Journal of Gambling Issues
Volume 45, November 2020
http://igi.camh.net/doi/pdf/10.4309/jgi.2020.45.3
DOI: http://dx.doi.org/10.4309/jgi.2020.45.3

The Efficacy of Personalized Feedback Interventions Delivered via Smartphone among At-Risk College Student Gamblers

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Abstract

At-risk gambling is a public health problem that college students engage in at a disproportionate level compared to the general adult population. Brief interventions that incorporate personalized feedback have been efficacious at reducing gambling and related problems. The purpose of the present study was to examine the efficacy of personalized feedback-based interventions delivered via smartphone and text message. Participants were 255 students who met our screening criteria for "problem" or "pathological" gambling, and were randomized to one of three conditions: personalized feedback and follow-up targeted text messages (PFB-TXT); personalized feedback and follow-up educational information about gambling (PFB-EDU); and a control condition that received no personalized feedback or follow-up text messages. Dependent variables included percent days abstinent (PDA) from gambling, average amount wagered on a gambling day, and gambling-related problems. Results indicated that the PFB conditions did not have a direct effect relative to the control condition on the dependent variables at the six-month follow-up, but a statistically significant mediated effect on gambling-related problems via gambling norms did emerge at one-month. No differences between the two PFB conditions in terms of direct or indirect effects on the six-month outcome variables were determined. Findings from this study suggest that the personalized text condition did not provide greater efficacy in changing gambling-related outcomes over general educational messages with personalized feedback. To help explain the lack of direct intervention effects, we explored two hypotheses related to our study design and sample of gamblers.

Keywords: brief interventions, cell phones, college students, problem gambling

Résumé

La pratique des jeux de hasard chez les étudiants universitaires constitue un problème de santé publique, car ils s'y adonnent en nombre disproportionné par rapport à la population adulte générale. Les interventions brèves qui incorporent une rétroaction personnalisée (RP) se sont avérées efficaces pour réduire la fréquence de jeu et les problèmes qui s'y rattachent. Ce projet visait à analyser l'efficacité des interventions axées sur la RP, relayées par téléphone intelligent et messagerie texte. 255 étudiants répondant à nos critères de sélection en matière de « problème de jeu » ou de jeu « pathologique » été répartis aléatoirement en trois groupes. Le premier groupe a reçu une RP et des messages textes de suivi; le deuxième groupe, une RP et du matériel d'information sur le jeu; et le troisième, soit le groupe contrôle, n'a reçu ni rétroaction ni message texte. Les variables dépendantes (VD) incluaient : le pourcentage de jours d'abstinence; la somme moyenne misée les jours de pari; ainsi que les problèmes de jeu. Selon nos résultats, la RP n'a aucun effet direct sur les VD au 6^{e} mois de suivi par rapport au groupe contrôle; toutefois, on a constaté au 1er mois un effet de médiation statistiquement significatif d'une variable relative aux habitudes de jeu sur les problèmes de jeu. Par ailleurs, aucune différence n'a été observée entre les deux interventions quant à leur effet direct ou indirect sur les VD au 6^{e} mois. Selon nos conclusions, la RP ne serait pas plus efficace que les messages d'information générale en ce qui touche l'incidence sur les problèmes de jeu. Pour tenter d'expliquer cette absence d'effet de l'intervention directe, nous proposons deux hypothèses, l'une relative à la méthodologie de notre étude et l'autre, à l'échantillon des joueurs.

Introduction

A significant portion of college students engage in disordered or problem gambling (i.e., meeting diagnostic criteria for Gambling Disorder vs. mild to moderate gambling problems, respectively). A recent meta-analysis of 72 studies involving 41,989 college students found over 6% of students met cutoff criteria for disordered gambling and over 10% met criteria for problem gambling (Nowak, 2018). These rates of disordered and problem gambling are consistent with prior meta-analyses (e.g., Blinn-Pike et al., 2007) and considerably higher than rates among the general adult population (Kessler et al., 2008; Petry et al., 2005).

The high rates of disordered and problem gambling among college students are particularly concerning in light of evidence indicating they regularly co-occur with other problematic health-related behaviors. Research has shown that gambling

among college students is associated with illicit drug use, alcohol use including binge drinking, and tobacco use (Engwall et al., 2004; Huang et al., 2011; LaBrie et al., 2003; Martens et al., 2009; Stuhldreher et al., 2007; Winters et al., 1998). One study found that those students who engaged in disordered gambling were four-to-eight times as likely as those who did not engage in such gambling to have an alcohol use disorder, drug use disorder, mood disorder, anxiety disorder, or personality disorder (Petry et al., 2005). College students who engage in problem gambling also appear to experience academic problems, such as missing class, not studying, and interpersonal discord with friends or family (Larimer et al., 2012; Neighbors et al., 2002). This literature suggests that college students who engage in problem gambling are likely to experience other psychological and academic consequences.

Both problem gambling and its outcomes have been linked to the presence of gambling-related cognitive distortions (i.e., ability to predict or control aspects of gambling) and protective behavioural strategies (i.e., behaviours that reduce gambling-related risks; Lostutter et al., 2014; Raylu & Oei, 2004). College students who endorse more gambling-related cognitive distortions and fewer protective behaviours to reduce gambling risk appear to be at higher risk of gambling problems (Granato et al., 2018; Marmurek et al., 2014). These aspects of problem gambling have received attention in multiple treatment studies, which have shown that decreases in gambling-related problems were associated with treatments that incorporated distorted cognitions and protective strategies to avoid gambling in their protocol (Geisner et al., 2015; Toneatto & Gunarante, 2009). Addressing both cognitive distortions and protective behaviours related to gambling in college students may be useful components of treatment.

Brief Interventions for At-Risk Gambling

An effective approach for reducing gambling-related behaviours among college students is the use of brief motivational interventions (BMIs) that incorporate personalized feedback (PFB). BMIs can be delivered in a variety of formats, including in-person sessions with a clinician (e.g., Dimeff et al., 1999) or by providing PFB in-person or electronically in the absence of any in-person contact (e.g., Larimer et al., 2007; Martens et al., 2010). BMIs have been consistently shown to be an effective intervention strategy across a variety of addictive behaviours (Burke et al., 2003; Jensen et al., 2011; Lundahl et al., 2010; Visilaki et al., 2006), and one finding across these studies is that PFB tends to positively impact the effects of BMIs (Carey et al., 2007; Lundahl et al., 2010). PFB typically includes several pieces of information about the behaviour in question, such as comparisons to social norms, problems experienced because of the behaviour, and risk factors that might increase the likelihood of the behaviour. Theoretically, this feedback serves as a catalyst to increase motivation to change.

Over the past decade, clinical trials have provided promising results regarding the efficacy of BMIs on gambling behaviours (Auer & Griffiths, 2015b; Cunningham et al., 2009; Cunningham et al., 2012; Hodgins et al., 2001; Hodgins et al., 2009; Larimer et al., 2012; Petry et al., 2008; Petry et al., 2009). Additionally, research in

both the laboratory and "real-world" settings has shown that personalized "pop-up" messages on gaming machines reduced gambling behaviour relative to control conditions (e.g., Auer & Griffiths, 2015a; Wohl et al., 2013). Results from two clinical trials are of particular relevance to this study, as they both involved examining the efficacy of a "PFB-only" intervention among at-risk college student gamblers where the feedback was delivered in the absence of clinician contact. Neighbors and colleagues (2015) examined the efficacy of a PFB-only intervention that provided personalized social norms information (i.e., how one's perception of typical student gambling and one's own gambling compared to actual gambling norms) among 252 participants. They found that this intervention reduced gambling losses at three- and six-month follow-up, and reduced gambling-related problems at three-month follow-up. Martens and colleagues (2015) examined the efficacy of a PFB-only intervention that included personalized normative feedback, feedback on several gambling-related behaviours and problems, and self-reported gambling cognitive distortions among 333 participants. They determined that the PFB-only intervention reduced dollars wagered and gambling-related problems at three-month follow-up. Together, these findings suggest that BMIs, including those where PFB is delivered without a clinical session, can reduce at-risk gambling behaviours.

Delivering Interventions via Smartphone

A promising avenue for enhancing the reach of BMIs for at-risk gambling is delivering them via smartphone and text message. Smartphone use is extremely common among college students, and is a habitual medium for them to receive and gain access to a variety of personal and general information. A 2016 Nielsen survey found that 98% of individuals age 18–24 owned a smartphone ("Millennials are top," 2016). Further, among college students and other young adults, text-message has become a much more popular form of communication than talking on the phone. One study found that college students spent an average of 14.35 hours per week text messaging (Hanson et al., 2011), which was over twice as many hours as talking on the phone. Smartphone-based interventions are therefore delivered via a medium that most college students frequently use in the everyday course of their lives, and allow the student to retrieve the intervention materials at their convenience.

Research across several health and behavioural domains has provided promising support for interventions delivered via smartphone. A recent meta-analysis of 35 studies found that interventions delivered via text-message across a variety of health-related behaviours had a small ($d = 0.24$) but statistically significant effect on short-term behaviour change (Armanasco et al., 2017). Another meta-analysis focusing on the efficacy of text-message interventions for smoking cessation reported positive intervention effects, with a 36% higher quite rate among intervention versus control participants (Spohr, 2015). A recent study among young adults showed that smartphone-based interventions may have relatively stable effects. Suffoletto and colleagues (2015) found an intervention that provided tailored feedback and goal setting via text message reduced binge drinking and alcohol-related injuries at nine-month follow-up. To date, though, we are aware of no randomized trials in the

gambling literature that have examined any type of smartphone-based or text message-based intervention.

Purpose of the Present Study

The purpose of the present study was to extend the findings regarding (a) BMIs for at-risk gambling behaviours, and (b) interventions delivered via smartphone, by conducting a clinical trial examining the efficacy of smartphone-based interventions among at-risk college gamblers. College students are an appropriate population for such a trial, considering their elevated gambling rates relative to the general adult population and their ubiquitous smartphone use. Participants who met our threshold for at-risk gambling were randomized to one of two intervention conditions or the control condition. Both intervention conditions received content via text message. One condition received personalized feedback plus targeted messages that related to their own reported use of strategies to reduce gambling-related harms, gambling-related cognitive distortions, and self-generated goals for future gambling behaviour (PFB-TXT). These texts by were crafted by study clinicians consistent with motivational interviewing techniques, i.e., summarizing both self-reported goals for gambling behaviour and their associated barriers, affirming the usage of gambling protective behavioural strategies, and highlighting discrepancies between goals and reported behaviour (Miller & Rollnick, 2013) while the other received personalized feedback plus general education messages about gambling (PFB-EDU). The control condition did not receive any personalized feedback or information delivered via text message. We tested three hypothesized causal chains. First, we hypothesized that participants in one of the two PFB conditions would report lower gambling norms at the one-month follow-up, and subsequently less gambling and fewer gambling-related problems at the six-month follow-up, than participants in the control condition. Second, we hypothesized that participants in the PFB-TXT condition would report fewer gambling-related cognitive distortions at the one-month follow-up, and subsequently less gambling and fewer gambling-related problems at the six-month follow-up, than participants in the PFB-EDU condition. Finally, we hypothesized that participants in the PFB-TXT condition would report greater use of gambling protective behavioural strategies at the one-month follow-up, and subsequently less gambling and fewer gambling-related problems at the six-month follow-up, than participants in the PFB-EDU condition.

Method

Design

College students who met our screening threshold were randomly assigned, stratified by gender, to one of the three study conditions. Self-report assessments were completed at baseline, one-month, and six-month follow-up.

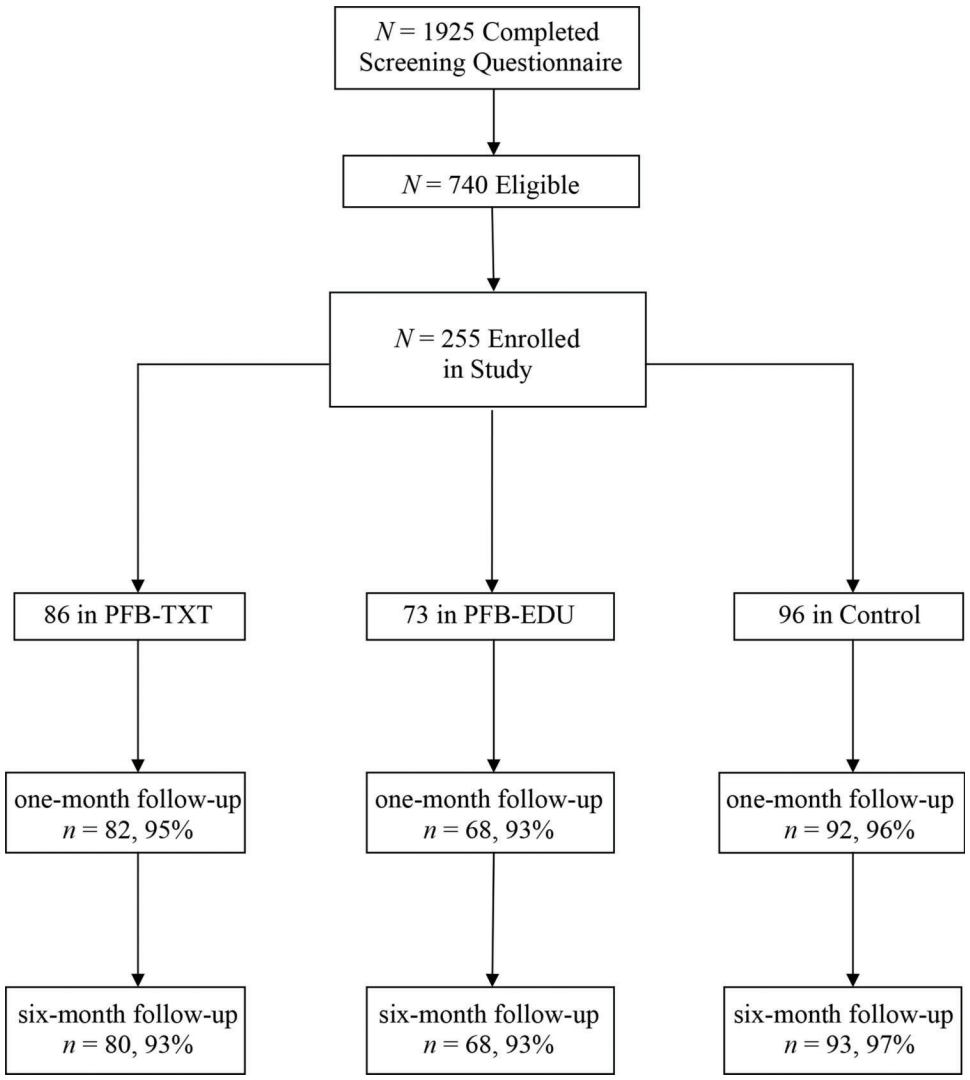
Participants

Participants were recruited through weekly e-mail announcements that were sent to all students on the campus where this study was conducted. The announcement

asked for volunteers interested in a study about gambling, with a link to the online screening questionnaire. Almost two thousand students completed the questionnaire (N = 1,925), 38.4% of whom (N = 740) met eligibility criteria. The research staff attempted to contact by phone all eligible participants to invite them to participate in the next phase of the study. If an individual was interested, we verified that the person had gambled at least once in the preceding 60 days and scheduled an in-person enrollment meeting at our on-campus laboratory. After completing the informed consent, participants completed the baseline battery of questionnaires and were randomly assigned to one of the three study conditions. Participants completed follow-up questionnaires online at one and six months. A total of 255 participants enrolled in the trial (see Figure 1 for the CONSORT diagram). All participants were compensated with a $25 check after completing each assessment.

Figure 1

Participant Flow Diagram. PFB-TXT = Personalized Feedback-Personalized Text Message; PFB-EDU = Personalized Feedback-Education.



Measures

Screening measures

The South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) and Brief Biosocial Gambling Screen (BBGS; Gebauer et al., 2010) were both used to screen for at-risk gambling. Scores of three or higher on the 20-item SOGS are indicative of "problem" gambling and scores of five or more are indicative of "pathological" gambling (Shaffer et al., 1999). We used scores of three or higher as cut-off for study eligibility. Participants were also eligible if they answered in the affirmative to one of the three BBGS items that assess withdrawal symptoms, hiding gambling behaviours from loved ones, and needing financial help from loved ones because of gambling in the past 12 months.

Gambling quantity of frequency

Our primary measures of gambling quantity or frequency were percent days abstinent (PDA) from gambling and amount of money wagered per gambling day. We assessed these variables via the Gambling Timeline Followback (G-TLFB; Weinstock et al., 2004), a calendar-based assessment tool. Participants were provided with an electronic calendar and asked to indicate on which days they gambled. For any day they indicated gambling, they completed additional questions that collected relevant information, including amount of dollars wagered. Cues to facilitate recall of gambling activities were included in the calendar, such as academic holidays and major on-campus events. The G-TLFB has shown concordance with daily self-monitoring of gambling and high test-retest reliability (Weinstock et al., 2004). We assessed gambling over the past 30 days at the follow-up points, and past 60 days at baseline. A longer timeframe was used at baseline because these data were also used to generate personalized feedback for participants in the intervention conditions.

Gambling problems

We assessed gambling-related problems over the past 30 days via the Problem Gambling subscale of the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001). The nine-item measure was developed to assess the degree to which participants experienced consequences associated with disordered or problem gambling over a specific timeframe (past month in the present study). Items are scored on a four-point scale ranging from zero (never) to three (almost always), and a single summary score is created. Research has supported the unidimensionality of the measure and shown its scores are associated in the expected direction with other mental health problems (Brooker et al., 2009). Internal consistency of the CPGI in the present study was .79.

Gambling norms

Perceived gambling among other students on the campus study site was assessed via a single-item measure assessing the number of times the participant perceived the

typical student at the university gambled over the preceding month. Normative data on this measure was available to create personalized feedback.

Gambling-related cognitive distortions

Participants completed 10 items from the Gambling-Related Cognitions Scale. (GRCS; Raylu & Oei, 2004), a 23-item measure designed to assess different cognitions associated with gambling. Participants completed items from the Illusion of Control and Predictive Control subscales, which are associated with distorted beliefs about being able to control gambling-related outcomes (e.g., "I collect specific objects that help my chances of winning"; "When I have a win once I will definitely win again"). Each item is scored on a seven-point scale ranging from strongly disagree to strongly agree, with higher scores indicating a greater level of cognitive distortions. Internal consistency of the items in the present sample was .76.

Gambling protective behavioural strategies

Gambling-related protective behavioural strategies were assessed via the Gambling Protective Behaviors Scale (GPBS; Lostutter et al., 2014), a 16-item measure designed to assess harm reduction and avoidance behaviours associated with reduced gambling. Example items included "I avoid borrowing money to gamble" and "I control the size of my bets not to exceed a personal maximum." Responses were scored on a five-point scale ranging from Never to Always. Internal consistency in the present sample was .82.

Demographics

Participants completed a brief measure that assessed basic demographic information, such as gender, ethnicity, age, year in school, and fraternity or sorority affiliation.

Interventions

PFB-TXT

Participants randomized to the PFB-TXT condition received a text-message that contained a link to their personalized feedback. The personalized feedback included two pieces of data: information on the number of times they gambled per month compared to the average rate of gambling among college students on the campus (i.e., descriptive social norms), and a summary of their self-reported negative consequences associated with their gambling behaviour (e.g., financial problems, taking foolish risks when gambling). For each participant we verified the person received the link and were able to view the feedback. After receiving the feedback, participants received a series of 12 targeted text messages over the subsequent 28 days. The messages were sent on Thursdays, Fridays, and Saturdays, as we assumed that gambling would be more likely on the weekends. The content of the text messages

was derived from two sources. First, participants completed a free-response item that asked them to indicate any gambling reduction goals they had, and barriers to completing such goals. If they indicated any goals, we developed brief messages to support those goals and strategies for overcoming barriers. We also developed personalized messages based on responses to the GPBS, or GRCS, or both. We asked participants to indicate which of the GPBS items they would find useful for reducing gambling, and then provided text messages based on the individual responses. Finally, if a participant indicated that he or she agreed with a cognitive error on the GRCS (e.g., losses when gambling are likely followed by a series of wins), we sent the person a text message addressing the error. Example text messages are provided in Table 1.

PFB-EDU

Participants in the PFB-EDU condition received personalized feedback identical to those in the PFB-TXT condition, as well as a series of 12 text messages over the subsequent 28 days. Instead of containing targeted information, the text messages contained general educational information about gambling. Examples of the educational text messages are provided in Table 1.

Control Condition

Participants in the control condition completed the same assessment measures as participants in the PFB conditions, but did not receive any personalized feedback or text messages.

Data Analytic Plan

We used the PROCESS program (Hayes, 2018) to test the study hypotheses. The PROCESS program allowed us to simultaneously test for direct, indirect, and total effects of intervention condition on the three dependent variables. We conducted three sets of analyses to test the hypotheses. In the first, the two PFB conditions versus the control condition served as the independent variable, gambling norms at one-month served as the mediator variable, and the three gambling outcomes at six-month served as the dependent variables. In the second, PFB-TXT versus PFB-EDU served as the independent variable, gambling-related cognitive distortions at one-month served as the mediator variable, and the three gambling outcomes at six-month served as the dependent variables. The third set of analyses mirrored the second, except gambling protective behaviours at one-month served as the mediator variable. All analyses were conducted in an intent-to-treat framework with the last observation carried forward to account for missing data. Baseline measures of the mediator variables and the dependent variables were included in each model as covariates. Outliers greater than three standard deviations above the mean were winsorized to that corresponding value.

Table 1
Example Text-Messages for the PFB-TXT and PFB-EDU Conditions

PFB-TXT	PFB-EDU
Remember that one of your goals is to not lose more money than you can afford. Only betting small amounts at a time and remembering why this goal is personally important to you may help prevent out of control spending. Please respond "yes" to confirm you received this message.	Did you know that approximately 58% of college students do NOT gamble in a given year? Please respond "yes" to confirm you received this message.
Your first goal is to set aside an amount of money only for gambling. One way to achieve this is to make a general budget so you can set aside gambling money with what is left over. Please respond "yes" to confirm you received this message.	Most people who gamble are recreational gamblers who only gamble a few times per year. Please respond "yes" to confirm you received this message.
A barrier to your goal of spending less is that you usually want to spend more. Writing down or coming up with a list of reasons why you want to spend less may help reduce this desire. Please respond "yes" to confirm you received this message.	About 5% of college students are considered "problem gamblers." They usually spend at least $50 when gambling and sometimes experience problems related to their gambling. Please respond "yes" to confirm you received this message.
When completing the questionnaires for our study you indicated that you believed that playing certain numbers or colors when gambling can increase your chances of winning. This is an example of a superstitious belief, as we know that when playing games that involve choosing numbers of colors the outcomes are all due to chance. Superstitious beliefs like these can increase the likelihood of at-risk gambling. Please respond "yes" to confirm you received this message.	Setting a "loss limit" can help reduce the likelihood of gambling-related problems. Please respond "yes" to confirm you received this message.
When completing the questionnaires for our study you indicated that if you win once you will definitely win again. In all forms of gambling chance plays a major role, and in many forms of gambling the outcomes are completely random. Thus, winning once has no bearing on whether or not you will win again. Please respond "yes" to confirm you received this message.	For most gambling games it is impossible, over the long run, to "beat the house." Please respond "yes" to confirm you received this message.

Results

Preliminary Analyses

Sample demographics and baseline gambling

Demographic characteristics of the sample and baseline gambling behaviours or problems, by condition, are presented in Table 2. The majority of the participants in the study were male (62.0%) and White (76.5%). The mean age of the sample was 22.21 years (*SD* = 4.09). Over one-fourth of the sample reported being active members in a fraternity or sorority (28.2%). At baseline participants reported a mean of 87.67% days abstinent (*SD* = 11.19%), a mean of $41.12 gambled per gambling day (*SD* = $55.01), and a mean score of 4.47 on the CPGI (*SD* = 3.68). No significant differences were determined across the three conditions on any gambling or demographic variable. A power analysis using the PowerUp! tool (Maynard & Dong, 2013) indicated that the overall sample size was sufficient to detect a treatment effect of .37 (Cohen's *d*).

Sample attrition

Overall follow-up rates were 95% at both time points (Figure 1). No significant differences emerged in rates of follow-up across conditions.

Intervention Effects

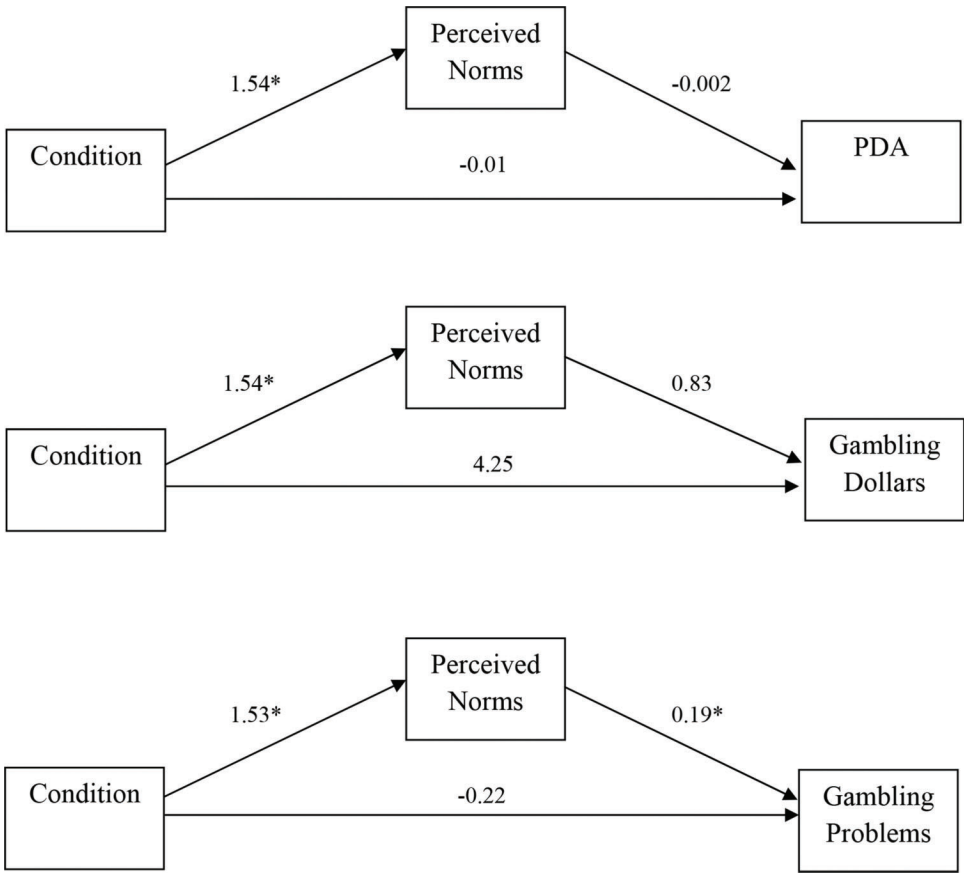
Comparing PFB-TXT and PFB-EDU to Control

Results examining the effects of the PFB conditions versus the control condition on the three dependent variables are summarized in Figure 2. A statistically significant effect of treatment condition on one-month gambling norms did emerge in the PDA model, $b = 1.54$, $p = .001$, 95% *CI* (0.60, 2.48), the dollars wagered per gambling day model, $b = 1.54$, $p = .001$, 95% *CI* (0.59, 2.49), and the gambling-related problems model, $b = 1.53$, $p = .001$, 95% *CI* (0.58, 2.48). Consistent with the hypothesis, those in PFB conditions reported lower perceived gambling among other students at the one-month follow-up than those in the control condition. Perceived gambling at the one-month follow-up was associated with the six-month follow-up values for gambling-related problems, $b = .19$, $p < .001$, 95% *CI* (0.11, 0.27), but not for PDA, $b = -.002$, $p = .14$, 95% *CI* (-.005, .001), or dollars wagered per day, $b = .83$, $p = .19$, 95% *CI* (-.42, 2.07). Consistent with the hypothesis, higher perceived gambling at the one-month follow-up was associated with more gambling related problems at the six-month follow-up. Finally, results indicated that treatment condition had a significant indirect effect on six-month gambling related problems, $b = .29$, 95% *CI* (.06, .58). However, the direct and total effect of treatment condition on six-month gambling-related problems was not statistically significant.

Table 2
Baseline Characteristics by Intervention Condition

	PFB-TXT (n = 86)			PFB-EDU (n = 73)			Control (n = 96)		
Variable	%	*M*	*SD*	%	*M*	*SD*	%	*M*	*SD*
Women	37			37			40		
Ethnicity									
White	78			75			76		
African American	5			10			9		
Hispanic	5			4			2		
Asian/Asian American	8			6			10		
Native American	0			0			1		
Other	5			6			1		
Year in School									
First Year	13			13			8		
Second Year	14			22			17		
Third Year	25			26			21		
Fourth Year+	48			39			54		
Fraternity/Sorority Member									
Yes	31			32			23		
No	69			68			77		
Age (years)		22.14	4.07		22.03	4.35		22.41	3.94
Gambling Variables									
Percent Days Abstinent		88.22	9.80		86.55	10.97		88.04	12.50
Average Dollars Wagered		45.39	60.21		44.38	67.50		34.83	36.45
CPGI Scores		4.34	3.11		5.27	4.62		3.97	3.25
Gambling Norms		4.42	3.89		4.77	4.74		4.14	3.80
GRCS Scores		33.07	10.61		32.14	11.37		32.55	10.42
GPBS Scores		55.05	8.76		52.59	11.51		53.64	11.20

Figure 2
Effects of PFB Conditions versus Control Condition on Gambling Outcome Variables.

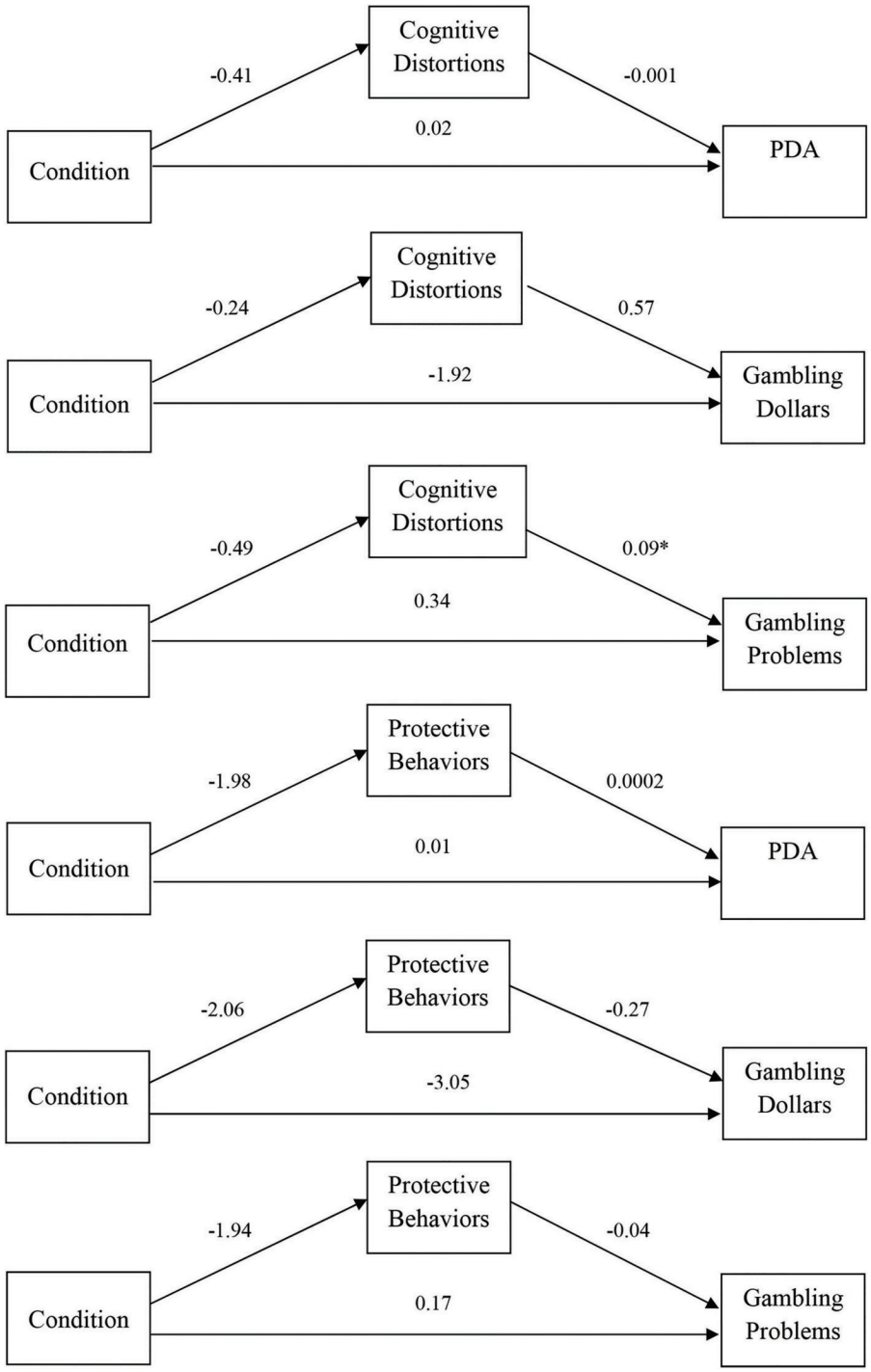


Note. Intervention was coded 0 = Intervention Condition, 1 = Control Condition; baseline covariate paths excluded from figure.

Comparing PFB-TXT to PFB-EDU

Results examining the effects of the PFB-TXT versus PFB-EDU condition are summarized in Figure 3. The first three models summarize the effects with cognitive distortions as the mediator variable; the final three models summarize the effects with protective behavioural strategies as the mediator variable. Treatment condition did not predict one-month gambling-related cognitive distortions in any of the models, PDA b = -0.41, p = .72, 95% *CI* (-2.64, 1.83); dollars wagered per gambling day b = -0.24, p = .83, 95% *CI* (-2.49, 2.01), gambling problems b = -0.49, p = .67, 95% *CI* (-2.75, 1.76). Cognitive distortions at the one-month follow-up were associated with six-month gambling-related problems, b = .09, $p < .01$, 95% *CI* (.04, .15), but not PDA, b = -.001, p = .45, 95% *CI* (-.003, .001) or dollars wagered per gambling day, b = 0.57, p = .17, 95% *CI* (-0.24, 1.39). However, for all three dependent variables there was no direct, indirect, or total effects associated with the intervention condition.

Figure 3
Effects of PFB-TXT versus PFB-EDU on Gambling Outcome Variables.



Note. Intervention was coded 0 = PFB-TXT, 1 = PFB-EDU; baseline covariate paths excluded from figure.

For protective behavioural strategies, treatment condition did not predict one-month follow-up scores in any of the models, PDA b = -1.98, p = .11, 95% *CI* (-4.44, .48), dollars wagered per gambling day b = -2.06, p = .10, 95% *CI* (-4.53, .42), gambling-related problems b = -1.94, p = .12, 95% *CI* (-4.40, .53). Protective behavioural strategies at one-month follow-up was also not associated with any of the six-month outcomes, PDA b = -.0002, p = .81, 95% *CI* (-.002, .001), dollars wagered per gambling day, b = -.27, p = .48, 95% *CI* (-1.02, .48), gambling-related problems, b = -.04, p = .16, 95% *CI* (-.09, 0.01). Similarly to gambling-related cognitive distortion models, there was no direct, indirect, or total effects associated with the intervention condition.

Post-Hoc Descriptive Analyses

Most of our analyses indicated that our treatment conditions did not produce significant changes in the mediator and outcome variables. After reviewing both our methods and sample, we conducted post-hoc analyses to determine if there were third variables that may have introduced effects we had previously unaccounted for. We chose two aspects of our study to descriptively examine: prevalence of gambling subtypes in our sample and rate of goal setting for future gambling behaviour across conditions. Similarly to other studies that have looked at the effect of type of gambling on gambling outcomes (Binde et al., 2017; Monson et al., 2019), we classified participants into various gambler subtypes. These included lottery only (engage only in lottery-type gambling; 9.4% of sample), majority casino gambling (majority of gambling at a casino on table games and slot machines; 22% of sample), majority sports gambling (majority of gambling occasions involves sports betting; 36.5% of sample), and other gamblers (majority of gambling that does not fit other categories, e.g., card games and betting on games of skill; 32.2%). Regarding goal setting, all participants, including the control condition, were asked to generate goals related to their gambling behaviour. A majority of participants indicated at least one goal at baseline (69%), and the rate of goal setting was similar between the assessment control (67%), PFB-EDU (73%) and PFB-TXT (68%) conditions.

Discussion

The purpose of this study was to examine the efficacy of brief motivational interventions for at-risk gambling behaviour delivered via smartphone. Our findings indicate some support for one of our hypotheses, particularly in terms of factors that mediated intervention effects on the dependent variables of interest. Participants in the personalized feedback conditions reported less perceived gambling among other students at the one-month follow-up, which was associated with fewer gambling problems at the six-month follow-up. Participants who received the targeted text-messages in addition to personalized feedback did not report a significantly greater usage of protective behavioural strategies at the one-month follow-up than participants who received educational information in addition to personalized feedback. Furthermore, participants who received the personalized text messages did not report fewer gambling-related cognitive distortions and the one-month follow-up.

Finally, the mediation tests indicated that intervention condition had an indirect effect on gambling-related problems, but this occurred in the absence of statistically significant total interaction effects. Such findings may seem confusing. However, methodological experts in mediation have addressed this scenario (e.g., Hayes & Rockwood, 2017; MacKinnon & Fairchild, 2009), which has interesting implications for researchers and clinicians in the area.

Intervention Effects on Mediator Variables

Results from this study provided support for the effects of the brief interventions on one out of the three hypothesized mediator variables. Consistent with prior studies from other health-related-behaviours such as alcohol use, participants in the two PFB conditions reported that the typical student at their university gambled less than what participants in the control condition reported. Most college students think that other students engage in unhealthy behaviours such as excessive alcohol use, drug use, and risky sexual behaviour more than they actually do, and correcting such misperceptions theoretically leads to reduced behaviour among the individuals themselves (Borsari & Carey, 2001; Martens et al., 2006). Only a handful of studies in the gambling literature have examined the effects of brief motivational interventions on changing perceived norms (e.g., Neighbors et al., 2015). This study reinforces these existing findings by confirming that brief motivational interventions can impact a factor that has been shown to be an important mechanism of behaviour change across a variety of health-related behaviours.

In contrast to the aforementioned intervention effects, participants in the PFB-TXT condition did not report fewer gambling-related cognitive distortions or a greater usage of protective behavioural strategies than participants in the PFB-EDU condition. Regarding cognitive distortions, superstitious beliefs about gambling may be strongly ingrained among individuals, making them more difficult to alter in a brief intervention. Second, it is possible that participants simply did not believe the information when we attempted to correct cognitive errors via the targeted information, perhaps because they have had "successes" in the past associated with the errors. For example, a participant might believe it is correct that gambling losses will be followed by a series of wins because they recently experienced a series of wins after a series of losses, thereby falling prey to the gambler's fallacy (Croson & Sundali, 2005). Personalized information will not be efficacious if the individuals who receive the information question the accuracy of the content. In terms of protective behavioural strategies, our findings suggest that providing personalized feedback did provide a statistically detectable benefit to those in the PFB-TXT condition. Certain studies from the alcohol literature have shown that changes in protective behavioural strategy use mediate the effects of brief motivational interventions (Barnett et al., 2007; Larimer et al., 2007); however, the efficacy of brief interventions focusing directly on protective behavioural strategy use is mixed (Kenney et al., 2014; Martens et al., 2013). While other factors may explain the lack of intervention effects, which we outline later, it is possible that feedback on protective behaviour usage may not be an effective intervention strategy.

Interpreting Statistically Significant Indirect Effects

If a clinical trial showed an intervention had a statistically significant indirect effect on a dependent variable while also demonstrating a statistically significant total effect on that variable, interpretation is relatively straightforward. One would conclude that the intervention affected the dependent variable, and some of the effect (perhaps the majority or even all of the effect) was because of changes in the mediator variable(s). In this study, however, we had the unique outcome of statistically significant interaction effects in the absence of statistically significant total effects.

Historically, the most common way researchers interpreted mediated or indirect effects involved the causal-step process identified by Baron and Kenny (1986). The foundation of this process involves a meaningful direct effect between the independent variable and dependent variable (e.g., a statistically significant effect) decreasing in magnitude when the mediator variable is included in the model (e.g., the direct effect becomes non-significant). Thus, if there is no relationship between the independent and dependent variables, one does not even test for the possibility of indirect effects. For a number of years this process was the most common way to test for mediation, in part because of articles popularizing the technique or derivatives thereof (Holmbeck, 1997; MacKinnon et al., 2002).

Over time, though, methodologists have addressed alternative ways to consider mediated effects, including a situation involving statistically significant interaction effects in the absence of statistically significant direct effects. More specifically, contemporary scholars who study mediation recommend focusing on the magnitude of the indirect effect (i.e., the $a * b$ path in a traditional simple mediation model); that is, the hypothesized independent variable affects the mediator variable, which in turn affects the dependent variable (Hayes & Rockwood, 2017; MacKinnon & Fairchild, 2009). It is possible that such effects can occur when the direct or even total effect of the independent variable on the dependent variable is zero (or not statistically significant). In other words, the lack of a direct linear relationship between two variables does not necessarily mean that one variable does not affect the other through a third variable.

How, then, should one best interpret the findings from the present study? One way to do so is to recognize that both of the following are true, using one of the study analyses as an example: (a) overall, participants in the intervention conditions did not report significantly fewer gambling-related problems at the six-month follow-up than participants in the control condition; and (b) participants in the interventions did report significantly lower gambling norms than participants in the control condition at the one-month follow-up, and those with lower gambling norms at one-month reported fewer gambling-related problems at six-month follow-up. Thus, the interventions did have some effect on two out of the three dependent variables, but only if one accounts for their impact on the hypothesized mediator variables. It is certainly fair to say that the lack of statistically significant total effects tempers the overall impact of the interventions on the dependent variables. In other words, one

could conclude that intervention effects would be more robust if there were both statistically significant indirect and total effects. But, our findings do also suggest that brief gambling interventions delivered via smartphone may have some promise in reducing at-risk gambling behaviours, particularly as a result of correcting elevated gambling norms.

Possible Explanations of Non-Significant Treatment Effect

A majority of our analyses indicated a lack of relationships between both the outcome variables and the one-month mediating variable. We surmise that this may have been the result of the type of gamblers in our sample and a feature or our assessment tool. Regarding our sample of gamblers, our post-hoc analysis of gambling sub-types indicated that over two-thirds of our sample primarily engaged in gambling outside of traditional establishments, i.e., purchasing lottery tickets and gambling at slot machines and table games at a casino. Our intervention may not have interfaced well with the large subsample of gamblers who were primarily engaging in sports betting and games of skill. Take for example the list of protective behavioural strategies, which were used to generate feedback in PFB-TXT condition. Certain of these strategies, (e.g., "I avoid borrowing money to gamble" and "I avoid drinking when I gamble") may be relevant for this group, while others may be irrelevant (e.g., "I leave the gambling venue [casino, track, etc.] before I run out of money," and "I avoid taking my credit/debit cards to the casino or gambling venue"), as these gamblers may not often visit a gambling venue (Lostutter et al., 2014). Additionally, though we did not collect specific data, it is likely that many of these gamblers were engaging in fantasy sports betting, as studies of fantasy sports betting among college students indicate that a large portion of students engage in this type of gambling (Martin & Nelson, 2014; Martin et al., Nelson, & Gallucci, 2016). Furthermore, other methods of sports betting were not legal in the region at the time of this study. This type of betting has different constraints than casino and lottery gambling, e.g., betting once per season, week, or per game (i.e., daily fantasy) and placing a singular non-modifiable bet on an outcome that will occur hours, days, or months away. Gamblers that place bets with months between the wager and outcome may not report many changes in protective behaviours, gambling-related cognitive distortions, days abstinent, or dollars wagered at one-month and six-month follow-ups.

The design of our assessment instrument also may have contributed to our study's lack of direct intervention effects on our outcome variables. Participants in each condition were asked to include any goals they want to work toward regarding their gambling behaviour in our assessment battery. Our post-hoc analysis showed that over two-thirds of the sample generated at least one gambling-related goal, and that there was a similar rate of goal setting across conditions. Participants had the option of not setting any goals and were able to freely write out any goal of their choosing, giving even the assessment-only participants a personalized, albeit simple, intervention. Outcomes from other gambling treatment studies that allowed individuals to set their own goals around treatment show that participants report lower rates of gambling problems no matter what treatment goal they choose (i.e., moderation or

abstinence; Dowling et al., 2009; Stea et al., 2015). This suggests that allowing participants to select a goal of their choosing may lead to reductions in gambling-related problems. The post-hoc nature of these conclusions is purely conjecture and not empirically derived making it impossible to draw any direct links to goal setting and clinical outcomes for this study. However, it seems likely that some of our control participants engaged in an unintended form of intervention.

There are several study limitations to note. One limitation was generalizability, as the data were collected at a single university. Second, all participants were required to attend in-person assessments rather than completing them remotely, which may have biased our sample of gamblers. Third, all measures were retrospective self-report that are susceptible to recall biases, though self-report is commonly employed in gambling intervention trials (e.g., Larimer et al., 2012; Petry et al., 2009). Fourth, the Problem Gambling subscale of the CPGI records problems over the past year, which may not have been sensitive to changes at our one-month and six-month follow-ups. Finally, because of several recruitment challenges, we were not able to enroll as many students as we would have liked.

Despite these limitations, the results from the current study provide an interesting addition to the at-risk gambling literature. We encourage future researchers to build on our findings by conducting additional cell phone or text message-based interventions with larger and more diverse samples that take into account the many different forms of gambling individuals command access to. They could also build on our existing interventions, both in terms of format and content. Considering the rate of technological changes, future interventions delivered via cell phone could have improved graphics and interactive features. They could also focus more on providing normative feedback (e.g., using multiple normative measures) and use of gambling-specific protective behavioural strategies (e.g., having participants report strategy use in real time), considering the findings from the present trial. It is likely that gambling opportunities will continue to expand around the world, and it is important researchers develop efficacious and easy to implement interventions designed to combat at-risk gambling among vulnerable populations.

References

Armanasoco, A. A., Miller, Y. D., Fjeldsoe, B. S., & Marshall, A. L. (2017). Preventive health behavior change text message interventions: A meta-analysis. *American Journal of Preventive Medicine, 52,* 391–402. https//:doi.org/10.1016/j.amepre.2016.10.042

Auer, M. M., & Griffiths, M. D. (2015a). Testing normative and self-appraisal feedback in an online slot-machine pop-up in a real-world setting. *Frontiers in Psychology, 6*, 339. https://www.frontiersin.org/articles/10.3389/fpsyg.2015.00339/full

Auer, M. M., & Griffiths, M. D. (2015b). The use of personalized behavioral feedback for online gamblers: An empirical study. *Frontiers in Psychology, 6*, 1406. https://www.frontiersin.org/articles/10.3389/fpsyg.2015.01406/full

Barnett, N. P., Murphy, J. G., Colby, S. M., & Monti, P. M. (2007). Efficacy of counselor vs. computer-delivered intervention with mandated college students. *Addictive Behaviors, 32,* 2529–2548. https//:doi.org/10.1016/j.addbeh.2007.06.017

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173–1182. https//:doi.org/10.1037/0022-3514.51.6.1173

Binde, P., Romild, U., & Volberg, R. A. (2017). Forms of gambling, gambling involvement and problem gambling: Evidence from a Swedish population survey. *International Gambling Studies*, *17*, 490–507. https//:doi.org/10.1080/14459795.2017.1360928

Blinn-Pike, L., Worthy, S. L., & Jonkman, J. N. (2007). Disordered gambling among college students: A meta-analytic synthesis. *Journal of Gambling Studies, 23,* 175–183. https//:doi.org/10.1007/s10899-006-9036-2

Borsari, B., & Carey, K. B. (2001). Peer influences on college drinking: A review of the research. *Journal of Substance Abuse, 13*, 391–424. https//: doi.org/10.1016/S0899-3289(01)00098-0

Brooker, I. S., Clara, I. P., & Cox, B. J. (2009). The Canadian Problem Gambling Index: Factor structure and associations with psychopathology in a nationally representative sample. *Canadian Journal of Behavioural Science, 41,* 109–114. https//:doi.org/10.1037/a0014841

Burke, B. L., Arkowitz, H., & Menchola, M. (2003). The efficacy of motivational interviewing: A meta-analysis of controlled clinical trials. *Journal of Consulting and Clinical Psychology, 71,* 843–861. https//:doi.org/10.1037/0022-006X.71.5.843

Carey, K. B., Scott-Sheldon, L. A. J., Carey, M. P., & DeMartini, K. S. (2007). Individual-level interventions to reduce college student drinking: A meta-analytic review. *Addictive Behaviors, 32,* 2469–2494. https//:doi.org/10.1016/j.addbeh.2007.05.004

Croson, R., & Sundali, J. (2005). The gambler's fallacy and the hot hand: Empirical data from casinos. *Journal of Risk and Uncertainty, 30,* 195–209. https//:doi.org/10.1007/s11166-005-1153-2

Cunningham, J. A., Hodgins, D. C., Toneatto, T., & Murphy, M. (2012). A randomized controlled trial of a personalized feedback intervention for problem gamblers. *PLoS ONE, 7*, e31586. https//:doi.org/10.1371/journal.pone.0031586

Cunningham, J. A., Hodgins, D. C., Toneatto, T., Rai, A., & Cordingley, J. (2009). Pilot study of a personalized feedback intervention for problem gamblers. *Behavior Therapy, 40,* 219–224. https//:doi.org/10.1016/j.beth.2008.06.005

Dimeff, L. A., Baer, J. S., Kivlahan, D. R., & Marlatt, G. A. (1999). *Brief alcohol screening and intervention for college students: A harm reduction approach*. New York, NY: The Guilford Press.

Dowling, N., Smith, D., & Thomas, T. (2009). A preliminary investigation of abstinence and controlled gambling as self-selected goals of treatment for female pathological gambling. *Journal of Gambling Studies*, *25*, 201. https//:doi:10.1007/s10899-009-9116-1

Engwall, D., Hunter, R., & Steinberg, M. (2004). Gambling and other risk behaviors on university campuses. *Journal of American College Health, 52,* 245–255. https//:doi.org/10.3200/JACH.52.6.245-256

Ferris, J., & Wynne, H. (2001). *The Canadian Problem Gambling Index: Final report*. Ottawa, ON: Canadian Center on Substance Abuse.

Gebauer, L., LaBrie, R., & Shaffer, H. J. (2010). Optimizing DSM-IV-TR classification accuracy: A brief biosocial screen for detecting current gambling disorders among gamblers in the general household population. *Canadian Journal of Psychiatry, 55,* 82–90. https//:doi:10.1177/070674371005500204

Geisner, I. M., Bowen, S., Lostutter, T. W., Cronce, J. M., Granato, H., & Larimer, M. E. (2015). Gambling-related problems as a mediator between treatment and mental health with at-risk college student gamblers. *Journal of Gambling Studies*, *31*, 1005–1013. https//:doi.org/10.1007/s10899-014-9456-3

Granato, H., Luk, J. W., Paves, A., Geisner, I. M., Cronce, J. M., Kilmer, J. R., Lostutter, T. W., & Larimer, M. E. (2018). Crossover effects of protective behavioural strategies for drinking on gambling consequences among college gamblers with alcohol or drug abuse. *Journal of Gambling Issues*, 38. http://jgi.camh.net/index.php/jgi/article/view/3997

Hanson, T. L., Drumheller, K., Mallard, J., McKee, C., & Schlegel, P. (2011). Cell phones, text messaging, and Facebook: Competing time demands of today's college students. *College Teaching, 59,* 23–30. https//:doi:10.1080/87567555.2010.489078

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). New York, NY: The Guilford Press.

Hayes, A. F., & Rockwood, N. J. (2017). Regression-based statistical mediation and moderation analysis in clinical research: Observations, recommendations, and

implementation. *Behaviour Research and Therapy, 98*, 39–57. https//:doi.org/10.1016/j.brat.2016.11.001

Hodgins, D. C., Currie, S. R., Currie, G., & Fick, G. H. (2009). Randomized trial of brief motivational treatments for pathological gamblers: More is not necessarily better. *Journal of Consulting and Clinical Psychology, 77,* 950–960. https//:doi.org/10.1037/a0016318

Hodgins, D. C., Currie, S. R., & el-Guebaly, N. (2001). Motivational enhancement and self-help treatments for problem gambling. *Journal of Consulting and Clinical Psychology, 69,* 50–57. https//:doi.org/10.1037/0022-006X.69.1.50

Holmbeck, G. N. (1997). Toward terminological, statistical, and conceptual clarity in the study of mediators and moderators: Examples from the child-clinical and pediatric psychology literatures. *Journal of Consulting and Clinical Psychology, 65,* 599–610. https//:doi:10.1037/0022-006X.65.4.599

Huang, J., Jacobs, D. F., & Derevensky, J. L. (2011). DSM-based problem gambling: Increasing the odds of heavy drinking in a national sample of U.S. college athletes? *Journal of Psychiatric Research, 45,* 302–308. https//:doi.org/10.1016/j.jpsychires.2010.07.001

Jensen, C. D., Cushing, C. C., Aylward, B. S., Craig, J. T., Sorell, D. M., & Steele, R. G. (2011). Effectiveness of motivational interviewing interventions for adolescent substance use behavior change: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 79,* 433–440. https//:doi.org/10.1037/a0023992

Kenney, S. R., Napper, L. E., LaBrie, J. W., & Martens, M. P. (2014). Examining the efficacy of a brief group protective behavioral strategies skills training alcohol intervention with college women. *Psychology of Addictive Behaviors, 28,* 1041–1051. https//:doi:10.1037/a0038173

Kessler, R. C., Hwang, I., Petukhova, M., Sampson, N. A., Winters, K. C., & Shaffer, H. J. (2008). DSM-IV pathological gambling in the National Comorbidity Survey Replication. *Psychological Medicine, 38,* 1351–1360. https//:doi:10.1017/S0033291708002900

LaBrie, R. A., Shaffer, H. J., LaPlante, D. A., & Wechsler, H. (2003). Correlates of college student gambling in the United States. *Journal of American College Health, 52,* 53–62. https//:doi.org/10.1080/07448480309595725

Larimer, M. E., Lee, C. M., Kilmer, J. R., Fabiano, P. M., Stark, C. B., Geisner, I. M., Mallett, K. A., Lostutter, T. W., Cronce, J. M., Feeney, F., & Neighbors, C. (2007). Personalized mailed feedback for college drinking prevention: A randomized clinical trial. *Journal of Consulting and Clinical Psychology, 75,* 285–293. https//:doi.org/10.1037/0022-006X.75.2.285

Larimer, M. E., Neighbors, C., Lostutter, T. W., Whiteside, U., Cronce, J. M., Kaysen, D., & Walker, D. D. (2012). Brief motivational feedback and cognitive behavioral interventions for prevention of disordered gambling: A randomized clinical trial. *Addiction, 107,* 1148–1158. https//:doi.org/10.1037/0022-006X.75.2.285

Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of pathological gamblers. *American Journal of Psychiatry, 144,* 1184–1188. https//:doi.org/10.1176/ajp.144.9.1184

Lostutter, T. W., Lewis, M. A., Cronce, J. M., Neighbors, C., & Larimer, M. E. (2014). The use of protective behaviors in relation to gambling among college students. *Journal of Gambling Studies, 30,* 27–46. https//:doi.org/10.1007/s10899-012-9343-8

Lundahl, B. W., Kunz, C., Brownell, C., Tollefson, D., & Burke, B. L. (2010). A meta-analysis of motivational interviewing: Twenty-five years of empirical studies. *Research on Social Work Practice, 20,* 137–160. https//:doi.org/10.1177/1049731509347850

MacKinnon, D. P., & Fairchild, A. J. (2009). Current directions in mediation analysis. *Current Directions in Mediation Analysis, 18,* 16–20. https//:doi.org/10.1111/j.1467-8721.2009.01598.x

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7,* 83–104. https//:doi:10.1037/1082-989X.7.1.83

Martens, M. P., Arterberry, B. J., Takamatsu, S. K., Masters, J., & Dude, K. (2015). The efficacy of a personalized feedback-only intervention for at-risk college gamblers. *Journal of Consulting and Clinical Psychology, 83,* 494–499. https//:doi.org/10.1037/a0038843

Martens, M. P., Kilmer, J. R., Beck, N. C., & Zamboanga, B. L. (2010). The efficacy of a targeted personalized feedback intervention among intercollegiate athletes: A randomized controlled trial. *Psychology of Addictive Behaviors, 24,* 660–669. https//:doi.org/10.1037/a0020299

Martens, M. P., Page, J. C., Mowry, E. S., Taylor, K. K., Damann, K. M., & Cimini, M. D. (2006). Differences between actual and perceived student norms: An examination of alcohol use, drug use, and sexual behavior. *Journal of American College Health, 54,* 295–300. https//:doi.org/10.3200/JACH.54.5.295-300

Martens, M. P., Rocha, T. L., Cimini, M. D., Diaz-Myers, A., Rivero, E., & Wulfert, E. (2009). The co-occurrence of alcohol use and gambling activities in first-year college students. *Journal of American College Health, 57,* 597–602. https//:doi.org/10.3200/JACH.57.6.597-602

Martens, M. P., Smith, A. E., & Murphy, J. G. (2013). The efficacy of single-component brief motivational interventions among at-risk college drinkers. *Journal of Consulting and Clinical Psychology, 81,* 691–701. https//:doi.org/10.1037/a0032235

Martin, R. J., & Nelson, S. (2014). Fantasy sports, real money: Exploration of the relationship between fantasy sports participation and gambling-related problems. *Addictive Behaviors, 39*, 1377–1382. https//:doi.org/10.1016/j.addbeh.2014.05.017

Martin, R. J., Nelson, S. E., & Gallucci, A. R. (2016). Game on: Past year gambling, gambling-related problems, and fantasy sports gambling among college athletes and non-athletes. *Journal of Gambling Studies*, *32*, 567–579. https//:doi.org/10.1007/s10899-015-9561-y

Marmurek, H. H. C., Switzer, J., & D'Alvise, J. (2014). A comparison of university student and community gamblers: Motivations, impulsivity, and gambling cognitions. *Journal of Behavioral Addictions*, *3*, 54–64. https//:doi.org/10.1556/JBA.3.2014.007

Maynard, R. A., & Dong, N. (2013). "PowerUp"!: A tool for calculating minimum detectable effect sizes and minimum required sample sizes for experimental and quasi-experimental design studies. *Journal of Research on Educational Effectiveness, 6,* 24–67. https//:doi.org/10.1080/19345747.2012.673143

Millennials are top smartphone users (2016, November 15). https://www.nielsen.com/us/en/insights/article/2016/millennials-are-top-smartphone-users

Miller, W. R., & Rollnick S. (2013). *Motivational interviewing: Helping people change* (3rd ed.). New York, NY: Guilford Press.

Monson, E., Kairouz, S., Perks, M., & Arsenault, N. (2019). Are general and activity-specific PGSI scores consistent? *Journal of Gambling Issues*, 41. http://jgi.camh.net/index.php/jgi/article/view/4039/4414

Neighbors, C., Lostutter, T. W., Larimer, M. E., & Takushi, R. Y. (2002). Measuring gambling outcomes among college students. *Journal of Gambling Studies*, *18*, 339–360. https//:doi.org/10.1023/a:1021013132430

Neighbors, C., Rodriguez, L. M., Rinker, D. V., Gonzales, R. G., Agana, M., Tackett, J., & Foster, D. L. (2015). Efficacy of personalized normative feedback as a brief intervention for college student gambling: A randomized controlled trial. *Journal of Consulting and Clinical Psychology, 83,* 500–511. https//:doi.org/10.1037/a0039125

Nowak, D. E. (2018). A meta-analytic synthesis and examination of pathological and problem gambling rates and associated moderators among college students:

1987–2016. *Journal of Gambling Studies, 34,* 465–498. https//:doi.org/10.1007/s10899-017-9726-y

Petry, N. M., Stinson, F. S., & Grant, B. F. (2005). Comorbidity of DSM-IV pathological gambling and other psychiatric disorders: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Journal of Clinical Psychiatry, 66,* 564–574. https//:doi.org/10.4088/JCP.v66n0504

Petry, N. M., Weinstock, J., Ledgerwood, D. M., & Morasco, B. (2008). A randomized trial of brief interventions for problem and pathological gamblers. *Journal of Consulting and Clinical Psychology, 76*, 318–328. https//:doi.org/10.1037/0022-006X.76.2.318

Petry, N. M. Weinstock, J., Ledgerwood Morasco, B J., & Ledgerwood, D. M. (2009). Brief motivational interventions for college student problem gamblers. *Addiction, 104,* 1569–1578. https//:doi.org/10.1111/j.1360-0443.2009.02652.x

Raylu, N., & Oei, T. P. S. (2004). The Gambling Related Cognitions Scale (GRCS): Development, confirmatory factor validation and psychometric properties. *Addiction, 99,* 757–769. https//:doi.org/10.1111/j.1360-0443.2004.00753.x

Shaffer, H. J., Hall, M. N., & Vander Bilt, J. (1999). Estimating the prevalence of disordered gambling behavior in the United States and Canada: A research synthesis. *American Journal of Public Health, 89,* 1369–1376. https//:doi.org/10.2105/AJPH.89.9.1369

Spohr, S. A., Nandy, R., Gandhiraj, D., Vemulapalli, A., Anne, S., & Walters, S. T. (2015). Efficacy of SMS text message interventions for smoking cessations: A meta-analysis. *Journal of Substance Abuse Treatment, 56,* 1–10. https//:doi.org/10.1016/j.jsat.2015.01.011

Stea, J. N., Hodgins, D. C., & Fung, T. (2015). Abstinence versus moderation goals in brief motivational treatment for pathological gambling. *Journal of Gambling Studies*, *31*, 1029–1045. https//:doi.org/10.1007/s10899-014-9461-6

Stuhldreher, W. L., Stuhldreher, T. J., & Forrest, K. Y.-Z. (2007). Gambling as an emerging health problem on campus. *Journal of American College Health, 56,* 75–83. https//:doi.org/10.3200/JACH.56.1.75–88

Suffoletto, B., Kristan, J., Chung, T., Jeong, K., Fabio, A., Monti, P., & Clark, D. B. (2015). An interactive text-message intervention to reduce binge drinking in young adults: A randomized controlled trial with 9-month outcomes. PLoS ONE, 10. https//:doi.org/10.1371/journal.pone.0142877

Toneatto, T., & Gunaratne, M. (2009). Does the treatment of cognitive distortions improve clinical outcomes for problem gambling?. *Journal of Contemporary Psychotherapy*, 39(4), 221-229. https://dx.doi.org/10.1007/s10879-009-9119-3

Visilaki, E. I., Hosier, S. G., & Cox, W. M. (2006). The efficacy of motivational interviewing as a brief intervention for excessive drinking: A meta-analytic review. *Alcohol and Alcoholism, 41,* 328–335. https//:doi.org/10.1093/alcalc/agl016

Weinstock, J., Whelan, J. P., & Meyers, A. W. (2004). Behavioral assessment of gambling: An application of the Timeline Followback Method. *Psychological Assessment, 16,* 72–80. https//:doi.org/10.1037/1040-3590.16.1.72

Winters, K. C., Bengston, P., Door, D., & Stinchfield, R. (1998). Prevalence and risk factors of gambling among college students. *Psychology of Addictive Behaviors, 12,* 127–135. https//:doi.org/10.1037/0893-164X.12.2.127

Wohl, M. J. A., Gainsbury, S., Stewart, M. J., & Sztainert, T. (2013). Facilitating responsible gambling: The relative effectiveness of education-based animation and monetary limit setting pop-up messages among electronic gaming machine players. *Journal of Gambling Studies, 29,* 703–717. https//:doi.org/10.1007/s10899-012-9340-y

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Submitted January 30, 2019; accepted August 28, 2020. This article was peer reviewed. All URLs were available at the time of submission.

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Competing interests: None declared (all authors).

Ethics approval: The University of Missouri Campus Institutional Review Board approved on October 30, 2013, the research project “Efficacy of a Brief Motivational Intervention Delivered via Smartphone and Short Messaging Service” (#1209124).

Acknowledgements: This project was supported by a grant from the International Center for Responsible Gaming.