An overview of the theoretical underpinning of the reviewed MHapps

Mindfulness

Mindfulness was a common theoretical approach applied in the MHapps (18/52; 25%). The MHapps that were informed by a mindfulness approach (e.g., *Headspace, Calm, It's Time to Relax*) offered users spoken meditations and meditation training during a specified programme of regular practice. Meditations took various forms, such as encouraging users to distance themselves from thoughts and emotions, and connect with their body via techniques such as a Body Scan (participants bring mindful awareness to different parts of the body), visualisation, or developing awareness of emotions (e.g., *Mindfulness-Based Resilience Training app, DeStressify*, *Aramgar*) [1,2].

CBT

CBT was another common approach applied in 10 studies (19% of the reviewed articles). CBT formed the basis of psychoeducation provided to users in apps to promote well-being (e.g., *Spring, Jibun kiroku, Shim, Living with Heart)* and manage symptoms of disorders such as anxiety and depression *(e.g., Feel Stress Free).* Some CBT apps aimed to help users identify factors associated with a change in mood or emotion, identify "automatic thoughts", adopt new thinking styles and encourage users to use cognitive reappraisal to manage stressful situations. Other CBT concepts included becoming aware of self-critical beliefs, tolerating uncertainty, avoiding *globalizing* (generalising from specific instances), challenging maladaptive beliefs, and adopting positive coping strategies, such as in the *GG Self Esteem* app [3]. Core concepts from CBT were generally taught as part of modules in psychoeducation (e.g., *Equoo*) [4].

ACT

ACT principles were applied in 4 studies (8% of MHapps) (e.g., *Act Daily*, *Mind Matrix*) [5,6]. MHapps applied insights from the ACT model such as *acceptance* (willingness to experience difficult emotions and experiences directly), *defusion* (relating to thoughts with reduced emotion), *present moment awareness* (flexible attention to current experiences), and identification of *values* (aspects of personal meaning and import) [7]. A key goal in ACT was to promote flexibility in behaviour based on personally-held values or direct contingencies [8].

EMA & EMI

Ecological Momentary Assessment (EMA) referred to the sampling of users' experiences in real time [9]. Relatedly, Ecological Momentary Intervention (EMI) referred to intervening in the users' life in the context of their everyday lives [10]. EMA and EMI were combined with other theoretical approaches. For instance, in one study, EMA was combined with CBT and ACT to sample users' moods and then provide them with psychological interventions, such as CBT-based exercises [11].

Another paper reported use of EMI to provide notifications at random, such as messages of hope, with the aim of increasing the users' daily experience [10].

Combination of multiple theoretical approaches

Many MHapps drew on a combination of various combined theoretical approaches (11/52; 21%). In such cases, a range of tools and techniques were used, such as encouraging app users to notice positive and negative cognitions and accept negative emotions. In one app, ACT was combined with tenets of positive psychology and CBT to provide users with guidance to engage in positive activities, practice gratitude and reflect on positive experiences (*Shim*) [12]. In a number of studies, MHapps incorporated principles of ACT combined with Ecological Momentary Assessment (EMA) (e.g., *Act Daily*). This involved recording users' moods and behaviours in real time, and then the app providing users with a message to encourage acceptance of a given emotion [13].

Other approaches

Other theoretical approaches applied in MHapps included Behavioural Activation (BA), a psychotherapeutic approach that promoted adaptive activities with the aim of reducing the risk of developing depression. Specifically, some apps built on theories that exposure to, and observing environments within nature and experiencing gratitude, could reduce stress and increase mental focus [14]. Less commonly applied theories included the notion that planning positive activities contributed to increased subjective well-being and that social activities could reduce the risk of mental health disorders (e.g. *Positive Activity Jackpot* [15]). Another example included undertaking social challenges to increase social connections with the aim of decreasing loneliness [16].

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