Regaining Joy of Life: Theory-Driven Development of Mobile Psychotherapy Support Systems

Research-in-Progress

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Abstract

This paper addresses the theory-driven design of a mobile health (mHealth) application that supports modern psychotherapy with information communication technology (ICT). It presents the initial stage of a larger multi-disciplinary project involving researchers from clinical psychology and information systems (IS). We derive guidelines for developing ICT that support cognitive behavioral therapy (CBT), a form of psychotherapy that is well established for the treatment of several mental disorders such as anxiety disorders and post-traumatic stress disorders. Furthermore, we identify core challenges of CBT that can be mitigated with ICT support: patient compliance with therapy homework as well as relapse prevention. These challenges are linked to the theoretical constructs of motivation and continued use intention. As a first step of our multi-disciplinary research-in-progress, we derive five principles and 14 guidelines for the design of an mHealth application supporting CBT before implementing and testing it within our research cluster.

Keywords: Mental health, psychotherapy, mobile health, CBT

Introduction

This paper is concerned with the theory-driven design of mobile health (mHealth) applications. We present the initial steps of a larger multi-disciplinary project involving researchers from the fields of clinical psychology and information systems (IS). There is some precedent for employing ICT to support psychological interventions, and evidence that this is a growing area of research (LeRouge et al. 2007). For example, past research brought forward mHealth applications to support the treatment of various psychological disorders, including borderline personality disorder (BPD; Good et al., 2013), depression (Løventoft et al., 2012; Ly et al., 2012), anxiety disorders (for reviews see Berry and Lai, 2014; Gee et al., 2015), and alcohol dependence (Gustafson et al., 2014; McTavish et al., 2012).

The aim of our project is to outline how psychotherapy interventions can be supported by information communication technology (ICT). Our focus is on cognitive behavioral therapy (CBT), a well-established
approach for treating psychological disorders such as anxiety, depression, trauma and stress-related disorders (Bang et al. 2007; Neudeck and Wittchen 2012). Although some studies looked at supporting specific subparts of the CBT process, no research exists that derives what the major challenges to CBT success are and how they can be mitigated using ICT. In order to fill this gap, we bring forward the following three research questions:

**RQ 1**: What challenges that occur during CBT can be mitigated through mobile ICT?

**RQ 2**: What behavioral theories provide a basis for understanding and overcoming these challenges?

**RQ 3**: What design principles can be derived from the theoretical explanations?

Answering these research questions requires an understanding of the psychotherapy domain (RQ 1 and RQ 2). Deriving and evaluating the design guidelines (RQ 3) requires bringing them into use in actual therapy scenarios. Therapy scenarios consist of several parties: patients, therapists, and institutions. Patients receive the therapy, which therapists provide, within institutions such as practices and clinics. All parties are stakeholders that require integration into the process of evaluating design principles and further refining them. For the purposes of this project, we work with a network of clinical psychologists, psychotherapists, and clinics. Clinical psychologists and psychotherapists provide expert knowledge on CBT and exposure therapy. They also have access to patients who are willing to take part in the project. Meanwhile, clinics provide the infrastructure and support staff for conducting studies. Finally, information systems researchers possess the theoretical knowledge for deriving design recommendations and the practical knowledge for developing ICT artifacts based on these guidelines.

Our research follows the theory-driven design science research approach of Hevner et al. (2004) and Peffers et al. (2007). We derive design principles for technology supported CBT from the existing theoretical body of knowledge. These principles will then guide the development of mobile applications supporting CBT and exposure therapy. Subsequently, we will evaluate the utility, quality and efficacy of the design principles and guidelines as well as the developed artifacts for therapy support (Hevner et al. 2004; Venable et al. 2012; Gregor and Hevner 2013). The results will then be used, in later stages of this research project, for refining and improving our IT artifact (Peffers et al. 2007).

The remainder of this paper is structured as follows. We present a brief review of the relevant previous research and we introduce CBT in greater detail. Afterwards, we derive the major challenges to CBT success from expert interviews and the literature. Finally, we introduce the theoretical basis for our subsequent development of design principles for overcoming these challenges. The paper closes with a discussion of the project’s further development beyond this research-in-progress.

**Literature Background**

**CBT and Exposure Therapy**

Exposure therapy is an evidence-based intervention for the treatment of anxiety disorders (Neudeck and Wittchen 2012, p. 2; Gonzales-Prendes and Resko 2012). This intervention involves patients repeatedly approaching feared situations or objects until their phobic avoidance is reduced. There is converging evidence that the inhibitory learning model is a mechanism that underlies exposure (Craske et al. 2014). Importantly, return of fear (renewal, reinstatement, and spontaneous recovery) is a common post-extinction phenomenon (Bouton et al. 2001), which suggests that the original association between feared situations and the subjective experience of anxiety is not erased, as previously assumed, but only inhibited. Thus, a central goal of the therapy is to identify factors that help increase the strength of the newly learned associations (i.e., that this previously feared situation can be tolerated and does not necessarily provoke the expected anxiety symptoms). For example, patients might learn about the importance of regularly confronting a variety of feared situations (multiple exposure contexts, Lang and Craske 2000). Another example may involve encouraging patients to remove safety signals or safety behaviors (e.g., any object, person or behavior that alleviates anxiety in the short term, like a phone, medication, another person) while confronting feared situations (Craske et al. 2014).

The process of CBT treatment for an anxiety disorder can be divided into several phases: assessment and diagnosis, psychoeducation, preparation for exposure sessions, therapist-accompanied exposure, unaccompanied homework exposure, and relapse-prevention training (Beck 2011, p. 17). During the...
assessment phase, therapists seek to understand what situations provoke fear and avoidance behaviors. Therapists and patients create a hierarchy of feared stimuli, ranging from those that are not particularly feared (easy to tolerate) to highly feared (unbearable) stimuli (Gonzales-Prendes and Resko 2012). During psychoeducation, patients also learn more about their anxiety symptoms, and exposure therapy. Patients then learn about the rationale behind exposure therapy, and about the possibility that during exposure therapy, anxiety symptoms may worsen before they reduce, but that they can be expected to eventually diminish (Beck 2011, p. 59). Finally, by regularly engaging in exposure, patients learn to tolerate their anxiety symptoms, to reduce safety behaviors, and to reduce their avoidance of feared situations (Gonzales-Prendes and Resko 2012). It is common for patients to be involved in the planning and undertaking of exposure homework (Beck 2011, p. 294). In the subsequent session, patients report their homework success or failures. Therapists use these sessions to review homework achievements and to assess patients’ progress by posing questions about their daily life experiences. Patients and therapists typically select the exposure targets from the patient’s fear hierarchy. Which stimuli are selected depends on the patient’s progress. After the last therapy session, patients can ideally manage their own symptoms using the skills they learned in therapy. They are usually informed that continued exposure to feared stimulus (so called “relapse prevention”) can help to maintain their therapy gains (Beck 2011, p. 334).

Prior Research on CBT and ICT

Considerable research effort has been directed at comparing the effectiveness of internet-based CBT (ICBT) to traditional offline CBT. In ICBT psychological counseling and communication with the psychotherapist is carried out through the Internet. Some researchers report both forms of CBT being equally effective. Månsson et al. (2013) developed a Website for supporting ICBT by enabling CBT-specific goals, such as setting up exposure therapy goals. Their results show that patients perceive the Website as helpful in coping with their daily lives. Researchers from within psychology have acknowledged the potential benefits of using mobile technology as an adjunct to psychotherapy (Boschen and Casey 2008; Boschen 2009). Mobile phones provide opportunities to access health information, monitor progress, collect real-time data (e.g., through built-in sensors such as GPS), and deliver personalized support. Context-aware applications that link data collected in real-time to patients’ self-reports have been discussed (Proudfoot 2013). Good et al. (2013) developed an application for supporting patients suffering from bipolar disorder, characterized by significant emotional instability, interpersonal difficulties, and impulsive and reckless behaviors. Other researchers have developed applications that automatically detect when symptoms resurface (e.g., Burns et al., 2011).

Identifying Challenges to Psychotherapy Success

Psychotherapy relies on the exchange of information between patients and therapists (Beck 2011, p. 123). In contrast to many medical procedures, psychotherapy does not rely on complicated equipment to gauge a problem, such as brain imaging or the like. Information itself stands at the core of psychotherapy, and it is produced through patient-to-therapist communication and through analysis of patient behavior. How well this information is exchanged, and how patients and therapists make sense of it, has important implications for the success of the therapy (Beck 2011, p. 46). Arguably, information systems (IS) can make important contributions to the advancement of modern psychotherapy practices. Developing such systems requires an understanding of the challenges that threaten the success of the therapy. The following section answers research question 1 by identifying and discussing the major challenges to psychotherapy and in particular CBT.

We approach research question 1 in two steps. In the first step, we report the results of semi-structured interviews with two clinical psychotherapists. In the second step, we synthesize these results with evidence from the literature. For the interviews, we used the above-introduced phases of the CBT process (assessment and diagnosis, psychoeducation, preparation for exposure sessions, therapist-accompanied exposure, unaccompanied homework exposure, and relapse-prevention training) as a guiding structure. We asked the therapists to report challenges they experience in their daily clinical work. We also asked about the challenges their patients experience. The therapists were encouraged to elaborate on all reoccurring problems. Although all phases of the CBT process were discussed, therapists controlled how much time was spent on each phase. Both therapists reported that homework compliance and relapse
prevention are particular difficult for patients. They agreed that low compliance with homework and relapse prevention tasks are the main reasons for lowered CBT success.

**Challenge 1: Low Compliance with Homework Exercises**

Homework exercises are an integral part of CBT. In fact, a review of the literature revealed strong evidence that patients who complete homework exercises have a better chance of gaining control over their disorder (Kazantzis et al. 2000; 2005). For example, patients suffering from anxiety disorders are encouraged to practice confronting feared events, objects or situations—a process known as situational exposure. Feared cues are patient-specific and can relate to previous experiences (e.g., a traumatic event, in the case of post-traumatic stress disorder). Although it is advisable for therapists to accompany patients during initial exposure sessions (Gloster et al., 2011), unaccompanied exposure between sessions is a key to effective treatment (Cammin-Nowak et al. 2013; Detweiler and Whisman 1999; Kazantzis et al. 2004). During exposure homework the central issue is patients' adherence to the assigned exercise programs. Patients' adherence is a widely discussed issue in the literature of exposure therapy (e.g. Boschen 2009; Cammin-Nowak et al. 2013; Detweiler and Whisman 1999; Helbig and Fehm 2004; Kazantzis et al. 2004; 2000). After having received their homework in a session with their therapist, patients autonomously control the completion of exercises. During homework there are no established means or processes to monitor and document the patients' behavior when exposed to feared objects or stimuli, nor to control his or her compliance to given homework. Nevertheless, the proper and continuous completion of the exercises is an integral part of a successful therapy.

**Challenge 2: Low Compliance with Relapse-Prevention Exercises**

Relapse-prevention exercises are critical for CBT success. Similar to homework exercises, patients expose themselves to fear-provoking situations. In contrast to homework exercises (challenge 1), relapse-prevention happens after therapy has ended (Beck 2011, p. 332). Patients are encouraged to engage in relapse-prevention because the relapse rate is very high. It is estimated that 30-60 percent of anxiety disorder patients relapse within 8 years of the end of therapy (Mavissakalian and Prien 1996; Yonkers et al. 2003). Often relapse starts with the resurfacing of avoidance behaviors (e.g. “not going into a park as there might be dogs”). Although the therapist explains the importance of continuous relapse-prevention through exercises, often patients do not follow this advice. This can be explained by the fact that there is no supervision and communication with the therapist during the relapse-prevention exercises. Patients are effectively alone during this phase.

Therefore, homework assignments and relapse-prevention exercises constitute critical parts of exposure therapy (Beck 2011, p. 133, 294). Table 1 summarizes the two identified challenges.

<table>
<thead>
<tr>
<th>Challenge 1</th>
<th>Challenge 2</th>
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<tr>
<td>Compliance with homework exercises</td>
<td>Compliance with relapse-prevention exercises</td>
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<td>Patients do not attempt or complete their homework exposure tasks. Since the gradual increase in exposure difficulty is an important part of CBT, a lack of homework compliance undermines the therapy’s success.</td>
<td>Patients do not comply with their relapse-prevention exercises. Ongoing exposure to feared situations helps maintaining the gains achieved during therapy. Failure to comply with the exercises often causes the psychological disorder to resurface.</td>
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In summary, two major challenges to CBT success emerged. First, patient’s adherence to homework instructions (compliance) is often low. Second, ongoing exposure training is necessary to prevent relapse, but patients fail to continuously practice exposure. In this paper we argue that both challenges relate to
the theoretical constructs of motivation (Reger et al. 2013) and continued use intention (Paykel et al. 2005). Accordingly, we proceed to derive the theoretical background for overcoming the two challenges, and concentrate on theories relating to motivation and continued use intention. Namely, we focus on self-determination theory and achievement-goal theory.

**Theoretical Basis**

This paper is concerned with the theory-driven design of mobile health (mHealth) applications. The last section identified the two main challenges to CBT success. The following will derive the theoretical basis for addressing these challenges. This theoretical basis will guide the development of design principles in the next section.

We identified low compliance and the lack of motivation as the major challenges to CBT success. The following relates these challenges to theories on motivation and task compliance. In particular, we rely on achievement goal theory and self-determination theory. Self determination theory (SDT) explains human motivation and how extrinsic motivation relates to intrinsic motivation (Williams et al. 2006). Based on SDT, an increased sense of autonomy, competence, and social relatedness increase the perceived intrinsic motivation (Deci and Ryan 2012, p. 101). The identified challenges to CBT success (motivation to comply with homework and motivation to engage in active relapse prevention) relate to a lack of intrinsic motivation. It is evident from the discussion of CBT (see above and e.g. Beck 2011), that several phases of the patient-therapist dialogue target motivating the patients to confront their fears. Based in SDT, this motivation is initially extrinsic. However, in line with previous research using SDT in the healthcare context (Williams et al. 2006; Sheldon et al. 2008; Mata et al. 2009), we expect increasing the above-mentioned factors autonomy, competence, and social relatedness to increase patients’ intrinsic motivation to comply with homework and relapse exercises. Thus, we choose self-determination theory and its prediction on the formation of intrinsic motivation as a basis for the following deduction of design principles. The second theory relating to the lack of motivation during CBT exercises is achievement goal theory (AGT). The theory distinguishes several goal types and their relationship to motivation (Elliot and McGregor 2001). Goals are either of the mastery or the performance type. Mastery goals relate to a self-defined sense of achievement and success. Thus, perceived mastery relates to how one has improved over time. This is connected to the willingness to improve (Elliot and McGregor 2001). Performance goals relate to interpersonal comparison. Performance is high, if one achieves more than others. This distinction is relevant because mastery goals were found to relate to a higher degree of interest and cognitive involvement (Maehr and Zusho 2009, p. 88). Accordingly, we include AGT and its concept of mastery into the deduction of design principles.

**Deduction of Design Principles**

The two identified challenges of CBT relate to deficits in motivation. Patients will only adhere to homework and conduct relapse exercises if they are motivated. Accordingly, we have developed design principles based on theories of motivation. In accordance with SDT, intrinsic forms of motivation can be achieved by satisfying the human needs for autonomy, competence and relatedness. The need for autonomy reflects the desire to have control over one’s actions. This need indicates that humans want to engage in activities that they find interesting and in line with their own values and opinions. In order to achieve this internal locus of control, users should be provided with flexibility and choices concerning the task they are supposed to perform (Ryan et al. 2000). This means that constraints with respect to activity selection as well as time constraints should be avoided (Muraven et al. 2008).

The use of therapy-supportive mHealth apps can be characterized as extrinsically motivated, since patients use such apps to enhance therapy success and not because of the inherent pleasure of use. The theories we present from positive psychology, however, inform about mechanisms that help increase the intrinsic value of such extrinsic activities. Taking account of these mechanisms facilitates the adoption of intrinsic forms of motivation, i.e. identified and integrated regulation.

The following design principle and guidelines consider the need for autonomy:

**P1: Enhance the perceived autonomy of users.**

G1: Provide patients with choices and flexibility concerning the task they are supposed to complete.
G2: Avoid using time pressure with respect to task completion.

The desire to feel capable and effective is reflected in the need for competence. In order to satisfy this need humans engage in demanding but feasible challenges that enhance their level of skills and abilities. According to SDT, optimal challenges, clear goals and competence-enhancing feedback can help satisfy the need for competence (Deci and Ryan 1985). Guidelines to apply the principle of encouraging competence can be derived from three principles: Progress feedback, clear goals and adjustment of difficulty level. Progress feedback enables individuals to track how well they have done at task completion, and thus it enables them to adjust their effort in order to achieve their desired outcome. Clear goals and adjustment of difficulty, meanwhile, provide individuals with an optimal challenge. Based on this, the resulting principle and guidelines are:

**P2: Promote the competence of users.**

- **G3**: Provide patients with information about their progress during task completion.
- **G4**: Make sure that patients understand the overall goal of a task.
- **G5**: Offer tasks that match the individual skill level, i.e. not too easy or too hard to accomplish.

The need for relatedness represents the human desire to be socially involved. When engaging in activities, humans desire acknowledgement of their actions. Two principles, leaderboards and recognition, can be used to develop the principle of relatedness. Leaderboards allow comparison of ones’ own achievements with those of other users. This competition related mechanism might motivate patients in specific contexts; however, it is deemed relevant that such social comparison might be harmful for some therapy-supportive mHealth apps. When performance between persons cannot be objectively compared such mechanisms should not be implemented. Therefore, it is essential to respect the specific context when designing such an app. Recognition instead enables users to acknowledge and praise the achievements of others.

The following principle and guidelines consider the need for relatedness:

**P3: Enable social interactions.**

- **G6**: Enable patients to compare their achievements with other patients.
- **G7**: Enable professionals to acknowledge the achievements of their patients.

AGT posits that providing individuals in achievement settings with a mastery-enhancing climate can facilitate the adoption of mastery goals, and thus increasing intrinsic forms of motivation. In order to create such a mastery-enhancing climate, task design, authority structure and evaluation mechanisms can be adapted.

Mastery-enhancing task design requires tasks to be both challenging and meaningful. In order to provide challenging tasks, we suggest using the mechanisms which satisfy the need for competence: clear goals, varying difficult levels and performance feedback. Thus, the guidelines for designing challenging tasks are already stated in P2: G3, G4 and G5. Conversely, making tasks meaningful requires considering other aspects of task design. Meaningfulness in this context refers to users understanding the benefits of performing an activity (Ames 1992 pp. 263-264). Therefore, it is important to ensure that users understand the relevance of a task and that they have access to this information. The principles communication of meaning helps to transfer this aspect of task design into concrete design guidelines.

The following principle and guideline are proposed concerning meaningfulness:

**P4: Emphasize the meaning of IS use.**

- **G8**: Ensure that patients understand the relevance of mHealth app use in the context of their therapy.

In order to ensure a mastery-enhancing authority structure, AGT suggests promoting flexibility and autonomy during task selection and management. Hence, giving people the opportunity to decide what they are doing and when they are doing it enhances a climate of mastery. This aspect of creating a mastery-climate is reflected in the 'need for autonomy' above, and thus already covered by P1: G1 and G2.

Finally, evaluation mechanisms can be adapted to promote a mastery-climate. In accordance with AGT, one mechanism is to recognize individual progress. This is partly represented by performance feedback.
(G3) and recognition of achievements by others (G7). However, a further aspect of this mechanism is to evaluate achievements with respect to a person’s own development (Ames 1992, pp. 264-265). This is represented in the principle *history of actions* and *shadowing*. History of action presents users with information about their past achievements, and thereby stimulates and directs future behavior. Shadowing, in a similar manner, allows individuals to compete against their past achievements, and thereby stimulates further skill development. These mechanisms can be used to ensure that individuals keep an achieved level of skills (mastery-avoidance) or to stimulate further skill development (mastery-approach). These aspects of evaluation are related to competence since they promote feelings of achievement and effectiveness. Therefore, the following guidelines are related to P2:

G9: Provide patients with information about their past achievements.

G10: Allow patients to compete against their own past achievements.

Other evaluation strategies suggested to enhance a mastery-climate are the promotion of failure tolerance, the provision of opportunities to improve and the avoidance of social comparison and rewards. Viewing mistakes as source for prospective improvements encourages people to stay motivated (Ames 1992 pp. 264-265). In the same way, indicating what they can do to improve in future activities motivates further engagement. Finally, AGT posits that social comparison and rewards are central extrinsic motivators, and thus harm the development of a mastery-climate. These mechanisms produce social pressure, triggering stress and anxiety related to task performance. It is important to note that social comparison is conceptualized differently in SDT and AGT. SDT, on the one hand, suggests that social comparison satisfies the need for relatedness (see G6). AGT, on the other hand, indicates that all forms of social comparison promote competition, and thus impede the creation of a mastery-climate. Due to this discrepancy two conflicting theoretical guidelines are included in the design recommendations, and a context-sensitive analysis is needed to determine which guidelines should be followed in each setting.

In sum, AGT posits that it is important to apply positive evaluation mechanisms and to avoid any form of negative experiences. These strategies reflect the importance of providing a positive experience to individuals, even when they fail to complete a task or interaction. Correspondingly, the following principle and guidelines are proposed:

**P5: Use positive evaluation mechanisms.**

- G11: Avoid any form of punishments when patients fail to complete a task.
- G12: Indicate patients how they can achieve prospective improvements.
- G13: Avoid social comparison.
- G14: Avoid using extrinsic rewards.

Table 1 presents the relation between the design principles, their corresponding guidelines and how AGT and SDT provide insights to design features for an exposure therapy application. Our proposed artifact features include the specific requirements and descriptions of functions that define an mHealth application for conducting CBT.

<table>
<thead>
<tr>
<th>Table 2. Principles and Guidelines and their Implications for an Exposure Therapy Application</th>
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<tr>
<td><strong>Design Principles</strong></td>
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<tr>
<td><strong>P1: Enhance the autonomy of users</strong> (G1, G2)</td>
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<tr>
<td><strong>P2: Promote the competence of users</strong></td>
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</table>
Provide a reminder of the relevance of completing exposure exercises for therapy success before an exercise session begins.

Patients should be appropriately challenged with regard to their therapy progress (related to G₁). This could be achieved by reminding them that they should take a step up after successfully completing a certain fear level repeatedly.

Summarize past achievements on the landing page of the app. This is especially important during relapse-prevention phase.

Anxiety disorders are a very sensitive issue and are very individual. Therefore, social comparison should be avoided.

Provide a summary of achievements to the therapist, and enable them to acknowledge these via a feedback function.

Provide information about the advantages of using the app. Make the app intuitive, appealing and engaging, so that patients realize the benefits.

When patients face problems with an exercise break up, provide them with methods to work on the problem. For example, breathing and relaxation methods.

Therapists sometimes use extrinsic rewards despite their negative effect on intrinsic motivation. This should be reassessed in further interviews.

Discussion and Limitations

This research-in-progress outlined two areas that pose challenges within the context of psychotherapy. First, we described how therapy success is, to a large extent, dependent on patient compliance, especially when therapists employ a cognitive behavioural therapy approach. To this end, we proposed how mHealth applications can help to overcome these challenges. Second, a low motivation to engage in psychotherapeutic homework exercises threatens the degree to which a patient will adopt and use such applications. Drawing on theories of motivation, we derived five design principles, consisting of 14 design guidelines, to support the development of mHealth psychotherapy applications.

In this paper, we outlined a project that is relevant to the field of IS, because psychotherapeutic interventions present an opportunity to apply principles from IS; yet to date, this idea has received insufficient research attention. The special needs of patients, therapists, and institutions require more scholarly attention. The design of IS for psychotherapy must take into account the cognitive and affective state of patients undertaking challenging exercises. This research-in-progress represents a first step in this direction, and should encourage more IS scholars to conduct research on the principles that support well-designed ICT solutions for psychotherapy.

This research-in-progress has several limitations. For answering RQ1, we conducted expert interviews and reviewed the literature. However, we did not yet include actual patients. As described in the introduction, we will include patients in later stages of this project. Another limitation is the selection of the interview partners. For further developing this paper, it would be helpful to include more psychotherapists. This would increase the chance to identify more challenges to CBT – beyond the two identified at the current stage. As an immediate next step, we plan to conduct additional expert interviews at clinics in Europe and Australia.

References


