Original Paper

An App-Delivered Just-in-Time Adaptive Intervention for Gambling in Adults (GamblingLess: In-The-Moment): Microrandomized Optimization Trial and Single-Arm Outcome Evaluation

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Abstract

Background: GamblingLess: In-The-Moment is an app-based just-in-time adaptive intervention (JITAI), informed by the Dynamic Model of Relapse, that delivers tailored interventions during moments of cognitive vulnerability to people seeking to reduce or quit gambling. It aims to reduce gambling symptom severity through short-term reductions in gambling episodes (primary proximal outcome) by improving craving intensity, self-efficacy, or positive outcome expectancies (secondary proximal outcomes).

Objective: This study aimed to inform the optimization of GamblingLess: In-The-Moment by using a microrandomized trial (MRT) to explore whether tailored interventions, compared with no intervention, reduced subsequent gambling episodes, and improved subsequent craving intensity, self-efficacy, and positive outcome expectancies. A concurrent single-arm outcome evaluation assessed changes in gambling symptom severity (primary distal outcome) and gambling frequency, expenditure, craving severity, self-efficacy, and positive outcome expectancies (secondary distal outcomes) over 6 months.

Methods: Australian adults seeking to reduce or quit gambling were recruited using online convenience sampling. In the fully automated, blinded 28-day MRT, participants reporting high craving intensity, low self-efficacy, and/or high positive outcome expectancies in ecological momentary assessments (EMAs), delivered by push notification 3 times daily, were randomized to a tailored intervention or a no-intervention control. Three modules (Curbing Cravings, Tackling Triggers, and Exploring Expectancies) targeted these cognitive processes; control messages comprised brief encouragement without intervention content.

Results: Among 192 participants completing at least one EMA (men: n=127, 66.2%; median age 35, IQR 24-44 years), 5116 EMAs were completed (31.7% compliance). In the MRT, the tailored intervention was no more effective than the control condition in reducing subsequent gambling episodes (odds ratio 1.05, 95% CI 0.79-1.38; P=.74) or associated expenditure, or in improving secondary proximal outcomes. No intervention module demonstrated clear evidence of reducing gambling episodes or associated expenditure, although Tackling Triggers and Exploring Expectancies produced small improvements in their target processes (self-efficacy and positive outcome expectancies, respectively). Sensitivity analyses, including adjustment for other help-seeking, demonstrated similar findings. Supplementary post hoc analyses not fully preserving decision-point randomization suggested small daily improvement in craving intensity and self-efficacy, and medium-to-large immediate improvements in all secondary proximal outcomes after intervention activities. The single-arm evaluation revealed large improvements in gambling symptom severity at postintervention (b=–11.30, 95% CI –12.96 to –9.64; d_z=–0.96; P<.001)

and 6 months (b=−12.33, 95% CI −14.01 to −10.66; d_z=−1.04; P<.001), with 64.6% (104/161) and 66.5% (105/158) of participants, respectively, showing clinically significant recovery or improvement. Small-to-large improvements were also observed across all secondary distal outcomes at both time points.

Conclusions: This study is the first to test a theoretically informed multimodule JITAI targeting dynamic cognitive relapse processes. The findings provide important guidance for optimizing gambling JITAIs and other scalable mobile health interventions delivered during moments of vulnerability in real-world settings, alongside promising distal improvements over an extended follow-up period.

Trial Registration: Australian New Zealand Clinical Trials Registry ACTRN12622000490774; https://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?id=380757&isClinicalTrial=False

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Introduction

Background

Gambling disorder, which is classified as an addiction and related disorder in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision* (DSM-5-TR) [1], is characterized by persistent and recurrent problematic gambling behavior leading to clinically significant impairment or distress in a 12-month period. According to public health perspectives, problem gambling is a term used to describe gambling behavior characterized by difficulties limiting the time and money spent gambling, which adversely affects the person who gambles, those close to them, and the broader community [2]. This perspective views gambling problems as occurring across a continuum of risk, including at-risk gambling (ie, low- and moderate-risk gambling) and problem gambling. Internationally, it has been estimated that 1.3% of the global adult population report past-year problem gambling or gambling disorder and that an additional 2.4% report moderate-risk or at-risk gambling [3]. In Australia, national prevalence rates estimate that 0.4% to 1.2% of adults report problem gambling and an additional 4.9% to 11.4% report moderate-risk or low-risk gambling [4-6]. In addition, a high burden of harm is associated with gambling problems, which encompasses harms to relationships, finances, health, well-being, work or academic productivity, cultural and religious connection, and criminal issues [7].

Precipitants of Gambling Behavior

Similar to other addictive behaviors, gambling problems can be conceptualized using the Dynamic Model of Relapse [8], which proposes that tonic (stable) and phasic (transient) precipitating factors dynamically interact to activate a lapse or relapse. Tonic processes are distal risk factors that are presumed to confer chronic vulnerability to relapse (eg, years of problem behavior and social support), whereas phasic responses (eg, cravings, affective states, and coping responses) are presumed to fluctuate across time and context to initiate a lapse. The model also posits that a lapse can influence these same factors to create a feedback loop or cycle of gambling behavior. These processes occur in a complex, nonlinear, and dynamic manner, which can be difficult to capture using traditional research designs.

The Dynamic Model of Relapse posits that transient changes in several cognitive processes, including gambling cravings, self-efficacy, and positive outcome expectancies, are phasic precipitating factors that interact with tonic precipitating factors to influence the probability of lapse or relapse [8]. Gambling cravings can be defined as a multifaceted desire to gamble, which may manifest as mental images, thoughts, and physiological sensations [9,10]. Self-efficacy, which also features in social cognitive theory [11], can be defined as confidence to resist gambling, particularly in high-risk situations, such as financial pressure, unpleasant emotions, social pressure to gamble, testing control over gambling, and conflict with others [12]. Finally, positive outcome expectancies are expectations or anticipation of a positive outcome from gambling, such as financial gain, excitement, or escape [13]. Although there is considerable cross-sectional evidence supporting the associations between these cognitive processes and gambling symptom severity or relapse [14], there is also emerging evidence that they constitute phasic precipitants of gambling behavior and/or interact with tonic factors or other phasic factors to predict subsequent gambling behavior [15-17].

Just-In-Time Adaptive Interventions

Given the fluctuating nature of these phasic precipitants, interventions that use a dynamic and tailored approach are needed to target gambling cravings, self-efficacy, and positive outcome expectancies as they occur in real time and real life, such as just-in-time adaptive interventions (JITAIs) [14]. JITAIs are tailored mobile health (mHealth) interventions that continuously monitor real-time changes in internal states and environmental factors to deliver the right type and amount of support in times of need to prevent negative health outcomes and promote positive health outcomes [18-22]. This information is collected using mobile and wireless technologies, such as smartphone-embedded or wearable sensors, or via ecological momentary assessments (EMAs) [18-20,22], which involve repeated smartphone-delivered self-report assessments across time and contexts [18,20,22]. JITAIs deliver interventions on a “push” basis, in which the

intervention protocol uses a computer algorithm to determine the type, timing, or amount of support needed, rather than a "pull" basis, where the user self-initiates the intervention on demand [21,22]. This approach facilitates the delivery of an evidence-based intervention in real time and real life, which lends itself to the provision of highly accessible, convenient, anonymous, immediate, cost-effective, and low-burden support [18,21,23-26]. This type of support is particularly important for people experiencing harm from their gambling, given that only a small proportion of them seek help [27] due to a range of personal, resource, and geographical barriers [28,29].

Despite these advantages, only a small number of JITAIs targeting gambling behavior have been developed, only 1 of which has been evaluated. Of the 3 JITAIs yet to be comprehensively evaluated, 2 (SPGeTTI [30] and Don't Go There [31]) use geolocation sensors to continuously collect data that can be used to alert users when they enter or approach gambling venues. These 2 JITAIs also provide on-demand self-monitoring tools, tips, help service contacts [30], and the opportunity to share user data with an elected health professional [31]. In contrast, the other JITAI yet to be trialed (Jeu-contrôle [32]) uses self-monitoring and personalized feedback to support consumers to adhere to their gambling time and expenditure limits.

To date, the only formally trialed gambling JITAI is GamblingLess: Curb Your Urge, which provides intervention activities for gambling craving management [33,34]. This JITAI was developed as an app-delivered offshoot of the online, evidence-based GamblingLess program [35,36]. This JITAI was positively evaluated by gambling clinicians, researchers, and end users in a usability trial [34]. There is also evidence from a single-arm acceptability and feasibility trial with 21 participants to support its preliminary effectiveness [33]. Specifically, the findings of this trial revealed a significant improvement in gambling episodes, craving occurrences, and craving intensity during the intervention period, with no intervention-related harms identified. There were also medium-to-large reductions in gambling symptom severity, gambling behavior, cravings, and self-efficacy at the postintervention and 1-month follow-up evaluations, such that 48% (10/21) of the participants reported recovery or improvement in gambling symptom severity at the follow-up evaluation. To build on these promising results, the current research team developed a more comprehensive JITAI, named GamblingLess: In-The-Moment [14,37]. This JITAI redresses the lack of empirically supported app-delivered gambling interventions and expands the growing suite of theoretically informed and evidence-based digital interventions derived from the GamblingLess program [14,33-42]. However, its optimal delivery and preliminary effectiveness have not yet been evaluated, underscoring the need for both optimization-focused and preliminary outcome evaluation research to inform the development of effective, efficient, and scalable gambling JITAIs.

The Development of GamblingLess: In-The-Moment

Theoretically informed by the Dynamic Model of Relapse, GamblingLess: In-The-Moment is an app-delivered JITAI for gambling that is freely available for download from the App Store or Google Play in Australia. Operationalizing the JITAI design framework of Nahum-Shani et al [19,20], this JITAI uses decision rules that specify that intervention options, which comprise 3 modules to address gambling cravings, self-efficacy, or positive outcome expectancies, are delivered to users when they are in a state of receptivity (available for treatment) and report a state of cognitive vulnerability characterized by high craving intensity, low self-efficacy, or positive outcome expectancies (tailoring variables) in 3 EMAs per day across a 28-day period (decision points). GamblingLess: In-The-Moment aims to reduce gambling symptom severity (primary distal outcome) and improve craving severity, self-efficacy, and positive outcome expectancies (secondary distal outcomes) in the long term. It aims to achieve these improvements by reducing the likelihood of gambling episodes (primary proximal outcome) and improving craving intensity, self-efficacy, and positive outcome expectancies (secondary proximal outcomes) in the moment. The program is intended for use as a standalone or adjunctive intervention for active gambling among people who want to quit or reduce their gambling or for relapse prevention. The development of GamblingLess: In-The-Moment was guided by a multidisciplinary team, including experts in behavior change from clinical and social psychology, implementation science, biostatistics and research design, and technology development, aligning with best practice recommendations for creating digital interventions [20]. A detailed outline of the intervention development process has been published elsewhere [14,37], and detailed descriptions of the intervention activities, EMA items, and intervention flow are provided in Multimedia Appendices 1-3. Initial usability testing of GamblingLess: In-The-Moment with 13 key stakeholders (clinicians, researchers, and consumers) produced promising results, whereby they endorsed the program's acceptability in terms of its engagement, functionality, aesthetics, information, quality, perceived impact, intervention content, ease of use, and EMA relevance [14].

Study Aims

This study aimed to build on the usability testing results by exploring the value of delivering a tailored intervention via GamblingLess: In-The-Moment at a time of cognitive vulnerability to people who want to quit or reduce their gambling, with a view to informing the optimization of the intervention to strengthen its effectiveness, efficiency, and scalability in future iterations [22,43]. The study therefore had two complementary components: (1) a 28-day microrandomized trial (MRT) designed to inform the optimization of the JITAI by estimating the proximal effects of intervention delivery at eligible decision points and (2) a single-arm outcome evaluation designed to provide a preliminary

evaluation of changes in distal gambling and cognitive processes over a 6-month period.

An MRT, a variant of a sequential factorial design in which each participant acts as their own control, was used to inform the optimization of GamblingLess: In-The-Moment [18,22]. This optimization component was designed to determine whether, when, and for whom tailored intervention content should be delivered within the JITAI. In this MRT, participants who were eligible to receive a tailored intervention because they reported high craving intensity, low self-efficacy, or high positive outcome expectancies were randomly assigned to either a tailored intervention condition or a no-intervention control condition at each EMA over a 28-day period. Consistent with recommendations for optimization-focused MRTs, a no-intervention control condition was used to estimate the proximal causal effect of delivering a tailored intervention relative to not delivering intervention content at an eligible decision point.

The primary aim of the MRT was to explore whether, compared with no intervention, tailored intervention delivery reduced the probability of subsequent gambling episodes (primary proximal outcome) and improved subsequent craving intensity, self-efficacy, and positive outcome expectancies (secondary proximal outcomes). Gambling episodes were selected as the primary proximal outcome because they represent the immediate behavioral lapse or relapse outcome that the JITAI is ultimately designed to prevent, whereas craving intensity, self-efficacy, and positive outcome expectancies were specified as secondary proximal outcomes because they represent the modifiable cognitive states through which reductions in gambling episodes were expected to occur [37]. It was hypothesized that the delivery of a tailored intervention would be more effective than no intervention in reducing the probability of a gambling episode and improving craving intensity, self-efficacy, and positive outcome expectancies by the subsequent EMA. Secondary exploratory research questions of the MRT were as follows: (1) *Which type of intervention option is most beneficial at a time of cognitive vulnerability?* Is the delivery of one intervention option (targeting cravings, self-efficacy, or positive outcome expectancies) more likely to reduce the probability of a subsequent gambling episode than the other intervention options? (2) *Under what conditions is the delivery of an intervention option most beneficial?* How do time-variant (EMA) factors (time of day, time of week, craving intensity, self-efficacy, positive outcome expectancies, psychological distress, impulsivity, subjective alcohol intoxication, readiness to change, gambling availability [financial and location], and social context) and time-invariant (preintervention survey) factors (gambling symptom severity, gambling frequency, gambling expenditure, gender, and age) influence the intervention effect on the probability of a subsequent gambling episode? (3) *How do the proximal effects of intervention options change over time as the treatment progresses?* How does the effect of a tailored intervention on the probability of a subsequent gambling episode change over the course of the 28-day MRT?

The MRT was conducted alongside a single-arm outcome evaluation to provide a preliminary assessment of changes in the primary distal outcome (gambling symptom severity) and secondary distal outcomes (gambling frequency, gambling expenditure, craving severity, self-efficacy, and positive outcome expectancies) at postintervention and 6-month follow-up evaluations. It was hypothesized that there would be significant improvements in these distal outcomes across both time points. A secondary exploratory aim of the single-arm outcome evaluation was to identify predictors of change in gambling symptom severity (primary distal outcome) at these time points. This single-arm component was intended to evaluate preliminary effectiveness rather than a controlled test of intervention efficacy.

Methods

Preregistration and Protocol Information

This study was prospectively registered with the Australian New Zealand Clinical Trials Registry on March 28, 2022 (ACTRN12622000490774). There is a published protocol and statistical analysis plan [14] and a review that describes the decisions, methods, and tools used to design the JITAI [37]. Deviations from this protocol included (1) an eligibility criterion was changed from current Australian or New Zealand residence to current Australian residence due to the successful recruitment of participants in Australia; (2) use of mixed-effect regression models instead of generalized estimating equation (GEE) models for the single-arm outcome evaluation analyses, which allowed analyses to account for missing data using a maximum likelihood approach; and (3) individual-level clinically significant change for the single-arm outcome evaluation analyses was calculated only for the primary distal outcome (gambling symptom severity) as this was the only outcome measure with a reliable cutoff distinguishing "functional" from "dysfunctional" ranges. Given that the MRT component was conducted to inform the optimization of GamblingLess: In-The-Moment, a series of post hoc supplementary analyses was conducted to enhance our understanding of the findings from the primary analyses, as previously outlined [42].

Ethical Considerations

Ethics approval was obtained from the Deakin University Human Research Ethics Committee (approval 2020-304). All participants provided informed consent before completing any study procedures. During app onboarding, participants were required to read the plain language statement and agree to participate in the trial, as well as agree to the app platform's Terms of Use and Privacy Policy. Participants also provided informed consent via a tick box before completing the postintervention and 6-month follow-up surveys in Qualtrics (Qualtrics LLC).

Participant privacy and confidentiality were protected by storing study data securely and analyzing data in deidentified form. Identifying information, including contact details collected for account verification, follow-up contact, and reimbursement purposes, was accessible only to authorized

members of the research team and managed in accordance with institutional ethics requirements. No images or supplementary materials include identifiable participant information.

Participants were reimbursed in e-gift vouchers at 2 points during the study (after the 28-day MRT and 6-month follow-up evaluation) using the following schedule: Aus $1 (US $0.70) per EMA completed and an Aus $20 (US $14) bonus for completing more than 75% of the EMAs (to a maximum of Aus $100 [US $70]); Aus $50 (US $35) for completing the postintervention survey; Aus $50 (US $35) for completing the 6-month follow-up survey; and Aus $30 (US $21) if an optional semistructured interview to evaluate the acceptability of the JITAI was completed (reported elsewhere [44]).

Study Design

This study involved 2 complementary evaluation components: a 28-day MRT designed to inform the optimization of GamblingLess: In-The-Moment and a single-arm outcome evaluation designed to provide a preliminary assessment of primary and secondary distal outcomes from preintervention to postintervention and 6-month follow-up evaluations. To maintain the integrity of the MRT, participants were only able to receive an intervention on a "push" basis across the 28-day period. During the 6-month follow-up period, participants could only use the app on a "pull" basis, in which no notifications were delivered and no microrandomization protocol was used, but tailored intervention content could be accessed via participant-initiated EMAs on demand. The MRT and single-arm outcome evaluation were also supplemented by an acceptability and engagement evaluation (reported elsewhere [44]), which included nonsystematic assessment of intervention-related harms and unintended effects, predominantly through semistructured interviews. There was no patient or public involvement in the design, conduct, and reporting of this trial. No modifications were made to the trial outcomes, intervention content, delivery procedures, or decision rules during the trial, and there were no critical secular events (eg, significant changes in internet resources available or changes in computer hardware or internet delivery resources). Reporting of the MRT is consistent with the CONSORT (Consolidated Standards of Reporting Trials) [45] and CONSORT-EHEALTH (Consolidated Standards of Reporting Trials of Electronic and Mobile Health Applications and Online Telehealth) guidelines [46]. Intervention reporting was additionally guided by the TIDieR (Template for Intervention Description and Replication) checklist; completed CONSORT, CONSORT-EHEALTH, and TIDieR checklists are provided in Checklists 1-3.

Participants

Participants were recruited across Australia using convenience sampling methods, including advertising on general and gambling-related websites, social media platforms, and online forums. Recruitment took place from March 28 to December 15, 2022. Participants were eligible to participate if they (1) currently resided in Australia, (2) were aged ≥18 years, (3) were willing to install the app that hosted the JITAI on an internet-enabled smartphone, (4) were willing to receive notifications from this app, (5) were fluent in English, and (6) wanted support for their own gambling. The intervention in this pragmatic trial was available to any interested person who gambled, regardless of their gambling symptom severity, treatment goal (abstinence or nonabstinence), or engagement in other treatment [47]. This project aimed to recruit a sample of 200 participants (see sample size calculation [14]). No interim analyses or stopping guidelines were specified, and the trial ended when the achieved sample size well exceeded the target sample size.

Onboarding

Study recruitment materials called for people who wanted to gamble less using support whenever and wherever they needed it most. They included information relating to the purpose of the app, the amount of reimbursement available, the eligibility criteria, and a brief description of what was involved when participating in the trial. These materials directed interested individuals to download the free, publicly available GamblingLess: In-The-Moment app from the App Store or Google Play in Australia. The recruitment materials and the app's landing page included logos of affiliated institutions, including Deakin University, GambleAware, Auckland University of Technology, Turning Point, Cogniss, and the funding body (New South Wales Government). The plain language statement and an "About the app" quick link on the app's home page provided descriptions of affiliated institutions and a brief description of the app. The onboarding process required participants to provide explicit consent to participate in the trial and agreement to the platform terms of use and privacy policy. By accepting the terms and privacy policy, participants confirmed that they read and understood the plain language statement, were voluntarily taking part in the trial as outlined in the statement, met the eligibility requirements, and were aware of their privacy rights. Participants then created an account by providing the requisite details (username, email address, password, and display name). Account verification then occurred via email (with plain language statement attached). After reading a brief description of the app and instructions on how to use the app, participants indicated their stakeholder status (gambler, family member, or other stakeholder), completed the 10-minute preintervention survey, provided their contact mobile phone number, and indicated their interest in participating in future research. Participants were then encouraged to complete their first EMA in the app.

EMA Protocol

During the 28-day MRT, participants were prompted via app notifications to complete 3 EMAs per day (decision points), which were administered semirandomly in the morning (8:30 AM to 11 AM), afternoon (1 PM to 3:30 PM), and evening (5:30 PM to 8 PM). To accommodate participant unavailability, participants could complete each EMA (1 min to complete) within 2 hours of receiving a notification via an auto-launch from the notification or the app itself via a "Check-In Here" quick link. EMAs comprised 10 multiple-choice self-report items (Multimedia Appendix 1), including 3 items to measure craving

intensity, self-efficacy, and positive outcome expectancies (tailoring variables and secondary proximal outcomes), and 7 items measuring other momentary internal states and ecological contexts to explore the conditions under which the intervention options were most beneficial: psychological distress, readiness to change, subjective alcohol intoxication, impulsivity, social context, financial gambling availability, and location gambling availability. Each EMA also incorporated an event record, in which participants recorded gambling episodes (primary proximal outcome) and associated expenditure. All items were rated on a variable 5-point scale, except those measuring social context (3-point scale), gambling episodes (yes or no), and gambling expenditure (open text). In the absence of validated instruments for use in online EMA studies, all EMA items used in this study were derived from previous EMA research [14]. The data from the 3 tailoring variables were used to specify the type, timing, and amount of support that each participant was eligible to receive. A score of more than 0 on any of these 3 items in an EMA conferred eligibility for the delivery of the corresponding intervention option. At each decision point, participants who were not eligible for any intervention received a brief encouraging message, and their interaction with the app ended.

Intervention Features

Intervention Options

GamblingLess: In-The-Moment comprised 3 tailored intervention options designed to target cognitive processes that represent a state of cognitive vulnerability: (1) the Curbing Cravings module, which included 10 craving management activities (eg, distraction and urge surfing); (2) the Tackling Triggers module, which included 25 activities to improve self-efficacy to resist gambling (eg, goal setting and behavioral substitution) evenly split across 5 types of high-risk situations (financial pressure, unpleasant emotions, social pressure to gamble, testing control over gambling, and conflict with others); and (3) the Exploring Expectancies module, which included 18 activities to redress positive outcome expectancies (eg, expectancy challenging and cognitive defusion) evenly split across 3 types of expectancies (excitement, escape, and money). For more information about each of these intervention options, see the study protocol by Dowling et al [14]. Each module had its own dashboard, in which participants were presented with a list of intervention activities from which to choose. Most activities were cognitive, behavioral, or third-wave strategies that took 5 minutes or less to complete. They were interactive and gamified through the use of audio and/or video components, personalized feedback, quizzes, or embedded questions. Icons were presented alongside each activity in the dashboard to indicate its form of gamification (eg, a headphone icon indicated audio components) to enable participants to select the most suitable activity in that moment. The intervention was delivered entirely automatically via the GamblingLess: In-The-Moment smartphone app, with no clinician, researcher, or other human provider involvement in intervention delivery or assessment. No cointerventions (including training or support) were provided in addition to GamblingLess: In-The-Moment. Illustrative screenshots of this JITAI are displayed in Figure 1, and an outline of the intervention modules and activities is provided in Multimedia Appendix 2.

Figure 1. Illustrative screenshots of GamblingLess: In-The-Moment, a smartphone app-delivered just-in-time adaptive intervention (JITAI) designed to support Australian adults seeking to reduce or quit their gambling through real-time delivery of tailored intervention content targeting gambling cravings, self-efficacy, and positive outcome expectancies.



Intervention Loop

Once participants completed an intervention activity, the app prompted them to recomplete the EMA item that conferred eligibility for that intervention option (eg, the EMA item measuring gambling cravings if they completed a Curbing Cravings activity; Multimedia Appendix 3). Participants subsequently received a feedback message that compared this score to the initial EMA item. When participant scores on the postintervention item remained above the cutoff indicating eligibility for an intervention (score >0), participants were returned to the module dashboard to select another activity. This intervention loop continued until the participant scored below the cutoff for an intervention (score of 0) or closed the app; hence, the postintervention administration of the EMA item specified the amount of support participants received. When participant scores on the postintervention item were below the cutoff for intervention eligibility, participants received an encouraging message and were returned to the app's home dashboard. Participants were informed in multiple locations in the app that they could stop the loop at any time by closing the app to reduce the likelihood that they would adjust their response to break the loop.

Other App Features

The app's home dashboard comprised links to several additional features, including "Get More Support" (also available on each intervention dashboard), which provided click-to-call and click-to-email buttons for Australian help services for crisis or on-demand support outside of the app; and "More," which presented information about the app and trial. In addition, each intervention dashboard had a "Pick For Me" feature, which randomly delivered an activity from the menu, and each intervention activity was preceded by a "Did You Know?" psychoeducational message about gambling cravings, self-efficacy, or positive outcome expectancies. Finally, the app had a "Provide Nothing" option, in which support was not offered if participants ignored the push notification or pressed the snooze function to indicate that they were unable to complete an EMA.

Microrandomization Protocol

A fully automated and blinded microrandomized protocol in the app determined whether eligible participants were assigned to the tailored intervention condition or no-intervention control condition at each decision point over the 28-day MRT. Owing to the MRT design, participants were somewhat blinded because they were not aware of the eligibility criteria at each EMA. A simple randomization protocol using a random number generator embedded in the app was used, with no blocking or stratification. The randomization sequence was generated and implemented automatically by the app at each eligible decision point. As allocation occurred in real time through the embedded algorithm, neither participants nor members of the research team were involved in treatment assignment or had access to upcoming allocations.

Participants who were eligible for an intervention were microrandomized to the tailored intervention condition on a 3:1 ratio (ie, 75% chance of receiving the tailored intervention condition and 25% chance of receiving the no-intervention control condition). Participants who were eligible for more than 1 intervention option had equal chances of receiving each option (eg, those eligible for 2 intervention options had a 37.5% chance per intervention). Participants microrandomized to the no-intervention control condition received a brief message of encouragement to address cravings, low self-efficacy, or positive outcome expectancies, but no intervention content, after which their interaction with the app ended. Given the nature of the data analysis, it was not possible to blind outcome assessors to intervention delivery.

Single-Arm Outcome Evaluation

In addition to the MRT, the single-arm outcome evaluation involved the administration of self-report surveys at preintervention, postintervention, and 6-month follow-up evaluations. The preintervention survey was delivered in-app during the onboarding process (wherein participants provided explicit informed consent prior to completing the survey), while participants were emailed to complete the postintervention and 6-month follow-up surveys via Qualtrics (which indicated the purpose and duration of the survey before obtaining informed consent via a tick box). Of the 192 participants in the analytic sample, 161 (83.9%) completed the postintervention survey, and 158 (82.3%) completed the 6-month follow-up survey. Detailed information on each of the measures used in the outcome evaluation is displayed in Multimedia Appendix 4.

All surveys (preintervention, postintervention, and follow-up) included a measure of the primary distal outcome (gambling symptom severity, measured by the Gambling Symptom Assessment Scale [G-SAS] [48]). They also included measures of the secondary distal outcomes: gambling frequency and expenditure (measured using a 28-day Timeline Follow-Back [TLFB] [49] at preintervention, aggregated EMA data at postintervention, and 2 single items at follow-up), craving severity (measured by the Penn Alcohol Craving Scale modified for Gambling [PACS-G] [50]), self-efficacy (measured using a 5-item adaptation of the Brief Situational Confidence Questionnaire-Gambling [BSCQ-G] [51]), and positive outcome expectancies (using the Excitement, Escape, and Money subscales of the Gambling Outcome Expectancies Scale [GOES] [13]). Descriptive, covariate, and predictor variables were also measured, including sociodemographic characteristics (preintervention survey), problem gambling activities (preintervention survey), intended gambling behavior (preintervention survey using a 28-day Timeline Follow-Forward [TLFF]), help-seeking (all surveys using the High-Intensity and Low-Intensity subscales of the Help-Seeking Questionnaire [HSQ] [52]), and app acceptability (postintervention survey using the Subjective Quality and Perceived Impact subscale of the Mobile App Rating Scale [MARS] [53]).

Compliance Protocols

To enhance EMA compliance during the MRT, participants were sent an automated welcome email following onboarding,

a reminder email where they failed to complete onboarding or an EMA for more than 48 hours after onboarding, and a subsequent reminder contact (via phone, SMS text messaging, or email) where they still failed to complete onboarding or an EMA in the following 48 hours. No further contact was made with participants who were unresponsive to these reminders. During the follow-up period, participants were sent an advance notice email a week before the follow-up survey was due. A reminder email was sent a week after the postintervention and follow-up survey invites were sent, and up to 2 further reminder contacts (via phone, SMS text messaging, or email) were made in the subsequent 3 weeks if the survey had not been completed. Participants who did not complete the postintervention survey were still invited to complete the 6-month follow-up survey. Intervention adherence and fidelity were assessed using EMA completion rates, intervention eligibility and assignment records, intervention uptake, and app usage metrics automatically captured by the platform.

Statistical Analyses

All analyses were conducted in Stata (version 17; StataCorp). No data were missing for pretreatment measurements, except for Socio-Economic Indexes for Areas (SEIFA; Index of Relative Socio-Economic Advantage and Disadvantage [IRSAD]: indicator of socioeconomic status), where missingness remained very low (0.52%). For EMA measurements, all participants provided values in at least one EMA, with the exception of gambling expenditure, which was nested within those who gambled (67/192, 34.90%). Among completed EMAs, missing data remained low for most measures (<0.3%), except for gambling expenditure (4601/5116, 89.93%). For the within-person follow-up surveys, among those who participated in follow-up collections, missingness ranged between 1.23% and 1.84%. Descriptive statistics were used to describe the sample sociodemographic and gambling characteristics, MRT participant-level and event-level app use (EMA compliance rate, "Check-In Here" quick link, eligibility, microrandomization and intervention option assignment, and EMA event record summary). Across the MRT and single-arm outcome evaluation, the magnitude of effects was interpreted using odds ratios (ORs) for binary outcomes and Cohen d_z for continuous outcomes (see formula 7 in [54]). The magnitude of effect sizes was interpreted as small (OR 0.59 and 1.68; d_z=0.20), medium (OR 0.29 and 3.47; d_z=0.50), or large (OR 0.15 and 6.71; d_z=0.80) [55,56]. Each effect size was accompanied by a 95% CI.

MRT Analyses

For the MRT, intervention was defined using two separate indicator variables: (1) a 2-level variable that compared the no-intervention control condition to the tailored intervention condition; and (2) a 4-level variable that compared the no-intervention control condition to the 3 intervention options (Curbing Cravings, Tackling Triggers, and Exploring Expectancies). Consistent with the intention-to-treat principle, decision points were analyzed according to their randomized intervention assignment, irrespective of whether the assigned intervention was accessed or completed. Only the first EMA (and corresponding randomization) from within a 2-hour window was included for each participant. The MRT data were analyzed using regression models estimated via GEE, with an exchangeable working correlational structure to account for within-person clustering (ie, multiple time points within each participant). In these analyses, gambling episodes (no vs yes) were treated as binary outcomes. Supplementary analyses conducted for expenditure also treated this dependent variable as a binary outcome (<Aus $50 [US $35] vs ≥Aus $50 [US $35]). Specifically, each (lagged) outcome of interest (eg, gambling episode at $time_{t+1}$) was regressed onto a variable denoting intervention assignment ($time_t$). All models were adjusted for the tailoring variables (ie, craving intensity, self-efficacy, and positive outcome expectancies), time between completed EMAs, week of intervention (ie, weeks 1-4), age, gender (men vs women or nonbinary participants), and annual personal gross income. The authors acknowledge that gender is a nonbinary spectrum; however, given that research has not agreed upon a set of best practices relating to gender in data coding and analysis, the binarization of gender as a covariate in the analyses was used due to the larger proportion of participants identifying as men in the analytic sample [57]. Sensitivity analyses that preserved the MRT decision-point randomization framework were conducted, which (1) excluded participant sessions in which more than 1 EMA was recorded in the 2-hour check-in window (194 sessions from 78 participants); (2) included the additional covariate variable of past-month help-seeking (measured with the HSQ at postintervention); and (3) examined unplanned gambling episodes or greater-than-planned (>10%) expenditure outcomes. Post hoc supplementary analyses that partially departed from the MRT's decision-point randomization framework also (1) examined the influence of collapsing EMAs across each day (only available for the 2-level intervention model due to the potential for participants to be exposed to more than one intervention option in any given day); and (2) compared participant responses on each tailoring variable with the associated postintervention EMA item after participants completed the first and last intervention activity in the intervention loop using a series of paired-sample t tests (2-tailed). Exploratory analyses examining the degree to which potential time-variant and time-invariant variables acted as moderators of the intervention effects were conducted. Given that there were 90 independent interaction effects for each of the intervention models (2-level and 4-level), an adjusted α of .01 was used, which balanced the possibility of false positives (type I error) with the need to explore any potential conditions under which the intervention was most effective.

Single-Arm Outcome Evaluation Analyses

In addition to the analysis of the MRT data, a single-arm outcome evaluation was conducted to determine whether there were changes in distal outcomes from preintervention (n=192) to immediately postintervention (ie, 28 days; n=161) and at 6-month follow-up evaluation (n=158). These group-level analyses used all available observations from the analytic sample. To accommodate incomplete

repeated-measures data under a missing-at-random assumption, these analyses used mixed-effects regression models with random intercepts [58]. For each model, the outcome of interest was regressed onto a variable denoting "time" (ie, preintervention, postintervention, and 6-month follow-up evaluations), as well as covariates of age, gender (men vs women or nonbinary participants), and annual personal gross income. Supplementary analyses that included the additional covariate variable of past-month help-seeking measured at postintervention were also conducted (help-seeking measured at the 6-month evaluation was not included as a covariate as help-seeking was only measured during the month prior to this evaluation time point).

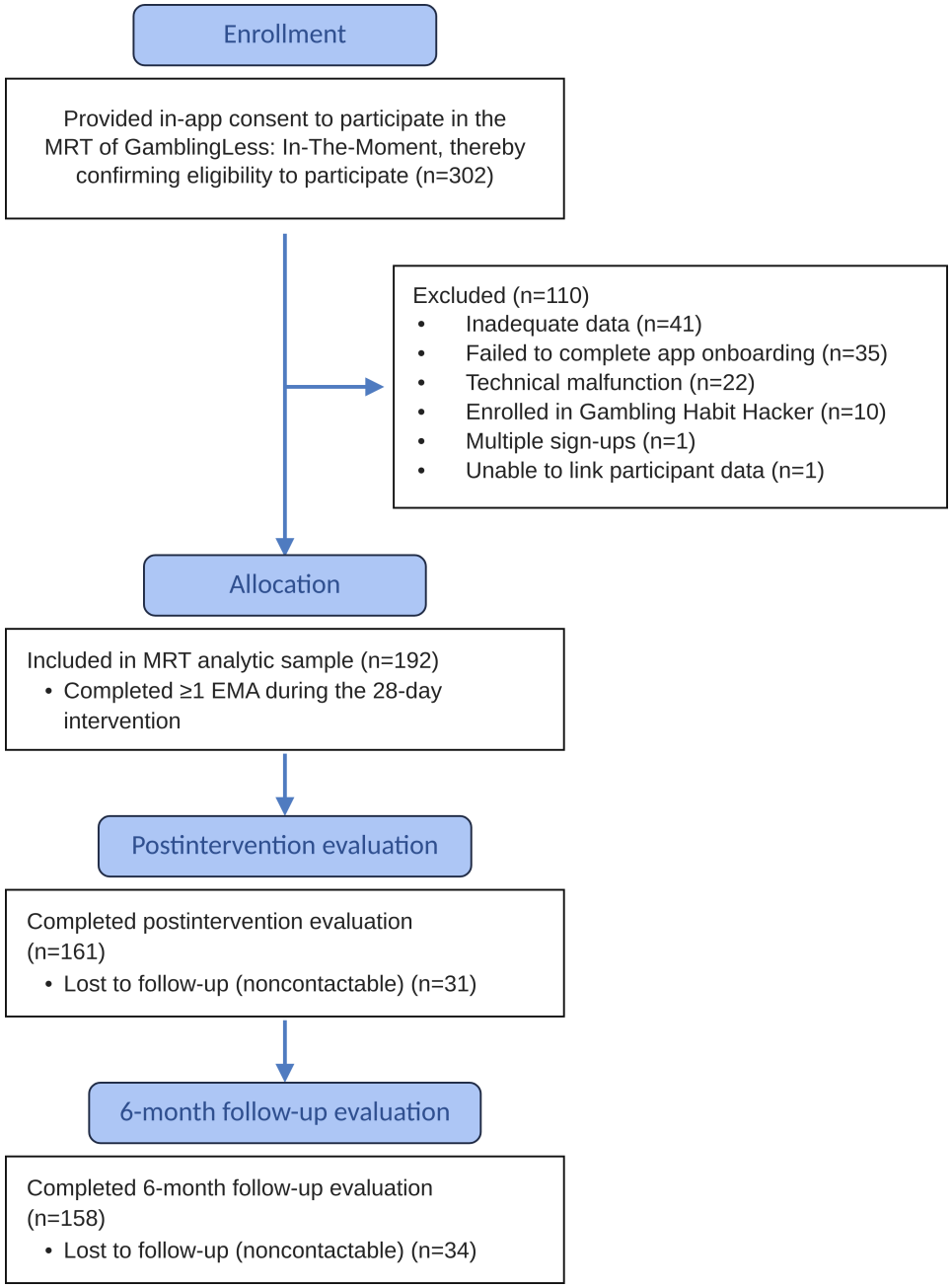
In the single-arm outcome evaluation, change at the individual level was also examined. Greater than 35% improvement in G-SAS gambling symptom severity scores was calculated as this has been identified as the optimal threshold for defining treatment response [59]. In addition, consistent with previous gambling treatment outcome studies [33,36], a 4-level change variable for G-SAS gambling symptom severity was derived that characterized whether each individual was recovered (ie, reliable change in a healthy direction with postintervention scores falling within the "functional range"), improved (ie, reliable change in a healthy direction, but postintervention score falling in the "dysfunctional range"), unchanged (ie, no reliable change over time), or deteriorated (ie, reliable change in an unhealthy direction). Reliable change was assessed using an established method [60], with reliabilities for the G-SAS based on α coefficients derived from the preintervention data. The cutoff denoting "functional" and "dysfunctional" range was set at ≤20, as in previous research [33,36]. In addition to this 4-level variable, a binary outcome at both postintervention and 6-month follow-up evaluations was derived for the primary distal outcome (G-SAS gambling symptom severity) that denoted unchanged or deteriorated (0) versus recovered or improved (1). These binary outcome variables were regressed onto a series of preintervention participant characteristics, postintervention participant characteristics, and app use or engagement indices during the intervention and 6-month follow-up period to examine whether these factors were associated with longer-term recovery or improvement.

Results

Participant Flow

The flow of participants through the trial is presented in Figure 2. The initial sample comprised 302 eligible users. Data from 110 of these users were removed due to failing to provide adequate data for analysis (n=41), failing to complete onboarding (n=35), a technical malfunction (n=22), sign-up to Gambling Habit Hacker (another gambling JITAI the team was concurrently evaluating [37,61,62]; n=10), multiple sign-ups to GamblingLess: In-The-Moment (n=1), and an inability to link participant data (n=1). The resulting analytic sample comprised 192 participants (127 men, 64 women, and 1 nonbinary participant) who completed at least one EMA during the 28-day MRT (with day 1 beginning on the day after onboarding). Participants who did not complete these evaluations were considered lost to follow-up. Figure 2 provides the CONSORT flow diagram.

Figure 2. Participant flow through a 28-day microrandomized trial (MRT) and single-arm outcome evaluation of GamblingLess: In-The-Moment among Australian adults seeking support to reduce or quit gambling (March 28 to December 15, 2022). As this study used an MRT design, participants were randomized repeatedly at eligible decision points throughout the intervention period rather than once at enrollment. Event-level eligibility, randomization, intervention assignment, and intervention uptake are reported separately in the Results section and Multimedia Appendix 5. EMA: ecological momentary assessment.



Sample Characteristics

Sociodemographic statistics from the preintervention evaluation survey for the 192 participants in the analytic sample are presented in Multimedia Appendix 6. The sample was aged between 18 and 72 years, with a median age of 35 years (IQR 24-44 years). Participants were predominantly men (127/192, 66.2%), of Australian ethnicity (145/192, 75.5%), and residents of New South Wales and Victoria (145/192, 75.5%), which are the 2 most populated Australian states. Most participants (120/192, 62.5%) earned between Aus $25,000 (US $17,500) and Aus $99,000 (US $69,300) per annum, and the average SEIFA (IRSAD: indicator of socioeconomic status) was just over the national average (standardized mean 1011.10, SD 75.93). There were no differences in sociodemographic characteristics between the nonanalytic sample who failed to provide adequate data for the 28-day MRT period for analysis (n=41) and the analytic sample (n=192), with the exception of state of residence, whereby the analytic sample was more likely to reside in Victoria and less likely to reside in Western Australia (Multimedia Appendix 7).

Preintervention gambling characteristics for the 192 participants in the analytic sample are displayed in Multimedia Appendix 8. Most participants reported problematic

gambling on electronic gaming machines (EGMs; 126/192, 65.6%), racing (103/192, 53.7%), and sports or events (91/192, 47.4%). The average G-SAS gambling symptom severity score was classified in the severe category, with most participants (149/192, 77.6%) classified in the moderate or severe G-SAS categories. Participants reported gambling an average of 8 times and spending over Aus $3300 (US $2310) in the past month. In contrast, they reported that they intended to gamble just under 3 times and spend approximately Aus $350 (US $245) in the next month. Just more than half of participants (97/192, 50.5%) indicated abstinence as a treatment goal in their TLFF, with the remainder selecting a nonabstinence goal. Participants reported an average PACS-G craving severity score of nearly 20 (maximum score of 30), an average BSCQ-G self-efficacy score classified in the low confidence category (with 148/192, 77.1%, participants classified in the low confidence category), and average GOES positive outcome expectancy subscale scores that well exceed those identified in an Australian general population sample and the associated at-risk subsample. There were no differences in preintervention gambling characteristics between the nonanalytic sample who failed to provide adequate data for the 28-day MRT period for analysis (n=41) and the analytic sample (n=192; Multimedia Appendix 9).

App Use

MRT Participant-Level App Use

Overall, 5116 EMAs were completed (compliance rate 31.7%), with participants completing a mean of 26.7 EMAs (SD 28.0; median 10, range 1-82). On average, participants used the *Check-In Here* quick link on 12.6 days of the 28-day intervention period (SD 11.1; median 10, range 1-28). A summary of the participant-level intervention eligibility, microrandomization, and intervention option assignment for the analytic sample is presented in Multimedia Appendix 10. On average during the intervention, participants most often exceeded the threshold for tailored intervention eligibility in relation to self-efficacy (7.7 times, SD 11.36) followed by positive outcome expectancies (6.8 times, SD 11.56) and craving intensity (5.2 times, SD 7.86). Each participant was microrandomized an average of 10.1 times: 2.6 times to the no-intervention control condition and 7.3 times to the tailored treatment condition. The highest number of participants used the Tackling Triggers intervention option (n=138, 71.9%), followed by Exploring Expectancies (n=130, 67.7%), and Curbing Cravings (n=108, 56.3%). They were most often assigned to Tackling Triggers (2.8 times) and Exploring Expectancies (2.7 times), followed by Curbing Cravings (1.7 times). Furthermore, participants reported an average of 3.1 gambling episodes, with an average of 2.0 gambling episodes that had an associated expenditure of Aus $50 (US $35) or more.

MRT Event-Level App Use

Multimedia Appendix 5 presents the event-level summary of intervention eligibility, microrandomization, intervention option assignment, and an EMA event record summary for the 192 participants in the analytic sample. The proportion of EMAs in which intervention eligibility scores on the tailoring variables exceeded the threshold for intervention eligibility (scores ≥1) was highest for the low self-efficacy item (28.8%), followed by the positive outcome expectancies item (25.5%), then the craving intensity item (19.5%). As per the MRT protocol, participants were microrandomized to either the tailored intervention condition (74% of the time) or the no-intervention control condition (26% of the time) in more than one-third of the EMAs (1929/5116, 37.7%). As per the individual-level app use statistics, the Tackling Triggers (544/1881, 28.9%) and Exploring Expectancies (517/1881, 27.5%) intervention options were delivered most often, and the Curbing Cravings intervention option was delivered least often (331/1881, 17.6%). Multimedia Appendix 5 also displays the EMA event record summary statistics, whereby a gambling episode was reported in 11.6% (589/5116) of EMAs, with an associated average expenditure of Aus $252 (US $176; SD Aus $487 [US $341]; median Aus $100 [US $70], range Aus $2-$5000 [US $1.40-US $3500]).

Post-MRT App Use

During the 6-month follow-up period in which no notifications were provided, 13% (25/192) of participants used the app.

MRT Findings

Primary Proximal Outcome

Table 1 presents associations between intervention status (2 level and 4 level) and the primary proximal outcome of subsequent gambling episodes, with supplementary analyses conducted for associated gambling expenditure (≥Aus $50 [≥US $35]). The 2-level models provided no evidence that delivering a tailored intervention, relative to the no-intervention control condition, reduced the odds of a subsequent gambling episode or associated gambling expenditure (OR 1.05, 95% CI 0.79-1.38; *P*=.74). Similarly, in the 4-level model, none of the 3 intervention options demonstrated superiority over the no-intervention control condition for either gambling outcome, with no evidence of a difference in the odds of a subsequent gambling episode in participants following the Curbing Cravings intervention option (OR 1.22, 95% CI 0.85-1.76; *P*=.28), Tackling Triggers intervention option (OR 1.05, 95% CI 0.74-1.49; *P*=.77), or Exploring Expectancies intervention option (OR 0.90, 95% CI 0.63-1.29; *P*=.56).

Table 1. Associations between intervention status and subsequent gambling episodes and expenditure during a 28-day microrandomized trial of GamblingLess: In-The-Moment among Australian adults seeking support to reduce or quit gambling (N=192)[a].

Intervention outcome	EMA[b] decision points, n	% (95% CI)	OR[c] (95% CI)	*P* value
Gambling episodes				
2-level intervention[d]				
No-intervention control	460	17.1 (13.1-21.2)	Base	Base
Tailored intervention	1312	17.7 (14.6-20.9)	1.05 (0.79-1.38)	.74
4-level intervention[e]				
No-intervention control	460	17.2 (13.1-21.2)	Base	Base
Intervention option 1: Curbing Cravings	318	20.0 (15.0-25.0)	1.22 (0.85-1.76)	.28
Intervention option 2: Tackling Triggers	511	17.9 (13.6-22.1)	1.05 (0.74-1.49)	.77
Intervention option 3: Exploring Expectancies	483	15.8 (11.7-19.9)	0.90 (0.63-1.29)	.56
Gambling expenditure (≥Aus $50; ≥US $35)[f]				
2-level intervention[d]				
No-intervention control	74	79.1 (69.8-88.4)	Base	Base
Tailored intervention	228	74.8 (67.7-81.9)	0.77 (0.42-1.42)	.41
4-level intervention[e]				
No-intervention control	74	79.1 (69.7-88.4)	Base	Base
Intervention option 1: Curbing Cravings	80	72.6 (61.2-83.9)	0.68 (0.32-1.47)	.33
Intervention option 2: Tackling Triggers	82	76.2 (66.1-86.3)	0.84 (0.39-1.78)	.64
Intervention option 3: Exploring Expectancies	66	75.6 (64.2-87.2)	0.81 (0.36-1.80)	.61

[a]Models adjust for tailoring variables, time between ecological momentary assessment sessions, week of intervention (weeks 1-4), age, gender (men vs women or nonbinary), and annual personal gross income.
[b]EMA: ecological momentary assessment.
[c]OR: odds ratio.
[d]2-level intervention: binary intervention status (no-intervention control vs tailored intervention).
[e]4-level intervention status (no-intervention control, Curbing Cravings, Tackling Triggers, and Exploring Expectancies).
[f]Model in participants who reported a gambling episode.

Secondary Proximal Outcomes

Table 2 presents associations between intervention status (2 level and 4 level) and the secondary proximal outcomes (subsequent craving severity, self-efficacy, and positive outcome expectancies). The 2-level models provided no evidence that delivering a tailored intervention, relative to the no-intervention control condition, improved the secondary proximal outcomes. In contrast, in the 4-level models, the Tackling Triggers intervention option was associated with an improvement in self-efficacy in comparison to the no-intervention control condition (b=–0.14, 95% CI –0.26 to –0.01; P=.04; d_z=–0.16). There was also some evidence that Exploring Expectancies produced a small reduction in subsequent positive outcome expectancies, although its 95% CI included no effect (b=–0.11, 95% CI –0.24 to 0.02; P=.10; d_z=–0.13). No associations between intervention status and craving intensity were identified in the 4-level models.

Table 2. Associations between intervention status and subsequent craving intensity, self-efficacy, and positive outcome expectancies during a 28-day microrandomized trial of GamblingLess: In-The-Moment among Australian adults seeking support to reduce or quit gambling (N=192)[a].

Intervention outcome	EMA[b] decision points, n	Mean (95% CI)	*b* (95% CI)	*P* value	d_z
Craving intensity					
2-level intervention[c]					
No-intervention control	462	0.6 (0.5 to 0.7)	Base	Base	Base
Tailored intervention	1314	0.6 (0.5 to 0.6)	–0.04 (–0.12 to 0.05)	.39	–0.07
4-level intervention[d]					
No-intervention control	462	0.6 (0.5 to 0.7)	Base	Base	Base
Intervention option 1: Curbing Cravings	318	0.6 (0.5 to 0.8)	0.05 (–0.08 to 0.17)	.46	0.06
Intervention option 2: Tackling Triggers	512	0.5 (0.4 to 0.6)	–0.07 (–0.18 to 0.04)	.22	–0.10
Intervention option 3: Exploring Expectancies	484	0.5 (0.4 to 0.6)	–0.06 (–0.18 to 0.05)	.26	–0.09

Intervention outcome	EMA[b] decision points, n	Mean (95% CI)	*b* (95% CI)	*P* value	d_z
Low self-efficacy					
2-level intervention[c]					
No-intervention control	461	1.1 (0.9 to 1.2)	Base	Base	Base
Tailored intervention	1315	1.0 (0.9 to 1.1)	–0.08 (–0.18 to 0.02)	.12	–0.12
4-level intervention[d]					
No-intervention control	461	1.1 (0.9 to 1.2)	Base	Base	Base
Intervention option 1: Curbing Cravings	319	1.1 (0.9 to 1.2)	0.00 (–0.15 to 0.15)	.99	0.00
Intervention option 2: Tackling Triggers	512	0.9 (0.8 to 1.1)	–0.14 (–0.26 to –0.01)	.04	–0.16
Intervention option 3: Exploring Expectancies	484	1.0 (0.8 to 1.1)	–0.07 (–0.20 to 0.05)	.26	–0.09
Positive outcome expectancies					
2-level intervention[c]					
No-intervention control	461	0.9 (0.7 to 1.0)	Base	Base	Base
Tailored intervention	1315	0.8 (0.7 to 0.9)	–0.05 (–0.15 to 0.05)	.31	–0.08
4-level intervention[d]					
No-intervention control	461	0.9 (0.7 to 1.0)	Base	Base	Base
Intervention option 1: Curbing Cravings	319	1.0 (0.8 to 1.1)	0.08 (–0.07 to 0.22)	.31	0.08
Intervention option 2: Tackling Triggers	512	0.8 (0.7 to 0.9)	–0.08 (–0.20 to 0.05)	.22	–0.10
Intervention option 3: Exploring Expectancies	484	0.8 (0.6 to 0.9)	–0.11 (–0.24 to 0.02)	.10	–0.13

[a]Models adjust for tailoring variables, time between ecological momentary assessment sessions, week of intervention (weeks 1-4), age, gender (men vs women or nonbinary), and annual personal gross income.
[b]EMA: ecological momentary assessment.
[c]2-level intervention: binary intervention status (no-intervention control vs tailored intervention).
[d]4-level intervention: 4-level intervention status (no-intervention control, Curbing Cravings, Tackling Triggers, and Exploring Expectancies).

MRT Sensitivity Analyses

Sensitivity analyses that preserved the MRT decision-point randomization framework showed a similar pattern of findings, including analyses that excluded sessions with multiple EMAs in the 2-hour check-in window (Multimedia Appendix 11); additionally adjusted for past-month help-seeking (measured at postintervention; Multimedia Appendix 12); and examined unplanned gambling episodes or greater-than-planned gambling expenditure (Multimedia Appendix 13).

Post Hoc Supplementary Analyses

Post hoc supplementary analyses that partially departed from the MRT's decision-point randomization framework revealed that, when EMAs were collapsed across each day using the 2-level intervention model, the tailored intervention option was associated with a small reduction in craving intensity (b=–0.14, 95% CI –0.27 to –0.01; P=.04; d_z=–0.17) and a possible small improvement in self-efficacy (b=–0.15, 95% CI –0.31 to 0.01; P=.07; d_z=–0.15) compared to the no-intervention control condition, although the CI for self-efficacy included no effect (Multimedia Appendix 14).

Moreover, comparisons of participant responses on each EMA tailoring variable and the associated postintervention EMA item after participants completed the first and last intervention activities in the intervention loop are presented in Table 3. Medium-to-large improvements were observed for all secondary proximal outcomes across all intervention options and groups after the first and last intervention activities in the loop (P<.001), with all but 1 postactivity item mean under the intervention eligibility threshold (score <1). Effect sizes were highest for the Curbing Cravings intervention option, followed by Tackling Triggers and Exploring Expectancies. Cross-tabulations of responses from the 192 participants in the analytic sample revealed that 63% (158/251), 51.8% (205/396), and 59.2% (206/348) of participants no longer met intervention eligibility after the first activity in the loop for Curbing Cravings, Tackling Triggers, and Exploring Expectancies, respectively. Moreover, 83.7% (210/251), 72.2% (286/396), and 72.1% (251/348) of participants no longer met eligibility criteria after the last activity in the loop for the 3 intervention options, respectively. Specifically, the highest proportions of postactivity threshold ineligibility were observed for self-efficacy in high-risk situations involving social pressure to gamble and conflict with others in Tackling Triggers and for money positive outcome expectancies in Exploring Expectancies.

Table 3. Comparison between ecological momentary assessment (EMA) tailoring variable to postintervention EMA item after first and last intervention activity in the intervention loop during a 28-day microrandomized trial of GamblingLess: In-The-Moment among Australian adults seeking support to reduce or quit gambling (N=192)[a].

Intervention stage and option	EMA[b] decision points, n	EMA tailoring variable		Postintervention EMA item		*P* value	d_z	No longer meeting eligibility threshold (%)
		Mean (SD)	95% CI	Mean (SD)	95% CI			
After first activity in the intervention loop								
Curbing Cravings	251	1.7 (0.9)	1.6-1.8	0.6 (0.9)	0.5-0.7	<.001	1.16	63.0
Tackling Triggers	*396*	*1.8 (1.0)*	*1.7-1.9*	*0.9 (1.2)*	*0.8-1.0*	*<.001*	*0.84*	*51.8*
Financial pressures	91	1.7 (1.0)	1.5-2.0	1.0 (1.3)	0.7-1.2	<.001	0.75	50.6
Unpleasant emotions	88	1.9 (1.0)	1.7-2.1	0.9 (1.2)	0.6-1.1	<.001	0.90	53.4
Social pressure to gamble	66	1.7 (0.9)	1.5-1.9	0.6 (1.0)	0.4-0.9	<.001	1.06	60.6
Testing control	110	1.9 (1.1)	1.7-2.1	1.1 (1.3)	0.9-1.4	<.001	0.71	42.7
Conflict with others	41	1.3 (0.7)	1.1-1.6	0.6 (0.9)	0.4-0.9	<.001	1.18	61.0
Exploring Expectancies	*348*	*1.9 (1.1)*	*1.8-2.0*	*0.8 (1.1)*	*0.6-0.9*	*<.001*	*0.74*	*59.2*
Excitement	113	1.8 (1.1)	1.6-2.0	0.9 (1.2)	0.7-1.1	<.001	0.59	54.9
Escape	89	1.9 (1.0)	1.7-2.1	0.8 (1.2)	0.6-1.1	<.001	0.72	55.1
Money	148	1.9 (1.1)	1.7-2.0	0.6 (1.0)	0.5-0.8	<.001	0.88	64.2
After last activity in the intervention loop								
Craving intensity	251	1.7 (0.9)	1.6-1.8	0.3 (0.7)	0.2-0.3	<.001	1.57	83.7
Self-efficacy	*396*	*1.8 (1.0)*	*1.7-1.9*	*0.6 (1.0)*	*0.4-0.7*	*<.001*	*1.16*	*72.2*
Financial pressures	91	1.7 (1.0)	1.5-2.0	0.6 (1.1)	0.4-0.8	<.001	1.04	71.4
Unpleasant emotions	88	1.9 (1.0)	1.7-2.1	0.6 (1.0)	0.4-0.8	<.001	1.26	70.5
Social pressure to gamble	66	1.7 (0.9)	1.5-1.9	0.4 (0.9)	0.2-0.6	<.001	1.42	78.8
Testing control	110	1.9 (1.1)	1.7-2.1	0.7 (1.2)	0.5-0.9	<.001	1.03	68.2
Conflict with others	41	1.3 (0.7)	1.1-1.6	0.4 (0.7)	0.1-0.6	<.001	1.71	78.1
Positive outcome expectancies	*348*	*1.9 (1.1)*	*1.8-2.0*	*0.5 (1.0)*	*0.4-0.7*	*<.001*	*0.96*	*72.1*
Excitement	113	1.8 (1.1)	1.6-2.0	0.6 (1.1)	0.4-0.8	<.001	0.85	69.9
Escape	89	1.9 (1.0)	1.7-2.1	0.6 (1.1)	0.4-0.9	<.001	0.93	68.5
Money	148	1.9 (1.1)	1.7-2.0	0.5 (1.0)	0.3-0.6	<.001	1.07	75.7

[a]Intervention loop analyses require cautious interpretation given the potential for participants to break the intervention loop by adjusting their responses on the postintervention EMA item.
[b]EMA: ecological momentary assessment.
[c]*Italicised rows present overall results for the Tackling Triggers and Exploring Expectancies intervention modules, with non-bolded rows presenting results for their respective subcategories.*

Time-Invariant and Time-Varying Moderators

Associations between gambling outcomes (episodes, expenditure, craving intensity, low self-efficacy, and positive outcome expectancies) and intervention status (2 level and 4 level) as moderated by several time-invariant (preintervention age, gender, income, G-SAS gambling symptom severity, TLFB past-month gambling episodes, and TLFB past-month gambling expenditure) and time-varying (EMA craving intensity, low self-efficacy, positive outcome expectancies, psychological distress, readiness to change, subjective alcohol intoxication, impulsivity, social context, financial gambling availability, location gambling availability, time of day, and week of intervention) variables were examined (Multimedia Appendix 15).

Using a more conservative α of .01, 3 interactions were evidenced (Figures 3-5): (1) gender interacted with the 4-level intervention status to predict subsequent low self-efficacy (*P*=.001), such that there was an observable reduction in low self-efficacy scores between the control and Tackling Triggers intervention option in female or nonbinary participants (*b*=–0.31, 95% CI –0.49 to –0.12; *P*=.001), but not in male participants (*b*=–0.02, 95% CI –0.18 to 0.14; *P*=.80); (2) positive outcome expectancies interacted with the 2-level intervention status to predict subsequent positive outcome expectancies (*P*=.004), such that an intervention effect was observed to be stronger when positive expectancies were higher (eg, "slightly agree": *b*=–0.02, 95% CI –0.12 to 0.08; *P*=.75; "very much agree": *b*=–0.38, 95% CI –0.63 to –0.13; *P*=.003); and (3) readiness to change interacted with the 2-level intervention status to predict subsequent low self-efficacy (*P*=.002), such that the intervention effect (ie, reduction in scores, relative to control) was observed to be stronger when readiness to change was higher (eg, "slightly important priority": *b*=0.09, 95% CI –0.05 to 0.24; *P*=.21;

"very important priority": *b*=–0.22, 95% CI –0.36 to –0.09; *P*=.001).

Figure 3. Estimated subsequent low self-efficacy scores following delivery of each intervention option (Curbing Cravings, Tackling Triggers, and Exploring Expectancies) compared with the no-intervention control condition during a 28-day microrandomized trial of GamblingLess: In-The-Moment among Australian adults seeking to reduce or quit gambling, stratified by gender.

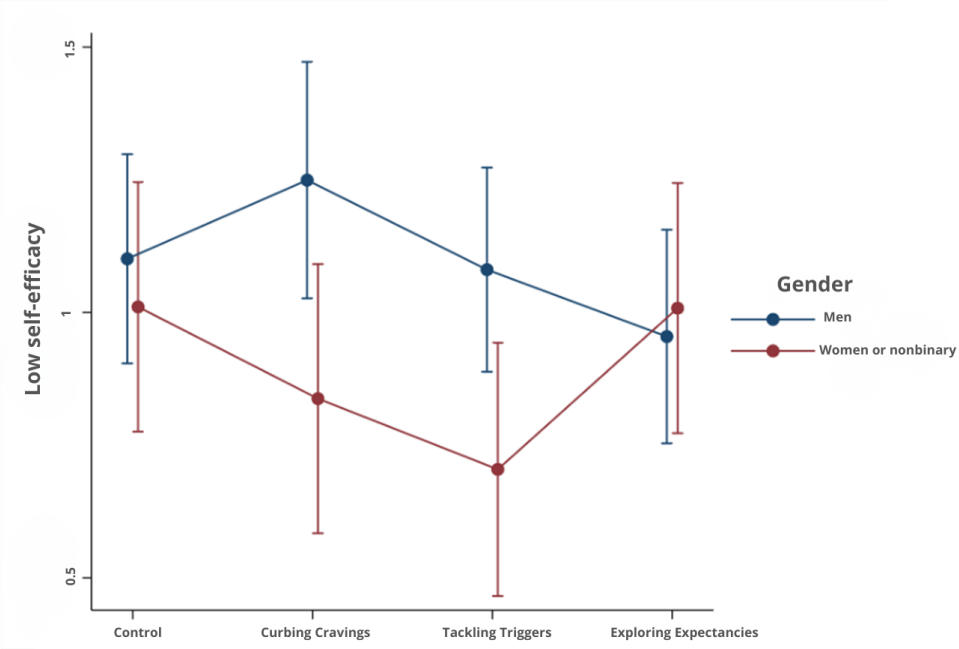


Figure 4. Estimated subsequent positive outcome expectancy scores following tailored intervention delivery versus the no-intervention control condition during a 28-day microrandomized trial of GamblingLess: In-The-Moment among Australian adults seeking to reduce or quit gambling, stratified by positive outcome expectancies measured at the time of intervention.

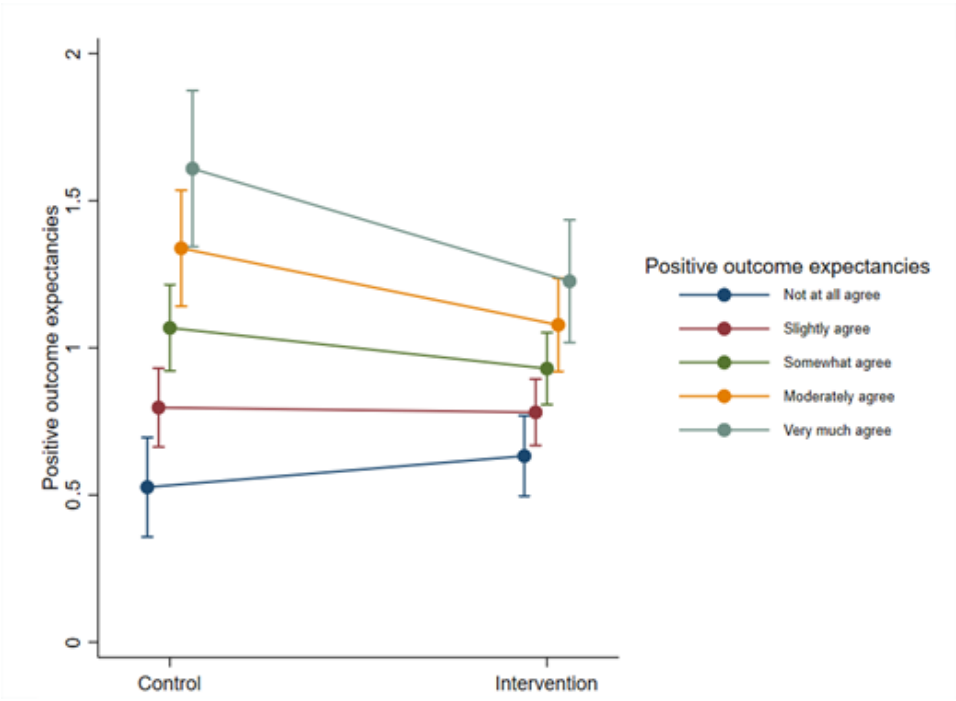
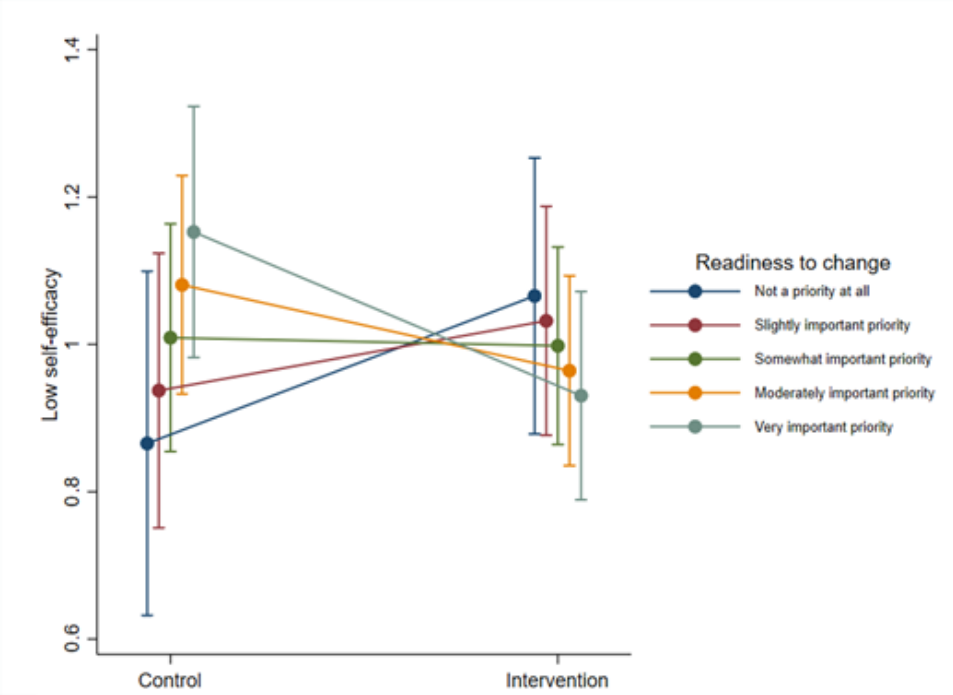


Figure 5. Estimated subsequent low self-efficacy scores following tailored intervention delivery versus the no-intervention control condition during a 28-day microrandomized trial of GamblingLess: In-The-Moment among Australian adults seeking to reduce or quit gambling, stratified by readiness to change.



Importantly, the associations between gambling outcomes and intervention status were not significantly moderated by week of intervention, indicating that the proximal effect of the intervention on the probability of a subsequent gambling episode did not change over the course of the 28-day MRT.

Single-Arm Outcome Evaluation

Group-Level Change in Distal Outcomes

Table 4 presents the longitudinal change in distal outcomes from preintervention to the postintervention and 6-month follow-up evaluations. There were large reductions in gambling symptom severity from preintervention to both the postintervention (b=–11.30, 95% CI –12.96 to –9.64; d_z=–0.96; P<.001) and 6-month follow-up evaluations (b=–12.33, 95% CI –14.01 to –10.66; d_z=–1.04; P<.001), with the average score moving from the upper end of the moderate category (bordering on the severe category) to the mild category at both time points. There were also small to large improvements in all secondary distal outcomes, ranging from d_z=0.41 (b=59.65, 95% CI 38.84-80.45; P<.001; BSCQ-G self-efficacy from preintervention to postintervention evaluations) to d_z=–0.99 (b=–6.37, 95% CI –7.28 to –5.46; P<.001; gambling frequency from preintervention to 6-month follow-up evaluations). Specifically, at postintervention, there were large improvements in gambling frequency; medium improvements in gambling expenditure, craving severity, and money expectancies; and small improvements in self-efficacy, excitement expectancies, and escape expectancies. At the 6-month follow-up evaluation, there were large improvements in gambling frequency and craving severity; medium improvements in gambling expenditure, excitement expectancies, escape expectancies, and money expectancies; and small improvements in self-efficacy. This pattern of findings was similar after additionally adjusting for past-month help-seeking (measured at the postintervention evaluation; Multimedia Appendix 16).

Table 4. Changes in primary and secondary distal outcomes in the single-arm outcome evaluation from preintervention to postintervention and 6-month follow-up among users of GamblingLess: In-The-Moment[a].

	Participants, n	Marginal mean (95% CI)	b (95% CI)	P value	d_z
G-SAS gambling symptom severity[b]					
Preintervention	192	30.5 (29.2 to 31.9)	Base	Base	Base
Postintervention	161	19.2 (17.8 to 20.7)	–11.30 (–12.96 to –9.64)	<.001	–0.96
6-month follow-up	158	18.2 (16.7 to 19.7)	–12.33 (–14.01 to –10.66)	<.001	–1.04
Gambling frequency[c]					
Preintervention	192	8.1 (7.4 to 8.7)	Base	Base	Base
Postintervention	192	3.1 (2.4 to 3.7)	–4.98 (–5.84 to –4.13)	<.001	–0.82

	Participants, n	Marginal mean (95% CI)	*b* (95% CI)	*P* value	d_z
6-month follow-up	158	1.7 (0.9 to 2.4)	–6.37 (–7.28 to –5.46)	<.001	–0.99
Gambling expenditure[c]					
Preintervention	192	3300 (2925 to 3675)	Base	Base	Base
Postintervention	192	662 (287 to 1036)	–2638.45 (–3153.20 to –2123.71)	<.001	–0.73
6-month follow-up	158	279 (133 to 692)	–3020.67 (–3564.14 to –2477.21)	<.001	–0.79
PACS-G[d] craving severity					
Preintervention	192	19.4 (18.4 to 20.4)	Base	Base	Base
Postintervention	161	13.0 (11.9 to 14.1)	–6.38 (–7.54 to –5.22)	<.001	–0.78
6-month follow-up	158	11.9 (10.8 to 13.0)	–7.48 (–8.65 to –6.31)	<.001	–0.91
BSCQ-G[e] self-efficacy					
Preintervention	192	236.6 (220.2 to 253.0)	Base	Base	Base
Postintervention	161	296.3 (278.5 to 314.0)	59.65 (38.84 to 80.45)	<.001	0.41
6-month follow-up	158	302.2 (284.3 to 320.1)	65.57 (44.63 to 86.50)	<.001	0.44
GOES[f] excitement expectancies					
Preintervention	192	3.7 (3.5 to 3.8)	Base	Base	Base
Postintervention	160	3.2 (3.0 to 3.3)	–0.50 (–0.65 to –0.35)	<.001	–0.47
6-month follow-up	158	3.1 (3.0 to 3.2)	–0.56 (–0.72 to –0.41)	<.001	–0.53
GOES escape expectancies					
Preintervention	192	3.3 (3.2 to 3.5)	Base	Base	Base
Postintervention	160	2.8 (2.7 to 3.0)	–0.51 (–0.67 to –0.36)	<.001	–0.46
6-month follow-up	158	2.7 (2.5 to 2.9)	–0.63 (–0.79 to –0.47)	<.001	–0.56
GOES money expectancies					
Preintervention	192	3.4 (3.3 to 3.6)	Base	Base	Base
Postintervention	160	2.8 (2.6 to 2.9)	–0.66 (–0.83 to –0.48)	<.001	–0.54
6-month follow-up	158	2.6 (2.4 to 2.8)	–0.82 (–0.99 to –0.65)	<.001	–0.68

[a]n=192 (preintervention analytic sample); n=161 (postintervention analytic sample); n=158 (6-month follow-up analytic sample). Models adjust for age, gender (men vs women or nonbinary), and annual personal gross income.
[b]G-SAS: Gambling Symptom Assessment Scale.
[c]Single-arm changes in gambling frequency and expenditure data require cautious interpretation, given that different measures were used at each evaluation time point and concerns that the relatively low EMA compliance may have compromised the validity of the aggregated EMA data for the postintervention time point. Gambling expenditure values are reported in Australian dollars (AUD $1 = US $0.70).
[d]PACS-G: Penn Alcohol Craving Scale (modified for gambling).
[e]BSCQ-G: Brief Situational Confidence Questionnaire-Gambling (5-item).
[f]GOES: Gambling Outcome Expectancies Scale.

Individual-Level Change in Gambling Symptom Severity

In terms of individual-level change, 49.7% (80/161) of participants at the postintervention evaluation and 57.6% (91/158) of participants at the 6-month follow-up evaluation demonstrated a treatment response on G-SAS gambling symptom severity (≥35% reduction in scores). Clinically significant change for G-SAS gambling symptom severity among the 161 participants completing the postintervention survey revealed that 73 (45.3%) had recovered, 31 (19.3%) had improved, 51 (31.7%) were unchanged, and 6 (3.7%) had deteriorated at the postintervention evaluation. Of the 158 participants at the 6-month follow-up evaluation, 85 (53.8%) had recovered, 20 (12.7%) had improved, 46 (29.1%) were unchanged, and 7 (4.4%) had deteriorated. Overall, 64.6% (104/161) and 66.5% (105/158) of participants demonstrated clinically significant recovery or improvement at the postintervention and 6-month follow-up evaluations, respectively.

Predictors of Individual-Level Change in Gambling Symptom Severity

Predictors of recovery or improvement on the primary distal outcome (G-SAS gambling symptom severity) at the postintervention and 6-month follow-up evaluations by participant characteristics and app use or engagement are displayed in Multimedia Appendix 17.

Preintervention Participant Characteristics

There was a positive association between PACS-G craving severity and clinically significant recovery or improvement at the postintervention (OR 1.54, 95% CI 1.10-2.17; *P*=.01) and 6-month follow-up (OR 1.48, 95% CI 1.05-2.10; *P*=.03) evaluations. In contrast, socioeconomic status, as measured by SEIFA (IRSAD), was negatively associated with clinically

significant recovery or improvement at both the postintervention (OR 0.62, 95% CI 0.42-0.89; *P*=.01) and 6-month follow-up (OR 0.68, 95% CI 0.47-0.98; *P*=.04) evaluations. Reporting number games as a problematic gambling activity at preintervention was negatively associated with clinically significant recovery or improvement at the 6-month follow-up evaluation (OR 0.36, 95% CI 0.16-0.81; *P*=.01), and GOES escape expectancies were positively associated with clinically significant recovery or improvement at the 6-month follow-up evaluation (OR 1.53, 95% CI 1.06-2.20; *P*=.02).

Postintervention Participant Characteristics

MARS subjective quality (OR 1.44, 95% CI 1.00-2.05; *P*=.048) and perceived impact (OR 1.56, 95% CI 1.07-2.27; *P*=.02) scores at postintervention were positively associated with clinically significant recovery or improvement at the 6-month follow-up evaluation, while postintervention GOES money expectancies (OR 0.59, 95% CI 0.40-0.86; *P*=.007) were negatively associated with clinically significant recovery or improvement at the 6-month follow-up evaluation.

App Use or Engagement

There was no evidence that the number of EMAs, number of interventions, number of activities completed, or week of intervention were associated with clinically significant recovery or improvement at the postintervention or 6-month follow-up evaluations. App use during the 6-month follow-up evaluation was also not associated with clinically significant recovery or improvement at the 6-month follow-up evaluation.

Adverse Events and Harms

No intervention-related adverse events, unintended effects, privacy breaches, or participant safety concerns were reported during the MRT or 6-month follow-up evaluation.

Discussion

Principal Findings

This study presents one of the first optimization-focused evaluations of a gambling JITAI and the first to examine a multimodule theoretically informed gambling JITAI targeting dynamic cognitive relapse processes. The MRT was designed to inform the optimization of GamblingLess: In-The-Moment by assessing whether this JITAI reduced the probability of subsequent gambling episodes (primary proximal outcome) and improved subsequent craving intensity, self-efficacy, and positive outcome expectancies (secondary proximal outcomes). The MRT was conducted alongside a single-arm outcome evaluation to provide a preliminary assessment of changes in gambling symptom severity (primary distal outcome) and gambling frequency, gambling expenditure, craving severity, self-efficacy, and positive outcome expectancies (secondary distal outcomes).

Sample Characteristics

The trial sample was characterized by relatively young Australian men with slightly above-average socioeconomic status, who frequently gambled on EGMs, racing, and sports or events, spending over Aus $800 (US $560) per week. Almost all participants (169/192, 88%) reported gambling classified in the moderate, severe, or extreme categories of the G-SAS, yet half (95/192, 49.5%) indicated nonabstinence treatment goals. These sociodemographic and gambling profiles align with previous evaluations of the pilot app, GamblingLess: Curb Your Urge [33], and the original online GamblingLess program [36]. These findings are consistent with the possibility that digital interventions may be particularly acceptable to younger men and suggest that counselors or peer workers supporting clients using these interventions should be prepared to address both strategic and nonstrategic forms of gambling [36]. The findings also support growing evidence that digital gambling interventions attract people with relatively severe gambling problems [33,36], challenging the conventional positioning of digital interventions as lower-intensity options best suited to people with less severe problems [63]. Moreover, G-SAS gambling symptom severity did not moderate any proximal outcome in the MRT, suggesting no evidence that proximal MRT findings differed by pretreatment gambling symptom severity. Finally, the high rate of nonabstinence goals highlights growing acceptance of flexible treatment objectives in digital settings [64,65], warranting further research into whether such self-directed interventions help reduce barriers linked to abstinence-focused treatment [28].

A key strength of this JITAI was its ability to tailor the delivery of real-time intervention content based on cognitive vulnerability characterized by high craving intensity, low self-efficacy, and/or high positive outcome expectancies. Aligned with previous GamblingLess user profiles [36], the sample profiles at the preintervention evaluation were characterized by high craving severity, low self-efficacy, and high positive outcome expectancies, thereby supporting the intervention content of GamblingLess: In-The-Moment. Interestingly, participants most often exceeded the eligibility thresholds for low self-efficacy and positive outcome expectancies, highlighting these as the dominant cognitive targets.

MRT Findings

The primary MRT findings indicated that delivering a tailored intervention at eligible decision points provided no evidence of reducing the subsequent probability of a gambling episode (or associated expenditure) relative to the no-intervention control condition (MRT primary aim). The point estimate was close to the null, and the 95% CI was reasonably precise, ruling out a substantial effect in either direction while remaining compatible with modest benefit or harm. The 2-level and 4-level intervention models therefore provided no evidence that tailored intervention delivery achieved the primary proximal gambling outcome under the prespecified MRT analytic framework. No intervention option demonstrated clear evidence of reducing the probability of a subsequent

gambling episode (or associated expenditure; MRT secondary aim 1). However, Tackling Triggers was associated with a small improvement in subsequent self-efficacy relative to the control condition, although the CI ranged from a negligible to a somewhat larger improvement. Exploring Expectancies produced a small reduction in subsequent positive outcome expectancies relative to the control condition, although the CI included no effect. These findings are theoretically coherent because the estimated effects for both modules were in the expected direction for the cognitive process they were designed to target, providing useful optimization-relevant evidence. Sensitivity analyses that preserved the MRT decision-point randomization framework showed a similar pattern of findings, including analyses excluding sessions with multiple EMAs in the 2-hour window, adjusting for past-month help-seeking, and examining unplanned gambling episodes or greater-than-planned expenditure. The selection of gambling episodes as a binary behavioral primary proximal outcome therefore provided a clinically meaningful but potentially less statistically sensitive test of proximal intervention effects than more frequently occurring internal states, such as self-efficacy and positive outcome expectancies. This issue was compounded by the low base rate of gambling episodes during the MRT, with participants reporting an average of only 3.1 gambling episodes across the 28-day period, thereby limiting the number of observed behavioral events available for estimating intervention effects.

Post hoc supplementary analyses that partially departed from the MRT's decision-point randomization framework indicated a small reduction in craving intensity and a possible small improvement in self-efficacy, although the CI for self-efficacy included no effect when EMAs were collapsed across the day, providing a longer assessment window than the prespecified next-EMA analyses. These daily-collapsed analyses are hypothesis generating because participants may have been exposed to multiple intervention states within a single day, weakening the temporal alignment between randomization and outcome assessment. Accordingly, these findings are best interpreted as optimization-relevant exploratory evidence of a reduction in craving intensity and a possible improvement in self-efficacy over a longer assessment window, rather than as confirmatory evidence of proximal causal intervention effects. There were also medium to large immediate improvements in all secondary proximal outcomes following intervention activities, with approximately three-quarters of participants no longer meeting intervention eligibility by the end of the intervention loop, with Curbing Cravings demonstrating the largest improvements. These findings provide preliminary evidence of short-term therapeutic impact on the targeted cognitive states because the observed improvements were medium to large, occurred immediately after completion of therapeutic intervention activities, and mapped directly onto the cognitive process targeted by each module. Although optimization relevant, these findings warrant cautious interpretation because these analyses were not controlled causal comparisons, involved repeated measurement of the same item used to trigger intervention eligibility, and may have been influenced by expectancy effects or participants breaking the loop by adjusting their postactivity responses.

The relatively low EMA compliance rate (31.7%) is an important constraint on the interpretation of the MRT findings. As randomization could only occur when participants completed an EMA and met intervention eligibility criteria, relatively low compliance reduced the effective number of observed randomized decision points available for analysis, thereby reducing the decision point–level effective sample size and likely reducing statistical efficiency [20]. Moreover, if EMA completion was associated with momentary vulnerability, receptivity, gambling risk, or participant engagement, the randomized decision points may not fully represent all clinically relevant moments in which intervention support could have been delivered. The predominantly null primary MRT findings should therefore be interpreted as optimization-relevant evidence that the current decision rules and intervention delivery approach did not measurably reduce subsequent gambling episodes within the prespecified proximal assessment window. Relatively low app usage may reflect low intervention engagement (a state of motivational commitment or investment in the client role over the treatment process [65]) or intervention fatigue (a state of emotional or cognitive weariness associated with intervention engagement [66]), which are distinct but interrelated states that fluctuate over time based on individual, contextual, and intervention factors [66]. Delivering support when people are unreceptive may further impact engagement and fatigue [20]. Given that engagement and fatigue are critical to the adherence and retention of mHealth initiatives [20], future research should explore these processes to optimize GamblingLess: In-The-Moment.

Limited understanding of the dynamics of problem gambling development [20], along with insufficient theoretical or empirical guidance for constructing the JITAI's decision rules [14,37], may also have influenced the MRT results. For instance, the time between decision points may not have matched the temporal dynamics of the underlying causal processes [20,67], or notifications may have been delivered when participants were unreceptive (eg, at work) rather than when they were more vulnerable (eg, late at night) [67]. Additionally, the EMA items measuring the proximal outcomes may not have adequately represented the broader distal outcomes, the cognitive processes may not have evidenced a large enough change to significantly affect the likelihood of gambling episodes, or the deliberate selection of low cutoffs might have resulted in interventions being delivered to participants who did not need them [68]. Future optimization efforts are therefore required to fully define the decision points, tailoring variables, and intervention options of this JITAI.

Single-Arm Outcome Evaluation Findings

The single-arm outcome evaluation revealed large improvements in gambling symptom severity (primary distal outcome), with average G-SAS scores dropping from the upper end of the moderate category (approaching the severe

category) to the mild category at the postintervention and 6-month follow-up evaluations (outcome evaluation primary aim). Small to large improvements were also observed for all secondary distal outcomes, even after controlling for help-seeking. However, because participants could access usual care during the trial, concurrent help-seeking remains a plausible contributor to observed change that cannot be fully addressed without a control group. For gambling symptom severity at the individual level, 57.6% (91/158) of participants demonstrated a treatment response on the G-SAS (≥35% reduction) [59], and 66.5% (105/158) demonstrated clinically significant recovery or improvement at the 6-month follow-up evaluation. These rates compare favorably with previous evaluations of GamblingLess (17.3%-69%) and face-to-face interventions (30%-69.6%) [33,36,69,70] and are consistent with promising and clinically meaningful distal outcome improvements over the follow-up period. These findings provide preliminary evidence consistent with potential longer-term intervention effects, given their magnitude, clinical meaningfulness, persistence to 6 months, and consistency across gambling symptom severity and related secondary distal outcomes. However, they do not provide confirmatory evidence that the observed improvements were caused by the JITAI. The absence of a control group in the outcome evaluation, together with high pretreatment gambling symptom severity and possible regression to the mean, limits conclusions about the causal impact of the observed longer-term improvements. Future trials with control groups are needed to establish causality, assess placebo effects, and enhance generalizability.

Moderators of Proximal MRT Effects and Predictors of Distal Outcome Change

The MRT also explored under what conditions the delivery of an intervention option is most beneficial (MRT secondary aim 2) [18,21,22]. These exploratory analyses suggested that the estimated intervention effect on subsequent positive outcome expectancies were more favorable when positive outcome expectancies were higher; that the estimated intervention effect on subsequent self-efficacy was more favorable when readiness to change was higher; and that the estimated effect of Tackling Triggers on subsequent self-efficacy was more favorable among female or nonbinary participants than among male participants.

The single-arm outcome evaluation identified several predictors of clinically significant recovery or improvement on gambling symptom severity (outcome evaluation secondary aim). Recovery or improvement was positively associated with pretreatment craving severity and escape expectancies and negatively associated with socioeconomic status, number of game problems, and postintervention money expectancies. Although many of these associations are in the unexpected direction, greater initial severity may have allowed more room for improvement. Notably, app acceptability (subjective quality and perceived impact), but not app use or engagement indices, was associated with clinically significant change, suggesting that app acceptability may be more closely related to distal outcome change than app use indices. These findings differ from those in the GamblingLess and other trials [36,71-76], underscoring the need to explore whether such predictors are unique to this emerging modality of treatment.

Implications for Optimization

The findings from this study provide several actionable insights for optimizing GamblingLess: In-The-Moment [18,21,22]. First, a closer examination of the decision rules that specify the decision points, tailoring variables, and intervention options is required, as the current adaptive strategies may not have captured the moments of greatest vulnerability. Moreover, because proximal MRT effects did not strengthen across the 28-day MRT period (MRT secondary aim 3) and EMA compliance was relatively low, it remains unclear whether participants received a sufficient intervention dose. Future research should investigate enhancing treatment personalization by exploring the dynamic adjustment of settings, such as personalized decision point frequency and timing, tailoring variable cutoffs, and program duration, through user preferences over time or machine learning–based adaptive algorithms [20,25,68].

Second, the small proximal effect of Tackling Triggers on self-efficacy provides support for retaining this module in the intervention. The imprecisely estimated effect of Exploring Expectancies on positive outcome expectancies provides tentative support for retaining this module pending further evaluation, although there were improvements in self-efficacy when EMAs were collapsed across the day, there were postactivity improvements in self-efficacy after Exploring Expectancies intervention activities, and there were improvements in self-efficacy at the postintervention and 6-month follow-up evaluations. In contrast, Curbing Cravings did not reduce the probability of a gambling episode, gambling expenditure, or craving intensity. However, other analyses provided more positive exploratory signals for this urge management intervention option, whereby the tailored intervention condition was associated with reduced craving intensity when EMAs were collapsed across each day, Curbing Cravings demonstrated the largest postactivity improvements in the intervention loop analyses, and craving severity demonstrated one of the largest improvements of all secondary distal outcomes in the single-arm outcome evaluation. These mixed findings, along with previous promising findings from the GamblingLess: Curb Your Urge trial [33], suggest that a factorial design may help clarify the specific contribution of Curbing Cravings when delivered alone or alongside other intervention options [77].

Third, the findings underscore the importance of personalized tailoring, as participants responded differently to various intervention strategies based on their unique characteristics. For example, readiness to change, which is another cognitive process in the Dynamic Model of Relapse, was associated with stronger proximal MRT effects, suggesting that incorporating strategies such as motivational interviewing techniques, with an associated readiness to change tailoring variable, may improve engagement and proximal intervention effects. Perceived intervention quality and impact

also predicted better outcomes in the single-arm outcome evaluation, highlighting the need for interventions to be acceptable, credible, and user-friendly. Exploring moderators not included in this trial and using adaptive algorithms to personalize intervention delivery based on individual profiles or real-time data could further inform JITAI optimization.

Finally, future evaluations should prioritize enhancing intervention engagement and reducing intervention fatigue to enhance receptivity, EMA compliance, adherence, retention, and outcomes [20]. Understanding how engagement and fatigue fluctuate over time and affect gambling symptom severity can guide the development of strategies to enhance engagement and reduce fatigue. Future versions of this JITAI could target engagement and fatigue by introducing new tailoring variables, proximal outcomes, and intervention strategies, including human support, feedback, rewards, and online communities [20,23,25,68,78].

Study Strengths and Limitations

This was a comprehensive evaluation of one of the first gambling JITAIs, including an MRT to inform optimization alongside a single-arm outcome evaluation over a longer-term period, as well as an acceptability and engagement evaluation [44]. Unlike most available gambling JITAIs, GamblingLess: In-The-Moment was based on pilot data from GamblingLess: Curb Your Urge, informed by the Dynamic Model of Relapse [8], and developed with a multidisciplinary user-centered approach. It features highly operationalized decision rules tying its decision points, tailoring variables, and intervention options together. It is one of the most complex JITAIs to date from an intervention content perspective, compared to simpler interventions, such as motivational messages or reminders [23]. Relative to other early-stage gambling JITAI evaluations, this study involved a large sample and had good follow-up retention, which allows for enhanced representativeness and generalizability to potential end users. Additional external validity was provided by the accessibility of the app through the app stores and the pragmatic nature of the trial, with very few eligibility requirements. Rigorous modeling approaches, investigation of clinically meaningful change, and sensitivity and supplementary analyses were used to contextualize the main findings and inform future optimization.

The MRT and single-arm outcome evaluation reported in the current manuscript were supplemented by a comprehensive acceptability and engagement evaluation (reported elsewhere [44]), in which app use and engagement indices, measures of app acceptability administered at postintervention, and semistructured interview data from a subset of participants were collected. The findings revealed that, on average, participants spent just over 30 minutes in the app and engaged in 9 intervention activities. Overall, 69.6% (112/161) and 87.6% (141/161) of participants scored above the minimum acceptability score (≥3) on the MARS Subjective Quality and Perceived Impact subscales, respectively. However, most participants (124/161, 77%) expressed the desire for a hybrid approach integrating both user-initiated (pull) and system-initiated (push) EMAs. The interviews revealed 2 key themes: facilitating reductions in gambling through check-ins or availability, personal tailoring, seamless and holistic support, and treatment experience suitability; and promoting behavior change through enhanced awareness, goal setting, skill-building, and positive habit formation. Moreover, since the MRT was conducted, GamblingLess: In-The-Moment has been subject to a feasibility evaluation under more "naturalistic" conditions, whereby the app was offered using this hybrid approach, there were no advertising or recruitment campaigns, the no-intervention control condition was removed, no participant reimbursement was provided, the EMA items were restricted to the tailoring variables, and no reminders were sent. The real-world conditions did not substantially change user sociodemographic or gambling profiles, but app uptake and use were somewhat lower than in the current trial. The app remained highly acceptable, with 72.7% (8/11) and 81.8% (9/11) of users scoring above the minimum acceptability scores on the MARS Subjective Quality and Perceived Impact subscales, respectively, and postintervention outcomes appeared at least as favorable as those in the current trial, with 61.5% (8/13) of users reporting clinically significant recovery (but none reporting improvement) on G-SAS gambling symptom severity.

Despite these strengths, this study represents an early stage of gambling mHealth JITAI development, with further research needed to optimize the intervention for greater effectiveness, efficiency, and scalability. Future research should refine and personalize decision rules, tailoring variables, and intervention content, while also addressing low EMA compliance through strategies that improve engagement and reduce assessment burden. As participants were randomized only at completed EMA decision points, low compliance may have introduced selection into who was randomized and when, particularly if EMA completion was related to momentary vulnerability, receptivity, or gambling risk. Cautious interpretation of some findings is required given limitations in the causal models when EMAs were collapsed across each day, the potential for participants to leave the intervention loop by adjusting their responses, and the use of different gambling frequency and expenditure measures across the single-arm outcome evaluation time points. Finally, the absence of a control group and the relatively short follow-up period in the single-arm outcome evaluation highlight the need for longer-term evaluations using randomized controlled trials. Accordingly, the single-arm outcome evaluation supports preliminary effectiveness but cannot establish that observed distal improvements were caused by the intervention.

Conclusions

Owing to insufficient theoretical and empirical evidence to fully specify its decision rules, an MRT was used to generate the empirical data to inform the optimization of GamblingLess: In-The-Moment, one of the first gambling JITAIs. A single-arm outcome evaluation was conducted alongside the MRT to provide a preliminary assessment of longer-term distal outcomes. The primary MRT analyses provided no evidence that tailored intervention

delivery reduced subsequent gambling episodes (or associated expenditure) or improved secondary proximal outcomes, relative to no intervention. Although no intervention option showed clear evidence of reducing gambling episodes (or associated expenditure), the Tackling Triggers and Exploring Expectancies intervention options were associated with small improvements in their associated secondary proximal outcomes (self-efficacy and positive outcome expectancies). Sensitivity analyses also revealed a similar pattern of findings. Post hoc supplementary analyses, which do not fully preserve the MRT's decision-point randomization framework, provided exploratory evidence of a reduction in craving intensity and a possible improvement in self-efficacy when EMAs were collapsed across each day, as well as medium to large immediate improvements in secondary proximal outcomes following intervention activities. The single-arm outcome evaluation showed large and clinically meaningful preliminary improvements in gambling symptom severity and small to large improvements in all secondary distal outcomes at postintervention and 6-month follow-up evaluations, although these changes cannot be causally attributed to the intervention in the absence of a control group. Together, these findings highlight the iterative nature of JITAI development and provide important guidance for the optimization and future controlled evaluation of gambling JITAIs. More broadly, the findings of this study contribute to the emerging evidence base for scalable, low-burden mHealth interventions capable of delivering support during moments of vulnerability in real-world settings.

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Generative AI Use

The authors declare the use of generative AI (GenAI) in the research and writing process. According to the GAIDeT (Generative AI Delegation Taxonomy; 2025), the following tasks were delegated to GenAI tools under full human supervision: proofreading and editing. The GenAI tool used was ChatGPT (GPT-5.5; OpenAI). Responsibility for the final manuscript lies entirely with the authors. GenAI tools are not listed as authors and do not bear responsibility for the final outcomes.

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Data Availability

Data and app digital archives are available from the corresponding author on reasonable request.

Authors' Contributions

Conceptualization: NAD (lead), SSM, SNR (supporting)
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Formal analysis: CJG, GJY (equal)
Funding acquisition: NAD (lead), SSM, SNR (supporting)
Investigation: NAD (lead), SSM, SNR (supporting)
Methodology: NAD (lead), SSM, SNR (supporting)
Project administration: ACT (lead), COH (supporting)
Writing – original draft: NAD (lead), COH, CJG (supporting)
Writing – review & editing: NAD (lead), SSM, SNR, ACT, COH, CJG, GJY, DIL (supporting)

Conflicts of Interest

None declared.

Multimedia Appendix 1

. GamblingLess: In-The-Moment EMA items.
[DOC File (Microsoft Word File), 46 KB-Multimedia Appendix 1]

Multimedia Appendix 2

. Overview of the GamblingLess: In-The-Moment intervention options.
[DOC File (Microsoft Word File), 38 KB-Multimedia Appendix 2]

Multimedia Appendix 3

. GamblingLess: In-The-Moment intervention eligibility.
[DOC File (Microsoft Word File), 38 KB-Multimedia Appendix 3]

Multimedia Appendix 4

. Self-report measures employed in the within-group follow-up evaluation.
[DOC File (Microsoft Word File), 96 KB-Multimedia Appendix 4]

Multimedia Appendix 5

. Event-level summary of intervention eligibility microrandomization intervention option assignment and EMA event record.
[DOC File (Microsoft Word File), 42 KB-Multimedia Appendix 5]

Multimedia Appendix 6

. Preintervention sample sociodemographic characteristics.
[DOC File (Microsoft Word File), 48 KB-Multimedia Appendix 6]

Multimedia Appendix 7

. Preintervention sample sociodemographic characteristics for nonanalytic and analytic samples.
[DOC File (Microsoft Word File), 58 KB-Multimedia Appendix 7]

Multimedia Appendix 8

. Preintervention sample gambling characteristics.
[DOC File (Microsoft Word File), 51 KB-Multimedia Appendix 8]

Multimedia Appendix 9

. Preintervention sample gambling characteristics for nonanalytic and analytic samples.
[DOC File (Microsoft Word File), 32 KB-Multimedia Appendix 9]

Multimedia Appendix 10

. Participant-level summary of intervention eligibility, microrandomization, and intervention option assignment.
[DOCX File (Microsoft Word File), 41 KB-Multimedia Appendix 10]

Multimedia Appendix 11

. Associations between intervention status and subsequent outcomes excluding multi-EMA sessions.
[PDF File (Adobe File), 76 KB-Multimedia Appendix 11]

Multimedia Appendix 12

. Associations between intervention status and subsequent outcomes after adjusting for past-month help-seeking.
[DOC File (Microsoft Word File), 75 KB-Multimedia Appendix 12]

Multimedia Appendix 13

. Associations between intervention status and subsequent unplanned gambling episodes and expenditure.
[DOC File (Microsoft Word File), 45 KB-Multimedia Appendix 13]

Multimedia Appendix 14

. Associations between intervention status and subsequent outcomes when the EMAs across each day were collapsed.
[DOC File (Microsoft Word File), 46 KB-Multimedia Appendix 14]

Multimedia Appendix 15

. Summary of intervention status × moderator *P* values.
[DOC File (Microsoft Word File), 84 KB-Multimedia Appendix 15]

Multimedia Appendix 16

. Longitudinal change from preintervention to postintervention and 6-month follow-up.

[DOC File (Microsoft Word File), 61 KB-Multimedia Appendix 16]

Multimedia Appendix 17

. Predictors of G-SAS gambling symptom severity recovery or improvement at postintervention and 6-month follow-up.
[DOC File (Microsoft Word File), 106 KB-Multimedia Appendix 17]

Checklist 1. CONSORT checklist.

[DOCX File (Microsoft Word File), 38 KB-Checklist 1. CONSORT checklist.]

Checklist 2. CONSORT-EHEALTH checklist.

[DOC File (Microsoft Word File), 400 KB-Checklist 2. CONSORT-EHEALTH checklist.]

Checklist 3. TIDieR checklist.

[DOCX File (Microsoft Word File), 32 KB-Checklist 3. TIDieR checklist.]

References

1. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. American Psychiatric Association; 2022. [doi: 10.1176/appi.books.9780890425787]
2. Neal P, Delfabbro P, O'Neil M. Problem gambling and harm: toward a national definition. Office of Gaming and Racing; 2005.
3. Gabellini E, Lucchini F, Gattoni ME. Prevalence of problem gambling: a meta-analysis of recent empirical research (2016-2022). J Gambl Stud. Sep 2023;39(3):1027-1057. [doi: 10.1007/s10899-022-10180-0] [Medline: 36586057]
4. Dowling NA, Youssef GJ, Jackson AC, et al. National estimates of Australian gambling prevalence: f indings from a dual-frame omnibus survey. Addiction. Mar 2016;111(3):420-435. [doi: 10.1111/add.13176]
5. Gainsbury SM, Russell A, Hing N, Wood R, Lubman DI, Blaszczynski A. The prevalence and determinants of problem gambling in Australia: assessing the impact of interactive gambling and new technologies. Psychol Addict Behav. Sep 2014;28(3):769-779. [doi: 10.1037/a0036207] [Medline: 24865462]
6. Hing N, Russell A, Browne M, et al. The Second National Study of Interactive Gambling in Australia (2019–20). Gambling Research Australia; 2021. URL: https://www.gamblingresearch.org.au/sites/default/files/2021-10/Final%20IGS%20report%202021.pdf [Accessed 2026-10-20]
7. Langham E, Thorne H, Browne M, Donaldson P, Rose J, Rockloff M. Understanding gambling related harm: a proposed definition, conceptual framework, and taxonomy of harms. BMC Public Health. Jan 27, 2016;16:80. [doi: 10.1186/s12889-016-2747-0] [Medline: 26818137]
8. Witkiewitz K, Marlatt GA. Relapse prevention for alcohol and drug problems: that was Zen, this is Tao. Am Psychol. 2004;59(4):224-235. [doi: 10.1037/0003-066X.59.4.224] [Medline: 15149263]
9. Canale N, Cornil A, Giroux I, Bouchard S, Billieux J. Probing gambling urge as a state construct: evidence from a sample of community gamblers. Psychol Addict Behav. Mar 2019;33(2):154-161. [doi: 10.1037/adb0000438] [Medline: 30614716]
10. Cornil A, Lopez-Fernandez O, Devos G, de Timary P, Goudriaan AE, Billieux J. Exploring gambling craving through the elaborated intrusion theory of desire: a mixed methods approach. Int Gambl Stud. Jan 2, 2018;18(1):1-21. [doi: 10.1080/14459795.2017.1368686]
11. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev. Mar 1977;84(2):191-215. [doi: 10.1037//0033-295x.84.2.191] [Medline: 847061]
12. Barbaranelli C, Ghezzi V, Fida R, Vecchione M. Psychometric characteristics of a new scale for measuring self-efficacy in the regulation of gambling behavior. Front Psychol. 2017;8:1025. [doi: 10.3389/fpsyg.2017.01025] [Medline: 28676781]
13. Flack M, Morris M. Problem gambling: one for the money…? J Gambl Stud. Dec 2015;31(4):1561-1578. [doi: 10.1007/s10899-014-9484-z]
14. Dowling NA, Merkouris SS, Youssef GJ, et al. A gambling just-in-time adaptive intervention (GamblingLess: In-The-Moment): protocol for a microrandomized trial. JMIR Res Protoc. 2022;11(8):e38958. [doi: 10.2196/38958]
15. Hawker CO, Merkouris SS, Youssef GJ, Dowling NA. Exploring the associations between gambling cravings, self-efficacy, and gambling episodes: an ecological momentary assessment study. Addict Behav. Jan 2021;112:106574. [doi: 10.1016/j.addbeh.2020.106574]
16. Dowling NA, Merkouris SS, Spence K. Ecological momentary assessment of the relationship between positive outcome expectancies and gambling behaviour. JCM. 2021;10(8):1709. [doi: 10.3390/jcm10081709]

17. Gee P, Coventry KR, Birkenhead D. Mood state and gambling: using mobile telephones to track emotions. British J of Psychology. Feb 2005;96(1):53-66. [doi: 10.1348/000712604X15536]
18. Carpenter SM, Menictas M, Nahum-Shani I, Wetter DW, Murphy SA. Developments in mobile health just-in-time adaptive interventions for addiction science. Curr Addict Rep. Sep 2020;7(3):280-290. [doi: 10.1007/s40429-020-00322-y] [Medline: 33747711]
19. Nahum-Shani I, Hekler EB, Spruijt-Metz D. Building health behavior models to guide the development of just-in-time adaptive interventions: a pragmatic framework. Health Psychology. 2015;34(Suppl):1209-1219. [doi: 10.1037/hea0000306]
20. Nahum-Shani I, Smith SN, Spring BJ, et al. Just-in-time adaptive interventions (JITAIs) in mobile health: key components and design principles for ongoing health behavior support. Ann Behav Med. May 18, 2018;52(6):446-462. [doi: 10.1007/s12160-016-9830-8]
21. Walton A, Nahum-Shani I, Crosby L, Klasnja P, Murphy S. Optimizing digital integrated care via micro-randomized trials. Clin Pharma and Therapeutics. Jul 2018;104(1):53-58. [doi: 10.1002/cpt.1079]
22. Klasnja P, Hekler EB, Shiffman S, et al. Microrandomized trials: an experimental design for developing just-in-time adaptive interventions. Health Psychol. Dec 2015;34S:1220-1228. [doi: 10.1037/hea0000305] [Medline: 26651463]
23. Liao P, Dempsey W, Sarker H, et al. Just-in-time but not too much: determining treatment timing in mobile health. Proc ACM Interact Mob Wearable Ubiquitous Technol. Dec 2018;2(4):1-21. [doi: 10.1145/3287057] [Medline: 30801052]
24. Bakker D, Kazantzis N, Rickwood D, Rickard N. Mental health smartphone apps: review and evidence-based recommendations for future developments. JMIR Ment Health. Mar 1, 2016;3(1):e7. [doi: 10.2196/mental.4984] [Medline: 26932350]
25. Kim J, Marcusson-Clavertz D, Yoshiuchi K, Smyth JM. Potential benefits of integrating ecological momentary assessment data into mHealth care systems. Biopsychosoc Med. 2019;13(1):19. [doi: 10.1186/s13030-019-0160-5] [Medline: 31413726]
26. Miralles I, Granell C, Díaz-Sanahuja L, et al. Smartphone apps for the treatment of mental disorders: systematic review. JMIR Mhealth Uhealth. Apr 2, 2020;8(4):e14897. [doi: 10.2196/14897] [Medline: 32238332]
27. Bijker R, Booth N, Merkouris SS, Dowling NA, Rodda SN. Global prevalence of help-seeking for problem gambling: a systematic review and meta-analysis. Addiction. Dec 2022;117(12):2972-2985. [doi: 10.1111/add.15952] [Medline: 35830876]
28. Dąbrowska K, Moskalewicz J, Wieczorek Ł. Barriers in access to the treatment for people with gambling disorders. Are they different from those experienced by people with alcohol and/or drug dependence? J Gambl Stud. Jun 2017;33(2):487-503. [doi: 10.1007/s10899-016-9655-1] [Medline: 27832520]
29. Quigley L. Gambling disorder and stigma: opportunities for treatment and prevention. Curr Addict Rep. 2022;9(4):410-419. [doi: 10.1007/s40429-022-00437-4] [Medline: 36093357]
30. Humphrey G, Newcombe D, Whittaker R, Parag V, Bulleen C. SPGeTTI: a smartphone-based problem gambling evaluation and technology testing initiative final report. Auckland UniServices Limited: The University of Auckland; 2019. URL: https://www.health.govt.nz/system/files/2019-06/20190424-spgetti-354913-00-final-report.pdf [Accessed 2026-10-20]
31. Coral R, Esposito F, Weinstock J. Don’t go there: a zero-permission geofencing app to alleviate gambling disorders. In: Weinstock J, editor. Presented at: 2020 IEEE 17th Annual Consumer Communications & Networking Conference (CCNC); Jan 10-13, 2020; Las Vegas, NV, USA. [doi: 10.1109/CCNC46108.2020.9045251]
32. Khazaal Y, Monney G, Richter F, Achab S. « Jeu-contrôle », rationnel d’une application de soutien aux limites de jeux. Journal de Thérapie Comportementale et Cognitive. Sep 2017;27(3):129-137. [doi: 10.1016/j.jtcc.2017.05.003]
33. Hawker CO, Merkouris SS, Youssef GJ, Dowling NA. A smartphone-delivered ecological momentary intervention for problem gambling (GamblingLess: Curb Your Urge): single-arm acceptability and feasibility trial. J Med Internet Res. Mar 26, 2021;23(3):e25786. [doi: 10.2196/25786] [Medline: 33769294]
34. Merkouris SS, Hawker CO, Rodda SN, Youssef GJ, Dowling NA. GamblingLess: Curb Your Urge: development and usability testing of a smartphone-delivered ecological momentary intervention for problem gambling. Int Gambl Stud. Sep 1, 2020;20(3):515-538. [doi: 10.1080/14459795.2020.1749293]
35. Merkouris SS, Rodda SN, Austin D, et al. GamblingLess: For Life study protocol: a pragmatic randomised trial of an online cognitive-behavioural programme for disordered gambling. BMJ Open. Feb 23, 2017;7(2):e014226. [doi: 10.1136/bmjopen-2016-014226] [Medline: 28235970]
36. Dowling NA, Merkouris SS, Rodda SN, et al. GamblingLess: a randomised trial comparing guided and unguided internet-based gambling interventions. J Clin Med. May 21, 2021;10(11):2224. [doi: 10.3390/jcm10112224] [Medline: 34063826]

37. Dowling NA, Rodda SN, Merkouris SS. Applying the just-in-time adaptive intervention framework to the development of gambling interventions. J Gambl Stud. Jun 2024;40(2):717-747. [doi: 10.1007/s10899-023-10250-x] [Medline: 37659031]
38. Humphrey G, Chu JT, Ruwhiu-Collins R, et al. Adapting an evidence-based e-learning cognitive behavioral therapy program into a mobile app for people experiencing gambling-related problems: formative study. JMIR Form Res. Mar 25, 2022;6(3):e32940. [doi: 10.2196/32940] [Medline: 35108213]
39. Rodda SN, Merkouris S, Lavis T, et al. The therapist experience of internet delivered CBT for problem gambling: service integration considerations. Internet Interv. Dec 2019;18:100264. [doi: 10.1016/j.invent.2019.100264] [Medline: 31890617]
40. Merkouris SS, Loram G, Abdelrazek M, et al. Improving the user experience of a gambling support and education website using a chatbot. Univ Access Inf Soc. Mar 2024;23(1):213-225. [doi: 10.1007/s10209-022-00932-5]
41. Dowling NA, Merkouris SS, Rodda S, Smith D, Lavis T, Lubman D, et al. Development and evaluation of an online gambling self-directed program: effective integration into existing services. Victorian Responsible Gambling Foundation; 2018.
42. Humphrey G, Chu J, Dowling N, et al. Manaaki - a cognitive behavioral therapy mobile health app to support people experiencing gambling problems: a randomized control trial protocol. BMC Public Health. Feb 6, 2020;20(1):191. [doi: 10.1186/s12889-020-8304-x] [Medline: 32028926]
43. Collins LM, Kugler KC. Optimization of Behavioral, Biobehavioral, and Biomedical Interventions. Springer International Publishing; 2018. [doi: 10.1007/978-3-319-91776-4] ISBN: 3319722069
44. Dowling NA, Merkouris SS, Greenwood CJ, et al. GamblingLess: In-The-Moment: a mixed-methods acceptability and engagement evaluation of a gambling just-in-time adaptive intervention. Addict Sci Clin Pract. 2025;20(1):80. [doi: 10.1186/s13722-025-00608-4]
45. Hopewell S, Chan AW, Collins GS, et al. CONSORT 2025 statement: updated guideline for reporting randomised trials. The Lancet. May 2025;405(10489):1633-1640. [doi: 10.1016/S0140-6736(25)00672-5]
46. Eysenbach G, CONSORT-EHEALTH Group. CONSORT-EHEALTH: improving and standardizing evaluation reports of web-based and mobile health interventions. J Med Internet Res. Dec 31, 2011;13(4):e126. [doi: 10.2196/jmir.1923] [Medline: 22209829]
47. Janiaud P, Hemkens LG. Pragmatic evidence and the nature of randomized trials. J Clin Epidemiol. Nov 2025;187:111961. [doi: 10.1016/j.jclinepi.2025.111961]
48. Kim SW, Grant JE, Potenza MN, Blanco C, Hollander E. The Gambling Symptom Assessment Scale (G-SAS): a reliability and validity study. Psychiatry Res. Mar 31, 2009;166(1):76-84. [doi: 10.1016/j.psychres.2007.11.008] [Medline: 19200607]
49. Weinstock J, Whelan JP, Meyers AW. Behavioral assessment of gambling: an application of the timeline followback method. Psychol Assess. Mar 2004;16(1):72-80. [doi: 10.1037/1040-3590.16.1.72] [Medline: 15023094]
50. Tavares H, Zilberman ML, Hodgins DC, el-Guebaly N. Comparison of craving between pathological gamblers and alcoholics. Alcohol Clin Exp Res. Aug 2005;29(8):1427-1431. [doi: 10.1097/01.alc.0000175071.22872.98] [Medline: 16131850]
51. Coloma-Carmona A, Carballo JL, Dowling NA. Psychometric validation and measurement invariance of the Brief Situational Confidence Questionnaire for Gambling (BSCQ-G) in a sample of adult gamblers from the general population. Psychol Addict Behav. Feb 2026;40(1):86-98. [doi: 10.1037/adb0001076] [Medline: 40471818]
52. Rodda SN, Dowling NA, Lubman DI. Gamblers seeking online help are active help-seekers: time to support autonomy and competence. Addict Behav. Dec 2018;87:272-275. [doi: 10.1016/j.addbeh.2018.06.001] [Medline: 29935737]
53. Stoyanov SR, Hides L, Kavanagh DJ, Zelenko O, Tjondronegoro D, Mani M. Mobile App Rating Scale: a new tool for assessing the quality of health mobile apps. JMIR mHealth uHealth. Mar 11, 2015;3(1):e27. [doi: 10.2196/mhealth.3422]
54. Lakens D. Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. Front Psychol. Nov 26, 2013;4:863. [doi: 10.3389/fpsyg.2013.00863] [Medline: 24324449]
55. Fey CF, Hu T, Delios A. The measurement and communication of effect sizes in management research. Manag Organ Rev. Feb 2023;19(1):176-197. [doi: 10.1017/mor.2022.2]
56. Patidar V, Sinha L, Sharma SK, Gaur R, Varshney S, Mudgal SK. A practical methodological primer on sample size determination using G*Power for biomedical research. Niger Med J. 2026;67(2):451-462. [Medline: 42553991]
57. Cameron JJ, Stinson DA. Gender (mis)measurement: guidelines for respecting gender diversity in psychological research. Social Personality Psych. Nov 2019;13(11). [doi: 10.1111/spc3.12506]
58. Gabrio A, Plumpton C, Banerjee S, Leurent B. Linear mixed models to handle missing at random data in trial-based economic evaluations. Health Econ. Jun 2022;31(6):1276-1287. [doi: 10.1002/hec.4510] [Medline: 35368119]

59. Grant JE, Ioannidis K, Chamberlain SR. Defining treatment response in gambling disorder. J Psychiatr Res. Dec 2024;180:382-386. [doi: 10.1016/j.jpsychires.2024.11.006]
60. Jacobson NS, Truax P. Clinical significance: a statistical approach to defining meaningful change in psychotherapy research. J Consult Clin Psychol. Feb 1991;59(1):12-19. [doi: 10.1037//0022-006x.59.1.12] [Medline: 2002127]
61. Rodda SN, Bagot KL, Merkouris SS, et al. Smartphone app delivery of a just-in-time adaptive intervention for adult gamblers (Gambling Habit Hacker): protocol for a microrandomized trial. JMIR Res Protoc. Jul 26, 2022;11(7):e38919. [doi: 10.2196/38919] [Medline: 35881441]
62. Rodda SN, Merkouris SS, Greenwood CJ, Thomas AC, Lubman DI, Dowling NA. Acceptability of the content and functionality of a just-in-time adaptive intervention for gambling problems: a mixed-methods evaluation of Gambling Habit Hacker. Addict Sci Clin Pract. 2025;20(1):46. [doi: 10.1186/s13722-025-00573-y]
63. Duffy D, Enrique A, Connell S, Connolly C, Richards D. Internet-delivered cognitive behavior therapy as a prequel to face-to-face therapy for depression and anxiety: a naturalistic observation. Front Psychiatry. 2019;10:902. [doi: 10.3389/fpsyt.2019.00902] [Medline: 31998149]
64. Ladouceur R. Controlled gambling for pathological gamblers. J Gambl Stud. 2005;21(1):49-59. [doi: 10.1007/s10899-004-1923-9] [Medline: 15789190]
65. King G, Currie M, Petersen P. Child and parent engagement in the mental health intervention process: a motivational framework. Child Adolesc Ment Health. Feb 2014;19(1):2-8. [doi: 10.1111/camh.12015] [Medline: 32878365]
66. Heckman BW, Mathew AR, Carpenter MJ. Treatment burden and treatment fatigue as barriers to health. Curr Opin Psychol. Oct 1, 2015;5:31-36. [doi: 10.1016/j.copsyc.2015.03.004] [Medline: 26086031]
67. Bidargaddi N, Schrader G, Klasnja P, Licinio J, Murphy S. Designing m-Health interventions for precision mental health support. Transl Psychiatry. Jul 7, 2020;10(1):222. [doi: 10.1038/s41398-020-00895-2] [Medline: 32636358]
68. Goldstein SP, Evans BC, Flack D, et al. Return of the JITAI: applying a just-in-time adaptive intervention framework to the development of m-Health solutions for addictive behaviors. Int J Behav Med. Oct 2017;24(5):673-682. [doi: 10.1007/s12529-016-9627-y] [Medline: 28083725]
69. Milton S, Crino R, Hunt C, Prosser E. The effect of compliance-improving interventions on the cognitive-behavioural treatment of pathological gambling. J Gambl Stud. 2002;18(2):207-229. [doi: 10.1023/a:1015580800028] [Medline: 12096449]
70. Petry NM, Weinstock J, Ledgerwood DM, Morasco B. A randomized trial of brief interventions for problem and pathological gamblers. J Consult Clin Psychol. Apr 2008;76(2):318-328. [doi: 10.1037/0022-006X.76.2.318] [Medline: 18377127]
71. Merkouris SS, Thomas SA, Browning CJ, Dowling NA. Predictors of outcomes of psychological treatments for disordered gambling: a systematic review. Clin Psychol Rev. Aug 2016;48:7-31. [doi: 10.1016/j.cpr.2016.06.004] [Medline: 27372437]
72. Beatty L, Binnion C. A systematic review of predictors of, and reasons for, adherence to online psychological interventions. Int J Behav Med. Dec 2016;23(6):776-794. [doi: 10.1007/s12529-016-9556-9] [Medline: 26957109]
73. Myrseth H, Brunborg GS, Eidem M, Pallesen S. Description and pre-post evaluation of a telephone and Internet based treatment programme for pathological gambling in Norway: a pilot study. Int Gambl Stud. Aug 2013;13(2):205-220. [doi: 10.1080/14459795.2012.759610]
74. Bücker L, Bierbrodt J, Hand I, Wittekind C, Moritz S. Effects of a depression-focused internet intervention in slot machine gamblers: a randomized controlled trial. PLoS One. 2018;13(6):e0198859. [doi: 10.1371/journal.pone.0198859] [Medline: 29883479]
75. Hodgins DC, Cunningham JA, Murray R, Hagopian S. Online self-directed interventions for gambling disorder: randomized controlled trial. J Gambl Stud. Jun 15, 2019;35(2):635-651. [doi: 10.1007/s10899-019-09830-7]
76. Carlbring P, Degerman N, Jonsson J, Andersson G. Internet-based treatment of pathological gambling with a three-year follow-up. Cogn Behav Ther. 2012;41(4):321-334. [doi: 10.1080/16506073.2012.689323] [Medline: 22620990]
77. Collins LM, Dziak JJ, Kugler KC, Trail JB. Factorial experiments: efficient tools for evaluation of intervention components. Am J Prev Med. Oct 2014;47(4):498-504. [doi: 10.1016/j.amepre.2014.06.021] [Medline: 25092122]
78. Yardley L, Spring BJ, Riper H, et al. Understanding and promoting effective engagement with digital behavior change interventions. Am J Prev Med. Nov 2016;51(5):833-842. [doi: 10.1016/j.amepre.2016.06.015]

Abbreviations

BSCQ-G: Brief Situational Confidence Questionnaire-Gambling
CONSORT: Consolidated Standards of Reporting Trials
CONSORT-EHEALTH: Consolidated Standards of Reporting Trials of Electronic and Mobile Health Applications and Online Telehealth
DSM-5-TR: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision

EGM: electronic gaming machine
EMA: ecological momentary assessment
G-SAS: Gambling Symptom Assessment Scale
GEE: generalized estimating equation
GOES: Gambling Outcome Expectancies Scale
HSQ: Help-Seeking Questionnaire
IRSAD: Index of Relative Socio-Economic Advantage and Disadvantage
JITAI: just-in-time adaptive intervention
MARS: Mobile App Rating Scale
mHealth: mobile health
MRT: microrandomized trial
OR: odds ratio
PACS-G: Penn Alcohol Craving Scale modified for Gambling
SEIFA: Socio-Economic Indexes for Areas
TIDieR: Template for Intervention Description and Replication
TLFB: Timeline Follow-Back
TLFF: Timeline Follow-Forward

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