues in the messages (Burnkrant & Unnava, 1995). As the self is a well-organized structure or schema related to memory, interpretation, and processing (Burnkrant & Unnava, 1995; Rogers et al., 1977), self-related cues in messages can activate the elaboration of information processing and favorable attitudes toward the messages (Ahn & Bailenson, 2011; Burnkrant & Unnava, 1995). In other words, self-referencing effects can occur when individuals assimilate the messages to themselves by connecting the cues to the self. In fact, self-referencing effect is a mechanism by which media users tailor messages by using customized functions and in turn make messages more personalized (Lee & Oh, 2012). Prior research on self-referencing effects indicates that personalized messages are more likely to produce positive attitudinal outcomes (Ahn & Bailenson, 2011; Debevec & Romeo, 1992; Lee & Oh, 2012). For example, Debevec and Romeo (1992) found that participants had more positive attitudes toward advertised products when they were exposed to the self-related messages. Similarly, Ahn and Bailenson (2011) demonstrated that using participants’ own photos (vs. others’ photos) and second-person pronoun (vs. third-person pronoun) in soft drink advertisements produced more positive brand attitudes and higher purchase intention.

As the interactive nature of mobile phones and game apps enables users to play personalized mobile games, the self-referencing effect can explain why an anti-drinking mobile game with self-related cues (e.g., personalization options) would generate better attitudinal outcomes than a game without personalized cues (Burnkrant & Unnava, 1995; Rogers et al., 1977). In mobile games, there are several self-related cues available by using personalization options, such as taking selfies to create unique game characters and entering players’ names in game characters. Those personalized functions on mobile games are expected to enable individuals to relate the game character with themselves, as compared to mobiles games
without personalized functions, based on self-referencing effects (Ahn & Bailenson, 2011; Burnkrant & Unnava, 1995; Debevec & Romeo, 1992; Lee & Oh, 2012; Rogers et al., 1977). Therefore, the following hypothesis is posed:

Hypothesis 1: The personalized anti-drinking mobile game condition will generate a higher level of perceived self-referencing than the default anti-drinking mobile game condition.

Previous studies have found that self-referencing effects would serve as an explanatory mechanism by which personalized messages generate positive emotional responses (e.g., Ahn & Bailenson, 2011; Burnkrant & Unnava, 1995; Debevec & Romeo, 1992, Martin, Lee, & Yang, 2004). Likewise, when individuals play a game with personalized characteristics, they would be more attached to the game, which in turn help them focus on the game. In this study, first, it is expected that self-referencing effects generated by personalization functions available in the anti-drinking mobile game would result in individuals’ positive attitudes toward the game. Additionally, self-referencing effects would have a negative impact on attitudes toward binge drinking. Thus, the following two hypotheses are posed:

Hypothesis 2: Perceived self-referencing will mediate the positive effect of the personalized anti-drinking mobile game condition on attitudes toward the game.

Hypothesis 3: Perceived self-referencing will mediate the negative effect of the personalized anti-drinking mobile game condition on attitudes toward binge drinking.

**Self-Referencing Effects on Flow**

Flow refers to the state where individuals are immersed in a particular experience (Csíkszentmihályi, 1990). The flow experience enhances people’s feelings, engagement, and involvement of a given activity (Csíkszentmihályi, 1990; Fang, Zhang, & Chan, 2013; Hoffman & Novak, 2009; Raphael, Bachen, & Hernández-Ramos, 2012). For example, Hoffman and Novak (2009) found that people enhanced their learning, perceptions of control, and positive experiences of
the Internet when they had the flow experience.

Moreover, it is found that flow is related to increase positive mental state such as feelings of flourishing and enjoyment, and positive attitudes toward the experience (Cheng, Chieng, & Chieng, 2014; Faiola et al., 2013; Nakamura & Csikszentmihályi, 2002; Sherry, 2004). Previous studies have suggested that media enjoyment could also be explained as a state of flow experience (Cheng et al., 2014; Faiola et al., 2013; Fang et al., 2013; Sherry, 2004). According to Sherry (2004), media enjoyment is consistent with many of the components of flow, stating that enjoyment of media produces “focused concentration, loss of self-consciousness, a sense that one is in control of the situation, distortion of temporal experience, and the experience of the activity as intrinsically rewarding” (p. 336). When people play mobile games, they feel enjoyment and fun, which helps them generate a flow experience.

In the context of personalized anti-drinking mobile games, the personalization options of mobile games and self-referencing resulting from playing personalized mobile games would lead them to be more immersed in playing the game (i.e., flow). This flow experience would also have a positive impact on people’s attitudinal responses. Consequently, it is expected that the personalized anti-drinking mobile games with self-related cues (e.g., the player’s photo and name) would help college students experience flow. Such flow experience would increase positive attitudes toward the games and negative attitudes toward anti-binge drinking. Therefore, the following two hypotheses are posed:

Hypothesis 4: The personalized anti-drinking mobile game condition will generate higher levels of perceived self-referencing and flow than the default anti-drinking mobile game condition, which subsequently will result in more positive attitudes toward the game.

Hypothesis 5: The personalized anti-drinking mobile game condition will generate higher levels of perceived self-referencing and flow than the default anti-drinking mobile game condition, which subsequently will result in more negative attitudes toward binge drinking.
Method

This study used a post-test only experimental design with two anti-drinking mobile game conditions. The first condition was a personalized anti-drinking mobile game condition using a participant’s own photo and name. The other condition was a control condition using a default game character.

Participants

A total of 143 undergraduate students participated in this study. They were recruited from a research subject pool at a large southern public university in the U.S., and they received extra credits for their participation. The mean age of study participants was 21.30 (SD = 2.79), and 58 percent of the participants were males. Most of the participants were Caucasians (58.7%), followed by African-Americans (24.5%), Hispanics (6.3%), Asians/Asian Americans (4.9%), and others (5.6%). The participants were randomly assigned to one of the two experimental conditions: (1) personalized condition (N = 80) and (2) control condition (N = 63).

Stimuli\(^1\)

All participants in the two conditions played a mobile game promoting anti-drinking. The name of the game is “Done Drinking,” which can be found at the Android App store. Although this study used an existing anti-drinking mobile game, none of the participants reported that they had played the game prior to this experiment. The purpose of the game was to guide a game character who was drunk to walk straight in order for the character not to die.

Experimental Procedure

Upon arriving at a campus computer lab, participants were seated individually at a computer station and asked to provide a written informed consent. Participants were given smartphones and those in the personalized condition were asked to take

\(^1\) The screenshots of the experimental stimuli are available from the corresponding author upon request.
a selfie before starting the game and save it on the smartphone. Next, they were asked to open the anti-drinking game app and go to the personalization menu. In the personalization option, they were instructed to use their selfies to create their own game character and enter their own names to name the characters. In contrast, participants in the control condition used the default game character.

Next, participants played the game for five minutes in a lab using a smartphone prepared by the researcher. The game character had three lives. If participants did not successfully guide the game character to walk straight, but instead, had the character fall down, the character would lose a life. If participants lost all three lives within five minutes, they were asked to start the game again. After playing the game for five minutes, they were asked to complete a questionnaire that includes the measurement items of perceived self-referencing, flow, attitudes toward the game, attitudes toward binge drinking, and demographics. On completion of the game and the questionnaire, participants were thanked, debriefed, and dismissed. The overall experiment took about 30 minutes.

Measures

Perceived self-referencing

Perceived self-referencing was measured using five 5-point Likert scales (Martin et al., 2004): “The game character helped me relate myself to the game personally”; “I was able to easily relate myself to the game character”; “The game seemed to be created with me in mind”; “I can easily form similarity judgments between myself and the game character”; and “The character in the game speaks for me.” The inter-item consistency was acceptable, and the responses were averaged across the five items ($Cronbach's \alpha = .92, M = 1.96, SD = 1.39$).

Flow

Flow was measured using four 7-point Likert scales (Kim & Han, 2014): “I completely concentrated on the game while I played it”; “When I played the game, time seemed to pass by very quickly”; “While I played the game, nothing seemed to matter”; and “While I played the game, I felt totally captivated.” The inter-item consistency was acceptable, and the responses were averaged across the four items.
(Cronbach’s $\alpha = .74$, $M = 4.47$, $SD = 1.47$).

**Attitudes toward the game**

Participants were asked to evaluate the binge drinking behavior based on six 7-point semantic differential scales (Baek, Shen, & Reid, 2013; O’Hara, Harker, Raciti, & Harker, 2008): “bad – good,” “negative – positive,” “not enjoyable – enjoyable,” “not favorable – favorable,” “unpleasant – pleasant,” and “unsatisfying – satisfying.” The inter-item consistency was acceptable, and the responses were averaged across the six items (Cronbach’s $\alpha = .94$, $M = 2.20$, $SD = 1.30$).

**Potential covariates**

Based on flow theory (Csikszentmihályi, 1990) and relevant prior research (e.g., Lee, Park, & Wise, 2014), an individual’s responses to the game and the promoted behavior in the game might vary by one’s perceived difficulty of the game. Consequently, perceived game difficulty was measured by asking, “please indicate how difficult you felt it was to complete the mobile game you just played.” The response option ranged from 1 (“very easy to play”) to 7 (“very difficult to play”) ($M = 2.99$, $SD = 1.88$). In addition, potential covariates included consumer demographics, such as age, gender, and race.

**Results**

**Randomization Check**

Before testing hypotheses, a series of Chi-square tests and ANOVAs were performed to examine differences in covariates and demographic characteristics between the two experimental conditions. As shown in Table 1, none of these variables were significantly different between two experimental conditions. Thus, no covariate was included in testing hypotheses.
Table 1 Results of ANOVAs and Chi-square Tests of Covariates and Demographics Across Two Experimental Conditions

<table>
<thead>
<tr>
<th>Variables</th>
<th>df</th>
<th>F / Chi-square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game difficulty</td>
<td>1, 141</td>
<td>.38</td>
<td>.54</td>
</tr>
<tr>
<td>Age</td>
<td>1, 140</td>
<td>.53</td>
<td>.47</td>
</tr>
<tr>
<td>Gender*</td>
<td>1</td>
<td>.29</td>
<td>.59</td>
</tr>
<tr>
<td>Race*</td>
<td>5</td>
<td>5.94</td>
<td>.31</td>
</tr>
</tbody>
</table>

*Chi-square test.

Hypotheses Testing

H1: The positive effect of personalized (vs. default) anti-drinking mobile game on self-referencing.

A one-way ANOVA was performed to examine the difference in perceived self-referencing between the personalized and the control game conditions. The results demonstrated that the personalized game condition ($M = 2.36, SD = 1.55$) generated a higher level of perceived self-referencing than the default game condition ($M = 1.44, SD = .94$) ($F(1, 141) = 16.93, p < .01$, partial $\eta^2 = .11$). The results showed that participants in the personalized game condition were more likely to relate themselves to the game character than those in the default game condition. Thus, H1 was supported.

H2 through H5 examine indirect effects of personalized vs. default anti-drinking mobile game on attitudes toward the game and toward binge drinking mediated through perceived self-referencing and flow. To test these four hypotheses, this study tested a mediation model with two mediators operating in serial (Hayes, 2013). Given that this study included two dependent variables (i.e., attitudes toward the game and attitudes toward binge drinking), this study examined two mediation models. The first model involved the effects of personalized (vs. default) mobile game on attitudes toward the game as mediated by two potential mediators (i.e., perceived self-referencing and flow) operating in serial, and the second model involved the effects of personalized (vs. default) mobile game on attitudes toward binge drinking as mediated by the aforementioned two potential mediators.

To test the significance of the indirect effects, this study used a bootstrap
analysis by employing an SPSS macro (i.e., a nonparametric sampling procedure) (Mallinckrodt, Abraham, Wei, & Russell, 2006; Preacher & Hayes, 2008). More specifically, the original sample of 143 participants was used to generate a bootstrap sample of 143 participants with replacement. The indirect effects were calculated with this set of bootstrap sample and repeated with 5,000 samples to generate parameter estimates.

H2 and H3: Perceived self-referencing as a mediator.

H2 predicted that perceived self-referencing would mediate the positive effect of the personalized anti-drinking mobile game condition on attitudes toward the game. As shown in Figure 2, the personalized mobile game condition had a direct positive effect on attitudes toward the game \((b = .47, SE = .22, p < .05)\), indicating that participants in the personalized game condition, as compared to those in the default game condition, showed more positive attitudes toward the game. Additionally, the personalized mobile game condition had positive effects on perceived self-referencing \((b = .91, SE = .22, p < .01)\), which positively influenced attitudes toward the game \((b = .28, SE = .08, p < .01)\). As shown in Table 2, the indirect effect of personalized (vs. default) anti-drinking mobile game condition on attitudes toward the game through perceived self-referencing was significant. The result indicates that participants in the personalized anti-drinking mobile game condition are more likely to relate themselves to the game, which results in generating more positive attitudes toward the game. As the direct path from the personalized mobile game condition to attitudes toward the game was statistically significant, the finding provided evidence for partial mediation of perceived self-referencing. Thus, H2 was partially supported.
Figure 1 A mediation model for attitudes toward the game. Unstandardized regression coefficients from a bootstrap analysis are provided along the paths.

Table 2 Indirect Effects of Personalized Mobile Game on Attitudes toward the Game and Binge Drinking

<table>
<thead>
<tr>
<th>Paths</th>
<th>Beta</th>
<th>SE</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Perceived self-referencing as a mediator</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2: Personalized mobile game → perceived self-referencing → A\textsuperscript{game}</td>
<td>.25</td>
<td>.11</td>
<td>.07</td>
</tr>
<tr>
<td>H3: Personalized mobile game → perceived self-referencing → A\textsuperscript{binge drinking}</td>
<td>-.30</td>
<td>.11</td>
<td>-.55</td>
</tr>
<tr>
<td><strong>Perceived self-referencing and flow as mediators operating in serial</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H4: Personalized mobile game → perceived self-referencing → flow → A\textsuperscript{game}</td>
<td>.12</td>
<td>.05</td>
<td>.05</td>
</tr>
<tr>
<td>H5: Personalized mobile game → perceived self-referencing → flow → A\textsuperscript{binge drinking}</td>
<td>-.01</td>
<td>.02</td>
<td>-.05</td>
</tr>
</tbody>
</table>

*Notes: A\textsuperscript{game} = Attitudes toward the game; A\textsuperscript{binge drinking} = Attitudes toward binge drinking; CI = confidence intervals; LLCI = lower level confidence intervals; ULCI = upper level confidence intervals.

The confidence intervals containing zero indicate that the indirect effects are not significant.
H3 predicted that perceived self-referencing would mediate the negative effect of the personalized anti-drinking mobile game condition on attitudes toward binge drinking. As shown in Figure 3, the personalized mobile game condition had a direct negative effect on attitudes toward binge drinking \( (b = -0.48, SE = 0.22, p < 0.05) \), indicating that participants in the personalized game condition, as compared to those in the default game condition, showed more negative attitudes toward binge drinking. In addition, the personalized mobile game condition had a positive effect on perceived self-referencing \( (b = 0.91, SE = 0.22, p < 0.01) \), which negatively influenced attitudes toward binge drinking \( (b = -0.33, SE = 0.08, p < 0.01) \). As shown in Table 2, the indirect effect of personalized (vs. default) anti-drinking mobile game condition on attitudes toward the binge drinking through perceived self-referencing was significant. The result indicates that participants in the personalized anti-drinking mobile game condition tend to relate themselves to the game, which results in generating more negative attitudes toward the unhealthy behavior, namely, binge drinking. As the direct effect of the personalized mobile game condition to attitudes toward the binge drinking was statistically significant, perceived self-referencing was found to be a partial mediator. Thus, H3 was partially supported.

Figure 2: A mediation model for attitudes toward binge drinking. Unstandardized regression coefficients from a bootstrap analysis are provided along the paths.
H4 and H5: Perceived self-referencing and flow as mediators operating in serial.

H4 predicted that the personalized anti-drinking mobile game condition would generate higher levels of perceived self-referencing and flow, which would positively influence attitudes toward the game. As shown in Figure 2, the personalized mobile game condition had a positive effect on perceived self-referencing ($b = .91, SE = .22, p < .01$), which positively influenced flow ($b = .32, SE = .09, p < .01$). Additionally, flow positively influenced attitudes toward the game ($b = .42, SE = .07, p < .01$). As shown in Table 2, the indirect effect of personalized (vs. default) anti-drinking mobile game condition on attitudes toward the game through two mediators, namely, perceived self-referencing and flow, was significant. That is, the personalized anti-drinking mobile game condition enabled participants to relate themselves to the game and experience greater flow, which resulted in more positive attitudes toward the game. As the direct effect of the personalized mobile game condition to attitudes toward the game was statistically significant, perceived self-referencing and flow served as partial mediators operating in serial. Therefore, H4 was partially supported.

H5 predicted that the personalized anti-drinking mobile game condition would generate higher levels of perceived self-referencing and flow, which would negatively influence attitudes toward binge drinking. As presented in Figure 3, the personalized mobile game condition had a positive effect on perceived self-referencing ($b = .91, SE = .22, p < .01$), which positively influenced flow ($b = -.01, SE = .08, p = .86$). However, flow did not significantly influence attitudes toward binge drinking ($b = .42, SE = .07, p < .01$). As shown in Table 2, the indirect effect of personalized (vs. default) anti-drinking mobile game condition on attitudes toward binge drinking through two mediators, namely, perceived self-referencing and flow, was not significant. Thus, H5 was not supported.

Discussion

Binge drinking is one of the most serious unhealthy behaviors among college students resulting in negative consequences (e.g., Baek et al., 2013; CDC, 2013; Laghi et al., 2014; Larimer & Crone, 2007). It is prominently important for health practitioners and university staffs to develop effective methods to deliver anti-
drinking messages to college students and educate them. Considering the pervasiveness of mobile phones and the popularity of mobile games among college students (Klasnja & Pratt, 2012; Pew Research, 2014), this study examined the effects of using an anti-drinking mobile game on college students’ attitudinal responses. Particularly, this study tested whether (1) an anti-drinking mobile game with personalization options would generate higher self-referencing effects (Burnkrant & Unnava, 1995; Rogers et al., 1977); (2) self-referencing effects would explain the positive effects of the personalized anti-drinking mobile game on attitudinal responses; and (3) whether a flow experience (Csikszentmihályi, 1990) heightened by self-referencing effects would explain the positive effects of the personalized anti-drinking mobile game on attitudes toward the game and the negative effects on attitudes toward binge drinking.

This study found that (1) the personalized anti-drinking mobile game generated a higher level of self-referencing effects than the default mobile game; (2) the self-referencing mediated the positive effect of the personalized anti-drinking mobile game on attitudes toward the game and the negative effect of the game on attitudes toward binge drinking; and (3) the personalized anti-drinking mobile game generated higher levels of self-referencing effects and flow than the default mobile game, which in turn produced more positive attitudes toward the game.

The findings of this study can provide some answers to a question – how to use mobile games more effectively to target college students? More specifically, it is important to develop anti-drinking games with personalization options, such as creating players’ own characters using selfies and names. These personalized mobile games make players feel that they are part of the game promoting anti-binge drinking (i.e., self-referencing effects) and thus they would be more immersed in the game (i.e., flow). These experiences can contribute to college students’ positive responses to the games and the messages in the game (i.e., anti-binge drinking). The findings of this study showed that the personalization option is a key factor to generate self-referencing and flow and ultimately positive attitudinal responses.

This study provides health communication scholars and practitioners with theoretical and practical significances to develop effective intervention strategies in
terms of college students’ binge drinking. First, although previous studies examined self-referencing effects in the context of product advertising (e.g., Ahn & Bailenson, 2011; Burnkrant & Unnava, 1995; Debevec & Romeo, 1992), few studies have tested self-referencing effects in the domain of mobile games promoting healthy behaviors. Therefore, this study expands the applicability of self-referencing effects to the contexts of mobile games and health communication, and contributes to advancing the knowledge of the psychological mechanisms by which mobile games change college students’ attitudinal responses to binge drinking and promote anti-binge drinking.

Additionally, this study advances previous research on flow (e.g., Cheng et al., 2014; Csikszentmihályi, 1990; Fang et al., 2013; Hoffman & Novak, 2009; Raphael et al., 2012), which has mainly put emphasis on new media and technology. In particular, this study examined the role of flow as an antecedent of positive attitudinal responses to the mobile game. The findings of this study suggest that health communication scholars and practitioners should identify the ways in which interactive media messages enable individuals to be immersed in the media use experiences (e.g., using personalization options) as such experience leads to positive attitudinal responses.

Moreover, this study can provide scholars with a useful framework to develop a psychological model of mobile games. Particularly, this study tested the mediating roles of self-referencing effects and flow experiences on individuals’ attitudinal responses to the game and binge drinking. Although self-referencing effects and flow have mainly been tested in the context of product advertising (Ahn & Bailenson, 2011; Burnkrant & Unnava, 1995; Debevec & Romeo, 1992) and new media and technology (Cheng et al., 2014; Csikszentmihályi, 1990; Fang et al., 2013; Hoffman & Novak, 2009; Raphael et al., 2012), respectively, this study showed that self-referencing effects and flow experience play a mediating role in addressing a public health problem, namely, college students’ binge drinking.

In addition to binge drinking, college students are vulnerable to other risky and unhealthy behaviors, such as binge eating (Halmi, Falk, & Schwartz, 1981) and smoking (Obermayer, Riley, Asif, & Jean-Mary, 2004). Consequently, it is critical for communication and health practitioners to devise strategies to effectively reach
college students. The findings of this study may give the practitioners insights how to leverage self-referencing effects and flow that directly or indirectly have positive impacts on health intervention outcomes.

In sum, from a narrow perspective, this study contributes to developing effective strategies to address college binge drinking issues by taking advantage of personalized mobile phone games. From a broad perspective, this study contributes to incorporating new and interactive media strategies into health intervention messages effectively targeting college students.

**Limitations and Suggestions for Future Research**

There are some limitations in this study. First, although the mobile game of this study included personalization options, this study used an existing game. Thus, it is difficult to control other factors in the game, such as the ethnicity of default character. Future research needs to develop its own anti-drinking game to control extraneous factors. Second, this study did not examine the degree of the personalization in the mobile game, but compared two conditions only (personalized vs. default condition). Future researchers are encouraged to investigate the effects of different levels of the personalization (e.g., high vs. medium vs. low personalization) in mobile games on attitudinal and behavioral responses. Third, this study did not incorporate participants’ consumption and drinking frequency of alcoholic beverage into the data analysis as a potential covariate. Considering the potential influence of drinking behavior on attitudinal responses, future researchers are encouraged to include them as a covariate. In addition, this study did not include behavioral responses and attitudinal changes due to the sensitivity of the questions. However, to fully understand and predict college students’ reactions to the anti-drinking game, it would be better to include their behavioral responses (e.g., intention to not to be engaged with binge drinking) and attitudinal changes (e.g., pre- and post-attitudes toward binge drinking) in the model.
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