

Investigating Sudden Gains during Virtual Reality Exposure Therapy for a Patient with Anxiety Disorders: A Single-Subject Research Design with an Evidence-Based Practice Approach

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Investigating Sudden Gains during Virtual Reality Exposure
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Research Design with an Evidence-Based Practice Approach

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Introduction

Anxiety disorder is a debilitating disorder that is often treated with exposure therapy, a type of cognitive behavioral therapy (Apolinário-Hagen et al., 2020). In the past years, it has been of increased interest to use new technology in treatment, such as Virtual Reality (VR) (Boeldt et al., 2019). For the treatment of anxiety disorders, more specifically, the efficacy of Virtual Reality Exposure Therapy (VRET) has been examined and has demonstrated numerous advantages such as lesser costs, more control over the feared stimulus, and improved patient's acceptability (Clemmensen et al., 2020; Kampmann, Emmelkamp, Hartanto et al., 2016). To date, several studies confirmed the effectiveness of VRET as a treatment for anxiety disorders such as specific phobias, social anxiety disorder, panic disorder, agoraphobia, and generalized anxiety disorder (Clemmensen et al., 2020; Eshuis et al., 2020; Kampmann, Emmelkamp, & Morina, 2016; Maples-Keller et al., 2017).

In the Psychological and Logopedic Clinic of the University of Liège (CPLU), patients suffering from an anxiety disorder who are seeking professional help have the opportunity to be treated with VRET. The choice to use VRET in the care of patients is made based on an Evidence-Based Practice (EBP) approach. EBP allows us to make the best decision in terms of therapeutic options by taking into account the patient's characteristics and preferences, the context, the clinician's expertise, as well as the recent literature (Willems et al., 2020).

Through a single-case study in a multiple baseline design, this study aimed at assessing the efficacy of VRET in improving the anxiety-related symptoms of patients. Moreover, this design allowed us to analyze more deeply the changes in the anxiety symptoms throughout the intervention. We were interested to examine whether there were sudden gains during the therapy as they are known to be a predictor of an improved treatment response (Shalom & Aderka, 2020). Furthermore, the implementation of EBP in our single-case study is of interest as there is a paucity of research on the implementation of EBP in clinical practice, despite the advantages that are later described.

Part I - Literature review

Chapter 1 - Anxiety disorders

Anxiety disorders are characterized by excessive worry and fear that disturb one's behaviors (Ling et al., 2014). They are considered the most prevalent psychiatric disorders (Bandelow, 2020). Indeed, their lifetime prevalence rates are high: it can be up to 33,7% (Apolinário-Hagen et al., 2020). Females tend to suffer more from this condition than men (Bandelow, 2020). In the DSM-V (American Psychiatric Association [APA], 2013), there are several types of anxiety disorders including social anxiety, specific phobia, panic disorder, agoraphobia, and generalized anxiety disorder, which will be later described. Anxiety disorders significantly impair the life of those who suffer from them: they have a reduced quality of life and impairments in social, academic, or professional functioning (Clemmensen et al., 2020; Kampmann, Emmelkamp, Hartanto et al., 2016).

Individuals with anxiety disorders experience periods of intense anxiety with several physical symptoms such as palpitations, faintness, vertigo, dizziness, or chest pain (Clark & Beck, 2011). Moreover, individuals often anticipate the threat or danger (that is, facing their feared stimuli or situation) and appraise the situations as more threatening than the general population (Arnaudova et al., 2017; Fatemi & Clayton, 2008). Consequently, they tend to avoid the situations or stimuli they fear. However, avoidance is maladaptive and impairs their general functioning (Arnaudova et al., 2017). Furthermore, it maintains their anxiety as they do not confront themselves with their feared stimuli and thus can not realize that their worse fear will probably not happen (Grupe & Nitschke, 2013). They also do not get the possibility to learn more adaptive behaviors and to learn how to handle the situations (Arnaudova et al., 2017). Therefore, individuals with anxiety disorders often think that they are incapable of facing their feared stimuli and have low levels of self-efficacy, which leads to even more avoidant behaviors as well as higher levels of anxiety (Muris, 2002; Ng & Lovibond, 2020).

As aforementioned, there are different types of anxiety disorders and they manifest themselves in different ways. Individuals with social anxiety disorder (SAD) fear social situations in which they might behave in an embarrassing manner in front of others or be negatively judged by them (APA, 2013). Specific phobia (SP) is characterized by a lasting and unreasonable fear or anxiety related to a specific object or situation such as spiders, needles, blood, flying, or heights (APA, 2013). Individuals with panic disorder (PD) have recurrent unexpected panic attacks. When having a panic attack, they experience periods of intense fear that are manifested by physiological and cognitive symptoms: heart palpitations, sweating,

shaking, choking sensations, as well as racing thoughts and fear of dying (APA, 2013). Individuals with agoraphobia fear and avoid situations where it might be difficult for them to escape. Agoraphobia (AG) often develops after the individual has suffered from panic attacks and is now afraid to have another panic attack in a public space in which they could not get help (APA, 2013). Lastly, generalized anxiety disorder (GAD) is characterized by persistent, excessive, and uncontrollable worry about everyday life events without adequate rationale (APA, 2013). In this single-case study, the patient suffers from GAD and agoraphobia. Therefore, these two types of anxiety disorders will be further described.

1.1. Generalized Anxiety Disorder

Generalized Anxiety Disorder is characterized by excessive worrying about ordinary, day-to-day situations, occurring most days for at least 6 months (McDowell et al., 2018; Stein et al., 2021). Wells (1999) defines worry as “*a chain of catastrophizing thoughts that are predominantly verbal. It consists of the contemplation of potentially dangerous situations and of personal coping strategies. It is intrusive and controllable although it is often experienced as uncontrollable. Worrying is associated with a motivation to prevent or avoid potential danger. Worry itself may be viewed as a coping strategy but can become the focus of an individual’s concern*” (p. 87). Individuals with GAD may also worry about worrying, which is described as meta-worry (Wells, 1995). Other symptoms include restlessness, concentration difficulties, fatigue, irritability, and continuously feeling on edge (Locke, Kirst, & Schultz, 2015; Stein et al., 2021). Physical symptoms such as sleep disturbance, muscle tension, gastrointestinal symptoms, and chronic headaches often accompany their anxiety (Locke et al., 2015).

GAD is one of the least well-understood and researched anxiety disorders. This can be partly due to the multiple revision of the diagnostic criteria and also to the fact that it has often been considered a “wastebasket” diagnosis when it was not possible to make another anxiety disorder diagnosis (Stein et al., 2021). Moreover, as worrying is usually a part of everyday life, it was frequently thought that worrying was associated with minimal impairment. Yet, GAD causes significant functional impairment, distress, and disability in multiple domains (e.g., work, finances, health, quality of life, psychosocial functioning) (Carl et al., 2020). Further, GAD has a high prevalence: it is estimated that 3.7% of the worldwide population will have GAD in their lifetime (Stein et al., 2021). Risk factors for developing GAD include being a

woman, lower education level, unmarried status, poor health, and history of stressful life events (Locke et al., 2015).

Concerning treatment, GAD can be treated with pharmacology, including selective serotonin reuptake inhibitors (SSRIs). However, SSRIs can have negative side effects (e.g., increased suicidality and aggression) (McDowell et al., 2018). Cognitive behavioral therapy (CBT), especially cognitive restructuring, is effective in the treatment of GAD (Carl et al., 2020; Hofmann & Reinecke, 2010). Moreover, the use of Virtual Reality in psychotherapy such as a VR-based worry exposure therapy has been shown to reduce GAD symptom severity and worry (Keshavarz et al., 2021). Yet, many individuals suffering from GAD do not receive treatment (Stein et al., 2021). If left untreated, GAD tends to follow a relatively chronic course that can be periodically punctuated by exacerbations (Hoffman, Dukes, & Wittchen, 2008). Besides, there can be a long delay between the first apparition of symptoms and the diagnosis and the receipt of treatment: between 5 to 10 years (Hoffman et al., 2008).

1.2. Agoraphobia

Individuals with agoraphobia experience anxiety when they are in a public or crowded space, from which it might be difficult to escape or to get help (Roest et al., 2019). Examples of situations include using public transportations, being in open or enclosed spaces, standing in lines or crowds, or being outside of the home alone (APA, 2013). In such situations, they may fear that they will have a panic attack or panic-like symptoms (Balaram & Marwaha, 2020; Roest et al., 2019). To meet the criteria for the diagnosis, exposure to public places must be feared but individuals must also make active attempts to avoid these situations, either through behavioral or cognitive modifications (APA, 2013; Balaram & Marwaha, 2020).

In the DSM-IV, agoraphobia was a qualifier of panic disorder and not a formal psychiatric diagnosis. Nevertheless, in the DSM-V, agoraphobia is now considered a distinct diagnosis that can occur independently of other diagnoses (Balaram & Marwaha, 2020). As it has been only considered a distinct diagnosis recently, most studies have examined agoraphobia in combination with panic disorder. Little attention has been paid to agoraphobia and it is, therefore, one of the least studied anxiety disorders (Roest et al., 2019).

Agoraphobia can lead to significant functional impairment and distress. The consequences of severe agoraphobia may involve being confined to one's home, being unable to leave the house without the presence of a companion, and thus being extremely dependent on others (Balaram & Marwaha, 2020; Roest et al., 2019). Lifetime prevalence rates of agoraphobia are around 1,3-1,5% (Balaram & Marwaha, 2020; Roest et al., 2019). Some

factors linked to agoraphobia comprise parental overprotectiveness, the presence of childhood fears or night terrors, negative or traumatic events in childhood, experiences of grief or bereavement early in life, or genetic predisposition (Balaram & Marwaha, 2020). Further, agoraphobia is associated with comorbid personality types such as dependent, obsessive-compulsive, or neurotic (Balaram & Marwaha, 2020).

Agoraphobia is a persistent and chronic disorder and complete remission is relatively rare without treatment or intervention (Balaram & Marwaha, 2020). Cognitive behavioral therapy has been demonstrated to be efficient in the symptomatic management of agoraphobia and in the amelioration of the patient's quality of life. More specifically, previous data have established that gradual exposure therapy and VRET were efficient in the treatment of agoraphobia (Bethencourt et al., 2015; Meyerbröker & Morina, 2021). Pharmacotherapy is also an adequate treatment choice, with SSRIs considered first-choice drugs (Bethencourt et al., 2015). Research suggests that the combination of CBT with pharmacotherapy is the most effective in alleviating the symptoms of agoraphobia (Balaram & Marwaha, 2020; Bethencourt et al., 2015).

1.3. Cognitive, emotional, and behavioral processes in anxiety disorders

Mental disorders are known to be caused by biological factors, as well as social and environmental factors, such as traumatic life events (Arango et al., 2018). Still, different cognitive and behavioral processes that affect psychological functioning also play a role in the development and maintenance of mental disorders (Kinderman et al., 2013). In anxiety disorders, the main processes involved include cognitive dysfunction, distorted cognitions, avoidance behaviors, and the sense of self-efficacy (Arnaudova et al., 2017; O'Toole et al., 2015; Vander Haegen & Etienne, 2016). Thus, treatment for anxiety disorders should focus on these processes to improve the patient's symptomatology.

As mentioned above, a person with an anxiety disorder usually has cognitive biases, dysfunctions, and distorted cognitions (Vander Haegen & Etienne, 2016). These can include overestimation of the probability and/or dangerousness of the feared situations, negative interpretation bias (i.e., interpreting ambiguous scenarios in a more threatening manner), attentional biases (i.e., selectively attending to certain stimuli that are worry-prone), hypervigilance and difficulties in disengaging attention from perceived threats, and deficits in attentional control (i.e., difficulties in directing their attention away from a stimulus and in shifting mental focus) (Hirsch et al., 2019; O'Toole et al., 2015; Vander Haegen & Etienne,

2016). All these dysfunctional processes maintain worry as they cause any anxiety-related stimuli to be more salient in the individual's cognition and also to lead to avoidance (Goodman et al., 2019; Hirsch et al., 2019).

In anxiety disorders, avoidance is a common phenomenon (Goodman et al., 2019). It can take many forms: an individual could physically avoid places or situations that he or she dreads: for example, individuals with social anxiety would not go to parties or any events where they think someone might judge them; an agoraphobic will not go to any crowded space; someone who has aerophobia will never travel by plane (Arnaudova et al., 2017). This can lead to behavioral deactivation and functional impairment such as not being able to do certain activities (e.g., groceries shopping) independently and relying exclusively on their close relatives; withdrawing from any social activities; isolating themselves; or taking down job offers because it involves speaking in public or traveling by plane for different meetings (Philippot et al., 2015). The avoidance can also be more cognitive: avoiding thoughts or emotions by suppressing them. However, since emotions are internal states, they can not be truly avoided. Emotional avoidance impedes the processing of emotional information. Thus, the emotion is maintained, and the person's distress is increased by their inability to control their emotions (Philippot et al., 2015).

In this manner, individuals with anxiety disorders will try, for better or worse, to maintain or extend the temporal, physical, or psychological distance between the situation they fear (as well as its accompanying feelings and physiological arousal) and themselves. (Arnaudova et al., 2017; Goodman et al., 2019). While these behaviors appear to be beneficial in the short term as they alleviate the person's anxiety, they are harmful in the long term because they contribute to the chronification of the disorder (Goodman et al., 2019; Philippot et al., 2015). Avoiding all situations eliciting anxiety does not allow the person to create new associations and learn that the situation may not be so dangerous after all. Importantly, it impedes the learning of more adaptive behaviors (Arnaudova et al., 2017). Avoidance leads to a feeling of failure which then decreases their sense of self-efficacy (Philippot et al., 2015). As their sense of self-efficacy is low, they will not believe that they are capable of overcoming the feared situation and they will continue to apprehend and avoid it. The anxiety disorder is thus maintained by the avoidance behaviors via this vicious circle (Goodman et al., 2019).

Self-efficacy refers to the trust into one's capacity to successfully perform a specific behavior (Brenninkmeijer et al., 2019; Meyerbröker & Morina, 2021). Self-efficacy plays a key role in the initiation and maintenance of behavioral changes (Brenninkmeijer et al., 2019). As individuals tend to avoid activities for which they experience low self-efficacy, increasing

self-efficacy can help break avoidance behaviors as patients: by believing in their capacity, they may find the motivation to expose themselves to their feared situations (Brenninkmeijer et al., 2019; Meyerbröker & Morina, 2021). It has also been established that individuals with a higher baseline self-efficacy had better treatment outcomes (Brenninkmeijer et al., 2019)

It is fundamental that treatments for anxiety disorders focus on the psychological processes summarized in Table 1 to alleviate the anxiety symptoms and cognitive behavioral therapy has been found to modify distorted cognitions and safety behaviors and increase self-efficacy (O'Toole et al., 2015).

Table 1

The cognitive, emotional, and behavioral processes in anxiety disorders

Cognitive (biases, dysfunctions, distorted cognitions)	Overestimation of the probability of dangerousness of the feared situations Negative interpretation bias Attentional biases Hypervigilance and difficulties disengaging from perceive threats Deficits in attentional control Self-efficacy deficiency
Emotional	Thoughts avoidance Emotional suppression
Behavioral	Avoidance (physical, cognitive) Behavioral deactivation Functional impairment

As previously stated in this chapter, anxiety disorders are one of the most common mental illnesses, interfere greatly with daily functioning, and present low rates of spontaneous recovery (Bandelow, 2020; Clemmensen et al., 2020). Despite the proven efficacy of traditional treatment options such as exposure therapy, many individuals suffering from an anxiety disorder do not seek treatment (Bandelow, 2020). Therefore, innovative treatment, such as VRET, could be a good alternative and may help improve accessibility and quality of healthcare. The following chapter of this paper moves on to describe in greater detail cognitive behavioral therapy for anxiety disorders, more specifically exposure therapy.

The most promising and investigated treatment for anxiety disorders is cognitive behavioral therapy (CBT). The characteristics of CBT are being directive, problem-oriented, structured, and time-limited (Apolinário-Hagen et al., 2020). Also, forming a strong therapeutic alliance is central to CBT (Apolinário-Hagen et al., 2020). Indeed, a good therapeutic relationship is one of the most important predictors of positive treatment outcomes (Easterbrook & Meehan, 2017). Having a good therapeutic alliance contributes greatly to the involvement, engagement, and compliance of the patient, and is thus the foundation of change (Crawford et al., 2018; Easterbrook & Meehan, 2017). CBT's aim is to modify maladaptive cognitions and behaviors: it is thought that those are learned and hence, can be unlearned (Apolinário-Hagen et al., 2020). This can be achieved by using strategies that can be cognitive, such as cognitive restructuring, or behavioral, such as exposure therapy (Kampmann, Emmelkamp, Hartanto et al., 2016).

In the cognitive strategies, the goal is to identify and test the validity of the learned maladaptive cognitions and then replacing them with more adjusted and realistic cognitions (Apolinário-Hagen et al., 2020). One core concept of CBT is that the cause of one's suffering is not the context or circumstances per se, but rather the way one perceives those situations and the associated beliefs and assumptions (Apolinário-Hagen et al., 2020). Therefore, by changing one's maladaptive perceptions of the situations, emotional symptom relief and more adaptive behaviors will ensue (Apolinário-Hagen et al., 2020).

In exposure therapy, individuals have to confront themselves with their feared stimuli. Through confrontation, patients become progressively habituated to the conditioned stimuli with the aim of achieving fear extinction (Kampmann, Emmelkamp, Hartanto et al., 2016). Depending on the type of anxiety disorders, individuals can be exposed to diverse stimuli or situations such as spiders, social interactions, doing groceries, or being in a crowd. Usually, the exposure is done during therapy and comprises homework exercises that patients have to do in their daily lives (Kampmann, Emmelkamp, Hartanto et al., 2016). The traditional versions of this type of treatment comprise imaginary exposure or in vivo exposure (Mota et al., 2015).

During imaginary exposure, patients are asked to imagine and describe their feared stimuli, with the optional help of videos or pictures (Clemmensen et al., 2020). While it is less confronting, time-consuming, and costly, this technique certainly has its limitations. Imagery exposure can suffer from a lack of realism and intensity (Clemmensen et al., 2020). Moreover, it is less controllable for the therapist and patients can avoid thinking about their feared stimuli.

Also, some people have difficulties imagining vividly the anxiety-provoking situations or on the contrary, can be overwhelmed with those thoughts and images (Clemmensen et al., 2020; Šalkevičius, Miškinytė, & Navickas, 2019).

By contrast, during *in vivo* exposure, patients are confronted with the anxiety-provoking stimuli in real life. This is effective but can be quite costly and time-consuming (e.g., flying on an airplane with a patient suffering from aviophobia) (Horigome et al., 2020). Furthermore, the therapist can not control everything: some situations can be difficult to predict, such as the reaction of others (Boeldt et al., 2019; Horigome et al., 2020). Importantly, patients can be reluctant to directly expose themselves to what they fear the most. Although the exposure is usually done progressively, it can be very challenging for the patients. Further, when the exposure exercise takes place in a public place, it can jeopardize the patient's privacy regarding the fact that he is following a therapy (Boeldt et al., 2019).

Even though the efficacy of the current treatments for anxiety disorders is well-established, very few patients seek treatment: the prevalence of the treatment-seeking population can be as low as 21% (Bandelow, 2020). The fact that many individuals suffering from anxiety disorders do not seek help is problematic as anxiety disorders have very low rates of spontaneous recovery as well as high rates of lifetime prevalence (up to 33,7%) (Apolinário-Hagen et al., 2020; Clemmensen et al., 2020). Due to its numerous advantages that will be later described (e.g., fewer treatment costs, the comfort, and safety associated with exposure in the virtual environments), implementing new technologies, such as Virtual Reality, in treatment may counteract this trend and increase the accessibility and quality of healthcare (Kampmann, Emmelkamp, & Morina, 2016).

While the efficacy of CBT for anxiety disorders is well established, less is known about the timing and mechanisms of therapeutic change. Understanding the individual time course of symptoms during psychological treatment is of interest in order to identify when the treatment mechanisms are at work and which active components of treatments are most crucial for improving the patients' symptomatology (Durland, Wyszynski, & Chu, 2018; Mychailyszyn, Carper, & Gibby, 2018). To this end, Tang and DeRubeis (1999) were the first to report sudden gains (SGs) in the treatment of depression. SGs can be defined as a large, sudden, and enduring improvement in symptom severity occurring between two consecutive treatment sessions (Durland et al., 2018; Mychailyszyn et al., 2018). Tang and DeRubeis (1999) recommended that for the decrease in symptoms to be considered an SG, the gain must be large in absolute terms, represent a 25% drop in symptom severity from one session to the next, and be stable across time (Aderka & Shalom, 2021; Butler et al., 2019).

SGs seem to be a common phenomenon: they occur in a range of disorders, treatments modalities, settings, formats, and among children, adolescents, and adults (Aderka & Shalom, 2021; Shalom & Aderka, 2020). However, the occurrence of SGs seems to differ between disorders. Sudden gains have been found to be relatively prevalent in the treatment of depression: around 40% of the patients who followed CBT for depression experienced an SG (Tang & DeRubeis, 1999). So far, SGs tend to be relatively less present in the treatment of anxiety disorders as they were reported to occur in approximately 20% of patients during CBT for anxiety disorders (Vincent & Norton, 2019).

Still, SGs have been reported to be large in magnitude: they can account for a major proportion of the patients' total symptom improvement: for CBT for anxiety, it has been found to explain approximately 50-66% of the total amelioration of symptoms (Shalom & Aderka, 2020; Vincent & Norton, 2019). Moreover, research has found that SGs predicted treatment outcomes: patients with an SG experienced greater symptom reduction than those without and had better post-treatment and follow-up outcomes (Collins & Coles, 2017; Durland et al., 2018; Shalom & Aderka, 2020; Tang & DeRubeis, 1999; Vincent & Norton, 2019).

Nevertheless, the timing of SGs still needs to be clarified: SGs have been found to occur relatively early in treatment, as well as mid-to-later sessions (Durland et al., 2018). Also, it is still uncertain as to why and how SGs occur (Aderka & Shalom, 2021; Thorisdottir et al., 2018). It has been previously observed that SGs enhance the therapeutic alliance, leading to an increase of the patients' engagement in therapy and in the improvement of their symptoms (Collins & Coles, 2017; Tang & DeRubeis, 1999).

Different predictors of SGs have been brought up in the literature. Tang and DeRubeis (1999) established that patients' experienced cognitive change before an SG during CBT for depression. Yet, cognitive changes have also been posited to be the result of an SG. The literature on cognitive changes and SGs offers contradictory findings which are difficult to interpret (Aderka & Shalom, 2021). Further, patients with a higher symptom variability were found to be more likely to experience SGs than patients with fewer symptoms fluctuations (Aderka & Shalom, 2021; Collins & Coles, 2017; Koffmann, 2021). This would help explain why SGs tend to occur more frequently in depression, a disorder with greater symptoms variability, than in anxiety disorders which are more chronic (Aderka & Shalom, 2021).

Other predictors of SGs such as feelings of hope, ethnicity, or pre-treatment symptoms levels have been examined but the findings have been inconsistent (Aderka & Shalom, 2021; Shalom & Aderka, 2020). More knowledge on the predictors of SGs would allow for the tailoring of interventions to the patients to maximize their efficacy (Shalom & Aderka, 2020).

Sudden gains appear to be an important, consistent, and robust predictor of treatment outcomes for mental disorders, including anxiety disorders (Aderka & Shalom, 2021; Shalom & Aderka, 2020). However, the literature is still recent and research to date has not yet determined the timing, the mechanisms, and the predictors of SGs. A better understanding of SGs would help boost treatment efficacy as SGs are associated with better treatment outcomes in the short- and long-term (Durland et al., 2018; Shalom & Aderka, 2020). Also, SGs improve the therapeutic alliance, which helps make the patient more engaged in the therapy (Collins & Coles, 2017; Tang & DeRubeis, 1999). Lastly, detecting SGs in a patient's symptomatology during a psychological intervention allows us to see that this particular intervention is beneficial for patients with this type of pathology. This knowledge can then be later used when taking care of a patient with the same or a similar pathology (Benner, Hughes, & Sutphen, 2008; Willems et al., 2020).

3.1. Virtual Reality

In today's society, technology is being increasingly used in many domains. For psychiatric disorders, more specifically, psychological interventions are now sometimes being assisted with technology (Apolinário-Hagen et al., 2020). This is done to achieve better treatment efficacy but also to overcome some weaknesses of traditional interventions such as access, acceptance, and implementation of the treatment (Kampmann, Emmelkamp, & Morina, 2016). One technology-based treatment that has been particularly investigated in the last decades is Virtual Reality.

In VR, three-dimensional (3D) entities are simulated with computer and behavioral interfaces (Šalkevičius et al., 2019). These entities can interact instantaneously with each other and with a user immersed via sensorimotor channels. The user of VR is immersed in a computer-generated or video-based virtual environment that is created by computer graphics or 360° 3D videos (Fernández-Álvarez et al., 2020). VR aims at creating an immersive and interactive world that is analog to reality. VR technology is continuously improving which allows for the virtual environments to seem increasingly real for the users: the sense of presence which expresses the feeling of “being there” in the virtual environment in terms of spatial reference, involvement, and realness is being constantly ameliorated (Fernández-Álvarez et al., 2020; Maples-Keller et al., 2017). The stimulation of multiple senses and active exploration of the virtual environment is made possible using technologies such as head-mounted displays, synthesized sounds, gesture-sensing gloves, and vibrotactile platforms (Maples-Keller et al., 2017).

Over the past two decades, Virtual Reality has been implemented in many treatment approaches for mental disorders. One of the VR-based treatments with the most scientific evidence is Virtual Reality Exposure Therapy for anxiety disorders (Eshuis et al., 2020).

3.2. Principles of Virtual Reality Exposure Therapy

Virtual Reality Exposure Therapy allows the patient to be fully immersed in diverse digital surroundings through a motion-sensitive head-mounted visual display system (HMD) (Eshuis et al., 2020). Videos, audios, and sometimes even tangible objects or sensations (e.g., smells) are used to depict the anxiety-provoking stimuli or situations in the virtual environment (Eshuis et al., 2020). Patients are hence exposed to diverse computer-generated stimuli which

raise their levels of anxiety within a highly controllable environment (Kampmann, Emmelkamp, Hartanto et al., 2016).

VRET has numerous advantages. The situations displayed in the virtual environment can be tailored and be remarkably similar to real life situations (Horigome et al., 2020). Moreover, the therapist has control over the different elements of the situations such as the degree of exposure to the stimuli or the reactions of the other people (e.g., in case of social anxiety) (Kampmann, Emmelkamp, Hartanto et al., 2016). Consequently, the virtual situations that patients encounter can be exaggerated and be worse than the ones they could experience in real life. This allows patients to learn how to handle such situations while being in a safe environment (Clemmensen et al., 2020; Eshuis et al., 2020). Therefore, VRET is a good treatment alternative for patients who are reluctant to go through in vivo exposure due to the anxiety and fear associated with being confronted with the stimuli in real life (Boeldt et al., 2019).

Also, VRET allows the exercises to be consistently replicated, tested, and modified which would not always be done in real life (Boeldt et al., 2019; Maples-Keller et al., 2017). As aforementioned, during in vivo exposure therapy, it can be difficult for the therapist to have control over the exposure: the planning and operation of such exercise can be difficult due to the unpredictability of life. Moreover, some exposure can be particularly challenging or impossible to implement (e.g., fear of flying, war combats) (Horigome et al., 2020; Kampmann, Emmelkamp, Hartanto et al., 2016). In VRET, the therapist can have control over the content, duration, and the difficulty of the anxiety-provoking situations (Boeldt et al., 2019). The pace of the exercise can be completely modulated to fit the patient's needs (Maples-Keller et al., 2017). Additionally, VRET can be done in the therapist's office which brings multiple advantages: there are fewer treatment costs, the planning of the exercise is flexible and takes less time, the patient's privacy is not violated, and the exercise is done in a comfortable and safe place (Clemmensen et al., 2020; Kampmann, Emmelkamp, Hartanto et al., 2016).

Further, exposure treatments using these kinds of virtual environments are less dependent on the patient's imagination compared to the more traditional exposure therapy, especially imagery exposure. Thus, this can improve the emotional engagement of patients that have difficulties immersing themselves in imagery exposure (Eshuis et al., 2020). Even though patients know that the virtual environment is not real, their bodies and mind behave as if it was. Therefore, patients can feel safer facing their feared situations while being able to learn to engage in more adaptive behaviors (Apolinário-Hagen et al., 2020).

Multiple meta-analyses have proven the efficacy of VRET: it has been found to be superior to waitlist control groups and imagery exposure and at least as effective as in vivo exposure (Clemmensen et al., 2020; Kampmann, Emmelkamp, & Morina, 2016). VRET has proven to be beneficial for treating specific phobias, social anxiety disorder, panic disorder, agoraphobia, and generalized anxiety disorder (Maples-Keller et al., 2017). Significant and lasting mid- and long-term effects of VRET have been reported in the literature (Bandelow, 2020; Horigome et al., 2020). Regarding the dropout rates, studies have demonstrated that VRET has similar rates compared to in vivo exposure (Fernández-Álvarez et al., 2020).

Still, VRET (and VR in general) has its limitations. VR can be difficult and expensive to develop: the VR equipment can be very costly, all stimuli need to be synthetic or digitized, and the therapist operating VRET often needs specific training (Fernández-Álvarez et al., 2020). Moreover, the use of VR is not without risk. A minority of patients may suffer from cybersickness during or following the use of VR. Cybersickness is a form of motion sickness that can lead to nausea, dizziness, or eye strain (Kemeny et al., 2020; Malbos, Burgess, & Lançon, 2020; Moreno & Zuanon, 2018). The intensity of these symptoms varies greatly between individuals. However, only a few individuals will experience cybersickness and the symptoms are temporary (Fernández-Álvarez et al., 2020). Additionally, the use of VRET with caution (such as moving slowly in the virtual environment and not turning the head too quickly) will significantly decrease the risk of cybersickness (Moreno & Zuanon, 2018). Concerning the accessibility of the technology, VR is becoming increasingly available: the equipment is getting more affordable, the stimuli and virtual environment are more realistic, it requires minimal training, and is now more user-friendly (Clemmensen et al., 2020; Fernández-Álvarez et al., 2020; Maples-Keller et al., 2017). It is therefore a promising approach to the treatment of mental disorders.

Chapter 4 - Evidence-Based Practice

Evidence-Based Practice (EBP) is a clinical approach that has first been developed in medicine before being adapted to various domains, such as psychology or speech language (Durieux, Étienne, & Willems, 2017). Nowadays, health professionals are confronted with the rapid evolution of their field knowledge due to research, the rapid evolution of technologies and interventions, as well as the rapid evolution of patients who are increasingly informed (Maillart & Durieux, 2014; Willems et al., 2020). Therefore, health professionals should be able to look for relevant and recent information, evaluate them, and decide whether it should be integrated into their professional practice (Willems et al., 2020).

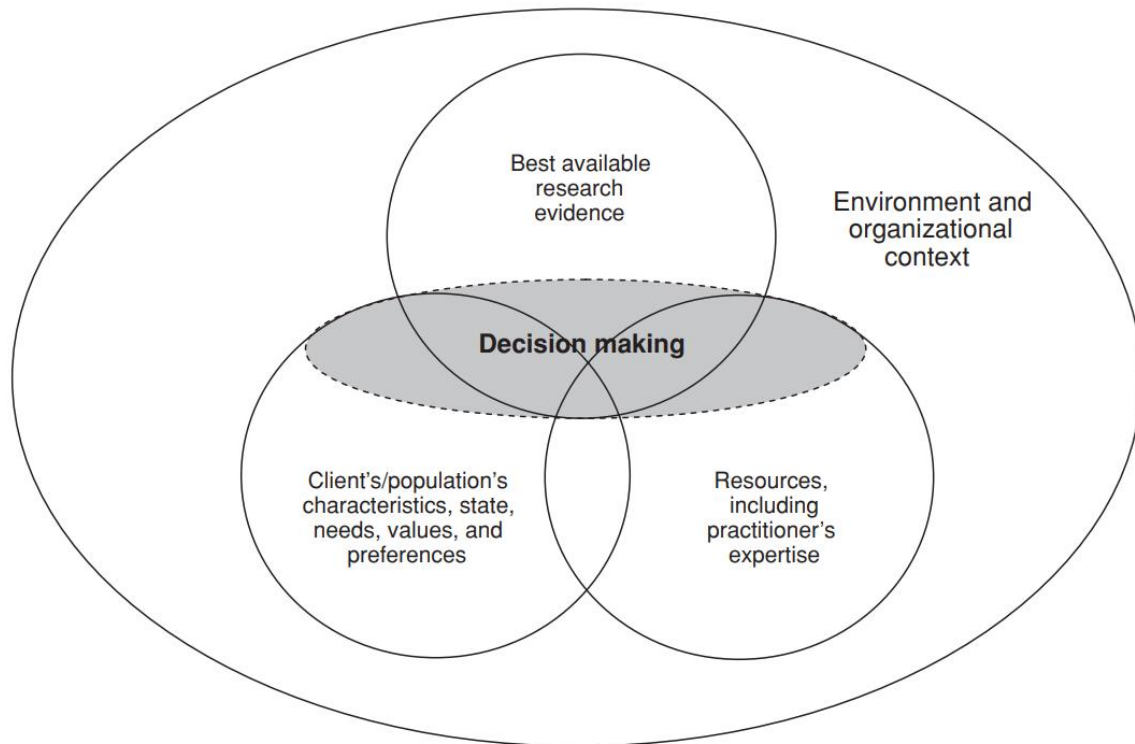
Besides, health professionals are bound to ethical rules. There are five ethical principles requesting that all psychologists must strive to conduct themselves with beneficence and nonmaleficence, fidelity and responsibility, integrity, justice, and respect for people's rights and dignity (APA, 2017). These ethical principles are accompanied by ethical duties and obligations towards patients such as acting within the limits of one's knowledge, giving honest and well-founded professional advice or opinions, and basing their actions on scientific evidence and professional consensus (APA, 2017). All these rules and conditions are the founding principles of EBP, which aims at ensuring that patients receive the most appropriate care based on well-justified clinical decisions (Willems et al., 2020).

4.1. The four pillars of EBP

The idea behind EBP is that to make the best decision concerning the care of a patient, practitioners should use diverse and complementary sources of information (Willems et al., 2020). Thus, clinicians can obtain and combine information from four different sources, which are called pillars. Those four pillars are the research, the clinical expertise of the therapist, the patient's preferences, and the context (Willems et al., 2020). As you can see in Figure 1, in an EBP approach, the clinical decision-making is at the crossroads of the four pillars. Also, it is important to note that the four pillars are equally important and there is no order of importance or any hierarchy associated with them (Satterfield et al., 2009; Willems et al., 2020).

Figure 1

The four pillars of EBP



Note. From Satterfield et al. (2009)

The first pillar, research, refers to the necessity for a therapist to be able to identify valid and reliable scientific evidence. The literature is very vast and there are always more publications. Moreover, not all studies have the same validity and reliability and the level and weight of evidence of a study depend on the study design, the methodological quality, and the analyses of the results (Maillart & Durieux, 2014; Willems et al., 2020). Due to the extensive literature available, it can be difficult to find appropriate information for the specific case and situation of the patient. However, it is essential to learn where and how to find good and pertinent scientific data while being critical of the used sources and being able to identify problems in the arguments or the methods used in a study (Willems et al., 2020).

The second pillar refers to the clinician's experiences and expertise. While the research pillar encompasses external data, the information gathered from this pillar is considered internal data (Willems et al., 2020). It can be divided into two categories: the theoretical knowledge (for example, the mechanisms behind psychological troubles, clinical assessment tools, or specific statistical analyses) and the knowledge from the clinical experience, which is gained by analyzing the intervention implemented for each patient (Willems et al., 2020). Besides those two categories, this pillar also includes clinical reasoning, which allows

clinicians to integrate these two types of knowledge, as well as critical thinking, which allows them to step back from the data and become aware of their own biases (Willems et al., 2020).

The third pillar concerns the preferences and the values of the patient, which are also considered internal data (Willems et al., 2020). To make the best decision concerning patients, clinicians must consider their difficulties, comorbidities, social and familial context, and cultural origins. Nevertheless, EBP goes beyond those aspects and invites clinicians to consider the preferences of patients in terms of interventions and care by investigating their values and objectives, and the definitions patients have of their well-being (Willems et al., 2020). The goal of EBP is to allow make an informed decision with the patient and it thus implies informing patients regarding the benefits, risks, practical implications, or costs of each therapeutic option (Maillart & Durieux, 2014). Making sure that patients understand the different alternatives allows them to be a partner in the process of decision-making (Willems et al., 2020).

Lastly, the fourth pillar is the context and the environment in which the clinician is practicing (Willems et al., 2020). Psychologists may work in different countries but also in different institutions: in hospitals, in schools, in private practice, in home care services, in mental health centers,... Different places of work call for different health politics or organizational models of care, which are constraints that need to be taken into account (Willems et al., 2020). The acceptability or the feasibility of an intervention is influenced by multiple factors such as the professional influences, the political support, the social and relational climates, the characteristics of the target population, the economic context and financing of care, the different local infrastructures, and the legal and political framework (Adriaenssens et al., 2017; Satterfield et al., 2009).

To resume, by using an EBP approach, therapists will make decisions based on the latest scientific advances, their clinical experiences, as well as the preferences and attitudes of the patients (Willems et al., 2020). Moreover, the context in which the therapist works will influence the process of decision-making. This requires reflexivity and reasoning. Therapists are encouraged to ask themselves questions such as *“Why am I proceeding in such a manner? Are there recent research data that could be integrated into my practice? Which is the best decision for this particular client, in this particular context? What can I take away from my previous clinical experience to adjust my intervention with this patient?”* (Willems et al., 2020).

4.2. The procedure of the EBP approach

The EBP process consists of five important steps (Durieux et al., 2017; Maillart & Durieux, 2014):

1. Asking a structured and specific clinical question

In this first step, the need for specific information will be translated into a clear and precise question. To help create this question, the acronym PICO, which consists of four components, can be used (Durieux et al., 2017; Maillart & Durieux, 2014).

- **P** = Patient/Problem: this component concerns patients' characteristics, situation, and problems, but also their age, gender, population, culture, or comorbidity.
- **I** = Intervention: this component encompasses treatments, diagnostic testing, methods of intervention, or prognostic factors.
- **C** = Comparison: this component refers to the examination of the efficacy of a therapeutic intervention which can be done, for example, by comparing one intervention with another, or with a control group.
- **O** = Outcomes / Objectives: in this component, the objectives will be specified as well as the parameters that will be taken into account to demonstrate that the objectives have been achieved (Durieux et al., 2017; Maillart & Durieux, 2014).

One example of a PICO question could be: "Does VRET (I) subsequently reduce avoidance behaviors (O) in patients with a social anxiety disorder (P) compared to traditional exposure therapy (C) ?"

2. Seeking the best available external evidence from research

The second step consists of researching the most robust data that is answering the specific question from step 1 and that provides information with a high level of evidence. For example, randomized controlled trials, systematic reviews, and meta-analyses generally provide interesting sources of information (Durieux et al., 2017; Maillart & Durieux, 2014).

3. Critically appraising the evidence

The selected publications and literature must then be evaluated in terms of, among others, internal validity, reliability, the significance of the results, and their applicability in the context of one's professional practice (Durieux et al., 2017; Maillart & Durieux, 2014). To help clinicians, specific assessment grids with different criteria exist (Durieux et al., 2017).

4. Applying the results in practice and making a decision: combining external evidence with internal evidence and the patient's preferences

In this important step, clinicians must integrate the external evidence from research and the internal evidence from their clinical experiences as well as the patient's preference to guide their therapeutic choice. They must use their clinical judgment to determine whether their patient shared common characteristics with the population of the publications found (Maillart & Durieux, 2014). Moreover, clinicians use their past experiences with patients with similar complaints and characteristics to fuel their decision-making. Patients participate actively in this step and thus need to have a shared understanding of their needs and difficulties, as well as the costs and benefits of each treatment alternative (Durieux et al., 2017; Maillart & Durieux, 2014).

5. *Evaluating the performance: evaluation of the efficacy of the clinical decision as well as the personal efficiency in carrying out the EBP approach*

Lastly, clinicians should reconsider and analyze the outcomes of the previous steps as well as the therapeutic option they have chosen. This is an essential step as it helps increase the quality of the application of EBP in the future. Also, the reassessment of the treatment of choice should be done continuously throughout the care as new information about the patient's situation and characteristics will come up during the intervention (Durieux et al., 2017; Maillart & Durieux, 2014).

4.3. The advantages and limitations of EBP

EBP has multiple advantages for both the clinician and the patient. Among others, it allows clinicians to be more confident in using different assessment tools or in implementing an intervention; reduce uncertainty in the clinical decision-making; respond as adequately as possible to the patients' expectations; discover new ideas for the care and methods of evaluation based on recent studies; and appraise the relevance and effectiveness of the care and thus reassure the patient about the evolution (Willems et al., 2020). Moreover, it emphasizes holistic care, that is, treating the patient as a whole person and not only focusing on the disorder or diagnosis. Also, patients may trust the clinician more as the latter uses recent and reliable knowledge, enables the process of decision-making to be more transparent and importantly, allows the patient to have a more active role (Willems et al., 2020). Therefore, EBP is patient-centered care that encourages shared decision-making and the active collaboration of the patient in the treatment, and is responsive to the patient's needs, values, and preferences (Epstein & Street, 2011).

The disadvantages and barriers to the implementation of EBP in one's practice are the poor accessibility of journals and scientific literature as well as the cost of access; the insufficient command of the English language; the lack of documentary research skills; difficulties in assessing and critically appraising the scientific evidence; or a fear of standardization in patients care (Maillart & Durieux, 2014). Another important disadvantage is that it is time-consuming. However, it tends to take less time as one gets used to implement it in his/her clinical practice (Willems et al., 2020). Thus, EBP can become a part of the professional identity and there are tips to help implement EBP in one's practice such as setting deadlines, being forgiving with oneself, showing perseverance, accepting that we might do things wrong in the beginning, and sharing questions, difficulties, or accomplishments with other professionals (Willems et al., 2020).

Still, the EBP approach is not widely implemented among clinicians and there is a paucity of research on the implementation of EBP in clinical practice. In fact, it has been found that many French-speaking health professionals ignore or are unfamiliar with EBP. Therefore, it seems necessary that universities, professional associations, and politics further support and promote this approach (Maillart & Durieux, 2014).

Chapter 5 – Objectives and hypotheses of the study

Overall, our study aimed at assessing the efficacy of an intervention (i.e., VRET) on the clinical symptomatology of patients suffering from anxiety disorders through case studies in a multiple baseline design. An EBP approach was implemented to make the best decision in terms of therapeutic options as well as to evaluate the efficacy of the treatment. Therefore, the intervention could be adjusted to better correspond to the participants' needs and interests.

Based on the existing scientific literature, we hypothesized that there would be a decrease in participants' anxiety following VRET compared to their pre-treatment anxiety. More specifically, the intensity of the anxiety, the anxiety-related physical symptoms, the frequency of the avoidance, and the anticipation of the feared stimuli should lessen and the sense of self-efficacy in regard to facing the feared stimuli should increase when following VRET. Also, we investigated when these changes arise and whether there are SGs at a certain time point during the intervention.

Research studies on the treatment of anxiety disorders are much needed since anxiety disorders are one of the most common mental illnesses and present low rates of spontaneous recovery (Bandelow, 2020; Clemmensen et al., 2020). However, many individuals suffering from an anxiety disorder do not seek treatment (Bandelow, 2020). Thus, finding alternatives such as VRET to the more traditional treatment options is of interest. Indeed, additional treatment options may allow patients to find the type of treatment that suits them the best.

Moreover, understanding the mechanisms behind those new types of treatments and exploring whether there are SGs during the intervention is of great importance: SGs are associated with better treatment outcomes in the short- and long-term (Durland et al., 2018; Shalom & Aderka, 2020). Also, in an EBP approach, detecting SGs will help the clinician acquire more clinical expertise: knowing that this intervention is useful for this type of patients will allow the clinician to adopt a similar approach with patients with a comparable pathology in the future. Lastly, implementing an EBP approach in this case study allows us to make sure that patients get the most pertinent and adapted care for their specific situations (Willems et al., 2020).

Part III – Experimental section

Chapter 6 – Methods

6.1. Recruitment

Originally, we expected to recruit between four to eight participants to meet the average sample size of multiple baseline designs (Ferron et al., 2009). Unfortunately, the activity of the Psychological and Logopedic Clinic of the University of Liège is still impacted by the covid-19 pandemic. Therefore, only one person met the criteria needed for this study which were being at least 18 years old, having a principal diagnosis of DSM-V anxiety disorders, and seeking treatment in the CPLU. Thus, the editorial style of this paper will now be changed into a single-case study.

6.2. Participant

The participant was a French-speaking patient that sought professional help in the CPLU. She was diagnosed with GAD and agoraphobia. The participant was asked by her clinical psychologist, Aurélie Wagener, if the data collected for the assessment of the clinical variables in the therapeutic procedure could be analyzed for the purpose of this study. As she agreed, she signed an informed consent allowing Ms. Wagener to use the data for scientific research. The collected data being confidential, it was anonymized with a specific code and was stored according to specific laws and regulations (i.e., in a closed cabinet for the data collected in a paper version). The data will be destroyed within five years after the results are published. The use of the data was approved by the Ethical Committee of the University of Liège, in Belgium.

The participant was a 39-year-old female. She has been married for twenty years and has a 6-year-old son. She is a housewife but undertakes sewing activities. Her parents are deceased and she has one older sister, whom she is very close to, and one younger brother. She has an extensive medical history: her parents and her father-in-law passed away because of cancer; her mother was diagnosed with bipolar disorder; her husband has heart problems; and she also has heart and thyroid problems. Moreover, her son was diagnosed with ocular cancer in 2020. Her initial requests were to be treated with Virtual Reality for her fear of driving the car alone and regaining independence in her daily life.

6.3. Measures

Anxiety-related measures. Five visual analog scales (VAS) were created to measure the participant's anxiety since the last session. The participant needed to make a mark somewhere along the horizontal line to indicate the magnitude of her response from 0 (*very weak*) to 10 (*very high*). The five VAS are:

1. Anxiety intensity: “*When you were confronted with the object of your fear, how severe or intense was your anxiety?*”;
2. Intensity of the physical symptoms of anxiety: “*When you were confronted with the object of your fear, how severe or intense was your physical symptoms? Select two symptoms that you dread the most.*” (For this question, there were two VAS, one for each of the selected symptoms which for the present participant were extrasystole intensity and dizziness intensity);
3. Avoidance frequency: “*How often have you avoided confronting the object of your fear?*”;
4. Anticipation frequency: “*How often have you anticipated the encounter with the object of your fear?*”; and
5. Intensity of the sense of self-efficacy: “*When you were confronted with the object of your fear, how intense was your sense of self-efficacy with regard to facing your fear?*”.

6.4. Experimental design

Single-case design is a good and scientifically valid alternative to large groups studies (such as randomized clinical trials) to identify a functional relationship where we want to make inferences about the effect of the independent variable on the dependent variable(s) (Gage & Lewis, 2013; Lobo et al., 2017). This type of design can assess a diversity of research questions and can be done in many settings and cases, with a variety of dependent and independent variables (Lobo et al., 2017). Their advantages include the need for fewer resources compared to large groups studies and the possibility for the study to be performed in settings and with a population where it can be difficult to recruit a substantial number of participants (Lobo et al., 2017). Moreover, single-case studies allow to have better experimental control than the classical case studies and an in-depth analysis of the changes before and during the psychological intervention (Tate et al., 2016).

In single-case studies, the outcomes (that is, the dependent variables) are measured at multiple time points and at different levels of an intervention that are referred to as “phases”.

The phases are the independent variables and generally encompass at least a baseline or comparison phase and an intervention phase (Lobo et al., 2017). Each phase contains multiple measurements of the outcome's variables, for each participant. Comparing the pattern of the observed outcomes under these two separate phases permits determining whether the intervention had an effect on the variables (Bouwmeester & Jongerling, 2020). Thus, the participant serves as his or her own control which allows for controlling for many confounding variables that can have an influence on the outcomes such as age, gender, socioeconomic status, cognition, living environment, medications, and concurrent interventions (Lobo et al., 2017).

A specific type of single-case study is multiple baseline design (MBD). There exist three possible applications of MBD: the measurement of three or more specific behaviors for one participant, the measurement of a specific behavior across three or more settings, or the measurement of a specific behavior across multiple participants (Ray, 2015). In the present study, the application was the measurement of three or more specific behaviors in one participant (the five different VAS scales).

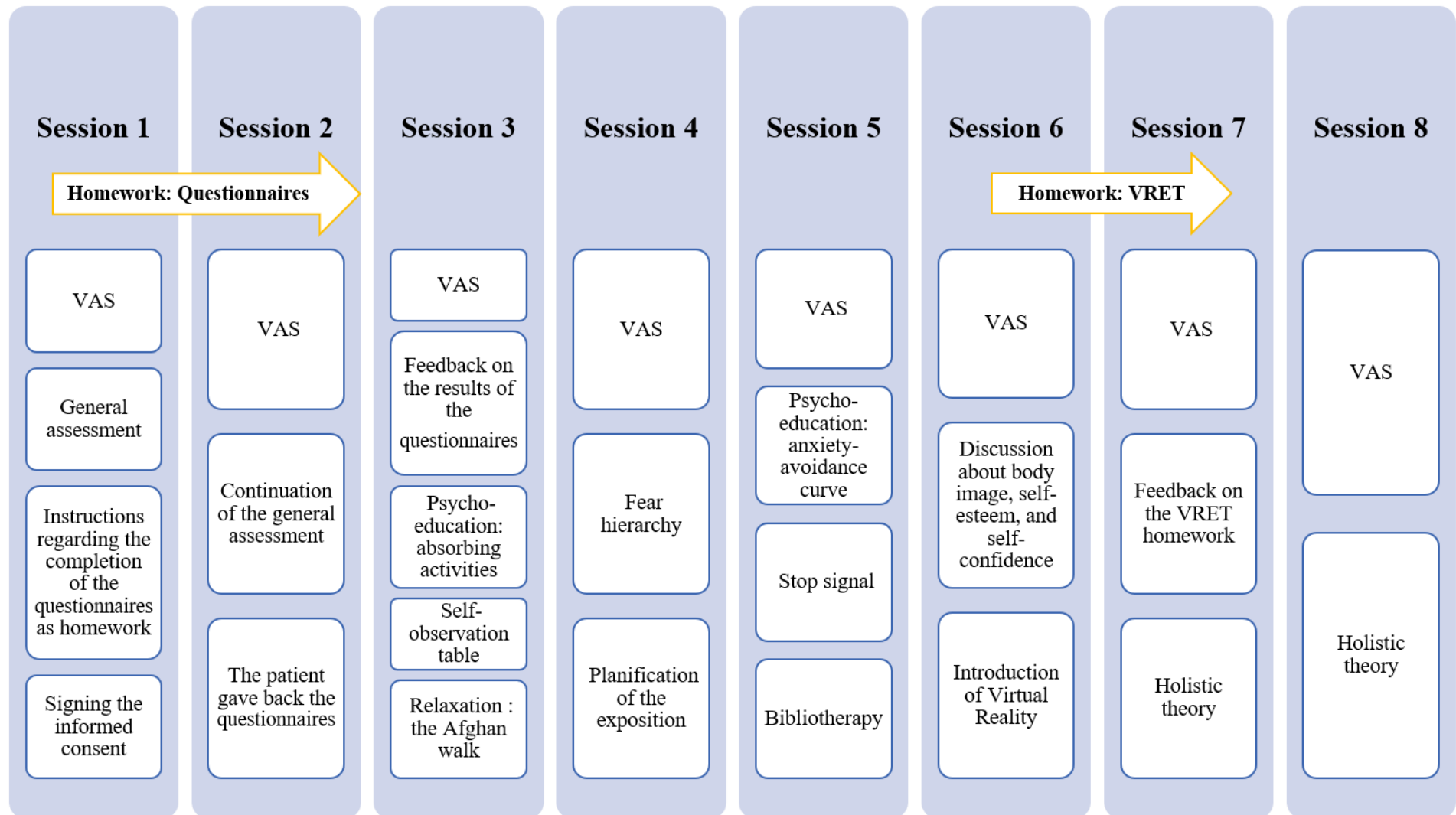
The study had two phases (A-B design). The baseline phase lasted for at least two sessions. Hence, it encompassed 3 data collections. This study comprises six sessions of the ongoing intervention. The dependent variables were the above-mentioned anxiety-related VAS that assessed the intensity of the anxiety, the anxiety-related physical symptoms, the frequency of the avoidance, the anticipation of the feared stimuli, and the sense of self-efficacy in regard to facing the feared stimuli. As indicated in Figure 2, the VAS were administered in every session. The repeated measurement of these outcome variables allowed us to scrutinize whether the participants experience SGs.

6.5. Procedure

The procedure of this study consisted of eight multiple individual sessions. In general, the sessions took place every other week. An overview of the study procedure can be found in Figure 2.

Figure 2

Overview of the study procedure



6.5.1. First session

In the first session, the patient was accompanied by her husband. A general assessment of the patient was made. It consisted of the anamnesis, an inventory of the problems, and the identification of the triggering stimuli. The patient spent much time explaining the medical history of her family members: the cancer-related deaths of her parents and father-in-law; her mother's bipolar disorder; the heart problems of her husband and the ocular cancer of her son. Moreover, she also mentioned her heart and thyroid problems.

Her initial demands were to regain her autonomy in her daily life and overcome her fear of driving alone. The patient was keen to try VRET as she had already met several health professionals and had gone through different types of psychotherapy in the past, which were of little help.

The patient completed the anxiety-related VAS. Then, she was asked to complete at home several questionnaires assessing different clinical variables for the next session. Her psychologist gave her instructions and information regarding their completion. The questionnaires were used to develop a deeper understanding of the patient's difficulties and help establish the diagnosis. The scores of these questionnaires were not included in the later statistical analyses but for information purposes, it included the Symptom Checklist-90 Revised (*SCL-90-R*; Derogatis et al., 1976), the State-Trait Anxiety Inventory Form Y (*STAI-Y*; Spielberger, 1983), the Fear Survey Schedule-III (*FSS-III*; Wolpe & Lang, 1964), the General Self-Efficacy Scale (*GSES*; Schwarzer & Jerusalem, 1995), the Outcome Questionnaire (*OQ-45*; Lambert et al., 1996), the Penn State Worry Questionnaire (*PSWQ*; Meyer et al., 1990), the Intolerance of Uncertainty Scale (*IUS*; Freeston et al., 1994), the Reward-Probability Index (*RPI*; Carvalho et al., 2011), and the Why Worry Scale II (*WW-II*; Gosselin et al., 2003).

Moreover, during this session, the patient was asked whether the data collected during the therapy to evaluate the efficacy of the intervention could be used and analyzed for research purposes. She agreed and signed the informed consent.

6.5.1.1. Reflections between sessions one and two

After the session, the psychologist felt that there were still many areas to explore and that the situation of the patient seemed complex, even though there was already evidence of GAD.

6.5.2. Second session

In the second session, the patient completed the VAS and the general assessment was continued. She also handed over the completed questionnaires.

6.5.2.1. Reflections between sessions two and three

After the second session, the general assessment was completed and we had a clearer view of the difficulties of the patient based on the description of the patient and the results of the different questionnaires. Therefore, we reviewed the relevant literature regarding the patient's diagnosis (i.e., GAD and agoraphobia) making sure that all facets associated with her complaints were considered. Table 2 resumes several relevant scores on the questionnaires that helped confirming the diagnosis.

Table 2

Summary of relevant scores and their interpretations

Instruments	Variable(s) of interest	Scores	Interpretations
STAI-Y	Anxiety (trait (Y-B) and state (Y-A))	Y-B : 59 Y-A: 39	High level Low level
FSS-III	Phobic anxiety	175	Slightly higher than the mean of the phobic population (174,12)
OQ-45.2	Therapeutic efficacy	77	High psychological distress
PSQW	Worry	65	High worry – presence of GAD

Besides, to implement an EBP approach, we translated the need for specific information into a clear and precise PICO question: “Is there a decrease in the anxiety symptoms (O) of a patient with GAD and agoraphobia (P) after VRET (I) compared to before the intervention (C)?”.

6.5.3. Third session

In the third session, the VAS were administered to the patient once again. Then, the psychologist gave her feedback concerning the results of the questionnaires she had completed. The questionnaires confirmed the difficulties raised by the patient. The psychologist also

offered some psychoeducation to augment the patient's knowledge of her disorder. Moreover, the key principles of CBT were further described.

Next, the patient received psychoeducation to help her stop or reduce her ruminations with an alternative behavior: performing "absorbing activities", which allow a person to be connected to the present moment (Nakamura & Csikszentmihalyi, 2005). Absorbing activities also refer to what Csikszentmihalyi (1990, 2004) called "flow". The "flow" is described as an optimal and rewarding mental state resulting from an intense engagement and immersion in an activity requiring attention and concentration (Csikszentmihalyi, 1990, 2004). Ideally, these absorbing activities should be in line with the values of the person, which would increase positive reinforcement. Such activities are performed for the pleasure they provide, allow the person to feel good, and may lead the individual who experiences them to lose the notion of time (Devynck, 2017; Nakamura & Csikszentmihalyi, 2005). Thus, the time devoted to these activities is less time spent ruminating as they are antagonistic to the activation of negative repetitive thoughts, through the well-being they provide (Devynck, 2017). Further, absorbing activities may increase a person's sense of self-efficacy as well as their behavioral activation (Devynck, 2017).

Additionally, as homework, the patient was asked to self-monitor by completing a self-observation table. The table includes the anxiety-eliciting situations she encountered, as well as the associated anxious thoughts, emotions and body feelings, and coping responses. Self-monitoring allows the patient to go from a general feeling to a more detailed evaluation of what she is experiencing by linking the context of the triggering of her situation-problem, her thoughts, her emotions, and bodily sensations as well as her behaviors and the consequences they entail (Korotitsch & Nelson-Gray, 1999). Self-observation is in itself therapeutic as it allows the person to have a first insight and understanding of what promotes the appearance of her problem and the vicious circles that maintain them (Proudfoot & Nicholas, 2010). Moreover, it supports patient engagement and motivation by fostering a sense of self-control and autonomy (Mahoney, 2014; Proudfoot & Nicholas, 2010). For the psychologist, the self-observations will both give elements on the dynamics of the problem, its context of appearance, its different modes of expression, but also on its frequency, intensity, and its duration (Mahoney, 2014; Korotitsch & Nelson-Gray, 1999).

Lastly, the patient was encouraged to try "Afghan walking" as a way to relax and reduce feelings of stress and anxiety (Royer, 2018). Afghan walking is also called "conscious" or "meditative walking" and is based on synchronizing breathing with the rhythm of the steps (3-1 3-1): three steps for an inhale, one step of holding the breath full lungs, and three steps for an

exhalation, one step of holding the breath with empty lungs (Stiegler, 2004). Besides its physical benefits, Afghan walking also has psychological assets such as being in a state of meditation and self-awareness, offering deep physical and emotional relaxation, and reducing stress and anxiety (Royer, 2018).

6.5.3.1. Reflections between sessions three and four

There were no proper reflections after the third session as the first methods of action were just being implemented and the time between the sessions was needed to assess whether one or more of the different therapeutic propositions would be beneficial for the patient.

6.5.4. Fourth session

In session four, a fear hierarchy was created in collaboration with the patient to prepare the future exposure therapy. The fear hierarchy helped outline the exposure treatment plan by listing out the feared situations or stimuli that the patient gradually would face in Virtual Reality (Abramowitz et al., 2019). Examples of hierarchical situations were driving the car with her husband and then driving the car alone.

6.5.4.1. Reflections between sessions four and five

Between sessions four and five, we did a literature review to examine which virtual environments were typically used for individuals with GAD and/or agoraphobia. Unfortunately, the literature was scarce and much of the research up to now has not been descriptive concerning the different VR environments used in the studies. Yet, we managed to find one study who did describe virtual environments that could fit our patient's needs. Guitard et al. (2019) used three types of virtual environments in their study with participants suffering from GAD: a hospital emergency waiting room created for patients suffering from worries related to health; an apartment in which an announcement is made on the radio concerning recent burglaries in the neighborhood and in which there is also a message left on the answering machine, reporting bad news; and lastly a student room created for students with academic difficulties and/or social isolation. In each environment, depending on the individual's specific worries, there are details or sounds that can be anxiety-eliciting such as unpaid bills, sounds of people crying, people fighting in the street, or doctors delivering bad news to other people in the room (Guitard et al., 2019).

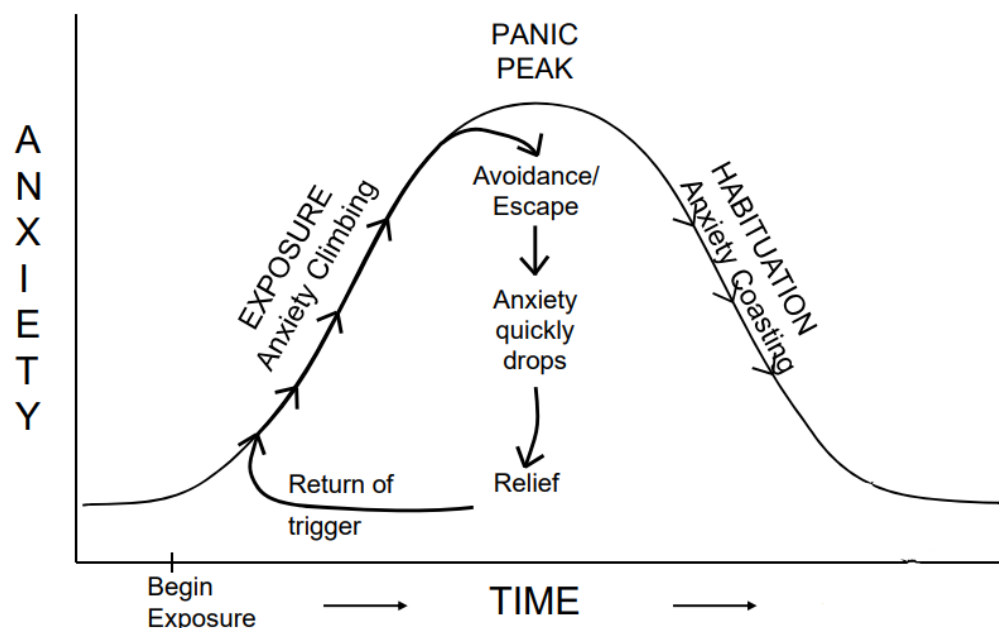
The first two environments could be appropriate for our patient. Besides, as the patient frequently referred to a particular road close to her home with which she has difficulties driving down, using this particular road in a VR environment might be pertinent.

6.5.5. Fifth session

In session five, after completing the VAS once again, some psychoeducation was offered to help the patient understand the reasons for the persistence of her difficulties, such as the factors that help maintain the anxiety or the fact that avoidance contributes to anxiety via the vicious cycle. As mentioned before, when faced with a threat, individuals suffering from anxiety disorders usually try to escape or avoid the situation (Goodman et al., 2019). This type of behavior can be beneficial in the short-term as individuals do not experience the negative feelings associated with the anxiety-eliciting situation (Figure 3). Yet, this negative reinforcement fuels their anxiety (Thomas & Michel, 2002). Thus, in the long-term, avoidance contributes to the chronification of the disorder and impedes the learning of more adaptive behaviors (Arnaudova et al., 2017).

Figure 3

The anxiety-avoidance curve



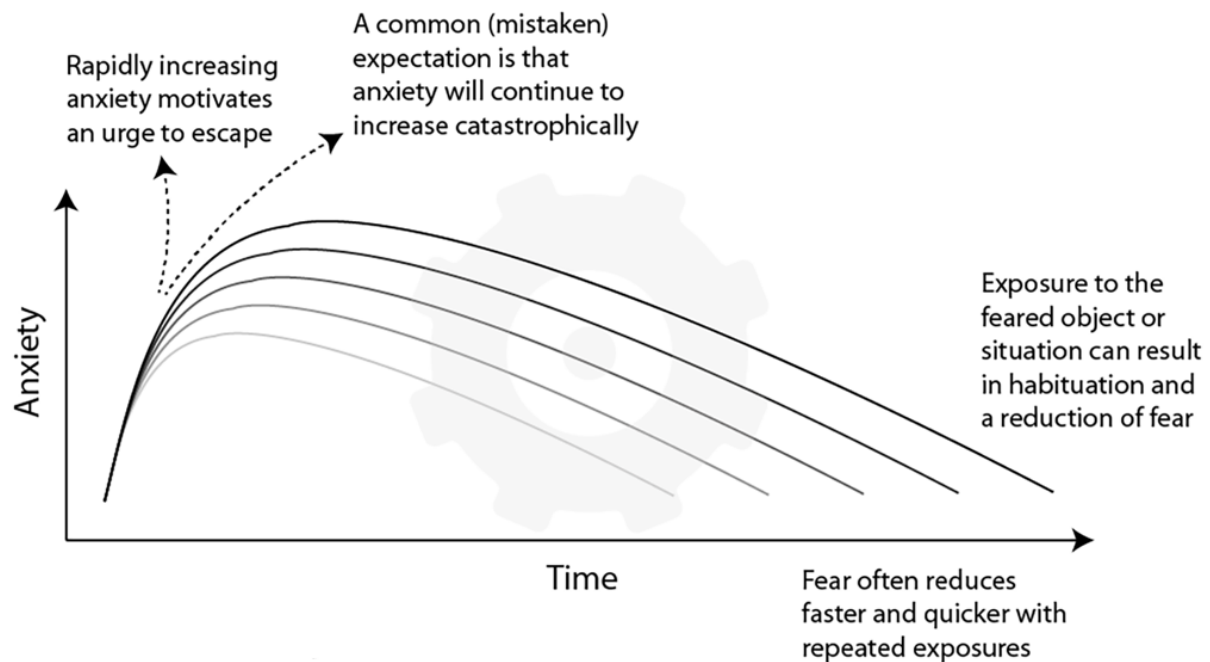
Note. From Wagner (2003, 2004)

On the contrary, as shown in Figure 4, during exposure and confrontation with the feared stimuli, individuals with anxiety disorder become progressively habituated. Multiple

expositions will elicit less and less anxiety and may finally lead to fear extinction (Kampmann, Emmelkamp, Hartanto et al., 2016).

Figure 4

The habituation curve



Note. From Whalley (2019)

Next, another strategy to cope with rumination was presented to the patient: the “stop signal”. When the patient realizes that she is ruminating, she should practice a “stop signal”. That is, she should take the time to recognize that she is ruminating, pause, and use metacognition regarding the processes of rumination. Identifying and realizing that the negative repetitive thoughts and useless and counter-productive may help stop the rumination (A. Wagener, personal communication, July 7, 2022).

Lastly, as part of bibliotherapy, the psychologist suggested that the patient read the book “Stop worrying about everything and nothing” (translated from the original French title “*Arrêtez de vous faire du souci pour tout et pour rien*”) by Ladouceur, Bélanger, & Léger (2003). It encompasses a complete program designed for worry-prone individuals. It includes psychoeducation, quizzes, questionnaires, examples, and exercises to learn to live more calmly, without unnecessary worry (Ladouceur et al., 2003).

6.5.5.1. Between sessions five and six

As the patient explained relying extremely on her relatives in her daily life, we searched the literature to find whether there were any associations between agoraphobia and/or GAD and the dependent personality type. The literature review showed that anxiety disorders (including agoraphobia) are strongly related to cluster C (anxious cluster) personality traits, especially avoidant and dependent traits (Bienvenu et al., 2009; Ng & Bornstein, 2005). However, it is not clear whether avoidant and dependent traits are predisposing factors for anxiety disorders such as agoraphobia or whether early symptoms of anxiety (such as panic symptoms) shape personality by enhancing avoidant and dependent tendencies (Bienvenu et al., 2009; Ng & Bornstein, 2005). Still, a majority of findings suggested that avoidant and dependent personality traits should be considered risk factors and not consequences of panic symptoms or attacks (Bienvenu et al., 2009; Ng & Bornstein, 2005). Yet, it has been shown that effective treatment for agoraphobia can diminish the avoidant and/or dependent personality traits (Bienvenu et al., 2009).

6.5.6. Sixth session

The sixth session began with filling out the VAS. Then, part of the session was dedicated to a discussion about body image, weight, self-esteem, and self-confidence as the patient struggles with these concepts from an early age.

Besides, the procedure and objectives of exposure therapy were explained. The different options of exposition in Virtual Reality and its potential adverse effects were discussed. The patient received a VR cardboard headset. As homework, she was asked to immerse herself in an environment that is specific to her needs and difficulties. In this case, the environment was a road in her neighborhood on which she has difficulties driving down. In the VR environment, she was alone in a car and had to drive down the entire road.

6.5.6.1. Reflections between sessions six and seven

As the patient often talked about her childhood and her mother's psychiatric difficulties, it seemed relevant to consider the attachment theory. Therefore, we searched the literature for links between attachment styles and agoraphobia and/or GAD.

Attachment theory posits that children with parents who are trusting and emotionally attentive to their needs will develop a secure attachment style and a positive image of the self

and others. Conversely, children who feel rejected by their parents will develop an insecure attachment style and an image of themselves as unworthy of love and others as unreliable (Ainsworth et al., 2015; Schimmenti & Bifulco, 2015).

Previous research has established that insecure attachment (including the anxious or avoidant styles) has been considered a contributing factor to the development of anxiety disorders, including GAD and symptoms of worry (Newman et al., 2015; Nielsen et al., 2017). Likewise, GAD has been found to be negatively correlated with secure attachment (Newman et al., 2015). The existing body of research on anxiety disorders indicated that attachment anxiety leads to emotion dysregulation strategies, which could increase symptoms of anxiety and therefore be a risk factor for the development of anxiety disorders (Nielsen et al., 2017). The literature suggests that individuals with anxiety disorders will rely on other people to help them with daily functioning and/or avoid anxiety-eliciting situations (Nielsen et al., 2017). This particularly fits with the situation of our patient. Moreover, as they believe they are unable to cope, individuals with anxiety disorders may seek reassurance in their relationships and worry about attachment-related matters, such as abandonment (Nielsen et al., 2017).

Further, an insecure attachment, especially the avoidant type, can negatively impact the efficacy of CBT (Newman et al., 2015). However, individuals with anxious insecure attachment are more likely to seek help, admit their distress, and be more compliant with treatment compared to those with the avoidant type (Newman et al., 2015). In the present study, we can hypothesize that our patient rather has an anxious attachment style.

These findings have clinical implications: treatment for anxiety disorders should integrate and target interpersonal aspects and altering the attachment style could improve emotion regulation skills and anxiety symptoms (Newman et al., 2015; Nielsen et al., 2017). It is relevant and beneficial to focus on attachment difficulties in the treatment of anxiety disorders (Nielsen et al., 2017), and thus in the care of our patient.

6.5.7. Seventh session

In the seventh session, the patient started by completing the VAS. Afterward, she described her experience with VRET. The patient explained that she did the homework at home and managed to immerse herself in the video without experiencing any anxious symptoms.

Next, the patient and the psychologist tried to identify all the different elements and aspects of the patient's life and difficulties with a holistic approach. The holistic theory is the assumption that the parts of any whole cannot exist and cannot be understood except in their

relation to the whole and also the idea that the mind and the spirit affect the body (Peng & Nisbett, 1999; Zamanzadeh et al., 2015). Therefore, in psychotherapy, adopting a holistic approach help patients understand their symptoms, foster a greater sense of self-awareness, and have a deeper understanding of the connections between their body, mind, and relationships, and how these elements play a role in mental health (Zamanzadeh et al., 2015). In holistic therapy, the entire person is addressed in the treatment, not just one aspect of the person (Zamanzadeh et al., 2015). Holistic therapy allows health professionals to better understand patients and their needs (Zamanzadeh et al., 2015).

6.5.7.1. Reflections between sessions seven and eight

Concerning the VRET homework, we tried to understand why the patient did not experience symptoms of anxiety. One of the reasons might be that she did the virtual exposure at home, in her comfort zone, where she feels safe. Secondly, as we started to better understand the patient's difficulties through the holistic approach, we made the hypothesis that her fear to drive alone was not the aspect that we needed to address first. Indeed, through all sessions, she made numerous references to her damaged self-image and the lack of autonomy in several aspects of her life. Thus, we questioned the initial therapeutic objective, which was working on her fear of driving through VRET, and deemed that we should work on ameliorating her self-image first and foremost.

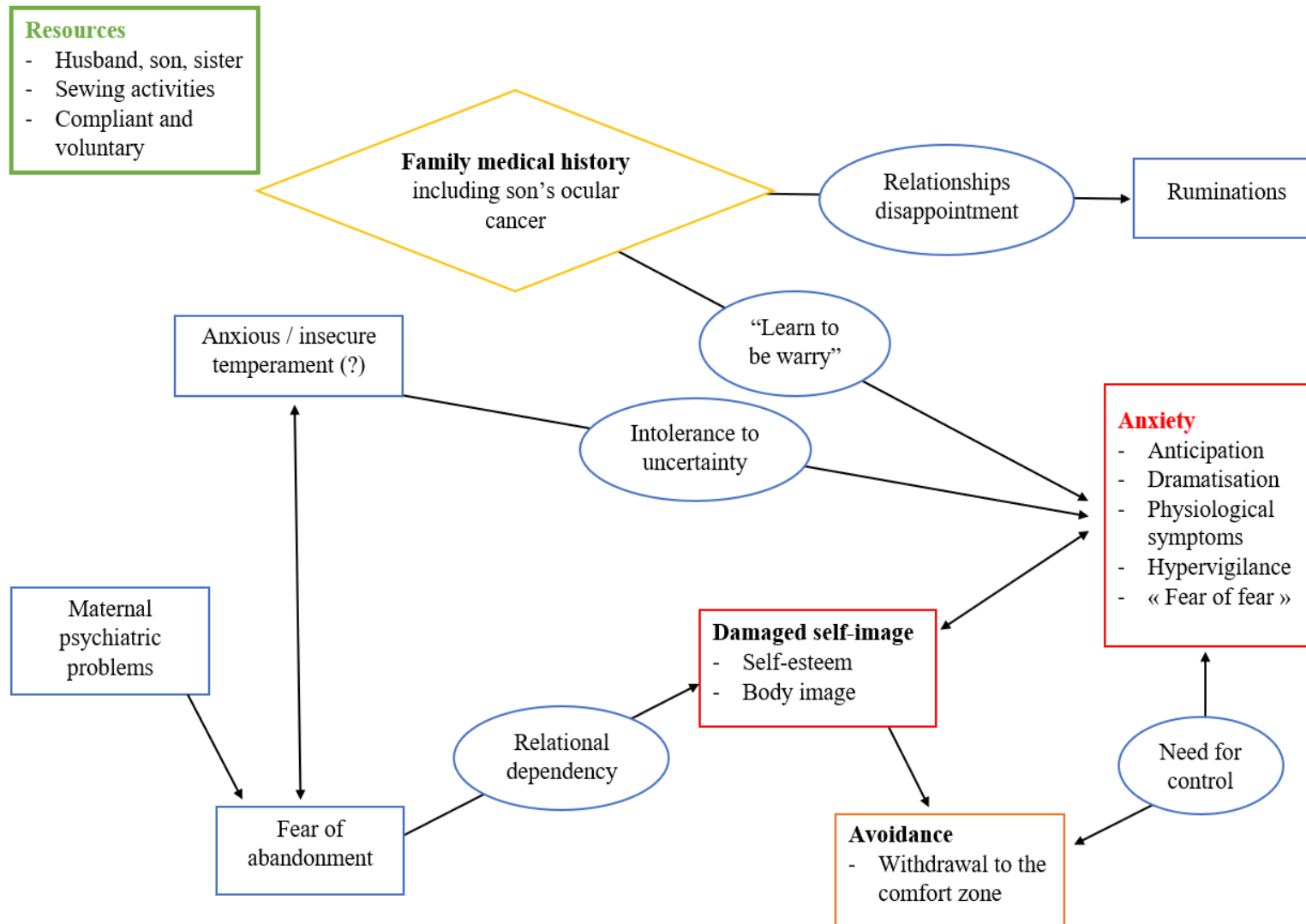
However, there is still a possibility of using VRET later in the intervention. For future exercises, the VRET environments could encompass situations in which the patient has to be independent and alone, such as driving her car, but also going to a store or picking up her son from school or another activity.

6.5.8. Eighth session

The patient was asked to complete the VAS once more. Then, the session was devoted to discussing the different elements of the diagram that was made in collaboration with the patient based on a holistic approach (Figure 5).

Figure 5

Holistic theory



6.6. Statistical analyses

This study consisted of a single-case study with a multiple baseline design. The participant was not compared to a control group but rather to herself at different time points before and during the therapy. The research design is within-subject with one categorical independent variable (i.e., the psychological intervention, which initially was following VRET) and quantitative dependent variables (the anxiety symptoms measured by the visual analog scales). The effect size of the treatment was measured by the method of Percentage of Nonoverlapping Data (PND). It allowed us to check whether there were significant statistical differences between the baseline data and the data collected throughout and after the intervention (Lenz, 2013). Moreover, the percentage of the treatment phase data that exceeds a particular point within the baseline phase was analyzed. A bigger percentage of nonoverlapping data indicates a better treatment efficacy (Lenz, 2013). These analyses were done using a free software (<http://www.singlecaseresearch.org>).

Further, we analyzed whether the participant experienced SGs in the anxiety symptoms measured with the VAS during the intervention. The presence of SG was determined in accordance with the criteria established by Tang and DeRubeis (1999):

- Criterion one: the gain between the two sessions should be large in absolute terms. A reliable change index (RCI) was used to examine this criterion (Collins & Coles, 2017; Durland, Wyszynski, & Chu, 2018);
- Criterion two: the SGs should represent a decrease of 25% in symptom severity between the two sessions (Butler et al., 2019);
- Criterion three: the mean scores of symptom severity in the three pre-gain sessions must be significantly larger than the mean scores in the three post-gain sessions. This ensures that the gain is stable across time and is not due to random fluctuations in treatment (Butler et al., 2019; Durland et al., 2018). To compare the means scores, independent sample t-tests were used.

7.1. Multiple Baseline Design

Table 3 resumes the scores of the VAS for each session. The baseline encompasses three measurements and the intervention consists of five measurements. Figure 6 presents a visual representation of the changes in those scores. Then, the results from the Percentage of Nonoverlapping Data can be found in Table 4.

All the variables' scores were found to be stable during the baseline phase as none of the p-values were significant (i.e., $p < .05$). Unlike the other variables, the scores of the variables "anxiety intensity" and "dizziness intensity" were found to be unstable during the intervention phase as the respective PND had significant p-values. Also, only the variables "dizziness intensity" and "avoidance" had statistically significant different scores between the baseline and the intervention. For both variables, there was a decrease in their scores during the intervention compared to the baseline. For the other variables (anxiety intensity, extrasystole anxiety, anticipation, and self-efficacy), there were no statistically significant differences between the scores of the baseline and the intervention.

Table 3

VAS scores

Sessions	1	2	3	4	5	6	7	8
<i>Intensity of anxiety</i>	10	9.9	7.9	10	7.7	6.9	7.4	2.0
<i>Extrasystole intensity</i>	10	9.3	3.4	3.9	7.3	7.1	6.7	3.1
<i>Dizziness intensity</i>	10	9.4	7.2	9.1	5.8	5.2	4.3	2.8
<i>Avoidance</i>	10	9.2	6.8	4.9	5.2	8.1	4.9	1.1
<i>Anticipation</i>	10	7.5	6.4	8.9	3.7	7.4	5.0	2.9
<i>Self-efficacy</i>	1.0	1.0	0.6	0.1	1.3	0.4	1.7	1.5

Note. VAS scores can range from zero to ten. The scores from the first three sessions belong to the baseline phase and the intervention phase encompasses the scores of the five other sessions. For clarity purposes, the red line marks the differentiation.

Figure 6

Changes in the VAS scores throughout the eight sessions

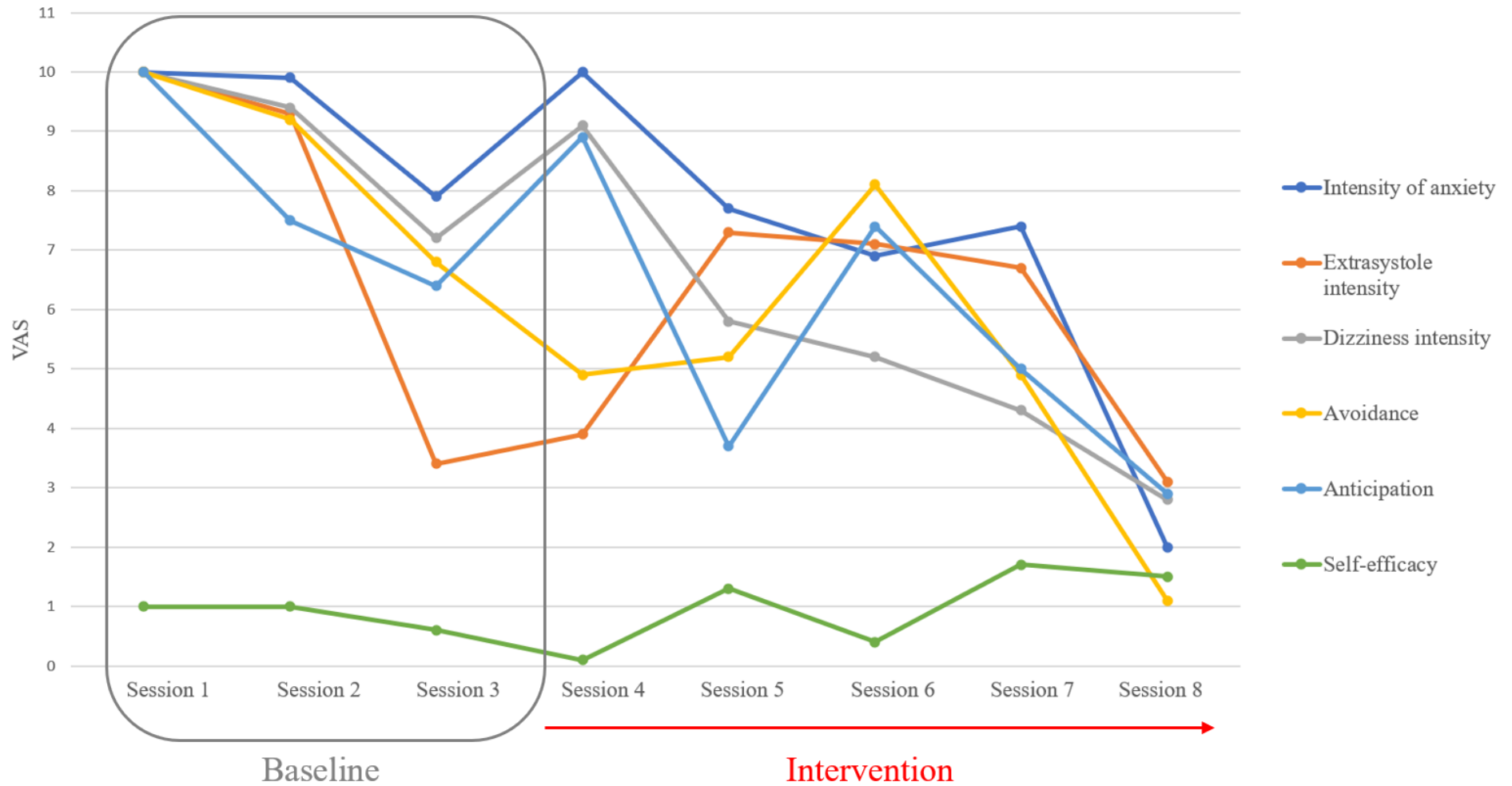


Table 4*PND results*

		<i>p-values</i>	<i>NAP (%)</i>
Anxiety intensity	Baseline scores	.12	83
	Intervention scores	.05*	
	Comparison between the baseline and intervention scores	.14	
Extrasystole intensity	Baseline scores	.12	73
	Intervention scores	.33	
	Comparison between the baseline and intervention scores	.30	
Dizziness intensity	Baseline scores	.13	93
	Intervention scores	.01*	
	Comparison between the baseline and intervention scores	.05*	
Avoidance	Baseline scores	.13	93
	Intervention scores	.46	
	Comparison between the baseline and intervention scores	.05*	
Anticipation	Baseline scores	.12	80
	Intervention scores	.14	
	Comparison between the baseline and intervention scores	.18	
Self-efficacy	Baseline scores	.30	40
	Intervention scores	.14	
	Comparison between the baseline and intervention scores	.65	

Note. *significant p-value (< .05). Concerning the NAP scores, a bigger percentage of nonoverlapping data indicates a better treatment efficacy (Lenz, 2013).

7.2. Sudden gains

When examining the presence of SGs during the intervention, only one variable, “dizziness intensity” (Table 5), had a gain that met the three criteria established by Tang and DeRubeis (1999), which are resumed in Table 6. Indeed, between sessions four and five, “dizziness intensity” had a decrease in the scores that can be considered an SG.

Table 5*VAS scores of dizziness intensity*

Sessions	1	2	3	4	5	6	7	8
	10	9.4	7.2	9.1	5.8	5.2	4.3	2.8

Table 6

Review of the SG criteria met in dizziness intensity between sessions four and five

Criterion one: <i>the gain between the two sessions should be large in absolute terms.</i>	The RCI revealed a statistically significant difference between the two measurements of the variables dizziness intensity ($RCI > 1.96$).
Criterion two: <i>the SGs should represent a decrease of 25% in symptom severity between the two sessions.</i>	Between 9.1 and 5.8, there is more than a 25% decrease in symptom severity.
Criterion three: <i>the mean scores of symptom severity in the three pre-gain sessions must be significantly larger than the mean scores in the three post-gain sessions.</i>	An independent sample t-test indicated that the mean scores in the three pre-gain sessions ($M = 8.57$) were significantly larger than the means scores in the three post-gain sessions ($M = 5.1$) ($p = .013$).

Note. These criteria were established by Tang and DeRubeis (1999)

Chapter 8 - Discussion

The overall objective of the study was to assess the efficacy of an intervention (i.e., VRET) on the clinical symptomatology of patients suffering from anxiety disorders through case studies in a multiple baseline design. We hypothesized that there would be a decrease in participants' anxiety following VRET compared to their pre-treatment anxiety. More specifically, the intensity of the anxiety, the anxiety-related physical symptoms, the frequency of the avoidance, and the anticipation of the feared stimuli was expected to lessen and the sense of self-efficacy in regard to facing the feared stimuli was expected to increase when following VRET. Also, another purpose of the study was to investigate whether there were SGs in symptoms amelioration during the intervention. Lastly, a specific objective of this study was to implement an EBP approach in the care of patients.

Despite aiming at recruiting around four to eight participants, this study only included one. This can be partly explained by the fact that the latest pandemic has slowed down the operation of the CPLU. Thus, our participant was a 39-year-old female with generalized anxiety disorder and agoraphobia. Her initial demands were to overcome her fear of driving her car alone and regain autonomy in her daily life. The original therapeutic objective was to use VRET to alleviate her anxiety symptoms. The patient did use VRET once as homework: she had to expose herself to a situation in which she must drive her car down a road close to her home. However, the patient managed to immerse herself without experiencing any anxious symptoms. Thus, in line with an EBP approach, the intervention was modified and adapted to the patient's current needs. As such, the psychologist deemed necessary to work first on ameliorating the patient's self-image before moving on to the use of VRET.

8.1. Multiple Baseline Design

Multiple baseline design provides a good demonstration of cause-effect relationships (Gravetter & Forzano, 2018). Moreover, it allows an in-depth analysis of the changes before and during the psychological intervention (Tate et al., 2016). This study aimed at examining changes in the intensity of anxiety, extrasystole and dizziness intensity, avoidance, anticipation, as well as the self-efficacy of the participant regarding facing their feared situations throughout eight sessions.

All variables were found to be stable during the baseline phase. A stable baseline allows us to be more certain that the changes after the implementation of the intervention are a result of the intervention (Engel & Schutt, 2014). Two variables, dizziness intensity and avoidance,

had significantly different scores during the baseline compared to the intervention. Thus, it seems as if the intervention had an effect on those two variables: the patient had a decrease in her dizziness intensity and her avoidance behaviors. Therefore, our hypothesis was partially supported as two out of the six symptoms investigated experienced a substantial improvement.

In Table 3, we can notice that the scores can be quite variable throughout the intervention: they sometimes increase and other times decrease. More specifically, the anxiety intensity and the dizziness intensity scores were found to be unstable during the intervention. These findings might not be completely unexpected: while anxiety disorders are among the most persistent mental health illnesses, they are prone to symptom variability (Lenze & Wetherell, 2022). Thus, these results may only reflect natural fluctuations of symptoms that are inherent to psychological disorders (Shalom & Aderka, 2020). Besides, studies demonstrated that individuals with anxiety disorders have higher mood variability than the general population (Bowen et al., 2006). Mood variability is characterized by “frequent ups and downs”, that is, frequent switching between depressed and high moods (Bowen et al., 2006). Moreover, individuals with GAD have been shown to experience variability in their affect as well as in their intensity of anxiety (Ranney, Behar, & Yamasaki, 2020).

Additionally, the variability of the patient’s symptoms might be related to the complexity and the multi-faceted nature of the patient’s situation. Indeed, while the initial demands were to overcome her fear of driving alone and regaining autonomy in her daily life, the following sessions revealed that the patient’s difficulties lie in several aspects of her life, as observed with the holistic theory (Figure 5).

Yet, despite the variability, Figure 6 suggests a trend of decrease in the anxiety-related symptoms (i.e., the intensity of anxiety, extrasystole intensity, dizziness intensity, avoidance, anticipation). As the intervention is still ongoing, we could hypothesize that changes would become statistically significant after few more sessions.

Besides, the initial objective was to use VRET. Nevertheless, as explained above, it was not done thoroughly yet, as there were other elements to consider first during the intervention (i.e., the patient’s self-image). Still, the patient may use VRET in future sessions. However, as the patient did not find the VRET exercise anxiety-inducing, it might be needed to reconsider the chosen virtual environment and/or the conditions of the exercise (i.e., self-guided or therapist-led). When she tried the VR exposure exercise, the patient was at home, in her comfort zone. Thus, she may have engaged in safety behaviors, distraction, or active coping strategies. In that case, the psychologist needs to remind her of the rationale for exposure and the importance of not engaging in such behaviors (Maples-Keller et al., 2017). Likewise, when the

exposure is done in the therapist's office, the psychologist can help the patient to emotionally engage during the exposure; guide her to manage any anxiety that arises; and discuss how to prevent safety behaviors (Boeldt et al., 2019; Maples-Keller et al., 2017). Such support can enhance the effectiveness of the exposure (Boeldt et al., 2019). Another solution might be to progress into the fear hierarchy and expose her to virtual environments which would more effectively engage the patient in activating the fear structure (Maples-Keller et al., 2017).

In light of this, after several exposures to relevant and adapted virtual situations, the patient's clinical symptomatology may be significantly ameliorated. Indeed, as already mentioned, multiple studies have shown the efficacy of VRET in improving anxiety symptoms (Clemmensen et al., 2020; Kampmann, Emmelkamp, & Morina, 2016). Thus, if VRET takes place later in the intervention, investigating further changes would be pertinent.

Yet, everyone is not a good candidate for VR-based treatment. There exist individual differences related to the individual's ability to experience immersion and the sense of presence. Thus, if the next trials of VRET are unsuccessful, it could be pertinent to check these two characteristics as they contribute to the effectiveness of VR-based treatments for behavior change (Donnelly et al., 2021; Maples-Keller et al., 2017).

All things considered, even though not all variables examined had a significant amelioration, it is nevertheless encouraging to observe a significant improvement in the patient's avoidance behaviors and dizziness intensity at this point. Indeed, the intervention is still ongoing and may provide more benefits to the patient's care and outcomes. Next, considering the presence of SGs may provide us with a better understanding of what was more beneficial for the patient.

8.2. Sudden gains

Investigating the presence of SGs is of interest as they predict treatment outcomes in the short- and long-term (Collins & Coles, 2017; Durland et al., 2018; Shalom & Aderka, 2020; Vincent & Norton, 2019). Moreover, in an EBP approach, detecting SGs allows the clinician to acquire further clinical expertise by recognizing that the intervention is helpful for patients with similar pathology (Willems et al., 2020).

In this study, one SG was spotted in the variable "dizziness intensity". Indeed, between sessions four and five, the patient experienced an improvement in her symptoms of dizziness intensity that met the recommendations of Tang and DeRubeis (1999): the gain was large in

absolute terms; represented a 25% drop in symptom severity from one session to the next; and was stable across time (Aderka & Shalom, 2021; Butler et al., 2019).

When we discovered that an SG happened between sessions four and five, it was necessary to look back on the content of session four. Surprisingly, it consisted mainly of the creation of a fear hierarchy and the listing of the feared situations or stimuli that the patient would gradually face in VR. It is thus complicated to grasp why the SG happened after this session and in this kind of variable. Yet, maybe other exercises that she was asked to do in previous sessions led to the SG such as Afghan walking, the self-observation table, or the psychoeducation concerning absorbing activities. Another possible explanation is that it is due to a positive event influencing the symptom trajectory or a meaningful insight that occurred in the previous treatment sessions (Aderka & Shalom, 2021).

Up to now, far too little attention has been paid to the examination of session content preceding SGs and the few empirical investigations mainly explored the presence of cognitive change (Lemmens et al., 2021; Shalom & Aderka, 2020). Indeed, several studies demonstrated that a change in cognition in treatment sessions preceded the SGs (Shalom & Aderka, 2020). On the other hand, other studies claimed that SGs were predicted by external life events (Shalom & Aderka, 2020). Analyzing the content of the sessions preceding SGs could help identify potential mechanisms and treatment-enhancing strategies, therefore capitalizing on these gains (Dour et al., 2013; Kelly et al., 2009; Lemmens et al., 2021). So far, there is a paucity of research focusing on this subject: a better understanding needs to be developed.

As stated above, the current study only found one SG in the symptom amelioration of the variable “dizziness intensity”. This may be partly explained by the fact that SGs tend to be relatively less present in the treatment of anxiety disorders, which are more chronic, compared to disorders that experience more symptom variability, such as depression (Aderka & Shalom, 2021). Indeed, SGs were reported to occur in approximately 20% of patients during CBT for anxiety disorders, compared to 40% of patients who followed CBT for depression (Tang & DeRubeis, 1999; Vincent & Norton, 2019).

Still, while several other symptoms also experienced a considerable decrease (i.e. more than a 25% drop) in their symptom severity throughout the sessions, the issue was that the gains were not stable. For most variables, a large amelioration of symptoms was followed by an aggravation of symptoms severity in the next sessions. Therefore, they could not be considered SGs. Moreover, many variables had a substantial decrease in their scores in the last two sessions (especially the last one, session eight). Yet, based on the criteria of Tang and DeRubeis (1999), to be considered an SG, the mean scores of symptom severity in the three pre-gain

sessions must be significantly larger than the mean scores in the three post-gain sessions. However, as the gain appeared in the seventh or eighth sessions, it was not possible to compare three post-gain sessions to the three pre-gain sessions. Thus, these symptom ameliorations could not be considered SGs either. It is possible that the improvements in the different anxiety-related variables in sessions 7 or 8 will be considered SGs once the data from the future sessions will be collected.

8.3. Evidence-Based Practice

With EBP, health professionals can make the best decisions in terms of therapeutic options based on the recent literature, the clinician's expertise, the context, and the patient's needs and preferences (Willems et al., 2020). While EBP has multiple advantages for both clinicians and patients, it is not yet widely implemented in practice (Maillart & Durieux, 2014).

This study carried out an EBP approach in the care of the patient. Indeed, the psychologist used the four pillars to obtain and combine information to achieve the most appropriate clinical decision. The following is a brief description of the application of the four pillars in our case study.

1. Research

As the psychologist knew more about the situation and the patient's characteristics, she searched the literature to verify her hypotheses and get some more insight concerning the patient's situation. For example, before the intervention, the literature regarding the patient's diagnosis (i.e., GAD and agoraphobia) was reviewed. Later, we explored the literature to find which virtual environments were typically used for individuals with GAD and/or agoraphobia. Next, we investigated the link between anxiety disorders and dependent personality traits. Lastly, we studied the literature on attachment theory and the association with the development of anxiety disorders, as well as its clinical implications. All the literature reviewed to base clinical decisions was critically analyzed.

2. The clinician's experiences and expertise

The hypothesis concerning the diagnosis of GAD and agoraphobia was formulated thanks to the clinical expertise of the psychologist. Moreover, the reflections made between the sessions were generated based on the psychologist's theoretical knowledge and insights from past clinical experiences.

3. The preferences and values of the patient

The initial demands of the patient were to use VRET to overcome her fear of driving and therefore regain autonomy in her daily life. Therefore, the initial plan was to find a relevant virtual environment in which she could immerse herself. The patient wanted to try VRET as she had already tried different types of therapy which did not work. The patient was informed of the benefits, risks, and practical implications of the therapeutic option (in this case, VRET). When the VRET exercise turned out to be unprofitable for the patient, the psychologist and the patient both discussed the reasons behind this non-success and agreed that other facets of her complaints should first be worked on.

Besides, the patient's preferences were also taken into account when it was needed to find a way for her to relax and lower her heart rate: she had already tried several mobile phone apps with breathing and meditation exercises. However, she did not find them effective. Therefore, the psychologist recommended her to try Afghan walking instead. Lastly, the EBP approach also invites to consider the patients' difficulties, comorbidities, social and familial context, and cultural origins. This was done through the holistic approach.

4. The context and environment of the clinician's practice

The use of VRET in this intervention could have been easily implemented as the CPLU frequently uses Virtual Reality as a treatment tool for anxiety disorders. The possibility to use VR in the CPLU was made possible through the collaboration of the department of psychoeducation and psychology at the University of Québec in Outaouais, In Virtuo, and of the Centre of Virtual Reality of the University Hospital of Charleroi.

This pillar also includes other factors such as, among others, the political support, the social climate, the legal and political framework, the economic context and financing of care (Adriaenssens et al., 2017). Nevertheless, these features will not be addressed in the present discussion.

Thus, by taking the four pillars into account, the five EBP steps were followed:

1. Asking a structured and specific clinical question

The PICO question was "Is there a decrease in the anxiety symptoms (O) of a patient with GAD and agoraphobia (P) after VRET (I) compared to before the intervention (C)?"

2. Seeking the best available external evidence from research

3. Critically appraising the evidence

4. Applying the results in practice and making a decision: combining external evidence with internal evidence and the patient's preferences

5. *Evaluating the performance: evaluation of the efficacy of the clinical decision as well as the personal efficiency in carrying out the EBP approach.*

Concerning this last step, at this point, the evaluation of the performance was made through the examination of the evolution of the clinical symptomatology with anxiety-related visual analog scales administered in each session. This allowed us to have a first insight into the efficacy of the intervention. Still, it would be interesting to continue this examination throughout the rest of the intervention and make a comparison between the measurements collected during the baseline (i.e. the different questionnaires listed in the procedure such as the OQ-45.2, the STAI-Y, ...) and the measurements of the same questionnaires as intermediate and post-intervention assessments. The advantages of these comparisons will be explained in more detail later in this paper.

Regarding the evaluation of the personal efficiency in carrying out the EBP process, the reflections made between each session allowed the psychologist to assess her implementation of the approach. The psychologist is very familiar with and makes use of EBP in her clinical routine. She was not confronted with barriers in the implementation of EBP such as poor accessibility to the scientific literature or an insufficient mastery of the English language.

In sum, it seems that this single case study made good use of the EBP approach. EBP allows clinicians to be more confident in their clinical choices; learn new ideas for care and assessment that are based on the recent literature; respond as adequately as possible to the patient's needs and expectations; evaluate the effectiveness and relevance of care; and inform or reassure patients about their evolution (Willems et al., 2020). The Evidence-Based Practice aims at treating the patient as a whole person within holistic care. Advantages for patients include more trust in clinicians and their therapeutic choice, more transparent clinical decision-making, and the adoption of an active role by the patient (Willems et al., 2020).

8.4. Strengths and limitations of the study

This study has several limitations. First, single-case study results are difficult to generalize from: there is uncertainty concerning the extent to which the data can explain phenomena or situations outside and beyond the specific scope of the particular study (Kazdin, 2019). Also, the data consisted of self-report questionnaires which are not preserved from self-report biases (Bauhoff, 2014). Moreover, in A-B designs, there are threats to the internal validity, such as history, which refers to any events or circumstances outside the intervention that may influence or account for the results of the study (Ray, 2015). However, repeated

baseline measurements discount most threats to the internal validity of the study design (Engel & Schutt, 2014). Additionally, the method of PND used in the statistical analyses has the disadvantage of being thrown off by outlier scores (Vannest & Ninci, 2015). Lastly, regarding the specificity of the effect in the intervention, the number of features (i.e., the psychoeducation on absorbing activities and the anxiety-avoidance curve, Afghan walking, the self-observation table, the stop signal, the bibliotherapy, the single VRET exercise,...) included in the intervention makes it difficult to appraise whether one of these features alone or their combination contributed to the results.

Notwithstanding these limitations, this study design allows for high experimental control (Tate et al., 2016). Another advantage of this design lies in the possibility of deeply analyzing the changes before and during the intervention as well as in the investigation of the presence of SGs (Tate et al., 2016). Further, this study offers valuable preliminary insights into the outcomes of an intervention for patients with GAD and agoraphobia. Moreover, this case study sets a good example of how to implement an EBP approach into one's clinical practice.

8.5. Recommendations and suggestions for future research

While this study already provides interesting insights into the outcomes of an intervention for patients with anxiety disorders (more specifically GAD and agoraphobia), it only includes part of the intervention and may be considered preliminary results. Indeed, there is still much to discover. Thus, this section will first concern recommendations regarding the present study and will then continue with more general suggestions for future studies.

Firstly, concerning this particular study, it would be of interest for the patient to complete the same questionnaires as those from the baseline (e.g., the STAY Y, the FSS-III, the PSWQ, the OQ-45.2, ...) as an intermediate measurement to evaluate the efficacy of the ongoing intervention. This would allow the psychologist to have a more complete understanding of the efficacy of the previous sessions and explore which outcomes variables would benefit from the intervention (Kazdin, 2019). Moreover, this would permit the psychologist to reorient the treatment to focus on aspects that have not yet improved. Besides, for the patient, it would be encouraging to be aware of the amelioration of the symptoms and to know that the time and effort spent in therapy are worth it (Kazdin, 2019). Thus, it might help the patient stay motivated for the rest of the therapy. Informing patients of their progress helps make the therapeutic process more transparent which can improve trust and help patients stay engaged (De Nadai et al., 2014).

Then, in line with the previous recommendation, future research based on this case study could also include a pre-post design by obtaining a pre-test measurement of the outcomes (i.e., before the intervention) as well as a post-measurement of the same outcomes (i.e., after the intervention). This would allow to examine whether the intervention led to an improvement in several clinical variables such as, among others, the patient's psychological symptomatology and distress, phobic anxiety, or dimensions of worry. It would enable us to gain more insights into the effects of the intervention, which would then expand the clinician's expertise, in line with the EBP approach.

Next, as already briefly mentioned, investigating all the anxiety-related VAS once the intervention is completed may demonstrate further amelioration of the patient's anxiety symptoms that were not significantly different from the baseline after eight sessions (such as anxiety intensity, extrasystole intensity, anticipation, and self-efficacy). This would allow for an in-depth examination of the outcomes of the entire intervention. Also, there is a possibility that the patient's amelioration of symptoms in sessions seven or eight could be considered SGs. As aforementioned, this hypothesis can not be confirmed with the current data as there were not enough post-gain sessions to compare with the pre-gain sessions to be able to match the criteria established by Tang and DeRubeis (1999).

Importantly, the initial objective of this research was to explore the effects of VRET on the clinical symptoms of anxiety patients. However, as the only VRET exercise the patient has done was not fruitful, the intervention was modified to properly address the patient's prevailing needs. Yet, there is still the possibility that the patient will use VRET in future sessions. Therefore, investigating the outcomes of the next sessions would be necessary to evaluate the efficacy of VRET.

Turning now to more general recommendations, future studies should include a bigger sample to allow for replication across participants (Lobo et al., 2017). With more than one participant, the baseline phase would have a different duration for the participants as the intervention phase ideally would not start at the same time for all participants. This would permit the separation of intervention effects from the effects of maturation or common history, which would help increase internal validity (Bouwmeester & Jongerling, 2020; Lobo et al., 2017). Concerning the external validity, the generalizability of the results increase when the study design incorporates randomization, replication, and multiple participants (Lobo et al., 2017).

Further research should be undertaken to examine the individual time course of symptoms during psychological treatment and the presence of SGs. Identifying what

specifically happened in the treatment session before an SG would help enhance overall therapy (Kelly et al., 2009). More research is also needed on the timing as well as the predictors of SGs.

Also, despite it being the initial aim, this study did not manage to assess the outcomes of VRET on the symptomatology of patients with anxiety disorders. Thus, there is still the need for future research to draw firm conclusions about the outcomes and mechanisms underlying VRET, as well as individual differences in the sense of presence and the ability to experience immersion. Moreover, future studies could describe in more detail the virtual environments used for different mental health conditions and specify the ones that were useful.

Lastly, more research should be carried out to establish the benefits of the implementation of EBP in clinical practice. It would be of interest to compare the outcomes of a therapeutic care adopting the EBP approach and one that does not (i.e., treatment-as-usual). Examples of variables of interest can include the clinician's confidence in the therapeutic choice, the patient's trust in the clinician, the efficacy of the care, or the patient's sense of agency.

Chapter 9 - Conclusion

The initial purpose of the current study was to investigate the effects of VRET on the clinical symptomatology of patients with anxiety disorders. Ultimately, our sample only included one patient with GAD and agoraphobia. Also, as the intervention did not thoroughly include the intended VRET exercises, the efficacy of different methods of action undertaken was examined. This study has demonstrated that after eight sessions, the patient experienced a decrease in her avoidance behaviors and dizziness intensity. Besides, despite some variability, a visual inspection of the changes in the anxiety symptoms suggests a trend: almost all assessed anxiety-related variables (except for self-efficacy) showed a decrease in their scores, thus an amelioration of clinical symptomatology. However, this trend was not statistically significant. Still, it might become significant once the intervention is completed.

The second aim of this study was to explore the presence of SGs, which are associated with better treatment outcomes (Collins & Coles, 2017). This study has identified one SG in dizziness intensity, between sessions four and five. There is still uncertainty on why an SG occurred in this variable at that particular moment. Moreover, an examination of the evolution of scores may reveal more SGs once the intervention is finished.

Lastly, an EBP approach was implemented in this case study. Therefore, by taking into account four pillars (i.e., research, the clinician's experiences and expertise, the preferences and values of the patient, and the context and environment of the clinician's practice), the psychologist ensured to make the best decision in terms of therapeutic options. Also, the intervention was adapted to fit to the patient's prevailing needs and the use of VRET was postponed to allow the care to focus on more pressing matters. EBP has multiple advantages for both the clinician and the patient and needs to be more implemented in clinical practice (Willems et al., 2020).

Taken together, these results indicate that we can already observe an amelioration of the patient's symptomatology after eight sessions, especially in terms of avoidance behaviors and dizziness intensity. Also, they confirm the presence of SGs in psychotherapy for anxiety disorders.

A natural progression of this work would be to further analyze the evolution of symptoms after the completion of the entire intervention. Then, the clinical symptomatology may further improve and there might be other SGs. Moreover, if future sessions include VRET exercises, the outcomes of VRET could be analyzed with the data subsequently collected.

Overall, this research has brought up many questions in need of further investigation: the timing, mechanisms, and predictors of SGs; the efficacy of VRET exercises for anxiety patients; the choice of the appropriate virtual environments; the individual differences in the sense of presence and the ability to experience immersion; and the benefits of implementing EBP into one's clinical practice.

Part III - References

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Part IV – Appendices

Appendix A. *Informed consent*



Faculté de Psychologie, Logopédie et des Sciences de l'Éducation

Comité d'éthique

PRESIDENTE : Fabienne COLLETTE

SECRETAIRE : Annick COMBLAIN

CONSENTEMENT ECLAIRE POUR DES RECHERCHES IMPLIQUANT DES PARTICIPANTS HUMAINS

Titre de la recherche	Sudden Gain in Virtual Reality Exposure Therapy for Patients with Anxiety Disorders: A Multiple-Baseline Case Studies Design
Chercheur responsable	Florine Remacle
Promoteur	Aurélie Wagener
Service et numéro de téléphone de contact	Psychologie de la Santé / CPLU 04 366 35 69

Je, soussigné(e) déclare :

- avoir reçu, lu et compris une présentation écrite de la recherche dont le titre et le chercheur responsable figurent ci-dessus ;
- avoir pu poser des questions sur cette recherche et reçu toutes les informations que je souhaitais.
- avoir reçu une copie de l'information au participant et du consentement éclairé.

J'ai compris que :

- je peux à tout moment mettre un terme à ma participation à cette recherche sans devoir motiver ma décision ni subir aucun préjudice que ce soit. Les données codées acquises resteront disponibles pour traitements statistiques.
- je peux demander à recevoir les résultats globaux de la recherche mais je n'aurai aucun retour concernant mes performances personnelles.
- je peux contacter le chercheur pour toute question ou insatisfaction relative à ma participation à la recherche ;
- des données me concernant seront récoltées pendant ma participation à cette étude et que le chercheur/mémorant responsable et le promoteur de l'étude se portent garants de la confidentialité de ces données. Je conserve le droit de regard et de rectification sur mes données personnelles (données démographiques). Je dispose d'une série de droits (accès, rectification, suppression, opposition) concernant mes données personnelles, droits que je peux exercer en prenant contact avec le Délégué à la protection des données de l'institution dont les coordonnées se trouvent sur la feuille d'information qui m'a été remise. Je peux également lui adresser toute doléance concernant le traitement de mes données à caractère personnel. Je dispose également du droit d'introduire une

Une copie du présent document est remise au participant.

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réclamation auprès de l'Autorité de protection des données (<https://www.autoriteprotectiondonnees.be>, contact@apd-gba.be).

- les données à caractère personnel ne seront conservées que le temps utile à la réalisation de l'étude visée, c'est-à-dire pour un maximum de 5 années.
- j'accepte que le psychologue transmette les données de mon dossier médical nécessaires à la réalisation de cette étude (et uniquement celles-là) au chercheur/mémorant responsable.

J'autorise le chercheur responsable à communiquer mes résultats à la psychologue qui me suit
OUI - NON

Le cas échéant, veuillez indiquer les coordonnées de la personne à qui les résultats doivent être transmis (adresse et/ou numéro de téléphone) :

Je consens à ce que :

- les données anonymes recueillies dans le cadre de cette étude soient également utilisées dans le cadre d'autres études futures similaires, y compris éventuellement dans d'autres pays que la Belgique.
- les données anonymes recueillies soient, le cas échéant, transmises à des collègues d'autres institutions pour des analyses similaires à celles du présent projet ou qu'elles soient mises en dépôt sur des répertoires scientifiques accessibles à la communauté scientifique uniquement.
- mes données personnelles soient traitées selon les modalités décrites dans la rubrique traitant de garanties de confidentialité du formulaire d'information.

En conséquence, je donne mon consentement libre et éclairé être participant à cette recherche.

Lu et approuvé,

Date et signature

Summary

Introduction. The present study was designed to assess the efficacy of an intervention (i.e., initially VRET) on the clinical symptomatology of patients suffering from anxiety disorders. Unfortunately, the patient only carried out a single VRET exercise, which did not cause her anxiety. Therefore, the intervention was modified to fit the patient's prevailing needs. Moreover, we aimed to explore the presence of SGs. This research also had the specific intention to implement an EBP approach in the care of the patient.

Methods. This case study consisted of a multiple baseline design. Our sample consisted of one patient with GAD and agoraphobia. The present study incorporates the data collected during the first eight sessions of the therapeutic intervention. In each session, we investigated the evolution of several anxiety-related variables such as the intensity of the anxiety, anxiety-related physical symptoms, the frequency of the avoidance, the anticipation of the feared stimuli, and the sense of self-efficacy in regard to facing the feared stimuli. The effect size of the treatment was measured by the method of Percentage of Nonoverlapping Data (PND). Moreover, the presence of SGs was determined in accordance with the criteria established by Tang and DeRubeis (1999).

Hypotheses. We hypothesized that there would be a decrease in the patient's anxiety during the psychological intervention compared to their pre-treatment anxiety. More specifically, the intensity of the anxiety, the anxiety-related physical symptoms, the frequency of the avoidance, and the anticipation of the feared stimuli would lessen and the sense of self-efficacy in regard to facing the feared stimuli would increase. Furthermore, we expected to detect SGs in the evolution of clinical symptomatology.

Results. The intervention led to a decrease in the patient's avoidance behaviors and the anxiety-related physical symptom dizziness intensity. Moreover, there was an SG between sessions four and five in the intensity of dizziness felt by the patient.

Conclusion. These results suggest that the first sessions of therapeutic intervention can lead to an amelioration of the patient's symptomatology, in this case, a decrease in avoidance behaviors and dizziness intensity. It also confirmed the presence of SGs in psychological intervention for anxiety disorders. It would be interesting to analyze the data again once the intervention is completed, with the hope to discover further amelioration of the clinical symptomatology and/or other SGs. More research on VRET, SGs, and the implementation of EBP in clinical practice is necessary.

Résumé

Introduction. L'objectif de cette étude était d'évaluer l'efficacité d'une intervention (i.e., initialement la TERV) pour des patients souffrant de troubles anxieux. Malheureusement, la patiente n'a effectué qu'un seul exercice de TERV, qui n'a pas provoqué d'anxiété. Par conséquent, l'intervention a été adaptée aux besoins actuels de la patiente. En outre, nous avons cherché à explorer la présence de gains soudains dans l'amélioration des symptômes. Cette recherche avait également l'intention spécifique de mettre en place une approche EBP dans la prise en charge de la patiente.

Méthodes. Un design en lignes de base multiples a été utilisé dans cette étude de cas. Notre échantillon était composé d'une patient souffrant de TAG et d'agoraphobie. Cette étude intègre les données recueillies au cours des huit premières séances d'une intervention thérapeutique. Au cours de chaque session, nous avons étudié l'évolution de plusieurs variables liées à l'anxiété telles que l'intensité de l'anxiété, les symptômes physiques liés à l'anxiété, la fréquence de l'évitement, l'anticipation et le sentiment d'auto-efficacité face aux stimuli redoutés. L'ampleur de l'effet du traitement a été mesurée par la méthode du pourcentage de non-chevauchement (NAP). Par ailleurs, la présence de SG a été vérifiée conformément aux critères établis par Tang et DeRubeis (1999).

Hypothèses. Nous avons émis l'hypothèse qu'il y aurait une diminution de l'anxiété de la participante pendant la prise en charge par rapport à avant le traitement. Plus précisément, l'intensité de l'anxiété, les symptômes physiques liés à l'anxiété, la fréquence de l'évitement et l'anticipation des stimuli redoutés diminueraient et le sentiment d'auto-efficacité face aux stimuli redoutés augmenteraient. D'autre part, nous nous attendions à détecter des gains soudains dans l'évolution de la symptomatologie clinique.

Résultats. L'intervention a conduit à une diminution des comportements d'évitement du patient et de l'intensité des vertiges, un symptôme physique lié à l'anxiété. De plus, nous avons détecté un gain soudain entre les sessions quatre et cinq dans l'intensité des vertiges ressentis par la patiente.

Conclusion. Ces résultats suggèrent que les premières séances d'une prise en charge peuvent amener une amélioration de la symptomatologie de patients anxieux, telle qu'une diminution des comportements d'évitement et de l'intensité des vertiges. Aussi, la présence de gains soudains dans la prise en charge des troubles anxieux a été confirmée. Il serait intéressant d'analyser à nouveau les données une fois l'intervention terminée, dans l'espoir de découvrir une amélioration supplémentaire de la symptomatologie clinique et/ou d'autres gains soudains. Il est nécessaire de poursuivre les recherches sur la TERV, les gains soudains et l'implémentation de l'EBP dans la pratique clinique.