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ReplaceIt: Lessons from a User-Centered Design Framework in Co-Creating an Alcohol Reduction App

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Abstract

Smartphone apps that target alcohol problems report mixed effectiveness data, which may be explained by a lack of evidence-based content and user-centred design (UCD). This paper presents the development of ReplaceIt, a smartphone application co-designed to reduce risky drinking using an evidence-based UCD framework. Initial steps included a systematic review of existing apps, interviews with end-users, and evidence-based intervention design by our multidisciplinary team, resulting in a prototype of the app. Next, the app's key components—goal setting, self-monitoring with feedback, and implementation intention strategies—were refined through co-design with end-users using a think-aloud study and iterative pilot testing. Refinement included the introduction of a module to enhance user interaction with implementation intentions, simplified instructions, and enhanced user engagement features. The resulting ReplaceIt app was then in an excellent position to undergo efficacy testing, with high usability scores and positive user reception suggesting strong potential for reducing risky drinking behaviours. Overall, the UCD framework proved essential in developing an app that aligns with user preferences and behaviours, ultimately enhancing its functionality and potential efficacy.

Keywords: alcohol; user-centered design; smartphone application; implementation intentions; risky drinking

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1. Introduction

While face-to-face interventions can effectively reduce alcohol consumption [1],[2],[3], many people engaging in risky drinking do not seek treatment due to a multitude of barriers including concerns about privacy, stigma, time commitment, limited trust in health professionals and a preference for self-reliance [3],[4],[5]. Smartphone health-related apps may mitigate many of these help-seeking barriers [6],[7], and therefore reduce the morbidity and mortality rates associated with alcohol misuse.

Despite their potential, most smartphone apps designed to address alcohol problems lack evidence-based content, and effectiveness data is mixed [8],[9]. These apps often employ complex, multicomponent interventions, leading to low rates of user adherence and retention. User-centred design (UCD) – a method widely used in developing software applications – can improve retention [10],[11]. UCD prioritizes the needs, preferences, and experiences of end users throughout the design and development process [12].

The UCD approach typically involves several stages. The first stage involves user research and a needs assessment, utilizing both qualitative and quantitative methods, to understand users' needs, goals, and behaviors [13]. The next stage includes prototyping and iterative design, where prototypes are created to gather user feedback and refine the design accordingly. This is followed by co- or participatory design which actively involves end users in an iterative design process to develop a prototype application. In the final stage, the prototype is evaluated for usability with representative users to collect feedback on the user experience and make further improvements to ensure the prototype is ready for use and efficacy testing.

To address the need for more evidence-based co-designed smartphone apps to reduce alcohol consumption, we set out to develop such an app using a UCD framework. In the current paper, we describe the development of the content and the design of the app.

2. App content and design development and lessons learned

The iterative design process involved conducting a systematic review, input from clinical experts, consumer feedback, user-testing of our prototype via the think-aloud method, and iterative co-design feedback, modifications and then further piloting until the app was ready for efficacy testing (see Fig 1). Each of these steps is described in more detail below. Ethics approval was sought and obtained from the relevant Human Research Ethics Committee for all elements involving end-user participants (DUHREC – 2016-059). Participants were recruited through social media and noticeboards and received AU$30 as reimbursement for their time.

Fig. 1. Iterative user-centred design (UCD) process for alcohol reduction smartphone app development

2.1. App content development

2.1.1. Systematic Review of Smartphone apps to reduce the use of substances

The app's intervention content is informed by our systematic review of smartphone applications aimed at reducing substance use [9]. The review found that there is a paucity of RCTs assessing the efficacy of smartphone apps for reducing alcohol consumption. Furthermore, of the 20 apps evaluated through randomized controlled trials (RCTs), only seven demonstrate superior outcomes compared to control conditions. Finally, effective apps tended to incorporate self-monitoring and feedback mechanisms and included a focused intervention approach which avoided complex and multidimensional components.

2.1.2. Expert and consumer input into intervention components

We set up an advisory group consisting of those with lived experience, clinicians in the alcohol field, and researchers with expertise on the topic. The advisory group consisted of ten people who provided pro bono input via one-on-one video calls, written feedback on the prototype and two team meetings in the form of focus groups. Through a process of reviewing the relevant literature and seeking advice from our advisory group, we chose to focus on three key intervention components for the alcohol app. The key components are described below.

Goal setting: Based on focus group feedback from our advisory group (n=7) we developed a goal setting approach which did not focus on drink number, but instead used realistic goals that better aligned with the functionality of an app, i.e. setting times and receiving notifications. We refer to this as the "Chronos approach" [14]. It comprised of four goals (Skip, Delay, Slow and Stop) that serve to limit drinking days, drinking times during the day, and drinking speed. The Skip Goals are designated alcohol-free days; the Delay Goal is delaying the time that drinking might commence on a drinking day; the Slow Goal targets slowing down while drinking; and the Stop Goal sets a time to cease drinking on a drinking day.

Self-monitoring and feedback: Self-monitoring and feedback are core components of interventions for substance use problems [15]. Notifications prompt participants to record the type and amount of alcohol consumed each day. The feedback component, delivered within the same daily notification, shows a daily consumption bar graph spanning the entire intervention (indicating whether each day's entry was above or below Australian safe drinking guidelines [16]) and a cumulative average line graph (indicating whether the consumption average is above or below Australian safe drinking guidelines).

Implementation intention behaviour change strategy: The app employs implementation intentions (i.e., If-then planning) to change behavior [17]. Evidence and user feedback shows that If-Then Plans have a strong evidence-base for reducing alcohol consumption [18] and are sufficiently simple and suitable to deploy within an app. Users set up personalized If-Then Plans associated with each of the above four goals. For each Plan, participants progress through a guided setup that involves selecting the most challenging obstacles for achieving each goal (the If statement; e.g., 'If I feel like a drinking when I'm feeling stressed'), selecting the best alternative response to that obstacle (the Then statement; e.g., 'Then I'll call/message a friend and talk about my struggles'), and then modifying some components of the Then statement to better personalize the If-Then Plan to them (e.g., in the example provided in Table 1, the words 'a friend' can be modified to the most relevant person) We received feedback during the codesign process that participants needed some guidance with developing their If-Then plans. We subsequently undertook an expert consensus Delphi study and, we developed a set of high-risk situations that individuals face that might trigger drinking, and then generated a list of plans to represent useful behavior change strategies on which experts identified and reached consensus. These plans were added to the app as templates which users could select from and modify.

Table 1. Example If-Then statements for each of the four goals.

Goal	If	Then
Skip	If I feel like a drink when I'm feeling stressed	Then I'll call/message (a friend) and talk about my struggles
Dealy	If I feel like a drink before (##) pm	Then I'll 'surf' the urge and watch it peak and pass
Slow	If I am about to have a drink	Then I'll remember to (put my drink down between each sip)
Stop	If I am about to go to a bar or social event	Then I'll limit the amount of drinks/money I take

Note: Components of 'then' statements within brackets can be personalised by participants

2.2. App design development

2.2.1 Prototype testing: Think Aloud study

A 'think-aloud study' [19] – i.e., where participants verbalize their thoughts and experiences while using the app – was conducted to evaluate the usability of a prototype version of the app aimed at supporting risky drinkers. This method provides insights into participants' cognitive processes and identifies usability issues in real time.

Participants and Procedure: Six participants (3 men, 3 women, age range 25-43 years) who wished to reduce

their drinking attended one-hour individual sessions in a laboratory setting. During these sessions, two researchers were present to facilitate the think-aloud process and observe participants' interactions with the app. Participants were asked only to “download the app on their phone and start to use it”, no further instructions on how to use the app were provided. Participants were asked to verbalize their thoughts, feelings, and actions while using the app, which were then recorded and transcribed. This information was then tabulated and discussed with the research team, key issues to improve the usability were identified and presented to the advisory group for feedback. A final list of areas for improvement was then provided to the app technical team (AS, EO) for actioning.

User-centered Feedback: The think-aloud procedure revealed seven key areas to improve usability:

- Inadequate guidance regarding procedural flow: Participants frequently encountered points in the app where they were unsure of what to do next, often verbalizing questions like "So, now what?" This indicated a need for increased guidance for procedural flow.
- Technical bugs: Some technical issues were noted, affecting the functionality of on-screen components. These bugs disrupted the user experience.
- Inadequate on-screen component functionality: Participants struggled with the functionality of certain on-screen elements.
- Unclear instructions: Participants found some instructions unclear or misleading particularly regarding how the cumulative drinking graphs were calculated.
- Non-intuitive task order: The sequence of tasks within the app was not intuitive for some users.
- Aesthetic issues: Participants expressed preferences regarding the design and aesthetics of the app, indicating areas where the app's visual appeal could be improved.
- Inadequate efficiency of use: Some concerns were raised about the time commitment regarding setting up the if then plans. Participants indicated that certain tasks took longer than anticipated or were perceived as too time-consuming.

The System Usability Scale [20] (SUS) was administered to quantify the usability of the app. The mean SUS score was 75.4 (SD=7.0), indicating above-average usability but the qualitative feedback indicated that there was considerable room for improvement.

Details of the next iteration of the app: The think-aloud study provided detailed input to the prototype and was a critical method enabling us to improve and then build a full version of the app. While the app demonstrated a reasonably high level of usability, users highlighted several areas requiring improvement to enhance the user experience and streamline procedural flow which were then addressed in the next iteration of the app.

2.2.2. Pilot study one

Participants and procedure: A total of 14 participants (9 women, 5 men, age range 23- 58 years) were recruited from the target population of individuals who wanted to cut down their drinking. Participants were asked to use the alcohol reduction app daily for a period of 9 days. During the 9-day period, participants completed daily online surveys to provide feedback on their experience, usability, and any encountered issues.

Measures: Daily Online Surveys: These surveys collected qualitative and quantitative data on user engagement, usability issues, and overall satisfaction with the app. SUS: The SUS was administered at the end of the study to assess the overall usability of the app. The SUS is a reliable tool that provides a single score based on a 10-item questionnaire, with scores ranging from 0 to 100. Key Outcomes: Key outcomes of interest included the centrality and engagement with the app's features, technical issues, usability issues, and agreeability issues.

User-centred feedback: The key lessons from the first pilot study are outlined below with opportunities for improvement provided by end-users:

- Inadequate participant engagement for If-Then Plans: All participants used the app daily over the 9-day period and provided positive feedback regarding the goals and self-monitoring and feedback components. However, the key feature of creating and following if-then plans (i.e., implementation intentions behaviour

change strategy) was not consistently understood as central by the participants, and engagement with this feature was low.

- Minimal technical bugs: Very few technical bugs were reported, indicating that the app was generally stable and functioned as intended.
- Usability issues: Participants identified several usability issues that required improvement. A key intervention component of the app (i.e., implementation intention strategy) was not noticed by users, and notifications were deemed too frequent, leading to potential annoyance.
- Agreeability issues: Some participants reported mixed responses to the app's design and content. There were concerns about the interpretation of the app's logo and name, which users felt could affect user acceptance and comfort in using the app. Some also felt that the explanatory videos were a little too formal and needed to be shorter.

SUS: The mean SUS score was 85.0 (SD = 9.86), indicating high overall usability had improved from the iteration testing during the think-aloud study. A score above 68 is considered above average, and a score of 85 places the app in the top percentile for usability.

Details of the next iteration of app: The pilot usability study revealed that while the app was generally well-received and stable, there were several areas requiring improvement to enhance user engagement and satisfaction. The low engagement with the app's primary intervention – If-Then planning – suggested a need for better integration and clearer communication of its importance and functionality. Based on user feedback, and oversight from the behavior change experts in our research team, we developed an additional component which we term an “If-Then Booster” to assist users in memorizing and visualizing plans. The function of the booster was to encourage people to remember their if-then plans so they could be implemented when they were needed most (i.e, If I feel stressed then I will call a friend and ask for support). Daily notifications were created to support participant’s use of the boosters and visual aides were used to make practicing the boosters engaging. These usability improvements focused on making this key component more noticeable. Given concerns about the initial name for the app (i.e., Alcowise, which had issues around privacy as the name had the word alcohol in it) and logo (not understanding the relevance), we changed the name to ReplaceIt following a process of further user input and expertise from a marketing consultant (see Fig 2).

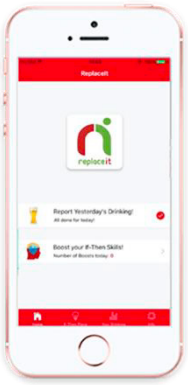

Fig. 2. Image of the app

2.2.3. Pilot study two

Participants and procedure: We recruited four participants (2 males, 2 females) from the target population – individuals wanting to cut down drinking – to provide feedback on all aspects of the app. The participants were asked to use the app daily for 14 days, during which they completed online surveys to provide feedback and qualitative feedback at the end.

User-centred feedback: The key lessons from the second pilot study are outlined below with opportunities for improvement provided by end-users.

- Technical Performance: Feedback regarding technical bugs and overall app performance was very positive with no technical issues reported or changes required.
- Usability improvements and issues: We sought detailed feedback from users regarding the usability aspects such as understanding of app aims, If-Then plans, and "booster" sessions. Substantial improvements in usability were identified based on qualitative feedback, although responses to the new Booster feature were mixed as some felt that the instructions could be clearer.
- User agreeability: We assessed participant preferences and acceptability of various key app features. Positive feedback was received on design, particularly the self-monitoring and feedback components, but some concerns were raised with the videos being too long. The name and logo were positively received, and the practice sessions focused on remembering to use the If-Then plans was seen as a positive by most of the participants.

The SUS score was 79.4 (SD = 9.66), indicating a high level of usability. Although slightly lower than the previous pilot study it is a positive score suggesting that the app is considered highly usable by end users.

Final iteration of the app: Key outcomes indicated that the app was appropriate to move to the efficacy testing stage. We based this decision on feedback from our advisory group following presentation to them of the following information: no technical bugs reported by users, the SUS score was satisfactory (i.e., around 80) and the qualitative feedback had reached saturation with only a few individual outlier comments which we then addressed. That is, qualitative feedback indicated that usability was improved as participants generally understood the app's aims, the If-Then plans, and the tasks, although the response to the new Booster feature was mixed. We made changes to the If-Then booster practice components, so they were easier to use and understand, and once again sought feedback from our advisory group for final sign off indicating that the app was ready for efficacy testing.

3. Discussion

The integration of UCD in the development of mHealth applications, as demonstrated in this study, underscores the critical importance of actively involving users throughout the design process. Importantly, we integrated UCD with an evidence-based approach guided by the expertise from our multi-disciplinary team of behavior change experts, clinicians, graphic designers, marketing experts, app designers and programmers. A UCD framework adopting innovative methodologies such as the think-aloud method supported by the iterative feedback from end-user piloting studies, ensured that the final product was not only functional but also aligned with the actual needs and preferences of its target audience. This process highlighted several key lessons for future mHealth app development.

It is essential to measure and address usability issues early in and throughout the development process. The think-aloud study, for instance, revealed critical usability problems such as unclear procedural flow, technical bugs, and instruction ambiguities, which would have severely impacted user engagement and satisfaction if unaddressed. By identifying and resolving these issues through iterative testing and feedback, the developers were able to significantly improve the app's usability, as evidenced by the increase in the SUS scores from the initial prototype to the final version. This iterative refinement process underscores the importance of continuous user feedback in creating an app that is both user-friendly and effective. A further important point is that the qualitative feedback from the think aloud study indicated quite a few substantial technical issues and yet the SUS score was high. This highlights the importance of gathering both qualitative and quantitative feedback when assessing usability.

Clear communication and integration of key app components is required for participant engagement. The low engagement with the app's primary intervention feature (If-Then Planning) in the first pilot study indicated that users did not fully understand the importance and functionality of this component. This led to the introduction of the "If-Then Booster" component and further user education efforts, which improved user engagement in subsequent iterations. This highlights the need for developers to ensure that all essential features are well-integrated into the app's workflow and that users are adequately informed about their benefits and usage.

A number of limitations warrant consideration. First, the software program we used made it difficult to ensure seamless functionality across both android and ios and so at times this was a cumbersome process. Secondly, the development process was also quite lengthy and so we would suggest conducting some of the testing components in parallel rather than sequentially.

A holistic approach to UCD – that considers not only functional usability but also user preferences and acceptability – is an effective way to refine app design. The feedback regarding the app's name, logo, and visual aesthetics made the app more appealing and trustworthy to users. Future app development should consider a comprehensive multi-disciplinary approach as essential in developing mHealth apps that users are willing to adopt and consistently use. By incorporating these lessons, future mHealth app development can achieve higher user retention, engagement, and ultimately, effectiveness in addressing health-related issues such as risky drinking.

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Conflict of interest declaration

Authors have no relevant conflicts of interest to declare

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