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Treating small animal phobias using a projective-augmented reality system: A single-case study

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ABSTRACT

In vivo exposure is the evidence based treatment for small animal phobias. However, this type of treatment still present a low treatment seek rate and a high drop-out rate, due to its aversive character for the patients. New technologies such as Virtual Reality (VR) and augmented reality (AR) have started to show their potential in anxiety disorders, including small animal phobia treatment and have demonstrated their efficacy. However, these systems still present limitations regarding the possibility to offer an optimal therapy to the phobia sufferers. This study evaluates the clinical efficacy of new AR exposure therapy – a projection-based system (P-ARET) for small animal phobias in the short (post-treatment), and long term (3- and 12-month follow-up). Four patients diagnosed with cockroach phobia participated in this pilot treatment study. The results show that all patients improved significantly in main outcome measures after the treatment. The study also follows a strategy of benchmarking, in which the results obtained from the evaluation of the P-ARET system in clinical setting are compared with two other clinically validated phobia therapies (traditional, in vivo exposure therapy (IVET); virtual reality exposure therapy (VRET); and AR exposure therapy with the use of a head-mounted display (HMD-ARET). The results indicate that the clinical effectiveness of new projection-based AR system for small animal phobia treatment was comparable to those achieved by the therapeutic conditions in other studies. However, the P-ARET system brings some advantages in terms of patient-therapist communication and more natural interaction with the system.

1. Introduction

Specific Phobias (SPs) used to be considered for a long time as a common but inconsequential psychological problem; nevertheless, they have been now shown as clinically significant and relatively unstudied disorders (Becker, Rinck, et al., 2007). Reports on the Mental Health show that the SPs correspond to one of the most common mental single disorder (Alonso, Angermeyer, Bernert, et al., 2004). More specifically, 8.7% of American population suffer from SPs (National Institute of Mental Health, 2008), and 4.7% is affected by small animal phobias (Stinson et al., 2007). The similar prevalence was found among European population. The report shows that the animal type of phobia is represented in this population with the highest score (i.e., 5%) among all the SPs (Becker et al., 2007).

The treatment of SPs can be performed according to different theoretic orientations (e.g. Choy, Fyer, & Lipsitz, 2007; Wolitzky-Taylor, Horowitz, Powers, & Telch, 2008), however, the empirically supported treatments such as in vivo exposure therapy have been demonstrated to be the most efficacious (Chambless et al., 1998). Although phobias can be treated with a precisely established protocol, numerous clinical reports show that the validated treatments can still be improved. For instance, between 60% and 80% of phobia sufferers do not seek treatment (e.g. Agras, Sylvester, & Oliveau, 1969; Essau, Conradt, & Petermann, 2000; Magee, Eaton, Wittchen, McGonagle, & Kessler, 1996), and 25% of potential patients refuse to participate in exposure therapy after understanding its procedure (García-Palacios, Botella, Hoffman, &

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Fabregat, 2007; García-Palacios, Hoffman, See, Tsay, & Botella, 2001). Moreover, according to Choy et al. (2007) in vivo exposure is associated with a high level of drop-out rates (i.e., up to 45%). Given the suffering that can cause a phobia and negative consequences that this disorder can have on the person's life, increasing the access, acceptance, and motivation in the therapy represent an important challenge.

Information and Communication Technologies (ICT) present potential solutions for SPs treatment challenges. Indeed, innovative technologies have been increasingly acknowledged as a potentially useful therapeutic tool in the Mental Health (MH) field (Doherty, Coyle, & Matthews, 2010) that allow to have easier access to MH services, enhance patients' engagement in the treatments (Coyle, Doherty, Sharry, & Matthews, 2007), and increase the standardization of health care (Hoffman, 1999). For instance, Virtual Reality (VR) – based exposure resolves some of the problems associated to in vivo exposure therapy (Botella et al., 2005), besides having the same effectiveness for the treatment of anxiety disorders as traditional exposure therapy (e.g. Opris et al., 2012; Parsons and Rizzo, 2008; Powers & Emmelkamp, 2008; Wolitzky-Taylor et al., 2008). Indeed, VR allows therapists to precisely control the virtual animal (i.e., make the animal immobile, move the animal in different directions, change its size, and multiply the animal as many times as the patient and therapist desire). Also, the virtual animals can appear with a simple click of the keyboard button, thus decreasing logistic issues. Finally, VR can recreate environments and situations that would be difficult to arrange in traditional treatments.

Recently, augmented reality (AR) technology has been introduced to the MH field. The AR technology differs from the VR environment by augmenting the real environment with virtual objects instead of replacing it (Azuma, 1997). In this way, the patients can observe the environment that combines both the real world and the virtual objects. AR includes the previously presented advantages of the VR technology, but it also has some additional features that might be interesting especially in the case of small animal phobias (Botella, Bretón López, Quero, Baños, & Garcia-Palacios, 2010; Botella et al., 2005). For instance, only some specific objects such as virtual animals have to be modeled, therefore; the costs of programming and modeling the application are lower. Also, perceiving the virtual object in the real environment may have great importance for a better sense of presence and reality judgment, which are recognized as key aspects in this field (Baños, Botella, Garcia-Palacios, et al., 2000). The AR systems is a relatively new technology in the MH field, however, it have already shown its efficacy in various area such as education (e.g. Arvanitis et al., 2007; Squire & Mingfong, 2007; Wrzesien & Alcañiz, 2010) or medicine (e.g. De Buck et al., 2005; Shuhaiber, 2004). Moreover, recent pilot studies confirm the effectiveness of this technology in the treatment of small animal phobia (e.g. Botella et al., 2010; Botella et al., 2011; Bretón-López et al., 2010).

Both VR and AR technologies have demonstrated their efficacy in MH field; however, some improvements still can be done. First, both applications typically use head-mounted displays (HMD) to visualize a virtual environment or virtual objects; this might limit communication between the patient and the therapist. Indeed, visual awareness plays an important role in all types of face-to-face communication (e.g. Piper & Hollan, 2009). During the in-situ analyses Wrzesien, Burkhardt, Alcañiz, and Botella (2011) calculated the frequency of visual contact between the patient and the therapist during technology-mediated therapy (HMD-based AR exposure therapy) and traditional therapy (in vivo exposure therapy). The visual contact between the patient and the therapist was significantly lower for the HMD-based AR exposure therapy than for the in vivo exposure therapy. Although the low frequency of visual contact in HMD-based ARET did not affect the clinical outcome, other visual displays such as projection-based systems might be proposed to improve patient-therapist non-verbal communication as well as patients' comfort. Second, both VR and AR applications do not allow the interactions between the patients and the animals. Although the control of the phobic stimulus is a priority issue to provide safe and secure environment for the patient, the natural behavior of the virtual animals seems important. Indeed, reactions of the animals to the patient's behavior seems to be necessary for greater sense of presence and reality judgment, which are both related with the anxiety activation (Baños, Botella, Guerrero, Liaño, Rey, & Alcañiz, 2004) allowing the anxiety curve during the treatment to occur. Moreover, the natural behavior of the virtual animal corresponds to the daily situations that the patient may encounter in everyday life, reinforcing in this way his/her self-efficacy belief about the possible confrontation with the phobic stimulus. Thus, the introduction of more natural interactions between the virtual animal and both patient and therapist, might bring some additional improvements.

All these improvements have been introduced in new developed AR tool for small animal phobia treatment (see Wrzesien et al., 2013 for the system description). The aim of this study is therefore to evaluate the clinical effectiveness of this new projection-based AR exposure therapy system (P-ARET) for small animal phobias. More specifically, this study reports data on pilot treatment study in clinical setting with this new developed tool for small animal phobia treatment, and compare it, based on the benchmarking strategy, to other studies that use different type of set-up for small animals phobia treatments, namely VR-based exposure therapy; AR-based exposure therapy; and in vivo exposure therapy. Although, numerous randomized controlled trials (RCT) exist in the field of VR applied to the therapeutic context, no RCT of either augmented reality or projection-based augmented reality exists in the literature. Therefore, this single case study would greatly contribute to the state of the art in this specific field.

2. Method

This study is based on the methodological recommendations and criteria (Hersen & Barlow, 1984; Kazdin, 2003, 2010; Nathan and Gorman, 2002) that make the single-case experimental designs useful and clinically valid. As expressed by Kazdin (1993) "Single-case experimental designs have been advanced as one way to introduce systematic assessment and evaluation in clinical practice" (p. 16). Single-case research methodology includes essential components and criteria that make the case study useful (i.e., assessment, design, and evaluation strategies). Therefore, although the usual number of participants in case studies (in our case $N = 4$) might seem small or inadequate, this type of studies have several important functions such as describing new clinical challenges and phenomena, and documenting the feasibility and preliminary efficacy of innovative interventions (Drotar, 2010).

2.1. Participants

In total, 4 women participated in this study ($M = 41.50$ years old; SD = 17.52). All the participants came to seek help at the Emotional Disorder Clinic at Jaume I University of Castellon (Spain) and were selected according to the DSM-IV-TR (American Psychiatric Association, 2000) criteria for a specific phobia to small animals (i.e., cockroaches). The diagnostic and assessment phase was carried out by two therapists working in the clinic, both trained in the application of cognitive-behavioral treatment programs for anxiety disorders and with at least a master degree. The co-therapists with extended clinical experience were available