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Usability of a Smartphone Application to Support the Prevention and Early Intervention of Anxiety in Youth

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Mental, emotional, and behavioral disorders are common in youth with anxiety problems being among the most prevalent, typically failing to spontaneously remit, and placing some youth at risk for additional difficulties. Mobile health (mHealth) might be a novel avenue to strengthen prevention efforts for child anxiety, since program effects are generally small. However, although a significant number of mHealth tools have been developed, few have been evaluated in terms of usability (or even clinical effectiveness). Usability testing is the first level of evaluation in responsible mHealth efforts as it is one of the main barriers to usage and adoption. As such, the objective of this research was to evaluate the usability of a smartphone application (app) corresponding to an indicated prevention and early intervention targeting youth anxiety. To accomplish this, 132 children (M_{age} = 9.65, 63% girls) and 45 service providers (M_{age} = 29.13, 87% female) rated our app along five established dimensions of usability (ease of use, ease of learning, quality of support information, satisfaction, and stigma). Findings showed that the app was highly and positively rated by youth and providers, with some variations (lower ratings when errors occurred). Path analyses also showed that system understanding was significantly related to greater system satisfaction, but that such relation occurred through the quality of support information offered by the app. Together, this has research and clinical implications as it highlights avenues for advancing youth care via mHealth usability evaluation, including prior to establishing effectiveness.

Anxiety disorders are among the most common psychiatric problems in children with prevalence rates ranging from 5 to 10% and as high as 25% in adolescents (Angold, Costello, & Erkanli, 1999; Kessler et al., 2005). Moreover, anxiety disorders cause significant impairment, fail to spontaneously remit, and are prospectively linked to clinical depression and problematic substance use for some youth (Aschenbrand, Kendall, Webb, Safford, & Flannery-Schroeder, 2003; Beidel et al., 2007; Cummings, Caporino, & Kendall, 2014). As a result, considerable strides have been made to develop strategies for the prevention of anxiety disorders (Anticich, Barrett, Silverman, Lacherez, & Gillies, 2013; Lowry-Webster, Barrett, & Dadds, 2001; Pina, Zerr, Villalta, & Gonzales, 2012). Despite progress, effect sizes for anxiety prevention are relatively small to moderate, often attenuating over time (Fisak, Richard, & Mann, 2011; Teubert & Pinquart, 2011).

We believe, however, that prevention effects could be dramatically improved by increasing the dosage of intervention skills targeting components theorized to disrupt pathways associated with child anxiety disorder development (e.g., reducing avoidant coping; Essau, Conradt, Sasagawa, & Ollendick, 2012; reducing negative self-talk: Kendall & Treadwell, 2007; Treadwell & Kendall, 1996). This possibility is supported by past research showing that program homework, or out-of-session skills practice, is a significant predictor of program response in child-focused intervention for anxiety and depression (Cummings, Kazantzis, & Kendall, 2014; Hudson & Kendall, 2002; Stice, Shaw, Bohon, Marti, & Rohde, 2009). In fact, increasing dosage of intervention homework could be achieved via mobile health (mHealth) tools because these can offer (a) on-demand access to review strategies, (b) notifications designed to promote practice, (c) gamification to increase engagement and appropriate use of strategies for managing anticipated anxiety-provoking situations, (d) personalized and tailored intervention schedules, and (e) data-driven corrective feedback. Despite these advantages, the large majority of mHealth tools (for anxiety or otherwise) have not been studied (Curioso & Mechael, 2010; Nilsen et al., 2012). Further, research evaluating the usability of these technologies is severely lacking. For example, in a review of the available smartphone applications (apps) for youth anxiety on Google Play and Apple App Store, we identified 55 apps, including the Mayo Clinic Anxiety Coach app (Whiteside, 2016), but no corresponding usability research was found in the literature.

Keywords: anxiety; child; usability; smartphone; prevention

With regard to apps not publicly available (i.e., downloadable by any potential user), our search of the literature showed only three studies reporting on usability for apps targeting child behavior problems (Dixon, Dehlinger, & Dixon, 2013; O'Malley, Dowdall, Burls, Perry, & Curran, 2014; Tang, Jheng, Chien, Lin, & Chen, 2013), with one focused on clinically anxious youth (Pramana, Parmanto, Kendall, & Silk, 2014). Usability testing has been identified as an essential process in mHealth tool development to ensure maximum usage and engagement in the target population and implementing necessary design iterations prior to clinical effectiveness testing (Brown, Yen, Rojas, & Schnall, 2013; Matthews, Doherty, Coyle, & Sharry, 2008). Thus, the objective of this research was to evaluate the usability of a smartphone app corresponding to an indicated prevention and early intervention program targeting youth anxiety.

The REACH mHealth Application

REACH for Success (hereafter referred to as REACH) is an indicated prevention and early intervention program targeting anxiety in youth. REACH is an exposure-based cognitive-behavioral protocol delivered in six sessions, each 20–30 minutes in length, and administered in a group format. REACH uses the core exposure-based cognitive and behavioral procedures common to the protocols typically evaluated via randomized controlled trials (RCTs; e.g., Barrett & Turner, 2001; Kendall, 1994; Pina et al., 2012). This first generation of the REACH app was designed to provide support for out-of-session practice of intervention skills rather than act as a standalone platform, as some have suggested that implementation of child anxiety interventions probably requires interventionist involvement (e.g., relevant to training in cognitive restructuring; Pramana et al., 2014). Our efforts in developing the REACH app were guided by a user and subject matter expert-centered design (Galer, Harker, & Ziegler, 1992) that utilized personas, iterative prototyping, and expert feedback from an advisory board comprising practicing social workers, school psychologists, and counselors (see Patwardhan et al., 2015, for more details). At this phase of development, the REACH app was self-contained; it did not rely on communication services (e.g., cellular or Internet connection). Instead, the focus was on leveraging the device as a vehicle for supporting intervention homework (i.e., skills practice) and data collection. In terms of technology features, we included speech capture, thematic and age-appropriate media, gaming (e.g., progressive reward incentives), notifications presented to the target user in fixed (daily time-based) and adaptive schedules (based on user interactions), password-based authentication for adults (e.g., interventionists, parent, teacher), on-device database to store user responses and actions (e.g., to estimate alarm fatigue, motivation, clinical content such as subjective units of distress associated with an anxiety-provoking situation), and a data export feature (csv files).

Interaction Design and Information Modeling

Turning to user interaction design and content, and as shown in Figure 1, when a user selects the REACH app from the home screen, the landing page shows five activities (Relaxation, Daily Diary, S.T.O.P, Show That I Can [S.T.I.C], and Worryheads). In the design, Relaxation is delivered via audio (e.g., breathing, muscle relaxation; see Figure 1a) while Daily Diary and S.T.O.P (Silverman & Kurtines, 1996; Silverman & Pina, 2008) are fillable forms that use speech capture, keyboard, or both with each response stored in a SQLite database on the device (see Figure 1b and c). S.T.I.C (Kendall & Barmish, 2007) scenarios present a list of events or situations that are typically anxiety provoking to youth (e.g., read aloud in front of the class, ask the teacher a question or for help) based on the Anxiety Disorders Interview Schedule for Children (Silverman & Albano, 1996; see Figure 1d) with a password-based unlock feature for adults who provide electronic "stamps of approval" when S.T.I.C.s are successfully completed by users. Worryheads is an activity with preselected ambiguous situations and possible negative thoughts ("S" and "T," respectively) based on the Children's Negative Cognitive Errors Questionnaire (Leitenberg, Yost, & Carroll-Wilson, 1986) in response to which the user is asked to select an appropriate alternative thought from a prepopulated menu (see Figure 1e).

A gender-neutral and animated avatar character in the form of a blob guides the five activities, delivers notifications, and praises the user (see Figure 1f). In addition, the user can tap directly on the blob and be taken to a table-oriented layout of progressive and leveled "tricks" the blob can perform (see Figure 1g), only when the user completes homework (e.g., listens to Relaxation). The design of the blob incorporated proven mHealth intervention methodology known as the *proteus effect*, which posits that animated representations that reward the user for positive behavior provide increased motivation to perform activities that promote the desired behavior change (Yee & Bailenson, 2007). Overdue activities are highlighted by a soft gold pulsing glow on the landing page to provide a visual cue for the user (see Figure 1h). Further, and as shown in Figure 2, the app includes a specific multitap sequence combined with a password that unlocks configuration settings controlling the export of data, establishing a start date (see Figure 2a), enabling/disabling activities (see Figure 2b), modifying the planned dosage (e.g., number of times Relaxation should be practiced) for