A social anxiety mobile-based CBT intervention for college students and therapists: theoretical framework

1. Introduction

Social anxiety disorder (SAD) is a debilitating disorder, marked by an intense anxiety and fear of negative evaluation in social situations (American Psychological Association, 2013). Research suggests a high prevalence of SAD among college students (Boukhechba et al., 2018; Tillfors & Furmark, 2007) with prevalence rates ranging from 10 to 33%, compared to 7 to 13% in the general population (Russell & Shaw, 2009). This is worrisome since social anxiety in college students is frequently associated with low quality of life, premature school dropout and low academic achievement (Brook & Willoughby, 2015; Fehm et al., 2005). Universities have specific counselling services that constitute a valuable resource for students with different psychological needs or difficulties (Spooner, 2000). However, these services often provide limited resources to face an increasing demand (Johnson & Kalkbrenner, 2017; Lee & Jung, 2018; Shaw et al., 2017) leading, for example, to an increased counselor caseload and decreased session frequency (Shaw et al., 2017). mHealth interventions may be a promising and interesting solution to deal with these challenges, enabling easy access to mental health interventions in one's everyday routine.

mHealth is defined as the use of mobile technologies to deliver or support psychological or mental health interventions and includes mobile devices such as smartphones, tablets, Personal Digital Assistants, and wearable devices (Alyami et al., 2017; Clough & Casey, 2015). In clinical settings, mHealth may enhance face-to-face treatments by increasing patient engagement in therapy sessions and adherence to therapy principles, providing better use of clinician time and resources, improving treatment outcome, and lowering the risk of relapse (Clough & Casey, 2015). Other major advantages are their ability to monitor symptoms, behaviours and mood in the moment, to facilitate in vivo exposure, or to provide information and support when, for example, anxiety triggering situations occur (Olff, 2015). According to Wilansky et al. (2016) mobile applications may increase youth adherence to Cognitive Behavioral Therapy (CBT) and improve treatment outcomes. Specifically in the case of college students, using mHealth may be appealing since they are more technology oriented, communicate frequently online and many express interest in and preference for web

based mental health resources and services (Shaw et al., 2017). The number of mhealth interventions in college settings has been raising and Johnson & Kalkbrenner (2017) concludes that mhealth is being used in college settings with increased popularity.

According to Webb et al. (2010) there are three intervention characteristics that may influence the impact on behavior, namely, theoretical basis of the intervention, behavior change techniques and mode of delivery. Thus, to develop such interventions, researchers often resort to behavioral theoretical models (Wang et al., 2017; Webb et al., 2010) and one of the most recent model sustaining the development of mobile interventions is the behavioral intervention technologies model (BIT Model; Mohr et al., 2014). The BIT model defines the conceptual and technological architecture of a BIT and intends to combine behavioral principles into technological features to help bridge behavioral science and technology (Mohr et al., 2014). Since these technologies are more often used and more effective when delivered with human support (Schueller et al., 2017), tending to be more efficacious than self-guided interventions (Andersson & Cuijpers, 2009), the supportive accountability model and the efficiency model of support (Schueller et al., 2017) emerged. Effectively, Torous et al. (2018) suggests that apps should strengthen the therapeutic relationship rather than disrupt or replace it.

The current paper addresses the process of developing a technological system to support psychological intervention in a university counselling center for college students with social anxiety. This technological system main component is a mobile app (SPICA) that is intrinsically linked to a Web database platform, which can only be accessed by a therapist. Our developing process included two studies, with different aims: Study 1 was performed to inform and substantiate study 2. Thus, Study 1 aims to characterize social anxiety symptomatology and explore mobile app usage and preferences in a Portuguese sample of college students with and without social anxiety symptomatology; additionally it also intends to explore the subjective opinion of students attending therapy regarding acceptability and potential adherence to a mobile application to support treatment, between sessions. Study 2 aims to provide a description of the development process, structure and features of a mobile-based

intervention for social anxiety; such process was based on findings from study 1 and published scientific literature in this area.

Study 1: Social anxiety in college students and reported interest of students attending therapy in using a mobile application to support treatment

2. Materials and Methods

2.1 Participants

The current study included a non-probabilistic sample of 296 university students, 77% (n=228) of which were female, and 23% (n=68) were male. The participants presented a mean age of 22.09 years (*SD=5.07*). Most of the participants are single (94.6%) and attending an undergraduate or bachelor's degree (77.2%). A subsample of 8.8% (n=26) of these students were attending therapy at the time of data collection.

From the total sample we created 3 study groups: 11.3% (n=34) are students presenting SAD symptomatology (G1); 78.1% (n=236) correspond to students without SAD (G2) and 8.8% (n=26) are students attending therapy (G3), which was subdivided into students attending therapy with and without social anxiety. Sociodemographic characteristics of each group are in more detail in [see appendix 1 - Table 1].

As for G3, students who reported attending therapy, are predominantly female (76.9%), single (93.8%) and in an undergraduate (65.6%) or master's degree (31.2%).

Concerning characteristics of mobile app use among college students, in the total sample 97.3% reported having a smartphone and 81% (n=268) of the students reported using mobile applications frequently, 16% (n=53) use it occasionally, with only 3.4% (n=10) indicating that it was rare or that they never used mobile applications. Most of G3 reported having a smartphone (96.9%) and app frequent use (81.3%).

Table 2 illustrates mobile app use among the 3 study groups and we can easily observe that most students, in all groups, have a smartphone and are frequent users of mobile applications.

Table 2 - Characteristics of mobile application use among the 3 study groups

	G1 Students with SAD	G2 Students without SAD	G3 Students attending therapy	
			With SAD	Without SAD

Do you have a smartphone?				
Yes	33 (97,1%)	230 (97,5%)	5 (100%)	20 (95,2%)
No	1 (2,9%)	6 (2,5%)	-	1 (4,8%)
Do you use mobile apps?				
Yes, frequently	28 (84,8%)	186 (79,5%)	4 (80%)	16 (76,6%)
Yes, occasionally	5 (15,2%)	39 (16,7%)	1 (20%)	4 (19%)
It's rare	-	7 (3%)	-	1 (4,8%)
Never use it	-	2 (0,9%)	-	-

2.2 Instruments

A sociodemographic questionnaire was included in this study to address sociodemographic variables such as gender, age, civil/marital status, school qualifications and therapy attendance. In this section, we also included a brief questionnaire regarding mobile app use and preferences. For participants that reported attending therapy, a brief questionnaire was available to explore their interest and adherence to a mobile app to support treatment between sessions.

2.2.1 Social Interaction and Performance Anxiety and Avoidance Scale (SIPAAS, Pinto-Gouveia, Cunha, & Salvador, 2003)

SIPAAS intends to assess the degree of discomfort and avoidance in various situations of social interaction and performance. This instrument includes 44 items that are answered regarding two subscales - distress/anxiety and avoidance. The total scores for each subscale ranges from 44 to 176. In addition, the authors suggest cut-off points that allow the distinction between individuals with generalized social anxiety and non-clinical population, specifically, through the cut-off points of 115 for the subscale distress / anxiety and 105 for the avoidance subscale (Pinto-Gouveia et al., 2003).

2.2.2 Sheehan Disability Scale (SDS; Sheehan, 1983, Portuguese version by Pinto-Gouveia, Cunha, & Salvador, 2000)

This scale aims to assess the degree of disability that Social Anxiety assumes in the daily life of the individual, as well as his/her perception of the interference of Social Anxiety in three areas of life: work or studies, social life and affective life. The

results of the scale allow obtaining an incapacitation index in these three areas of life, as well as a total incapacitation index (Pinto-Gouveia et al., 2000).

2.3 Procedure

Data collection was carried out in person at the Universities of Aveiro and Coimbra, where students voluntarily completed the informed consent and questionnaires. Participants were informed of the right to non-participation, the anonymous and confidential nature of the data, as well as research goals. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software (version 24.0, IBM, 2016).

Descriptive statistics were used to characterize the sample regarding social situations that generate more anxiety and discomfort and mobile applications usage habits. First, we selected a group of students that reported attending therapy and created G3. We used the reported cut-offs points suggested by the author of the SIPAAS and thus obtained two groups of students not-attending therapy, one with social anxiety symptomatology (G1) that obtained scores above the cut-off point of the scale, and a group of students without social anxiety symptomatology (G2) that obtained scores below the cut-off points.

Through a brief questionnaire, we explored G3 perception regarding interest and potential adherence to a mobile application to support therapy between sessions. In G3 we were able to identify social anxiety students attending therapy through the reported cut-off points (SIPPAS) and thus acceptability and adherence was also explored in this specific group.

3. Results

3.1 Most feared social situations and degree of discomfort/anxiety and avoidance among students with and without SAD

We explored the 3 most feared social situations among students with and without social anxiety (regardless of attending therapy or not), rated as severe according to the SIPPAS scale. From the total sample (n=296) we identified 12.9% of students with SAD (n=39) and 87.1% of students without SAD (n=257). Considering all students identified with SAD symptomatology, only 13% are attending therapy (n=5).

Students with SAD identified the 3 situations that generate high levels of anxiety and discomfort to do an oral test/exam (89.7%); to represent, act or speak before an

audience (79.5%); to get up and make a short speech, without prior preparation, at a party (76.9%) and to present an assignment orally (76.9%). According to our results students without SAD have the same most feared social situations as students with SAD, namely, 25.6% of students fear to do an oral test/exam; to get up and make a short speech, without prior preparation, at a party (19.5%) and to represent, act or speak before an audience (14.8%).

3.2 Daily life interference [Sheehan Scale]

Additionally, to understand interference from the anxiety/discomfort and avoidance symptomatology in daily life, particularly in the three dimensions (i.e., work/studies, social life/friendships and affective life), the Sheehan Disablity Scale scores were analysed. These results indicated that students without social anxiety reported that symptomatology interfered more strongly in work/studies (M = 2.53, SD = 2.55), followed by social life/friendships (M = 2.37, SD = 2.19), and lastly affective life/ finding a boyfriend/girlfriend (M = 2.34, SD = 2.46). As for the social anxiety group of students, they reported that social anxiety symptoms appeared to interfere more in the following dimensions, first affective life/ finding a boyfriend/girlfriend (M = 4.74, SD = 3.48), followed by social life / friendships (M = 4.59, SD = 2.75) and, lastly, work / studies (M = 4.31, SD = 2.40).

3.3 Mobile app use characteristics

In table 3 we can observe a tendency among the 3 study groups regarding categories of the most used apps ("The apps you use more often are associated with which of the following categories?") associated with social networks and news, followed by games and entertainment; with health and education having a poor expression.

Table 3 – Categories associated with most used apps

Categories	Groups			
	G1	G2	G3	
			With SA	Without SA
Games	12 (36,4%)	62 (26,6%)	1 (20%)	9 (42,9%)
Health	2 (6,1%)	26 (11,2%)	-	6 (28,6%)
Education	2 (6,1%)	17 (7,3%)	-	6 (28,6%)
Entertainment	10 (30,3%)	106 (45,5%)	2 (40%)	8 (38,1%)

News	12 (36,4%)	91 (39,2%)	4 (80%)	10 (47,6%)
Social network	30 (90,9%)	209 (89,7%)	5 (100%)	19 (90,5%)

We also explored what aspects students consider when they download a mobile app (Figure 1), and we can conclude that utility is the most important aspect when downloading a mobile app in all groups, except for students with social anxiety attending therapy. The latter group emphasizes mainly security and privacy, with a higher expression of app classification and reviews, compared to other groups. Very few participants consider important information from the app programmer.

Figure 1 – Most important aspects when downloading an app
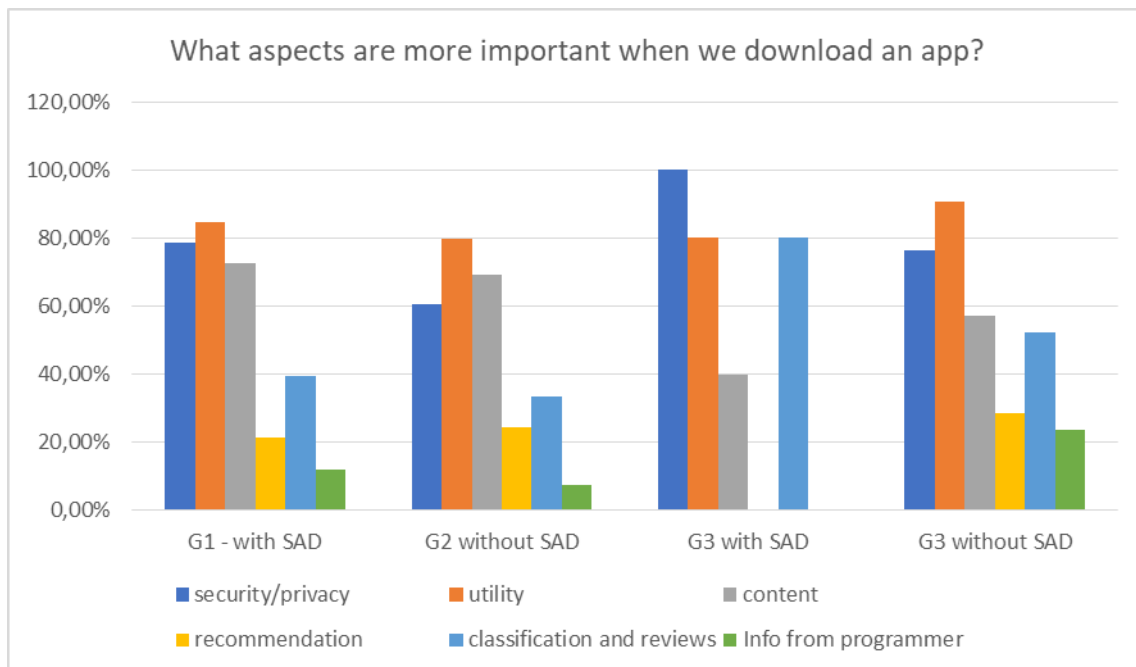
3.4 Exploring students attending therapy interest and adherence in mobile interventions and mobile app use characteristics

Students' in G3, without symptoms of social anxiety (n=21, 80,8%), 80% considered it useful to have an application that would aid them in therapy, and 85% of students considered that they would easily adhere to the application. All social anxiety students attending therapy considered that it would be relevant to exist and that they would adhere to an application containing information acquired during sessions, as well as guidelines for the practice of exercises related to the intervention they would be performing [see appendix 2 – Table 4].

Study 2: Social anxiety mobile application development process

4. development process

4.1 Creating a multidisciplinary research team

To develop the mobile app and the Web Database Plataform [Therapist Web Plataform] a multidisciplinary team of psychologists and mobile computing engineers was gathered. Psychologists designed the mobile intervention, determining the app theoretical conceptual framework, clinical content and structure according to published scientific literature and previous research made by the team. The mobile computing research team developed the app technical components according to its conceptualization. Both teams worked together in several meetings and studied the translation of clinical content to features and functionalities, while programming the mobile app.

4.2 Architecture

Our research team designed a mHealth intervention that combines face-to-face psychological intervention with a mobile app for social anxiety. This system is parallel to a therapist web platform linked to the mobile app. Thus, it includes a smartphone and a backend (firebase), responsible for the database and storage, only accessible to the therapist. As such, the social anxiety app main objective is to support patients between sessions, particularly with CBT homework assignments. The application is intrinsically linked to a therapist web platform (database) where the therapist has access to all the information his patient submits in the application. The nature of this system is to support, in a balanced way, patient and therapist simultaneously.

4.3 Conceptual Framework

The mobile application was conceptualized according to the cognitive behavioral models of social anxiety (Heimberg & Barlow, 1991; Clark & Wells, 1995) and so the mobile app was structured according to cognitive behavioral therapy (CBT) for social anxiety (Hope et al., 2010).

The current technological system is strongly aligned with therapeutic alliance and Cognitive-Behavioral Therapy (CBT) principles, given that it is considered the most effective treatment for social anxiety (Heimberg, 2002). One of the most widely used

protocols considers several techniques such as psychoeducation, self-monitoring, cognitive restructuring, social skills training, relaxation exercises and exposure exercises (Hope et al., 2010). This protocol integrates cognitive restructuring into exposure exercises, enabling individuals to identify and challenge maladaptive thoughts and to use the exposure exercises to test their beliefs (Gordon et al., 2014). Such exposure exercises are often asked of the patients as homework assignments, which are seldom concluded, thus representing a strong limitation of CBT (Clough & Casey, 2015). In addition, very frequently homework is still performed with pen and paper, which may be inconvenient for patients (Michelle et al., 2014). Patients who comply with homework assignment have higher treatment gains then those who don't (Gordon et al., 2014).

Furthermore, considering our intervention characteristics we also included a technological model, particularly the Behavioral Intervention Technology (BIT) Model (Mohr et al., 2014), which intends to help us with the translation process of clinical content to a mobile health intervention app. Also, the Efficiency Model of Support, specifically the Blended Care Model (Schueller et al., 2017), was also considered, since it provides a conceptual framework to guide the action of human supporters of patients using BITs. The Blended Care Model integrates the latter model and offers patients a combination of face-to-face sessions and BITs, providing more information of the real world into sessions, thus supporting learning and use of skills outside of sessions (Schueller et al., 2017). One of the major goals of this model is to reduce clinicians' burden which is aligned with one of our most important goals regarding our mobile intervention.

4.4 Behavior Change Techniques considering CBT for social anxiety

The social anxiety mobile application integrates several elements or components (described in Table 5), representing each behavior change technique according to CBT for social anxiety. Additionally, a therapist messaging element was included to enable a unidirectional communication between the therapist with the patient, to provide additional information, reminders or incentives. A timeline feature exposes all data the user submits in the mobile app to the therapist, in chronological order, providing a broader view of the self-monitoring exercise. Other aspects refer to

incentive of app usage through notifications/prompts, security features and data protection. More detailed information regarding behavior change techniques and its corresponding BIT elements are depicted in Table 6 (see appendix 3).

Table 5 - Behavior Change Techniques and corresponding Elements

Behavior Change Technique	Description	BIT Elements
Psychoeducation	Includes psychoeducational information about anxiety in social situations, symptoms and the cycle that maintains this disorder; Provides rationale about cognitive restructuring, social skills and exposure. It is written in a first-person plural, with a non-clinical language.	Text and image based;
Self-monitoring	Includes registration of emotions, thoughts and behaviors, before, during and after a feared social situation. Therapist may identify the most fear-evoking social situations, core belief systems, negative automatic thoughts, safety behaviors etc. through the therapist database.	This registration can be made in text or audio format, and may include images. After the registration it is possible to categorize the registration as predominantly positive, neutral or negative. When negative, the student is asked if he wants to challenge his thoughts (directed to the cognitive restructuring module).
Relaxation exercises	Applied relaxation is taught to clients to help them cope with autonomic arousal during exposures practices. Includes abdominal breathing exercises and progressive muscular relaxation (PMR).	Exercises are provided interactively trough video (abdominal breathing) and relaxation audios.
Cognitive restructuring	Identify anxiety-provoking assumptions and question whether these assumptions are valid, truthful, or helpful.	Interactive exercise where individuals submit negative thoughts, test their validity and afterwards submit

	Afterwards, individuals are challenged to create alternative thoughts, as a more functional and adaptive thinking pattern.	alternative thoughts. The entire process is sent to the therapist database.
Social skills exercises	Verbal and non-verbal communication and interpersonal communication styles. The therapist should identify if the patient has some social skills deficit and personalize the interactive exercise.	Interactive exercise that challenges users to practice several social skills, submitted by the user and combined with the therapist.
Exposure exercises	Allows the creation of a rank-ordered list of the most anxiety-evoking social situations. With therapist guidance, the user is encouraged to gradually apply the exposure exercises. Naturally, these exposure exercises should be "studied" with the therapist, so each exercise can be customized to the patient and to create exercises able to intervene in the patient fear of negative evaluation, a core characteristic of social anxiety.	Interactive exercise that challenges users to practice the suggested exposure exercises studied along with the therapist. Users are able to rate each exposure challenge according to the anxiety it provokes. These challenges are submitted in the app by the user but require therapist approval. When a challenge is active, a chat system also activates to enable brief contacts with therapist to provide small incentives and support.

4.5 Therapist Web Platform (Data Base)

The therapist database is a website linked to the mobile app; it gathers all the information submitted by the patient, through the app. Thus, the therapist has access to all texts, audios and images the patient submits and sends to the therapist, namely, self-monitoring reports, cognitive restructuring exercises and outcomes of exposure exercises. The therapist can also send messages, contacting the patient if needed, for example to give incentives or to suggest or guide homework exercises. This message system does not allow the patient to respond or contact the therapist through these messages. The website also intends to support therapists by avoiding messages and information overload. All the information stored in the database is structured and organized according to CBT intervention protocol, facilitating an improved monitoring and management of patients. A chat system is however embedded in the exposure

module so therapists can give small incentives and guidelines to patients undergoing exposure exercises *in vivo*.

4.6 Privacy Settings and Data Protection

Privacy is considered a crucial component in mHealth apps, so three main functionalities were applied to ensure patients privacy and data protection, namely, authentication (i.e., to use the app patients must create an account with a valid e-mail, create a password and verify the e-mail by opening their inbox). A customizable pin lock enables the user to choose a four-digit pin to block the app; the user must insert the pin every time he opens the mobile app. Customizable proactive messages (notifications) can be altered by the user, so, if someone sees the reminder pop-up, he isn't able to identify the app, or associate the user with someone attending therapy. The app also contains a privacy policy, always accessible, informing patients about the entity and research team responsible for the project; information about the study and app purpose; privacy methods and information about data retention. Finally, the chosen app name is "SPICA", so it may blend naturally in the middle of other apps and avoids identifying the student as being in therapy because of its name (e.g. "therapyAssist").

5. Discussion

The present study explores students' anxiety in social situations and habits of mobile use and interest in mobile intervention to complement treatment. In addition, it describes the theoretical framework and development process of a mobile app and a Web database, that is being developed, informed by study one and published literature. We conceptualized and developed an mhealth intervention as a solution to specific problems (i.e. social anxiety prevalence and negative impact in college students and the overburdened college counselling centers), considering users' needs.

The first study demonstrates levels of social anxiety symptoms in line with research indicating a high prevalence of social anxiety symptomatology among college students (Russell & Shaw, 2009), with most socially anxious students not attending psychological treatment, which is in accordance with research suggesting that these individuals have significant difficulty in seeking psychological help (American

Psychological Association, 2013; Olfson et al., 2000). These results reinforce the crucial need for solutions regarding social anxiety intervention among college students.

Concerning situations that generate more anxiety and discomfort, they are mainly associated with performance anxiety; however, when asked in what degree these situations interfere in daily life regarding work, affective life and social life, students with SAD primarily chose affective life/getting a boyfriend/girlfriend. This suggests that although these students suffer from great anxiety in social situations regarding their studies and academic performance, it's their affective and social life that they perceive to be more affected in their daily lives. These results impacted our mobile app content, since it reveals the importance of including skills to enhance social interaction, directed to social and affective life. Moreover, our app is highly customizable, allowing therapist to create exercises adapted to each patient.

Concerning usage habits of mobile applications, the large majority of students reported having a smartphone and using mobile applications frequently, which is consistent with research indicating that students are one of the largest consumers of smartphone technology (Shaw et al., 2017). Thus, we can suggest that also Portuguese students may easily adhere to mhealth interventions.

Results also indicated that in college students attending therapy, most of them considered relevant and would adhere if a mobile app to support treatment existed; in the specific case of students with social anxiety attending therapy, all of them reported relevance and potential adherence. Socially anxious students may have a greater tendency to adhere to these technologies, due to their fear of being subjected to scrutiny (Olfson et al., 2000), they may see these tools as a way to disclose and provide internal discourse that otherwise they wouldn't be able to verbalize. Naturally, we hope this to be a way for therapists to access reliable information more easily; afterwards they need to work closely with the patient to overcome their fears of negative evaluation and being subjected to scrutiny. In general, we can suggest that most students attending therapy perceive technology as a useful and relevant tool in these settings, indicating acceptability of these interventions.

Exploring which features they consider most important when downloading a mobile application, most students considered utility, content and privacy, respectively. When we asked students attending therapy what features they considered more

important in an application to support them between sessions, all considered privacy as being the most important, particularly students attending therapy with SAD. This is crucial for futures studies, and particularly study 2, to develop mobile apps for mental health, by giving special attention to privacy features and security, especially since many available apps do not respect privacy (Torous et al., 2018).

Results from study 1 guided us in some important features when developing our mobile app and therapist database; namely we tried to develop a highly customized app so therapists could also customize exercises (e.g. addressing specific situations associated with their social or affective life). In addition, students reported utility and privacy as very important features, to respond to this need, the app includes several characteristics to ensure privacy and security.

Overall, we consider that the app is also based in a solid conceptual framework, by including a clinical/ psychological model combined with a technological model for behavioural intervention, in line with evidence-base principles.

The present study has some limitations, namely, small sample size of students with social anxiety attending therapy, a larger sample is important to better determine and study the most preferred features of mobile apps in psychotherapy settings. Also, a more robust study addressing preferred features of mHealth apps from the user perspective are needed to better design these apps according to users' needs (e.g. by using focus groups). These studies reporting evaluation of needs should also be done from the therapist point of view, since these combined interventions, include the therapist.

Future studies in the field of mobile-based interventions in psychotherapy settings should continue to attempt to create a concise and robust protocol for the design, development, implementation and evaluation of these technologies. Many mHealth studies, in clinical psychology, address primarily the importance of evidence-based principles and experimental trials to establish efficacy, which is crucial. However, this may be better accomplished, with an adequately designed app, based on a user centered study, and with good usability. This study emerges to reinforce the importance of a multidisciplinary team, and their equal contribution in this field. It is our understanding that these technologies may have an important role in university and clinical settings, providing real support for both students and therapists.

References

Alyami, M., Giri, B., Alyami, H., & Sundram, F. (2017). Social anxiety apps: A systematic review and assessment of app descriptors across mobile store platforms. *Evidence-Based Mental Health*, *20*(3), 65–70. https://doi.org/10.1136/eb-2017-102664

Andersson, G., & Cuijpers, P. (2009). Internet-based and other computerized psychological treatments for adult depression: A meta-analysis. *Cognitive Behaviour Therapy*, *38*(4), 196–205. https://doi.org/10.1080/16506070903318960

APA. (2013). *Diagnostic and statistical manual of mental disorders (DSM-V)*. American Psychiatric Pub.

Boukhechba, M., Daros, A. R., Fua, K., Chow, P. I., Teachman, B. A., & Barnes, L. E. (2018). DemonicSalmon: Monitoring Mental Health and Social Interactions of College Students Using Smartphones. *Smart Health*. https://doi.org/10.1016/J.SMHL.2018.07.005

Brook, C. A., & Willoughby, T. (2015). The Social Ties That Bind: Social Anxiety and Academic Achievement Across the University Years. *Journal of Youth and Adolescence*, *44*(5), 1139–1152. https://doi.org/10.1007/s10964-015-0262-8

Clough, B. A., & Casey, L. M. (2015). The smart therapist: A look to the future of smartphones and mHealth technologies in psychotherapy. *Professional Psychology: Research and Practice*, *46*(3), 147–153. https://doi.org/10.1037/pro0000011

Fehm, L., Pelissolo, A., Furmark, T., & Wittchen, H. U. (2005). Size and burden of social phobia in Europe. *European Neuropsychopharmacology*, *15*(4), 453–462. https://doi.org/10.1016/j.euroneuro.2005.04.002

Gordon, D., Wong, J., & Heimberg, R. G. (2014). Cognitive-Behavioral Therapy for Social Anxiety Disorder. In *The Wiley Blackwell Handbook of Social Anxiety Disorder* (pp. 477–497). John Wiley & Sons, Ltd.

Heimberg, R. G. (2002). Cognitive-behavioral therapy for social anxiety disorder: Current status and future directions. *Biological Psychiatry*, *51*(1), 101–108. https://doi.org/10.1016/S0006-3223(01)01183-0

Hope, D. A., Heimberg, R. G., & Turk, C. L. (2010). *Managing Social Anxiety: A Cognitive-Behavioral Therapy Approach Therapist Guide*. Oxford University Press

USA.

Johnson, K. F., & Kalkbrenner, M. T. (2017). The Utilization of Technological Innovations to Support College Student Mental Health: Mobile Health Communication. *Journal of Technology in Human Services*, *35*(4), 314–339. https://doi.org/10.1080/15228835.2017.1368428

Lee, R. A., & Jung, M. E. (2018). Evaluation of an mhealth app (destressify) on university students' mental health: Pilot trial. *Journal of Medical Internet Research*, *20*(1). https://doi.org/10.2196/mental.8324

Michelle, Jarzabek, S., & Wadhwa, B. (2014). CBT Assistant: MHealth App for Psychotherapy. *2014 IEEE Global Humanitarian Technology Conference - South Asia Satellite, GHTC-SAS 2014*. https://doi.org/10.1109/GHTC-SAS.2014.6967572

Mohr, D. C., Schueller, S. M., Montague, E., Burns, M. N., & Rashidi, P. (2014). The Behavioral Intervention Technology Model : An Integrated Conceptual and Technological Framework for eHealth and mHealth Interventions, *16*(6), e146. https://doi.org/10.2196/jmir.3077

Olff M. (2015). Mobile mental health: a challenging research agenda. *European journal of psychotraumatology*, *6* 27882. https://doi.org/10.3402/ejpt.v6.27882

Olfson, M., Guardino, M., Struening, E., Ph, D., Schneier, F. R., Hellman, F., & Klein, D. F. (2000). Barriers to the Treatment of Social Anxiety, (April), 521–527.

Oliveira, C., Varela, A., Esteves, J., Henriques, C., & Ribeiro, A. (2016). Programas De Prevenção Para a Ansiedade E Depressão : Avaliação Da Percepção Dos Estudantes Universitários. *Programas De Prevenção Para a Ansiedade E Depressão*, *111*(42), 96–111.

Pinto-Gouveia, J., Cunha, M., & Salvador, M. C. (2000). Um protocolo para a avaliação clínica da fobia social através de questionários de auto-resposta. *Ansiedade Social: Da Timidez à Fobia Social. Coimbra: Quarteto*.

Russell, G., & Shaw, S. (2009). A study to investigate the prevalence of social anxiety in a sample of higher education students in the United Kingdom. *Journal of Mental Health*, *18*(3), 198–206. https://doi.org/10.1080/09638230802522494

Schueller, S. M., Tomasino, K. N., & Mohr, D. C. (2017). Integrating Human Support Into Behavioral Intervention Technologies: The Efficiency Model of Support. *Clinical Psychology: Science and Practice*, *24*(1), 27–45.

https://doi.org/10.1111/cpsp.12173

Spooner, S. E. (2000). "The college counseling environment", in College counseling: Issues and strategies for a new millennium (American Counseling Association), 3–14.

Shaw, B. M., Lee, G., & Benton, S. (2017). Work Smarter , Not Harder : Expanding the Treatment Capacity of a University Counseling Center Using Therapist-Assisted Online Treatment for Anxiety, 197–204. https://doi.org/10.1007/978-3-319-23736-7

Tillfors, M., & Furmark, T. (2007). Social phobia in Swedish university students: Prevalence, subgroups and avoidant behavior. *Social Psychiatry and Psychiatric Epidemiology*, *42*(1), 79–86. https://doi.org/10.1007/s00127-006-0143-2

Torous, J., Nicholas, J., Larsen, M. E., Firth, J., & Christensen, H. (2018). Clinical review of user engagement with mental health smartphone apps: evidence, theory and improvements. *Evidence Based Mental Health*, *21*(3), 116 LP – 119. Retrieved from http://ebmh.bmj.com/content/21/3/116.abstract

Wang, Y., Fadhil, A., Lange, J.-P., & Reiterer, H. (2017). Towards a Holistic Approach to Designing Theory-based Mobile Health Interventions. Retrieved from http://arxiv.org/abs/1712.02548

Webb, T. L., Joseph, J., Yardley, L., & Michie, S. (2010). Using the Internet to promote health behavior change: A systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *Journal of Medical Internet Research*, *12*(1), 1–18. https://doi.org/10.2196/jmir.1376

Wilansky, P., Eklund, M., Milner, T., Kreindler, D., Kovacs, T., Shooshtari, S., … Mills, R. (2016). Cognitive Behavior Therapy for Anxious and Depressed Youth: Improving Homework Adherence Through Mobile Technology. *JMIR Research Protocols*, *5*(4), e209. https://doi.org/10.2196/resprot.5841

APPENDIX 1

Table 1 - Sociodemographic characteristics

	G1 n=34, 11.3%	G2 n=236, 78.1%	G3 n=26, 8.8%	
			With SAD n=5, 19.2%	Without SAD n=21, 80.8%
Gender				
Female	32 (94.1%)	176 (74,6%)	5 (100%)	15 (71.4%)
Male	2 (5.9%)	60 (25.4%)	-	6 (28.6%)
Mean age (SD)	20.5 (3.37)	21.9 (4.46)	22.4 (2.96)	24.4 (5.31)
Civil status				
Single	32 (94.1%)	224 (94.9%)	5 (100%)	19 (90.5%)
Married	1 (2.9%)	6 (2.5%)	-	1 (4.8%)
Others	-	2 (0.8%)	-	1 (4.8%)
Academic degree				
Bachelor	30 (88.2%)	176 (74.6%)	4 (80%)	14 (66.7%)
Masters	3 (8.8%)	50 (21.2%)	1 (20%)	6 (28.6%)
Doctorate	-	-	-	1 (4.8%)

Note. G1 - students with SAD symptomatology; G2 – students without SAD; G3 – students attending therapy

APPENDIX 2

Table 4 – Students attending therapy that demonstrated interest and adherence to mobile apps for mental health

	G3 (n=26)	
	With SAD (n=5, 19.2%)	Without SAD (n=21, 80.8%)
Do you think it would be interesting to have a mobile app that could guide you throughout therapy?	5 (100%)	16 (80%)
If there was a mobile app that guided you between therapy sessions and with guidelines for exercises you learnt in therapy, would you easily adhere to this mobile app?	5 (100%)	17 (85%)
If there was a mobile app of this nature, which of the following features would you consider most important?		
Security and privacy	4 (80%)	14 (73.7%)
Interactivity	2 (40%)	12 (63.2%)
Being simple and easy to use	2 (40%)	11 (57.9%)

APPENDIX 3

Table 6 *- Modelo BIT*

	BIT Component	Social anxiety app
Theoretical		
Why	Intervention Aims	Clinical Aims:
		Larger treatment goal (Aim): reduce anxiety in social situations
		Sub-aims:
		-increase education about the disorder;
		-increase self-monitoring and the ability to identify and challenge negative automatic thoughts;
		-create more functional and adaptive thinking patterns;
		-enhance social skills;
		-reduce avoidance behaviors;
How (Conceptual)	Behavior change techniques	Grounded in cognitive behavioral intervention for social anxiety
		-Psychoeducation
		-Self-monitoring
		-Cognitive restructuring
		-Social skills training
		-Relaxation exercises
		-Exposure exercises (Goal setting)
		-Feedback from therapist and from the app.
Instantiation		
What	Elements	Psychoeducation delivered through text and images – information delivery.
		Cognitive restructuring, Exposure exercises and social skills training involve data collection through interactive logs that guide the user through the exercise. It also includes an anxiety rating scale (from 0 to 10).
		Relaxation exercises include abdominal breathing illustrated by an interactive image explaining the exercise and the progressive muscular relaxation delivered through and audio recording.
		Exposure and social skills training additionally engage in a combination of data collection and brief, predominantly unidirectional messaging component with the therapist.
		Timeline component is a report that provides the user all data submitted and aggregated in chronological order.
		Notifications include individual messages within the mobile application (app notifications).
How	Characteristics	Medium (text and audio)

(technical)		Medium Complexity: educated users and moderate comfort with technologies. Aesthetic: simple and clean Personalization: pin lock and notifications.
When	Workflow	BIT interventions are delivered according to changes in BIT elements, according to a task-completion rules determined by the therapist. Thus, not all BIT elements are immediately available to the patient. This intervention delivery is in accordance with the cognitive behavioral intervention protocol.