

## Initial Usability and Feasibility of a Web-Based Behavioural Activation Program for Young Adults With Comorbid Depression and Problem Gambling: A Case Study and Case Series

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### Abstract

Approximately 20%–32% of youth and adults with problem gambling also experience comorbid depression, yet treatment for this comorbidity is not readily accessible. We sought to extend and customize DoNamic, our existing web-based app for treating depression, to also treat young adults who experience comorbid problem gambling. We conducted a laboratory-based usability case study (Study 1) and a usability and feasibility clinical case series (Study 2). Study 1 involved an individual with problem gambling who tested the DoNamic version tailored to problem gambling (DoNamic-PG) in the laboratory. Changes based on participant feedback were implemented. Study 2 involved two cycles of testing in which five participants used the revised version of DoNamic-PG and provided feedback. Indicators of feasibility and usability of DoNamic-PG were predominately met; however, even with the increased accessibility and ease of use of DoNamic-PG, recruitment issues suggest it may not fully overcome the problem of attracting gamblers into treatment. This study highlights an existing concern in the field of problem gambling: Even when interventions are accessible for problem gambling populations, they are not necessarily used. Ultimately, the results of our case studies highlight how existing apps can be adjusted for specific subgroups. DoNamic-PG has the potential to be a feasible and usable app that could increase the accessibility,

efficiency, and quality of care for younger adults with depression and problem gambling, if recruitment problems can be overcome. The next steps for developing DoNamic-PG include further feasibility testing, followed by trials to determine its efficacy and effectiveness.

**Keywords:** Gambling, depression, comorbidity, youth, application

### Résumé

Entre 20 et 32 % des jeunes et des adultes aux prises avec une dépendance au jeu éprouvent aussi des problèmes de dépression. Et pourtant, il n'est pas facile d'obtenir un traitement pour ce trouble concomitant. Nous souhaitons donc adapter DoNamic, notre application web pour le traitement de la dépression, aux besoins des jeunes adultes qui éprouvent un trouble dépressif concomitant à leur dépendance au jeu. À cette fin, nous avons mené une étude d'utilisabilité en laboratoire (étude 1), puis une série d'essais cliniques sur l'utilisabilité et la faisabilité (étude 2). Dans l'étude 1, nous avons demandé à un joueur pathologique de mettre à l'essai en laboratoire une version de DoNamic adaptée aux problèmes de dépendance au jeu (DoNamic-PG), puis nous avons effectué des changements à l'application en fonction des commentaires du participant. L'étude 2 comprenait deux cycles d'essais cliniques au cours desquels cinq participants ont utilisé la version révisée de DoNamic-PG, puis ont fourni leurs commentaires. Les indicateurs de faisabilité et d'utilisabilité de DoNamic-PG ont été en bonne partie atteints; toutefois, même si l'application est plus accessible et facile à utiliser, les difficultés de recrutement suggèrent que cette solution ne suffit pas pour inciter les joueurs à se faire traiter. Cela met en évidence un enjeu actuel des traitements de la dépendance au jeu : même lorsqu'il existe des solutions de traitement accessibles, les joueurs compulsifs ne les utilisent pas nécessairement. Les résultats de nos études de cas révèlent par contre qu'il est possible d'adapter les applications existantes aux besoins de sous-groupes spécifiques et que DoNamic-PG constitue une application potentiellement utilisable pour accroître l'accessibilité, l'efficacité et la qualité des soins offerts aux jeunes adultes aux prises avec des problèmes concomitants de jeu et de dépression, à condition d'améliorer le recrutement. Les prochaines étapes du développement de DoNamic-PG comprennent d'autres études de faisabilité, suivies d'essais cliniques pour déterminer l'efficacité et la performance de l'application.

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### Introduction

Problem gambling—gambling behaviour that has a negative effect on the gambler, society, and/or the gambler's friends and family (Ferris & Wynne, 2001)—has been

identified as a significant issue in Canada (e.g., Hodgins et al., 2013). Prevalence studies indicate that ~2% of the adult Canadian population experiences problem gambling (Williams & Volberg, 2013). This is concerning, as problem gambling is associated with significant economic, social, and personal costs (e.g., negative impacts on relationships, financial loss), as well as mental health comorbidities (e.g., depression; Hodgins et al., 2011).

Despite the existence of effective treatments for problem gambling (e.g., cognitive behavioural therapy or motivational interviewing; Cowlshaw et al., 2012; Petry et al., 2017; Yakovenko et al., 2015), there are significant issues in the delivery of services to individuals with problem gambling. Existing programs have a high dropout rate (e.g., > 30%; Melville et al., 2007; Smith et al., 2015), and fewer than 10% of problem gamblers seek formal treatment (e.g., Suurvali et al., 2008). Of the small percentage of individuals with problem gambling who do seek treatment, only slightly more than half receive the full course of an intervention.

Research suggests that barriers to treatment in problem gambling populations include lack of access to affordable services, shame, and wanting to self-manage (Gainsbury et al., 2014; Hing et al., 2012). Providing treatment in an online format may mitigate some of these treatment barriers, as online treatment is often accessible and flexible and it can be anonymous (Gainsbury & Blaszczynski, 2011). In line with this, online problem gambling interventions show promising results, whether they involve contact with a mental health professional or are self-guided (Hodgins et al., 2019; van der Maas et al., 2019). Self-guided programs may have particular benefit, as they can be produced and maintained at a lower cost to individuals and public health agencies.

When developing self-guided programs for gambling, it is important to remember that problem gambling is often comorbid with other mental health concerns that may also need to be addressed. For example, problem gambling and depression often co-occur; between 20% and 25% of adolescents and young adults and 32% of adults who experience problem gambling also report clinical levels of depression (Nower et al., 2004; Quigley et al., 2015). When comorbid, gambling and depression can interact, resulting in an escalation in the severity of both conditions via mutual influence (Dussault et al., 2011). Unsurprisingly, the combination of problem gambling and depression is related to poorer treatment outcomes (e.g., Merkouris et al., 2016).

Research has begun to examine how to treat comorbid problem gambling and depression with online and distance treatments. Preliminary research into approaches that target a single disorder suggests that targeting depression can reduce gambling behaviours, and targeting gambling behaviours can reduce depression (Bücker et al., 2018; Ranta et al., 2019). Comorbidities can also be targeted concurrently (i.e., simultaneously providing separate treatments for both gambling and depression; see Cunningham et al., 2019) or in an integrated fashion, with both disorders being the focus of a single treatment. Although face-to-face

treatment suggests that integration is an effective approach to treating symptoms of both gambling and depression (e.g., Linnet et al., 2017), online treatments do not appear to offer integrated depression and gambling treatment to date. We sought to fill this gap by adapting an existing self-guided online intervention for depression, DoNamic (see Cowie et al., 2019), to treat comorbid depression and problem gambling.

Our app, DoNamic, is an online program for depressed adolescents and adults aged 14–40 years, an age group that is also significantly more likely to experience problem gambling (Huang & Boyer, 2007). DoNamic is grounded in behavioural activation (BA), a well-established treatment for mild-to-moderate depression (e.g., Cuijpers et al., 2007). BA or “activity scheduling” is often also used within gambling treatment to help individuals increase their involvement in healthy activities that are pleasurable and rewarding, yet incompatible with the problem behaviour (or activities associated with it; Dowling et al., 2008). We therefore reasoned that a BA-based intervention could be effective for treating both gambling and depression. Our objective was to adapt our existing online program by adding features that specifically target gambling-related problems. An in-laboratory case study and case series were undertaken with several individuals aged 14-40 with depression and/or gambling to provide an initial evaluation of the usability and feasibility of this intervention. Such evaluation is necessary before proceeding to efficacy evaluation of this integrated online program.

### **Study 1: Usability Case Study**

Usability evaluation is essential for the development of apps, as it is a way of ensuring that the user interface and the content are relevant and acceptable to the target group and that there are no significant problems with their usage (Bastien, 2010). We undertook a utilization-focused (user-centred) evaluation approach (Patton, 2008) in order to identify concerns with the user interface or content of DoNamic-PG (DoNamic app tailored to problem gambling) and to improve it. After studying the usability of DoNamic, we added gambling features to create DoNamic-PG. These features included daily and weekly gambling check-ins, which prompt the user to record urges to gamble, triggers, gambling behaviours (e.g., time and money spent), and interference of gambling with other activities. At the end of every week, users are shown a weekly summary of their check-in results. Users also have access to gambling progress reports, which graphically present their check-in results from the 4 most recent weeks and offer users the opportunity to view results from previous weeks. In addition, we added gambling resources and new library topics (i.e., “Connection between gambling and depression” and “Cope with gambling”). The additional features were modelled after existing DoNamic features for depression, which had already been vetted through two cycles of usability testing.

## Method

### *Participant*

As we wanted specific feedback on the problem gambling additions, we recruited a 27-year-old man with problem gambling.<sup>1</sup> To be included, the participant was required to answer “yes” to at least one item on the National Opinion Research Center (NORC) DSM-IV Screen for Gambling Problems – Loss of Control, Lying, Preoccupation (NODS-CLiP), indicating the likely presence of problem gambling. A total of 15 participants applied to take part in the usability session; however, 13 participants did not meet the inclusion criteria (five did not meet problem gambling criteria, three did not complete the eligibility survey, two did not provide accurate contact information, and three had significant risk for suicide and were excluded). One additional participant met the inclusion criteria but declined to take part in a usability session.

### *Measure*

The NODS-CLiP (Toce-Gerstein et al., 2009) is a three-item screen for problem gambling based on the 17-item NODS (Gerstein et al., 1999). The NODS-CLiP has demonstrated the ability to discriminate between problem and non-problem gambling at a level equal to the full NODS (Toce-Gerstein, et al., 2009). Answering “yes” to any of the three items indicates that problem gambling may be present.

### *Procedure*

To recruit our participant, we used posters and brochures in the community, as well as posts on websites for youth, classified ads (e.g., Kijiji), social media, and hospital-affiliated websites. Our participant completed an in-laboratory usability session. During this session, he was asked to complete a series of tasks (e.g., register for the app, log in and explore on his own, review specific features) while speaking aloud about his interaction and perceptions. The participant also completed a semi-structured interview regarding the overall app, its potential, and how to engage with the intended end-user population. At the end of the session, he was given a \$20.00 CAN gift card honorarium. The usability session took approximately 70 min.

An analysis plan was established a priori. The usability session was transcribed and two independent coders (SR, VV) reviewed it and highlighted participant-identified concerns and any suggested solutions or improvements. Following this, three raters

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<sup>1</sup>We originally aimed to test usability with at least five participants with comorbid depression and problem gambling (see Nielsen, 1994b; Virzi, 1992). However, given recruitment challenges, we altered our protocol and proceeded as a case study of an individual with problem gambling only, because we simply sought to receive feedback on the usability of the added gambling components of DoNamic-PG.

(SR, VV, AH) independently rated the severity of the usability problems by using the protocol outlined by Nielsen (1994a). The three raters then prioritized which problems to fix and which solutions should be implemented. The final portion of the interview was coded by one coder (SB) who used thematic analysis.

## Results

### *Participant Interaction With Prototype*

See Table 1 for problems identified by the participant, suggested solutions, severity ratings, and the changes that were made to DoNamic-PG in response.

### *Final Interview*

**Opinion of the Overall Program.** The participant stated he could learn things from DoNamic-PG and that the app would foster insight into what was triggering gambling. He reported it would be easy to use. The participant noted that the app could be used as a stand-alone self-guided tool, rather than a tool to be used in conjunction with a mental health professional. He stated that if the app were to be stand-alone (i.e., no professionals available for consultation), he would not be willing to pay for it, but that he would consider using it if it were freely available.

**Suggestions for Improvement Not Raised During the Usability Test.** The participant suggested several changes that were not rated as being of high importance (e.g., monthly progress reports vs. weekly progress reports) and were not raised by any of the participants who took part in the usability testing for the original DoNamic. Thus, these suggestions were not implemented.

## Discussion

In this case study, we sought to evaluate the usability of DoNamic with added problem gambling features, that is, DoNamic-PG. The participant with problem gambling identified several concerns with the gambling check-in questions and progress sections. The participant's comments that multiple triggers to gamble may occur and urges to gamble may vary in strength throughout the day broadly align with the psychological conceptualization of gambling (e.g., Ladouceur & Lachance, 2007). Thus, several changes were made to the wording and format of the check-in questions in response to this participant's feedback in order to improve usability.

Given that there were no significant problems with the individual's use of the gambling features, that the usability of the main aspects of the app had already been extensively tested by participants with depression only, and that the next step in the development of DoNamic-PG also provided an opportunity to examine usability, we reasoned that our adaptations were sufficient to move on to the feasibility testing

Table 1  
*Participant-Identified Problems, Suggestions, Severity Ratings (SR), and Changes Made*

Problem	Suggestion	SR	Change
Participant indicated that gambling check-in Part 1 question “How strong has your urge to gamble been today? (options for <i>No urge</i> to <i>Very strong</i> ) assumes that urge has been consistent throughout the day, which may not be the case.	Separate question into multiple questions that assess urge to gamble in the morning, afternoon, and evening.	3	As it is important to take into account the burden of the app on the user when introducing changes, we changed the check-in Question 1 to “What is the strongest urge to gamble that you have had today?” This reflects the participant’s comment that urges may be different throughout the day but does not add additional questions.
Participant indicated that gambling check-in Part 1 question “What triggered your urge to gamble?” has multiple options, but only lets you pick one. Participant reported that individuals may have multiple urges to gamble.	Allow for the selection of multiple urges.	2	Changed to allow for the selection of multiple options for what triggered the urge to gamble (i.e., “Select all that apply”).
Participant indicated that gambling check-in Part 1 question does not allow for you to know which trigger may be the strongest.	Rate the strength of each relevant trigger from 0 to 5.	0	No change implemented, as the raters reasoned that the relative importance of specific triggers would be indicated by their frequency of appearance across days without adding the burden of providing relative strength ratings.
Participant indicated that gambling check-in Part 2 question asks for the time spent on gambling activities today (in minutes). This may not capture different sessions.	Time should be split up into different sessions of gambling (e.g., morning and evening).	0	No change implemented, as raters believed that showing the total time gambling across days would minimize the burden while maximizing useful information for users.
Participant indicated that gambling check-in Part 2 question also asks about the total money spent on gambling activities today and the total money won on gambling activities today. These things can be difficult to determine. Participant gave example: If	No suggestion.	3	Check-in questions changed from “total money spent on gambling today” and “total money won from gambling today” to include “total amount of money you have put in from your pocket on gambling today,” “total amount of money you have won from gambling today,” and “total amount of money you

Table 1 Continued.

Problem	Suggestion	SR	Change
you started with \$50, then won \$50, but lost it all, how do you answer the question?			have lost from gambling today” in order to reflect money bet, won, and lost. Assessing these three aspects is part of highly used gambling measures such as the Gambling Timeline Follow Back (Weinstock et al., 2004).
Participant stated that in the progress section, users are shown how much they have won and lost during the past week and their net win or loss from the beginning. Participant suggested that this information may increase desire to gamble because (a) the participants may see that their wins go up, and/or (b) they may want to see their wins go up.	Take out how much money was won, lost, or net win/loss.	1	Statistics showing how much participants won or lost was removed. Only net win/loss amounts were shown. Although this change does not resolve the concern raised by the participant, the participant reported earlier in the session that this information was meaningful. Moreover, it is most likely that, given the nature of gambling, this value will reflect a net loss. This may be helpful, as gamblers have been shown to have memory biases in which they tend to focus on wins and ignore losses (Fortune & Goodie, 2012). Showing the net win/loss may counter this bias.
Participant indicated that the extent to which gambling interfered with life would be better shown in a chart in the progress section because that is more important than time spent gambling, which is currently shown in a chart.	Change gambling interference to a chart and the current chart of time spent gambling can be written out in words.	0	No changes made. Given that DoNamic-PG is a behavioural activation treatment, raters viewed the primary goal of DoNamic-PG to be behavioural (i.e., reducing the time spent gambling). Moreover, as time spent gambling was viewed as being more likely to show more immediate treatment effects, it was chosen for the chart for motivational reasons.

*Note:* Severity ratings were as follows: 0 (“I don’t agree that this is a usability problem at all”), 1 (“Cosmetic problem only: need not be fixed unless extra time is available on the project”), 2 (“Minor usability problem: fixing this should be given low priority”), 3 (“Major usability problem: important to fix, so should be given high priority”), and 4 (“Usability catastrophe: imperative to fix this before product can be released”). Ratings were made based on a combination of three factors: (a) the frequency with which the problem occurs, (b) the impact of the problem if it occurs, and (c) the persistence of the problem. DoNamic-PG = DoNamic app with added features for comorbid problem gambling.



case series (Study 2). Nonetheless, our results may be limited by only having one participant, as five are recommended (e.g., Nielsen & Molich, 1989).

### **Study 2: Clinical Case Series**

Following Study 1, we sought to further evaluate the usability of DoNamic-PG in a real-world context to further improve its usability and feasibility. Following the PACMAD (People At the Centre of Mobile App Development) usability model (Harrison et al., 2013), we broadly conceptualized usability in terms of whether the app was effective, efficient, satisfactory, learnable, memorable, and error free, as well as whether it had a low cognitive load. We were specifically interested in the acceptability of the app (i.e., satisfaction), whether it was error free, and user adherence. We conducted two cycles to evaluate and, if necessary, improve DoNamic-PG.

Our primary objective was to reach or surpass our minimum acceptable level of feasibility and usability, defined by our team as follows:

1. Users report at least moderate levels of satisfaction on the Client Satisfaction Questionnaire-8 (CSQ-8) and through interviews.
2. Users do not report any major technical issues.
3. We observe that in each cycle at least 30% of the users read 30% of the learning topics in the DoNamic-PG library (i.e., 4 of 14 topics).
4. We observe that at least 30% of the users plan activities through DoNamic-PG planning at least once.

### **Method**

#### *Participants*

In accordance with minimum usability standards (Nielsen, 2012), we recruited five participants (Cycle 1 = 2; Cycle 2 = 3). See Table 2 for participant demographic information, as well as depression and problem gambling scores. To be eligible, participants had to have a Problem Gambling Severity Index (PGSI) score of at least 3 and a Patient Health Questionnaire-9 (PHQ-9) score of 10+, indicating at least a moderate level of gambling problems and depression, respectively. In Cycle 1 and Cycle 2, 49 individuals (Cycle 1) and 47 individuals (Cycle 2) who had gambled in the past month applied to take part. A total of 34 individuals in Cycle 1 and 28 individuals in Cycle 2 were deemed eligible to complete the inclusion questionnaires (i.e., evidence of depression and had gambled in the past month). Of these individuals, 17 in Cycle 1 and 18 in Cycle 2 completed the eligibility questionnaires. In Cycle 1, 13 participants did not meet the inclusion criteria (10 = did not meet gambling criteria; 3 = had significant risk for suicide and were excluded), and

Table 2  
*Demographic Characteristics and Baseline PHQ-9 and PGSI Scores*

Cycle	Participant	Sex	Age	PHQ-9 (at study entry)	PGSI (at study entry)
1	1	F	26	10	7
	2	F	38	23	21
2	3	M	36	14	9
	4	M	33	10	6
	5	M	25	16	9

*Note:* For the Patient Health Questionnaire-9 (PHQ-9), scores of 10–14 indicate moderate depression, scores of 15–19 indicate moderately severe depression, and scores of 20–27 indicate severe depression. For the Problem Gambling Severity Index (PGSI), scores of 3–7 indicate a moderate level of problems likely leading to some negative consequences, and scores of 8 or more indicate problem gambling with negative consequences and possible loss of control. F = female; M = male.

2 participants who were eligible declined to participate. In Cycle 2, 15 participants did not meet the inclusion criteria (13 = did not meet gambling criteria; 2 = had significant risk for suicide and were excluded).

### *Measures*

**DoNamic-PG Usage Data.** We automatically tracked program usage.

**Patient Health Questionnaire-9 (PHQ-9).** The PHQ-9 (Kroenke et al., 2001) is a brief self-administered nine-item questionnaire used to screen for depression. Scores can range from 0 to 27, with a higher score indicating higher depression symptom severity. This tool has been shown to be a valid and feasible measure of depression severity in both adults and adolescents (Allgaier et al., 2012). It was used as a screening tool to recruit participants with at least moderate depression.

**Problem Gambling Severity Index (PGSI).** The PGSI is a nine-item scale that is a subset of questions from the Canadian Problem Gambling Index (Ferris & Wynne, 2001). Items are answered on a 4-point scale, with higher scores indicating greater symptom severity. The PGSI has adequate reliability (Ferris & Wynne, 2001) and validity (Holtgraves, 2009). It was used as a screen to recruit participants with at least a moderate problem gambling.

**Brief Online Opinion Survey During the Testing Phase.** To gather the participants' initial impressions of the program and identify any major issue that could impede program usage, we created a brief survey that included three questions about barriers to using DoNamic-PG and satisfaction with the app (0 = *not satisfied at all*; 10 = *very satisfied*).

**Client Satisfaction Questionnaire-8 (CSQ-8).** The CSQ-8 (Larsen et al., 1979) is an eight-item measure designed to assess client satisfaction with services, as well as the client's perspective of the value of the services received. This measure has been

shown to have good internal consistency and predictive validity (Attkisson & Greenfield, 1996).

### *Procedure*

Participants were recruited through posters and brochures in various health facilities, online classified sites, hospital websites, social media, and a university research participant pool that expressly sought individuals aged 14–40 years who feel sad, down, or depressed; often feel like gambling; and are interested in trying a web-based app to improve their mood and help with gambling-related problems. Eligible participants in Cycle 1 were asked to use DoNamic-PG for 3 weeks to gather initial impressions and quickly identify any major issues that could impede usage. Eligible participants in Cycle 2 were asked to use it for 6 weeks, as we wanted to gather participants' opinions and track their level of app usage over a longer period. Seven days following the first log-in, participants were sent the brief online opinion survey. Participants who completed this survey ( $n = 4$  of 5) were entered into a draw for a chance to win a gift card. At 3 weeks (Cycle 1) or 6 weeks (Cycle 2), all participants were also asked to complete a semi-structured interview, preferably by using the online meeting software ( $n = 3$  of 5), or by using a survey version of the same questions ( $n = 1$  of 5). Following the interview, participants received a \$25.00 CAN Amazon gift card. The semi-structured interviews were coded independently by two coders (SB, AH) who used thematic analysis (Braun & Clarke, 2006) and the PACMAD model. Usage data were extracted from the DoNamic-PG website after participants in each cycle had finished the trial period.

## **Results**

### *Program Adherence*

Participant usage of the app was low in both cycles. All but one participant (Participant 3) interacted with the app for less than half of the weeks requested. As indicated by the brief online opinion survey, Participant 3, who used the app every week, indicated that his busy schedule prevented him from using the app more frequently. Participants 1, 4, and 5 did not identify anything that stopped them from using the app. (Participant 2 did not complete the survey). See Table 3 for details on their level of app usage and participation in study activities.

### *Technical Errors*

Both Cycle 1 participants chose not to complete the semi-structured interview and thus were not asked questions about technical problems. However, we encouraged users to contact us for technical support whenever needed and we did not receive any such requests. In addition, we conducted routine monitoring of the app and did not detect any technical errors within the system. All three Cycle 2 participants stated that they did not experience technical problems.

Table 3  
*Participant Usage of the App and Participation in Study Activities*

Cycle	Participant	Weeks app used/solweeks asked to use the app	Weekly mood check-ins completed/promoted	Daily gambling check-ins completed/promoted	Weekly gambling check-ins completed/ prompted	Plan for tough times completed	Topics read/topics available	Total activities scheduled	Scheduled activities reported as completed	Scheduled activities reported as incomplete	Scheduled activities with no report	Completed the brief online opinion survey	Completed the semi-structured interview	Completed the questionnaire version of the semi-structured interview
1	1	1/3	1/1	0/7	0/1	No	2/14	0	N/A	N/A	N/A	Y	N	N
	2	1/3	0/1	0/7	0/1	No	0/14	0	N/A	N/A	N/A	N	N	Y
2	3	7/7	6/7	26/42	5/7	Yes	12/14	28	10	2	16	Y	Y	N
	4	2/7	2/2	6/7	2/2	No	0/14	0	N/A	N/A	N/A	Y	Y	N
	5	1/7	1/1	0/0	1/1	No	0/14	0	N/A	N/A	N/A	Y	Y	N

*Note:* Although participants were asked to use the app for a total of 6 weeks, they were also given a baseline check-in as week zero. Thus, for Participant 1, there was a total of 7 weeks. Note also that the Client Satisfaction Questionnaire-8 was included as part of the semi-structured interview. N/A = not applicable given no activities were scheduled. Y = yes; N = no.

### ***Participant Satisfaction***

Cycle 1 participants were mildly to moderately satisfied with DoNamic-PG and its features. In the brief online opinion survey, Participant 2 rated her satisfaction as 8/10, and Participant 1 rated her satisfaction with the features of DoNamic-PG as being from 2/10 to 7/10 (median 5).

All three Cycle 2 participants had an overall positive opinion of the program during the interview (e.g., “I love the whole idea,” “It’s going to be useful and interesting,” “It will definitely help people”), rated the quality of service positively in the CSQ-8, and rated satisfaction with the app as either 5/10 (one participant) or 7/10 (two participants) in the brief online opinion survey. They liked many features of DoNamic-PG, including the planning feature (three participants), the progress features (two participants), the library feature (one participant), weekly gambling check-ins (three participants), and weekly depression check-ins (three participants). They also reported many features as being useful. All three participants reported that the planning feature was motivating and resulted in action. Planning, to do, and negative overthinking were said to be useful because they relate the activities they had planned to their mood and thoughts (three participants). Check-ins were described as providing insight (two participants). On the CSQ-8, all three participants indicated that if they had access to DoNamic-PG, they would continue to use it and they would recommend it to others.

Despite reporting an overall positive opinion, Participants 3 and 5 indicated on the CSQ-8 that they did not receive the service desired; Participant 3 hoped to have had access to a mental health professional, and Participant 5 hoped that the app would be “more fun.” Similarly, despite reporting an overall liking of the planning and the depression and gambling check-in features, all participants identified aspects of these features that they disliked or would like to see improved. Suggestions included highlighting benefits of planning activities (one participant), more personalized planning options (one participant), suggesting ways to improve mood at mood check-ins (one participant), adding notes at mood check-ins (one participant), and fewer gambling check-ins (two participants).

### *Learnability, Efficiency, and Cognitive Load*

Cycle 2 participants provided feedback on learnability, efficiency, and cognitive load. One participant indicated that he initially found it difficult to learn to use the app, whereas the others indicated that DoNamic-PG was easy to learn (two participants). One participant also indicated that using all the features of DoNamic-PG was time-consuming, whereas two indicated that it did not take too long to use. One participant reported that DoNamic-PG had a low cognitive load.

### *Changes Made After Cycles*

Following Cycle 1, a reward feature was added that gave points to participants for using the app and allowed them to set rewards for reaching a certain number of points.<sup>2</sup> Following Cycle 2, the only major change that we planned was to highlight the rationale for BA more explicitly and to present the BA rationale in the initial tour of the application. Most of the participants did not engage in the main BA aspects of the app (i.e., scheduling activities and tracking activity completion) and appeared to have a limited understanding of the concept of BA as it relates to gambling and depression. Moreover, although the rationale for BA was outlined in one of our library topics, most participants did not read this topic. Given that an understanding of therapeutic rationale predicts treatment response and engagement with depressed populations (e.g., Illardi & Craighead, 1994), making the rationale of BA more accessible is essential. Notably, as the levels of satisfaction with the app were at least moderate for all three participants in Cycle 2, and there were contradictory opinions on specific aspects to change (e.g., two participants reported that DoNamic-PG was easy to learn and did not take long to use, whereas the other participant indicated the opposite), we did not plan to make any other major changes to the app following Cycle 2.

<sup>2</sup>This addition was not triggered by the participants but planned a priori by the investigators to be added after Cycle 1 in an attempt to encourage users to adhere to the program and learn to reinforce themselves. As we wanted to test a more parsimonious version of the app given the short 3-week time frame, this was not added prior to Cycle 1.

## Discussion

In Study 2, we sought to attain a minimum acceptable level of usability and feasibility. Although Cycle 1 participants showed minimal use of the app, engagement with the app was higher in Cycle 2. Despite this, only one participant used all features of the app. Thus, it is important to note that the comments of most participants in this case series represent their perceived usability of DoNamic-PG without having used all of the features. Similar issues with participant engagement are documented in other studies on this subject (e.g., Cunningham et al., 2019).

Overall, the results of Study 2 provide preliminary evidence for the usability and feasibility of DoNamic-PG among individuals with both problem gambling and depression. As indicated by the CSQ-8, opinion surveys, and semi-structured interviews, all participants indicated at least moderate levels of satisfaction with the final version of DoNamic-PG. These results suggest that our first feasibility and usability criterion, moderate satisfaction (i.e., the PACMAD “satisfaction” attribute), was met across the two cycles. Similarly, our second feasibility and usability criterion, lack of technical issues (i.e., PACMAD error attribute), was also met; participants in the two cycles did not report any major technical issues with the program. In contrast, our third and fourth feasibility criteria (i.e., PACMAD effectiveness attributes) were only partially met in Cycle 2. In Cycle 2, one of the three participants read at least 30% of the library topics, but the other two did not read a single library topic. Similarly, one of the three participants in Cycle 2 used the planned activities feature. Because of conflicting participant reports, we are unable to comment on the PACMAD attributes of learnability, cognitive load, and efficiency; these attributes remain to be addressed more fully in future research. Although we met the minimal recommended number of participants for a usability study (Nielsen, 2012), these results suggest that we did not include a sufficient number to reach saturation.

Overall, it appears that DoNamic-PG is acceptable and usable and that our integrative approach to comorbid problem gambling and depression concerns shows promise. In terms of feasibility, additional testing is required. Engagement with the app was low, but it is not clear whether this reflects problems with feasibility or participant willingness to engage. Despite trying to engage this community through many different sources over several months, we had a low recruitment rate. It is likely that the low levels of help-seeking behaviour in individuals with problem gambling (e.g., Suurvali et al., 2008) contributed to our low recruitment rate. Moreover, we sought to recruit individuals with comorbid problem gambling and depression, which may have compounded our recruitment difficulties; individuals with this comorbidity may be at a more reduced likelihood to seek help because of symptoms of depression (e.g., apathy). Furthermore, for safety reasons, we required an emergency contact to be provided in case high suicide risk was indicated on the PHQ-9. It is possible that this dissuaded some individuals from participating.

In order to develop self-guided interventions that are able to increase access to care, we must first find ways to reach this population, especially those who are adolescents and emerging adults, as our participants were at the upper end of our intended age range. It may be helpful to recruit directly from gambling facilities (e.g., casinos) or cultivate relationships with gambling help lines and child/adult mental health and addiction services. Such recruitment strategies would provide better access to individuals who engage in problem gambling or who are interested in seeking treatment. Moreover, as most of our participants were recruited through Facebook or institutions or organizations (e.g., existing gambling research lists), similar avenues may be useful in the future. Once we are able to reach this population and highlight the BA portions of the app, we hope to run further feasibility testing, followed by trials to determine the efficacy and then effectiveness of DoNamic-PG. Eventually, DoNamic-PG could be offered as an intervention to adolescents and emerging adults following school-based screenings in an effort to better reach this high-risk age group.

### Conclusion

We sought to adapt DoNamic, a web-based BA app originally designed for participants with depression, for participants who also have comorbid problem gambling. This adaptation was a two-step process involving an in-laboratory usability case study with an individual with problem gambling followed by a clinical case series feasibility study with individuals with comorbid problem gambling and depression. Overall, our research highlights how an existing online application can be adapted to treat a comorbidity and outlines the steps involved in this process. DoNamic-PG represents the first self-guided online application to provide the opportunity to target both problem gambling and depression in an integrated fashion. It has the potential to bring this integrated approach to life and has adequate usability and acceptability; however, before efficacy of this intervention can be tested, participant engagement strategies must be developed, changes to the app (e.g., promoting BA aspects of the app) must be made, and additional feasibility testing must be completed.

### References

- Allgaier, A. K., Pietsch, K., Frühe, B., Sigl-Glöckner, J., & Schulte-Körne, G. (2012). Screening for depression in adolescents: Validity of the patient health questionnaire in pediatric care. *Depression and Anxiety, 29*(10), 906–913. <https://doi.org/10.1002/da.21971>
- Attkisson, C. C., & Greenfield, T. K. (1995). The Client Satisfaction Questionnaire (CSQ) Scales. In L.L. Sederer & B. Dickey (Eds.) *Outcome assessment in clinical practice* (pp. 120-127. Williams & Wilkins.

- Bastien, J. C. (2010). Usability testing: A review of some methodological and technical aspects of the method. *International Journal of Medical Informatics*, 79(4), e18–e23. <https://doi.org/10.1016/j.ijmedinf.2008.12.004>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Bücker, L., Bierbrodt, J., Hand, I., Wittekind, C., & Moritz, S. (2018). Effects of a depression-focused internet intervention in slot machine gamblers: A randomized controlled trial. *PloS One*, 13(6), e0198859. <https://doi.org/10.1371/journal.pone.0198859>
- Cowie, M. E., Huguet, A., Moore, C., McGrath, P. J., Rao, S., Wozney, L., Kits, O., & Stewart, S. H. (2019). Internet-based behavioral activation program for depression and problem gambling: Lessons learned from stakeholder interviews. *International Journal of Mental Health and Addiction*, 1, 1–16. <https://doi.org/10.1007/s11469-019-00094-1>
- Cowlshaw, S., Merkouris, S., Dowling, N., Anderson, C., Jackson, A., & Thomas, S. (2012). Psychological therapies for pathological and problem gambling. *Cochrane Database of Systematic Reviews*, 11, 1–91. <https://doi.org/10.1002/14651858.CD008937.pub2>
- Cuijpers, P., van Straten, A., & Warmerdam, L. (2007). Behavioral activation treatments of depression: A meta-analysis. *Clinical Psychology Review*, 27, 318 – 326. <https://doi.org/10.1016/j.cpr.2006.11.001>
- Cunningham, J. A., Hodgins, D. C., Mackenzie, C. S., Godinho, A., Schell, C., Kushnir, V., & Hendershot, C. S. (2019). Randomized controlled trial of an Internet intervention for problem gambling provided with or without access to an Internet intervention for co-occurring mental health distress. *Internet Interventions*, 17, 100239. <https://doi.org/10.1016/j.invent.2019.100239>
- Dowling, N., Jackson, A. C., & Thomas, S. A. (2008). Behavioral interventions in the treatment of pathological gambling: A review of activity scheduling and desensitization. *International Journal of Behavioral Consultation and Therapy*, 4(2), 172–187. <http://dx.doi.org/10.1037/h0100841>
- Dussault, F., Brendgen, M., Vitaro, F., Wanner, B., & Tremblay, R. E. (2011). Longitudinal links between impulsivity, gambling problems, and depressive symptoms: A transactional model from adolescence to early adulthood. *Journal of Child Psychology and Psychiatry*, 52(2), 130–138. <https://doi.org/10.1111/j.1469-7610.2010.02313.x>
- Ferris J, & Wynne H. (2001). *The Canadian problem gambling index: Final report*. Canadian Centre on Substance Abuse.



Fortune, E. E., & Goodie, A. S. (2012). Cognitive distortions as a component and treatment focus of pathological gambling: A review. *Psychology of Addictive Behaviors, 26*(2), 298–310. <https://doi.org/10.1037/a0026422>

Gainsbury, S., & Blaszczynski, A. (2011). Online self-guided interventions for the treatment of problem gambling. *International Gambling Studies, 11*(3), 289–308. <https://doi.org/10.1080/14459795.2011.617764>

Gainsbury, S., Hing, N., & Suhonen, N. (2014). Professional help-seeking for gambling problems: Awareness, barriers, and motivators for treatment. *Journal of Gambling Studies, 30*(2), 503–519. <https://doi.org/10.1007/s10899-013-9373-x>

Gerstein, D. R., Murphy, S. A., Toce, M. T., Hoffmann, J., Palmer, A., Johnson, R. A., Larison, C., Chuchro, L., Buie T., Engelman, L., Volberg, R., Harwood, A., Tucker, A., Christiansen, E., Cummings, W., & Sinclair, S. (1999). *Gambling impact and behavior study: Report to the National Gambling Impact Study Commission*. Chicago: National Opinion Research Center at the University of Chicago.

Harrison, R., Flood, D., & Duce, D. (2013). Usability of mobile applications: Literature review and rationale for a new usability model. *Journal of Interaction Science, 1*(1), 1–16. <https://doi.org/10.1186/2194-0827-1-1>

Hing, N., Nuske, E., & Gainsbury, S. (2012). *Gamblers at-risk and their help-seeking behavior*. Report for Gambling Research Australia, Centre for Gambling Education & Research. Southern Cross University.

Hodgins, D. C., Cunningham, J. A., Murray, R., & Hagopian, S. (2019). Online self-directed interventions for gambling disorder: Randomized controlled trial. *Journal of Gambling Studies, 35*(2), 635–651. <https://doi.org/10.1007/s10899-019-09830-7>

Hodgins, D. C., Fick, G. H., Murray, R., & Cunningham, J. A. (2013). Internet-based interventions for disordered gamblers: Study protocol for a randomized controlled trial of online self-directed cognitive-behavioural motivational therapy. *BMC Public Health, 13*(1), 10–18. <https://doi.org/10.1186/1471-2458-13-10>

Hodgins, D. C., Stea, J. N., & Grant, J. E. (2011). Gambling disorders. *The Lancet, 378*(9806), 1874–1884. [https://doi.org/10.1016/S0140-6736\(10\)62185-X](https://doi.org/10.1016/S0140-6736(10)62185-X)

Holtgraves, T. (2009). Evaluating the Problem Gambling Severity Index. *Journal of Gambling Studies, 25*, 105–120. <https://doi.org/10.1007/s10899-008-9107-7>

Huang, J.-H., & Boyer, R. (2007). Epidemiology of youth gambling problems in Canada: A national prevalence study. *Canadian Journal of Psychiatry, 52*(10), 657–665. <https://doi.org/10.1177/070674370705201006>

- Ilardi, S. S., & Craighead, W. E. (1994). The role of nonspecific factors in cognitive-behavior therapy for depression. *Clinical Psychology: Science and Practice*, 1(2), 138-155. <https://doi.org/10.1111/j.1468-2850.1994.tb00016.x>
- Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16(9), 606–613. <https://doi.org/10.1046/j.1525-1497.2001.016009606.x>
- Ladouceur, R., & Lachance, S. (2007). *Overcoming pathological gambling*. Oxford University Press.
- Larsen, D. L., Attkisson, C. C., Hargreaves, W. A., & Nguyen, T. D. (1979). Assessment of client/patient satisfaction: Development of a general scale. *Evaluation and Program Planning*, 2(3), 197–207. [https://doi.org/10.1016/0149-7189\(79\)90094-6](https://doi.org/10.1016/0149-7189(79)90094-6)
- Linnet, J., Mensink, M. J., de Neergaard Bonde, J., & Winterdahl, M. (2017). Treatment of gambling disorder patients with comorbid depression. *Acta Neuropsychiatrica*, 29(6), 356–362. <https://doi.org/10.1017/neu.2017.5>
- Melville, K. M., Casey, L. M., & Kavanagh, D. J. (2007). Psychological treatment dropout among pathological gamblers. *Clinical Psychology Review*, 27(8), 944–958. <https://doi.org/10.1016/j.cpr.2007.02.004>
- Merkouris, S. S., Thomas, S. A., Browning, C. J., & Dowling, N. A. (2016). Predictors of outcomes of psychological treatments for disordered gambling: A systematic review. *Clinical Psychology Review*, 48, 7–31. <https://doi.org/10.1016/j.cpr.2016.06.004>
- Nielsen, J. (1994a). Enhancing the explanatory power of usability heuristics. In *CHI '94: Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 152–158). ACM Press.
- Nielsen, J. (1994b). Estimating the number of subjects needed for a thinking aloud test. *International Journal of Human-Computer Studies*, 41(3), 385–397. <https://doi.org/10.1006/ijhc.1994.1065>
- Nielsen, J. (2012, June 3). *How many test users in a usability study?* <https://www.nngroup.com/articles/how-many-test-users/#:~:text=If%20you%20want%20a%20single,users%20in%20a%20usability%20study.>
- Nielsen, J., & Molich, R. (1989). Teaching user interface design based on usability engineering. *ACM SIGCHI Bulletin*, 21(1), 45–48. <https://doi.org/10.1145/67880.67885>
- Nower, L., Gupta, R., Blaszczyński, A., & Derevensky, J. (2004). Suicidality and depression among youth gamblers: A preliminary examination of three studies.

*International Gambling Studies*, 4(1), 69–80. <https://doi.org/10.1080/1445979042000224412>

Patton, M. Q. (2008). *Utilization-focused evaluation*. Sage Publications.

Petry, N. M., Ginley, M. K., & Rash, C. J. (2017). A systematic review of treatments for problem gambling. *Psychology of Addictive Behaviors*, 31(8), 951–961. <https://psycnet.apa.org/doi/10.1037/adb0000290>

Quigley, L., Yakovenko, I., Hodgins, D. C., Dobson, K. S., el-Guebaly, N., Casey, D. M., Currie, S. R., Smith, G. J., Williams, R. J., & Schopflocher, D. P. (2015). Comorbid problem gambling and major depression in a community sample. *Journal of Gambling Studies*, 31(4), 1135–1152. <https://doi.org/10.1007/s10899-014-9488-8>

Ranta, J., Bellringer, M., Garrett, N., & Abbott, M. (2019). Can a brief telephone intervention for problem gambling help to reduce co-existing depression?: A three-year prospective study in New Zealand. *Journal of Gambling Studies*, 35(2), 617–633. <https://doi.org/10.1007/s10899-018-9783-x>

Smith, D. P., Battersby, M. W., Harvey, P. W., Pols, R. G., & Ladouceur, R. (2015). Cognitive versus exposure therapy for problem gambling: Randomised controlled trial. *Behaviour Research and Therapy*, 69, 100–110. <https://doi.org/10.1016/j.brat.2015.04.008>

Suurvali, H., Hodgins, D., Toneatto, T., & Cunningham, J. (2008). Treatment seeking among Ontario problem gamblers: Results of a population survey. *Psychiatric Services*, 59(11), 1343–1346. <https://doi.org/10.1176/ps.2008.59.11.1343>

Toce-Gerstein, M., Gerstein, D.R., & Volberg, R.A. (2009). The NODS–CLiP: A rapid screen for adult pathological and problem gambling. *Journal of Gambling Studies*, 25(4), 541–555. <https://doi.org/10.1007/s10899-009-9135-y>

van der Maas, M., Shi, J., Elton-Marshall, T., Hodgins, D. C., Sanchez, S., Lobo, D. S., Hagopian, S., & Turner, N. E. (2019). Internet-based interventions for problem gambling: Scoping review. *JMIR Mental Health*, 6(1), e65. <https://doi.org/10.2196/mental.9419>

Virzi, R. A. (1992). Refining the test phase of usability evaluation: How many subjects is enough? *Human Factors*, 34(4), 457–468. <https://doi.org/10.1177/001872089203400407>

Weinstock, J., Whelan, J. P., & Meyers, A. W. (2004). Behavioral assessment of gambling: An application of the Timeline Followback method. *Psychological Assessment*, 16(1), 72–80. <https://psycnet.apa.org/doi/10.1037/1040-3590.16.1.72>

Williams, R. J., & Volberg, R. A. (2013). *Gambling and problem gambling in Ontario*. Ontario Problem Gambling Research Centre & The Ontario Ministry of Health and Long-Term Care.

Yakovenko, I., Quigley, L., Hemmelgarn, B. R., Hodgins, D. C., & Ronksley, P. (2015). The efficacy of motivational interviewing for disordered gambling: Systematic review and meta-analysis. *Addictive Behaviors*, *43*, 72–82. <https://doi.org/10.1016/j.addbeh.2014.12.011>

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