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Therapist-Guided & Self-Guided Virtual Reality Exposure Therapy To Combat Glossophobia: A Scoping Review

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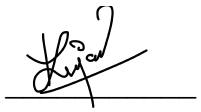
Signed: 

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Abstract

The ability to speak efficiently in public is a value-added skill in today's day and age, yet a large part of the population suffers from the irrational fear of speaking in front of a large audience, otherwise known as glossophobia. There are many ways to treat glossophobia, but it is often neglected due to a lack of understanding, social stigma, or pure neglect. This scoping review will start with an introduction to glossophobia, cover its traditional treatment methods, and then move onto Virtual Reality Exposure Therapy (VRET) and its potential in being used as a clinical intervention to help combat glossophobia. Literature searches were associated with self-guided and therapist-guided topics specific to glossophobia, in an effort to provide relevant information for anyone interested in the matter to try whatever VRET intervention they please: the hand-held approach of therapist-guided VRET, or the self-led, self-containing method of self-guided VRET. Three databases were used for this search, namely Google Scholar, Scopus, and The Library of Trinity College Dublin. After thorough vetting based on a specific inclusion criteria, ten papers were shortlisted for this scoping review (five were therapist-guided, four were self-guided, and one was both therapist-guided and self-guided). This study concluded that both types of VRET interventions were equally successful in reducing the anxiety of glossophobia in varying effects, and each had their own strengths and weaknesses. The purpose of this paper is not to declare the better of the two types of interventions, but simply to provide the necessary information on both to the reader, who can gain a deeper understanding of VRET as a clinical practice, and more importantly, the significance of identifying the symptoms of glossophobia at an early stage in life and working towards relieving the symptoms. Further, by identifying gaps in research that currently exist, this scoping review highlights the areas that require further inquiry.

TABLE OF CONTENTS

Glossary of Terms

VRET: Virtual Reality Exposure Therapy

PSA: Public Speaking Anxiety

SAD: Social Anxiety Disorder

CBT: Cognitive Behavioral Therapy

ET: Exposure Therapy

IVET: In-Vivo Exposure Therapy

VR: Virtual Reality

PSAS: Public Speaking Anxiety Scale

PRCA: Personal Report of Confidence as a Speaker

LSAS: Liebowitz Social Anxiety Scale

SATI: Speech Anxiety Thoughts Inventory

BFNE: Brief Fear of Negative Evaluation Revised Scale

SUDS: Subjective Unit of Distress Scale

Significance of Study

Possessing good oral communication skills will always be a requirement in one's life – from adolescence to late adulthood. Identifying the symptoms of individuals who struggle with glossophobia at an early age, and using Virtual Reality Exposure Therapy (VRET) to combat these symptoms has been suggested as an effective solution in many studies. The two major types of VRET interventions are therapist-guided VRET (conducted in the presence of a qualified therapist), and self-guided VRET (self-contained, in the privacy of one's own home). While there is sufficient research in the field of VRET today on each of these VRET interventions independently, there is a lack of research with both interventions in the same study. As glossophobia is ever-present between all age groups, this paper will focus on the age demographics of adolescents and adults. The final aim is for this paper to provide enough information to individuals with glossophobia about both types of VRET interventions (self-guided & therapist-guided), so they can make an informed decision on which type they might be better suited for.

Chapter 1: Introduction

Public speaking is an act of delivering a speech in front of an audience, often with the purpose of communicating an idea to retrieve a desired response. Human communication has been referred to as "*a basic need for our well-being, as important as the food we eat, water we drink, and air we breathe*" by (Brydon & Scott, 2011). As important as it is, there is a large chunk of the population that suffers from glossophobia, the irrational fear of speaking in front of an audience. Brydon & Scott (2011) further contend that depriving humans of this basic need would affect them severely, both physically and psychologically. This emphasises the importance of identifying glossophobia and treating it at the earliest possible.

This paper will start with a deep dive on glossophobia, its prevalence and origin in different age groups, and the importance of identifying symptoms at adolescence (in this chapter). It will continue with the traditional treatment methods of glossophobia and why those methods are lacking (found in chapter 2), before moving onto the main crux of the paper: VRET (in chapter 3). In the same chapter, the current role that VR plays in exposure therapy will be discussed, before exploring its applications in exposure therapy, and then finally, the two major types of VRET interventions – self-guided and therapist-guided – will be discussed at length. In this chapter, it will become known that there is a lack of conclusiveness with regard to which form of intervention might be better suited for a particular type of individual battling with glossophobia. This is where chapter 4 starts developing the protocol for the scoping review, and evaluates several VRET-based experiments in an effort to determine the efficacy of the two interventions independently. The selection criteria used for narrowing down the selected papers along with the data extracted from each paper are presented in tables and figures (found in chapter 4). Finally, the results gleaned from the papers will be presented in chapter 5, ending with the final discussion and conclusion in chapters 6 and 9 respectively. In between, the limitations and future areas for improvement in the VRET sector will be briefly touched upon in chapters 7 and 8.

The reason to evaluate their overall efficacy in terms of clinical impact on glossophobia is simply that successful VRET treatments can help address the large treatment gap for individuals with glossophobia and SAD (Social Anxiety Disorder) by attracting them to seek treatments alternative to the traditional methods (Wang et al., 2007). Further, it could be

speculated that clinics would be able to provide alternate treatment options using VRET that would otherwise be either infeasible or too expensive. This way, one main concern surrounding glossophobia – that individuals often overlook treatment options – can be addressed, hopefully at an early stage.

1.1 Glossophobia

Public speaking plays a key role in our everyday lives – be it giving a presentation in school, attending an interview in a professional setting, or delivering a sales pitch to a client – a vast majority of the general public is faced with these situations on a daily basis. Yet, one out of every three people report anxiety symptoms, particularly when delivering a speech in front of an audience (Stein, 1996, p.93). In fact, public speaking has been referred to as the most commonly reported fear amongst general populations (Dwyer & Davidson, 2012 referred to in (Gallego et al., 2022, p. 1)). This is referred to as Public Speaking Anxiety (PSA), or more specifically, glossophobia. Some of the common symptoms of glossophobia include somatic markers (like body shaking, trembling, etc.), irrational thinking, ranting on irrelevant topics, or simply not being able to talk.

1.2 Glossophobia & Social Anxiety Disorder

SAD is defined as the feeling of humiliation or embarrassment upon being negatively evaluated by others in a social setting. It is one of the most common psychiatric disorders reported, with a lifetime prevalence of 16% as reported in a National Comorbidity Survey that took 26 countries into consideration (*The Cross-National Epidemiology of Social Anxiety Disorder: Data From the World Mental Health Survey Initiative - BMC Medicine*, 2017). The majority of the individuals with SAD report anxiety particularly in performance environments, which helps chart out the connection between glossophobia and SAD (Blöte et al., 2009, p. 305).

One of the most taxing aspects of glossophobia is the implied social consequences that follow, and therefore, individuals with glossophobia possess an increased risk of also developing SAD (Blöte et al., 2009). According to Ruscio et al. (2008, p.8), about 40% of individuals with SAD suffer from extreme, and often debilitating glossophobia. As public speaking anxiety is primarily a “performance only” SAD category, it can be distinguished from generalised SAD, which covers both performance and interactive anxiety. For instance,

research suggests that individuals with glossophobia have more difficulty with cardiovascular arousal during performance (Gramer & Sprintschnik, 2008). They also experience varying levels of physiological, cognitive and behavioural changes, such as increased heart rate, blood pressure, perspiration, gastrointestinal discomfort, muscle, tension, and more (Bernátová et al., 2016). For this reason, this paper will focus on highlighting studies on glossophobia, or public speaking anxiety, rather than generalised SAD.

1.3 Identifying The Symptoms of Glossophobia Early

Glossophobia has an early onset in most individuals, typically by the age of 15. The initial symptoms of glossophobia in adolescents would typically start appearing at school - perhaps, the inability to participate actively in class, partake in oral assignments confidently, etc. In fact, studies suggest that this eventually leads to the interference with attending school regularly (Ferreira Marinho et al., 2017). Students have often been found to be too shy to seek help when they're asked to speak aloud in classes. They have reported that oral presentations often render them "paralyzed by fear" to the point where their minds become blank, and even simple questions are hard to answer. This anxiety leads them to perform at poorer levels – well below their capabilities (Powell, 2004).

But the problem doesn't end there. Adolescents with glossophobia show an increased risk of dropping out of school. A study reported that 25% of high school students dropped out of school, with glossophobia being the primary reason (Moreno-Peral et al., 2017). This could further explain why many students from the same report did not pursue higher education. (It may also be associated with financial difficulties and unemployment rates). Unfortunately, the problem doesn't end at that either. Glossophobia, combined with other social fears can be further associated with comorbid disorders, such as panic anxiety, specific phobias, depressive disorders, and even nicotine substance use (Wittchen et al., 1999).

The relationship between glossophobia and generalised SAD has already been discussed – around one-third of individuals with glossophobia risk developing generalised SAD. Symptoms of pervasive glossophobia in adolescents should not be ignored; they are reported to feel more lonely, socially isolated, and lean towards a lower quality of life (Wittchen et al., 1999). Over 80% of individuals with glossophobia do not receive any treatment, and those that do, typically start at the age of 27 years (Grant et al., 2005). As most of them go

unrecognised, and in effect, untreated, glossophobia is prevalent in all age groups, starting at adolescence and spilling into late-adulthood. One would therefore hope that targeting interventions to treat glossophobia would begin at adolescence to reduce the societal pressures and personal cost that go hand in hand with this disorder.

1.4 Prevalence & Aetiology

Glossophobia has been reported as the most common fear across most age groups in the general population. While different studies report varying prevalence rates ranging from 16.1% to 63.9% (Kahlon et al., 2019, p. 22), one particular study went further to show the percentage of the population that reported glossophobia as their only social fear. Carl et al. (2019) took a community sample and telephone-interviewed 339 participants, reporting that almost one-third of the participants reported exceedingly-high glossophobia symptoms, of which 5% said glossophobia was their only social fear. Individuals who have glossophobia as their sole social fear have quantitative and qualitative variances than other subtypes of SAD (Blöte et al., 2009). In fact, the same study shows that individuals that have "performance only" social anxiety disorder, that experience fear at a later onset, are often less related to childhood factors, and are neither shy nor behaviorally inhibited.

Many factors play a role in the development of glossophobia - genetic predisposition, biological markers, and environmental factors, etc. (Stemberger et al., 1995). There is no evidence that suggests a singular etiological route to anxiety. Certain personality attributes, like neuroticism, low self-esteem, and being shy are all predictors for anxiety disorders (Blöte et al., 2009). Additionally, stressful peer relationships – such as bullying – and other negative feelings, such as loneliness, social exclusion, etc. have all been identified as potential risk factors for anxiety disorders (Aune et al., 2021). The exact aetiology behind glossophobia is still complex and yet to be determined.

Chapter 2: Glossophobia & Traditional Treatments

There are various approaches that can help tackle glossophobia – psychotherapy, hypnosis, and prescribed medication are all effective approaches. The typical traditional treatment methods for glossophobia, however, are carried out in a counselling fashion.

Physiological Treatments

Physiological symptoms, such as sweaty palms, can play a significant role in narrowing down treatment options for glossophobia. This is often done using electro-dermal exercises. An interesting experiment measured the sweat gland activity of participants that gave an oral presentation in front of a live audience (Keith & Turpin, Graham, 1996). The results showed high levels of anxiety before and during the performance, and low levels after the performance.

Behavioural Treatments

Treatments targeting an individual's behaviour during public speaking is also an effective step in the treatment of glossophobia. An interesting experiment brought in a "treatment package" that focused on rehearsals and feedback to train appropriate skills one needed during a public speaking event (Fawcett & Miller, 1975). A range of data points were recorded in this experiment, including eye contact, voice modulation, topic introduction, gestures, facial expressions, etc. After each speech task, the participant received feedback on their behaviours, which they worked on before the next task. Results were promising (eye contact shot up from 12% to 81%, gestures from 4% to 98%, etc.) Even though this experiment had a relatively small audience (5-8 people), some participants found this daunting. A more gradual approach may have been more appropriate.

Cognitive Treatments

The treatment for glossophobia typically tends to target cognitive constructs and attitudes towards the fearful stimuli. A particular experiment involved comparing self and observer ratings of performances by individuals with glossophobia (Beidel et al., 1985). In cognitive research, the individuals with glossophobia feel they are not able to receive a desirable evaluation of their performance.

2.1 Cognitive Behavioural Therapy (CBT)

In the simplest of words, CBT can be defined as the process of identifying and tackling patterns of thinking and behaving that act as the building blocks for anxiety (Allen et al., 1989). Traditional treatment modes of CBT specific to glossophobia would take one of the following techniques:

Functional Analysis

The therapist helps the individual identify the key triggers before, during, and after the public speaking event. This will help the individual to identify, replace, and hopefully let go of the unhelpful thoughts that occur during the event This in turn helps defuse the physical sensations that occur simultaneously.

Graded Exposure

The therapist encourages the individual to practise public speaking by exposing them to the fearful stimuli, but in a tolerable way. Once the triggers have been identified (and graded from least intense to most intense), the individual will practise with slight anxiety-provoking situations, and slowly work their way to the more intense situations. Obstacles observed along the way will be noted by the therapist, who then plans on ways to overcome said obstacles.

Assertive Training

It is not only important to speak confidently in a public setting; one's assertiveness while delivering a speech matters. This technique incorporates techniques of assertiveness, including eye contact, tone of voice, and overall self-confidence.

CBT is well established as an effective tool to treat anxiety disorders and social phobias. There is strong evidence that suggests CBT with graded exposure is a fruitful treatment option to treat both generalised SAD and glossophobia (Ebrahimi et al., 2019). However, studies show that CBT can also result in a substantial number of patients remaining symptomatic with low response rates. In the works of Loerinc et al. (2015), the attrition rate for individuals with anxiety disorders that try to use CBT range from 0 to an alarming 53%. This finding is sufficient to speculate that there is a need for a more effective mode to treat glossophobia and its often-crippling symptoms. There is also a need to identify which of the several means of treatment works best for a particular individual.

While CBT would be the umbrella term that refers to both cognitive and behavioural therapies, there is yet another approach to treat glossophobia, which is Exposure Therapy (ET), that falls primarily under behavioural therapy (Lakin, J., 2018). Exposure Therapy is when the individual with glossophobia is met with systematic, graded exposure to the feared stimuli in a controlled setting (Craske et al., 2014). It is just as well an established treatment for anxiety disorders, both as a component for CBT, as well as a stand-alone intervention.

2.2 In-Vivo Exposure Therapy (IVET)

The most traditional form of exposure therapy is IVET, wherein individuals directly confront their fears in reality. IVET specific to glossophobia would demand a large audience for its "feared stimuli". IVET is considered the most traditional form of exposure therapy, and it involves individuals with glossophobia directly confronting their fearful stimuli without being able to avoid it. The idea of exposing individuals to directly confront their fears is to modify the relationship between the fear stimulus and memory structure. When the individual feels the absence of escape and avoidance, the aforementioned relationship is changed in that the fear elicited by the stimulus decreases (Bouchard et al., 2017, p. 21). Additionally, IVET considers the therapeutic process of habituation – a process wherein the individual is habituated to the fearful stimuli, thereby making it less daunting, and subsequently results in a decrease in anxiety. This is where other anxiety disorders, such as animal phobias, (Öst, 1996) prove extremely effective with the help of IVET.

When the cause of anxiety is inaccessible (for instance, the fear of flying (aviophobia), or death phobia), IVET becomes a less reliable form of therapy. Conducting IVET sessions for glossophobia also falls under the "unreliable" category, as it is impractical, time-consuming, and expensive – not to mention taxing for therapists on the whole, especially when it comes to adhering to traditional exposure hierarchies (Bouchard et al., 2017). Therefore, other means need to be found to tackle the impracticality factor.

Chapter 3: Virtual Reality Exposure Therapy As A Clinical Support

3.1 The Role of Virtual Reality In Exposure Therapy

One way to tackle the impracticality factor of IVET is considering Virtual Reality (VR) technology. By creating an illusion of a realistic audience, VR technology takes IVET and makes it virtual reality exposure therapy (VRET).

The individual wears a headset with dual displays that shades the eyes from the outside world, while simulating depth perception. The displayed content in this virtual environment can be interacted with head movement - lending the illusion of being able to look around the virtual world as effectively as in the real world (within the confines of the virtual simulation). VRET for glossophobia is increasingly becoming a popular choice since it provides a convenient solution to conduct in-session exposure therapy with immediate access to the "feared stimuli".

It is important to note that the virtual audiences in VRET have been successful in eliciting a fear response in the individuals with glossophobia (Bouchard et al., 2017), which in effect, is the foundation of exposure therapy. To confirm that the practice of VRET in glossophobia has been effective, we can see that randomised controlled trials have displayed positive results (Anderson et al., 2013; Bouchard et al., 2017). With the boon of virtual reality, mental health has a new alternative treatment method. Virtual reality has already been used in various fields, from post-traumatic stress disorder to eating disorders (Botella et al., 2015; Riva et al., 2021). Compelling evidence can also be seen in the treatment of very specific phobias, such as arachnophobia: the fear of spiders, (Lindner et al., 2020), aviophobia: the fear of flying (Fehribach et al., 2021), acrophobia: the fear of heights (Rimer et al., 2021), etc.

To that end, in order to really understand how a virtual environment can be envisioned as real, two factors must be understood:

3.1.1 Sense of Presence

When aiming to create a virtual environment that simulates a real-life situation that invokes glossophobia, it is important to make it with a high sense of presence for the individual. After

all, presence can be defined as "*the response to a given level of immersion*" (Slater, 2003). Slater further goes on to say that "*it arises from an appropriate conjunction of the human perceptual and motor system and immersion*" (p. 4). It is important to note that in any VR environment that successfully incites emotions within the participant, their sense of presence is elevated, which in turn aids their learning capabilities and overall performance (Witmer & Singer, 1998). Therefore, when a participant notices virtual social avatars in the environment and treats them as actual social avatars (in either sensory or non-sensory ways), this is defined as an increased social presence (Lee, 2004), and is essentially what would be key in helping create the VR environment as life-like as possible, which in turn would help use VRET as an effective clinical tool in combating glossophobia.

3.1.2 Plausibility Illusion

Slater (2009) explains the plausibility illusion as "*the illusion that what is apparently happening is really happening (even though you know for sure that it is not)*" (p. 3553). He goes on to say that if the VR environment provides a connection between VR events that are not directly caused by the participant, then the plausibility illusion is bound to happen. For instance, if in the VR environment, the participant and a VR avatar meet eyes, a physical reaction in the participant (such as a change in heart rate, etc.) is more than likely to occur. This situation is indicative of the situation being interpreted as real and is important to invoke in a participant in order to make the VRET intervention as effective as possible.

3.2 VRET vs CBT?

Many studies have been successful in proving the use of VR exposure interventions for glossophobia. One particular study, conducted by Wallach et al. (2009) evaluated the key difference between Virtual Reality Cognitive Behaviour Therapy (VR-CBT) and Cognitive Behaviour Therapy (CBT), in hopes to bring to light whether VR could replace, or be used as an alternative to CBT. One could speculate that certain difficulties arise when it comes to the "exposure" part in exposure therapy with CBT - this could be the lack of control of the therapist to manipulate external factors, the patient's inability to imagine, self-flooding, etc. In this particular study, participants were divided into three groups – CBT, VR-CBT, and WL (waiting list). The participants in both CBT and VR-CBT groups showed reduced anxiety (the average of the 5 anxiety outcome measures, as well as the participant's self-rating anxiety scale). It was interesting to note the attrition rate – the CBT group had twice the number of

dropouts as did the VR-CBT group. It was therefore suggested that the VR element, even though not necessarily superior in any way, adds the element of comfort to participants.

As promising as VRET looks in randomised controlled trials, exposure therapy is not actively being used as a therapist tool among clinicians. This may be explained by the fact that not all therapists believe exposure therapy is the most effective method to treat glossophobia; for instance, in-vivo exposure therapy doesn't allow therapists to control the fear stimuli. This is further exacerbated by the fact that few mental health providers are trained in exposure therapy (Boeldt et al., 2019). However, studies have shown that 4-hour protocol-specific training is sufficient for therapists to lead therapist-led VRET (Kahlon et al., 2019), so this shouldn't be too challenging, should therapists choose to test the veracity of VRET.

3.3 The Prevention of Glossophobia

The main consequences of glossophobia and the toll it can take on one's quality of life have already been outlined. The reason it continues to be a problem today is that very few adolescents with glossophobia actually seek mental health advice. An epidemiological study from 1999 shows that only 10.9% of individuals with glossophobia and 27.3% of individuals with generalised SAD reach out to therapists for help (Wittchen et al., 1999). A common reason for not seeking help during the earlier stages of glossophobia may be due to stigma, unawareness about anxiety, and concerns over confidentiality (Gulliver et al., 2010). Further, a common misconception related to glossophobia is that shyness is an inherent personality trait that cannot be changed, and glossophobia cannot be treated (Sareen & Stein, 2000).

It is therefore important to take preventative measures – develop effective prevention programs for adolescents with glossophobia to ensure the negative long-term consequences of glossophobia do not continue on into adulthood.

With the accessibility of VRET, there are many options when it comes to effective prevention programs. One of the first considerations to take into account would be the kind of intervention - would the individual like a hand-held approach with a qualified therapist, or would they prefer a self-led approach, wherein the individual takes control.

3.4 Therapist-Guided VRET

Using VRET with the aid of a qualified therapist is what is referred to as therapist-guided VRET. The therapist can manage the level of graded exposure in the virtual environment based on the individual's hierarchy of fears (Anderson et al., 2013). Undergoing therapist-guided VRET would imply focusing more on establishing a strong therapeutic alliance between the therapist and the individual. By agreeing upon therapeutic tasks and achievable goals through graded VR exposure, the individual can expect visible treatment outcomes. It is more about controlling the exposure to ensure there is little to no risk of overexposure to threat - in this case, the virtual audience. Treatment adherence is key in this type of VRET intervention. (Buchholz & Abramowitz, 2020).

As effective as therapist-guided VRET is, it is more about offering a hand-held approach, and less about the individual themselves gaining autonomy over the situation. This is where self-guided VRET comes into play.

3.5 Self-Guided VRET

Being regarded as the latest advancement in VRET technology, self-guided VRET is where the exposure to virtual threat is controlled by the individuals themselves. There are multiple examples that prove the efficacy of self-guided VRET (Premkumar et al., 2021; Zainal et al., 2021). Several studies show that even one-time treatment sessions of self-guided VRET have proven effective in symptoms of glossophobia (Lindner et al., 2019). A reason why self-guided VRET seems to be as effective as it is could be perceived control – individuals are more likely to comply with the required structure of the intervention if they feel like they're in charge.

It is further interesting to note that this form of intervention can be combined with therapist-guided VRET if needed, i.e, a therapist assigned to an individual for therapist-guided VRET sessions could possibly assign "homework" to the individual in the form of self-guided VRET sessions. This would be of particular benefit to those individuals who are uncertain about the efficacy of either self-guided VRET or therapist-guided VRET sessions individually.

Understandably, the implementation of either self or therapist-guided VRET was until very recently hindered by previous generations of VR hardware – some costing more than 10,000 USD, requiring technical skills to operate, were not lightweight, and low graphical quality

leading to side effects like motion sickness. With the more recent release of VR, the world sees a paradigm shift in the accessibility of VR – now starting at rates as little as 240 USD! With the introduction of user-friendly and accessible VR technology, VRET treatments for glossophobia could be adapted into regular care in the future (Gega, 2017, p.245), but like any other clinical intervention, it must be subject to scientific evaluation. In order to decide the clinical effects of either self-guided, therapist-guided, or both self and therapist-guided VRET treatments, there is a need to understand the landscape on a deeper level. The first step to work towards this goal would be to put together existing research that shows VRET being used as a clinical intervention. The remainder of this paper will be devoted to achieving the same.

Chapter 4: Method

To do justice to broad topics like SAD and glossophobia, ideally, a systematic literature review would be the best fit. A systematic review is defined as a type of research synthesis that is conducted by review groups with specialised skills who identify and retrieve evidence that pertains to a particular research question. They often follow more structured and rigorous methods to ensure the results are meaningful and reliable to its readers (Munn et al., 2018). Since the arena of VRET is quite large, and there are many studies that would be good fits for the current paper's research area, a systematic literature review would be the most ideal way to go about it. However, given the scope available to this paper, a systematic review will not be possible. Instead, a scoping review will be conducted. A scoping review, true to its name, determines the scope of the literature on a given topic and gives a clear understanding of the studies available and a detailed overview of its focus (Munn et al., 2018). The purpose of this paper is to identify knowledge gaps, clarify concepts, and scope a body of literature – and since the resources available to this paper are limited, a scoping review will be a better fit. In many ways, scoping reviews act as precursors to systematic reviews – therefore, this scoping review will confirm the relevance of the VRET in treating glossophobia, and contribute towards evidence synthesis for the same, with hopes of future systematic reviews using it as a reference.

The important steps in a scoping review include a) defining a clear review objective; which in the case of this paper is clearly defined as analysing therapist-guided and self-guided VRET as clinical interventions to scope their strengths and weaknesses in Chapter 1, b) identifying a PCC framework (Population/Concept/Context); which describes the target audience (adolescents and adults), concept area of research (VRET in treating glossophobia), and context (self-guided and therapist-guided interventions), also described in detail in sections 1.2 and 1.3, c) developing a protocol, which includes planning the review – charting out the eligibility criteria, the overall screening and charting process, etc, which will be done in sections 4.1 and 4.2. This is then followed by conducting systematic searches across various databases, followed by a screening process that helps shortlist the number of studies to be included in the scoping review (seen in section 4.2.3). The final steps of a scoping review include extracting and charting relevant data from the included studies (seen in section 4.2.4), and finally, concluding with answering the review objective (seen in chapter 6).

4.1 Search Strategy

Relevant studies for this paper were identified through thorough searches in three major bibliographical databases, namely Google Scholar, Scopus, and The Library of Trinity College Dublin, between January - April 2023. The search term on each database involved words like “public speaking anxiety”, “glossophobia”, “presentation phobia”, “presentation anxiety”, etc., as glossophobia can be described in various ways. Additionally, the phrase “virtual reality exposure therapy” was included here. More specific queries like “virtual reality exposure therapy for public speaking anxiety”, and “virtual reality exposure therapy for glossophobia” for bigger databases like Google Scholar were used. There was slight variation in the searching process for each database. For instance, for the The Library of Trinity College Dublin database, the searches were “refined” by language (English); no other restrictions were applied on this database. For Scopus, the keywords were searched using Titles, Abstract and Keywords in a Title-Abs-Key fashion. No data restrictions were applied on this database. For Google Scholar, the “advanced search” option was used to filter the keywords specifically in the title, narrowing down the options significantly.

4.2 Eligibility Criteria

4.2.1 Inclusion criteria

It was important to list out a few criteria that made the paper eligible for inclusion in this scoping review. The first factor to consider was to look at the scientific terms - SAD and Glossophobia from a zoomed-out lens. As specified earlier, glossophobia is considered a specific type of social anxiety disorder. For this reason, it was important to focus on this very specific category of anxiety disorders, and discard studies that reported general SAD results.

The second factor to consider was the individuals with glossophobia. This scoping review includes studies where the individual with glossophobia has elevated levels of the anxiety disorder. This is often identified using PSA measuring tools, such as Personal Report of Confidence as a Speaker (PRCA), Public Speaking Anxiety Scale (PSAS), etc. (find in-depth explanation in 4.2.5). It is considered an important part when shortlisting the studies, simply because it would be a pertinent measure while trying to comprehend the results, and ensure

that all participants fall within the same range. For this reason, it was kept as the second cut-off factor.

The third factor considered was actual experimentation, wherein the results were quantitative. This experimentation would involve an actual Virtual Reality intervention, wherein the participants with glossophobia would interact with a VR audience at least once. This intervention would either be self-led or therapist-guided. The interventions of VRET could be delivered either as a stand-alone intervention or a wider treatment package wherein one type of intervention included VRET. Studies were included if there was a control group involved, a waitlist control group, no treatment control group, etc. - either active or inactive. This was not kept as a cut-off factor, however. Studies included were required to be published in an academic journal or a book chapter. There were no age limit restrictions as such for the participants in the studies. Since the onset of glossophobia in most cases was established to be during adolescence, it was made sure to include that particular age group as well. The majority of participants were, however, adults (between the ages of 18 years to 40 years).

4.2.2 Exclusion criteria

Studies were excluded from the mix if they did not meet the inclusion criteria mentioned above. Additionally, there were various duplicates between all three databases (and a few within the same database). Even though one database had the “refine by English” filter on, there were six papers published in a non-English language across all databases. Most importantly, the study was excluded if the intervention was a generic form of glossophobia, such as social anxiety, or other forms of speech disorders, not directly related to anxiety.

4.2.3 Study Screening Method

The flow diagram (Fig 1) below shows the number of studies screened, along with the screening process. A total of 10 studies with a sample size of 303 participants met the final inclusion criteria and were included in this review. The first screening process involved using boolean operators to make sure VRET and glossophobia or public speaking anxiety was included in the search query. The next screening process was a thorough vetting process, wherein the titles were checked for a gist of the study. The final step involved checking for

duplicates across all databases. Of the remaining studies, the titles and abstracts were reviewed to make sure it was in line with all the aforementioned inclusion criteria.

First screening: Google Scholar: 156, Scopus: 73, LTCD: 328

Reasons for excluded records: This process made sure only studies that included “virtual reality exposure therapy” and “public speaking anxiety” were included – even if briefly mentioned somewhere in the paper.

Second screening: Google Scholar: 25, Scopus: 31, LTCD: 74

Reasons for excluded records: Many of the studies involved some element of public speaking anxiety related to virtual reality exposure therapy, but they were highlighted somewhere in the paper – they were not solely dedicated to VRET in glossophobia. This could be gleaned from the title and further, the abstract of each paper.

Third screening: Google Scholar: 25, Scopus: 31, LTCD: 48

Reasons for excluded records: Google Scholar and Scopus did not have any duplicates, but LTCD did. They were removed.

Of the 104 studies that remained, several were eliminated for similar reasons. For instance, a large number of them were dedicated to studies on social anxiety disorder, the umbrella term for glossophobia (Anderson et al., 2013; Zainal et al., 2021). Some others (Dansieh et al., 2021) did not actually have any VR interventions, it was based on a series of questions on an “opinion poll” to understand where glossophobia stems from; they were therefore excluded from the final list. Other studies like Gruber & Kaplan-Rakowski (2020) and El-Yamri (2019) were excluded because even though they had experiments involving participants with glossophobia and had quantitative results that showed the efficacy of VR as a clinical intervention, there was no mention of how the glossophobia was measured in the participants. This is often the first step in most experiments, wherein the participants are shortlisted depending on their level of glossophobia. For instance, in the study of Kahlon et al. (2019), in order for the applicants to qualify as participants, they had to report symptoms of glossophobia on the Public Speaking Anxiety Scale (PSAS) and further prove functional impairment due to glossophobia (Kahlon et al., 2019). A few studies did not include control groups in their experiments – i.e, though they showed the positive effects of using VRET to

combat symptoms of glossophobia, the lack of control groups in the studies would imply the results should be taken with caution. They were still included in the final list of papers because they had good quantitative and qualitative results for both self-guided and therapist-guided VRET. Another study by Heuet & Heuett (2011) would seem like the optimal example for this scoping review; however, the VRET group has no mention of whether it was self-guided or therapist-guided. While it can be gleaned that it was most likely self-guided, it was decided to exclude this study from the final list.

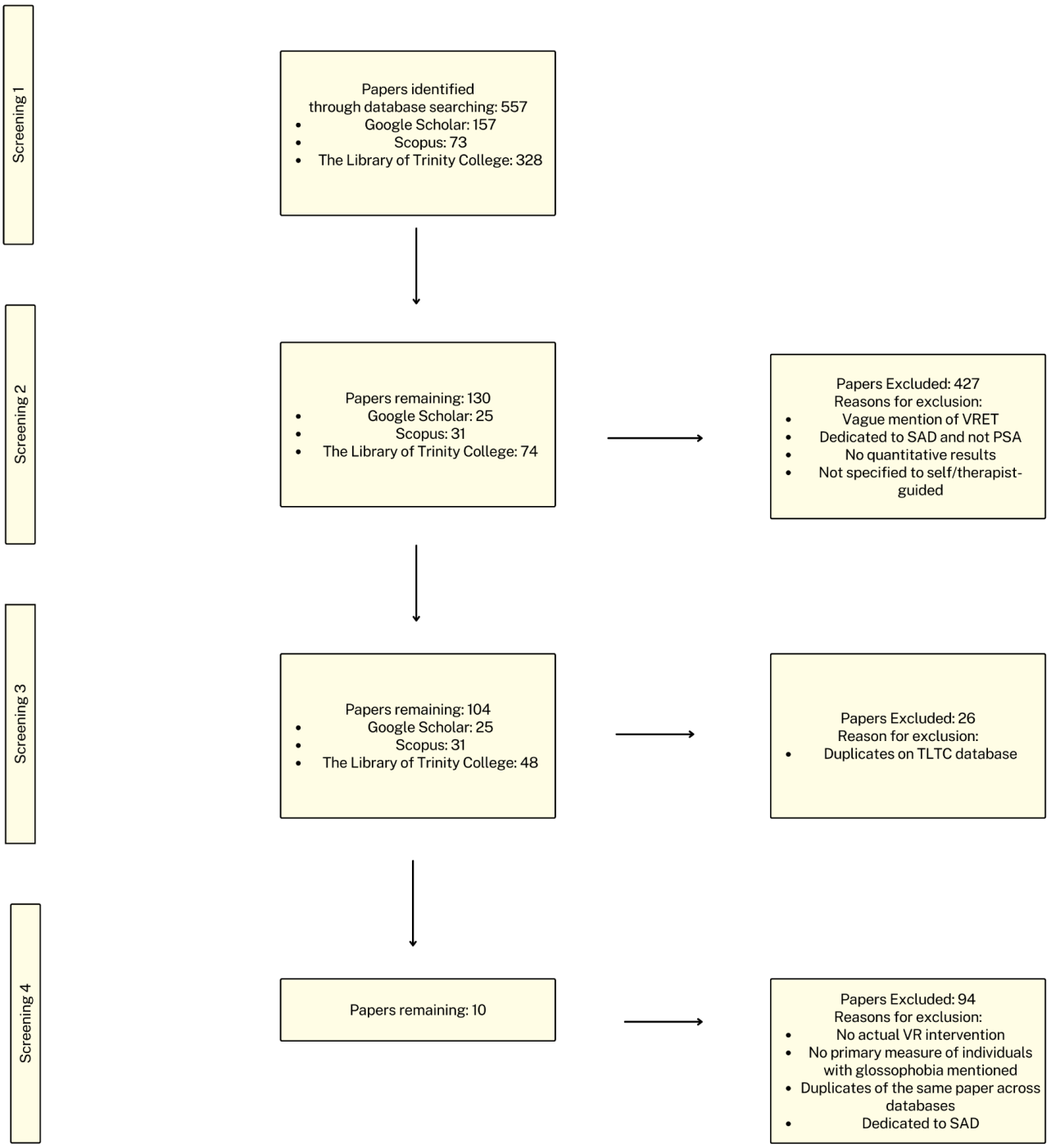

Fig 1: The screening process of studies

Paper Name	Country	VRET Type	Age Group	Participants	Primary Measure	Effect size/p-value/a-value	Follow up sessions
Virtual reality exposure therapy for adolescents with fear of public speaking: a non-randomized feasibility and pilot study	Norway	Therapist-Led	15 yrs*	27	PSAS	d= 1.53	1 & 3 month
Virtual Reality exposure therapy for public speaking anxiety in routine care: a single-subject effectiveness trial	Sweden	Therapist-Led	18+ yrs	23	PSAS	d= 1.15	3 month
An Interactive 3D Virtual Environment to Reduce the Public Speaking Anxiety Levels of Novice Software Engineers	Turkey	Therapist-Led	20-24 yrs	14	LSAS & SUDS	p < 0.05	None
Brief Virtual Reality Therapy for Public Speaking Anxiety	USA	Therapist-Led	18+ yrs	14	PRCS	d= 0.43	None
Behavioral Therapy and Virtual Reality Exposure for Public Speaking Anxiety	Brazil	Therapist-Led	18-26 yrs	6	SSPS & SUDS	α < .05	1 & 3 month
Virtual Reality Exposure Therapy for Adolescents with Public Speaking Anxiety	Norway	Self-Led	14.2 yrs*	100	PSAS	d > 0.8	3 month & 12 month
The Effectiveness of Self-Guided Virtual-Reality Exposure Therapy for Public Speaking Anxiety	England	Self-Led	18-40 yrs	27	PSAS	d= 0.38 p < 0.001	1 month
Virtual Reality Therapy: A Means of Reducing Public Speaking Anxiety	USA	Self-Led	18-26 yrs	40	PRCA	d= 0.81	None
The effect of virtual reality therapy and counseling on students' public speaking anxiety	Iran	Self-Led	20-50 yrs	15	PRPSA	d= 0.33	None
Therapist-led and self-led one-session virtual reality exposure therapy for public speaking anxiety with consumer hardware and software: A randomized controlled trial	Sweden	Both	30 yrs*	50	PSAS	d (Therapist)= 1.35 d (Self)= 1.67	6 month & 12 month

*Represents mean age

Table 1: Data extracted from 10 studies

4.2.4 Data Extraction

The data extracted from all 10 studies included in the analysis of this paper can be found in Table 1. The various columns in the table specify a) which type of VRET intervention it was (self-guided or therapist-guided), b) the age group the experiments targeted, c) the total number of participants, d) total number of VRET sessions, and e) the glossophobia measuring instrument. Some other columns, such as country wherein the experiment was conducted, follow up sessions, effect size help provide additional information about the overall experiment to envision the study more clearly.

In order to determine the veracity of the glossophobia interventions conducted in these papers, the means and standard deviations of the results were collected in each. For the papers that also included control groups, the same was collected for the sole purpose of comparing. However, for most papers, a single outcome measure was selected as the primary measure, and any others were used as secondary measures. The decision of selecting the single outcome measure as the primary measure was bolstered by Card & Little, who said "*a single outcome measure which provides data which best represents the focus of the meta analysis is a recommended statistical method*" (2016). Each of the glossophobia measuring methods used in the ten papers will be discussed in detail in the following section.

Five out of the ten papers use PSAS (Public Speaking Anxiety Scale) as the primary glossophobia measuring scale, as it covers cognitions, behaviours, and physiological manifestations of glossophobia, and as this tool shows high consistency, it is not surprising that 50% of the papers selected (Kahlon et al., 2019; Kahlon, 2022; Lindner et al., 2019; Lindner et al., 2021; Premkumar et al., 2021) use this tool as their primary measuring scale. Another study (Denizci Nazligul et al., 2019) uses self-rated SUDS (Subjective Units of Distress Scale) as their primary measure of glossophobia, wherein the participants rated their anxiety levels at each stage on a scale from 0-100 (100 being the most anxious). Harris et al. (2002) uses PRCS (The Personal Report of Confidence as a Speaker) as the primary measure, as it was widely used in many other studies within the meta analysis. Zacarin et al. (2019) uses the SSPS (Self-Statements of fear of public speaking), which includes a positive and a negative self-assessment subscale. The negative subscale has been said to be a more direct measure of glossophobia and shows more sensitivity to change, compared to the positive subscale (Hofmann & Dibartolo, 2000). In Heuett L. & Heuett B. (2011), PRCA (Personal

Report of Communication Apprehension) was identified as the primary glossophobia scale within the study, and therefore used as the primary measure. In Sarpourian et al. (2022), PRPSA (Personal Report of Public Speaking Anxiety) was used as the primary measure as it gave a global measure of glossophobia. Four of the ten papers use LSAS (Liebowitz Social Anxiety Scale) as a secondary measure, and another four use SUDS (Subjective Units of Distress Scale) and BFNE (Brief Fear of Negative Evaluation Revised Scale) as their secondary measures.

The columns that mention the countries wherein the studies were conducted help us understand the different papers that used the aforementioned glossophobia measures by translating them into their respective native languages (for instance, Sarpourian et al. (2022) used the PRPSA measure but translated it into Persian so it could be used easily by the participants. Similarly, the same was done with the studies conducted in Sweden and Norway).

4.2.5 Methods

There are various methods of measuring glossophobia that have been used across the papers selected for this study. The most commonly used methods will be discussed, but it is to be noted that there are many more.

Public Speaking Anxiety Scale (PSAS)

The PSAS is the most common method for diagnosing and measuring glossophobia across all studies included in this scoping review. It consists of 17 Likert-scale items and it thoroughly assesses the manifestation of behavioural, cognitive, and physiological responses to glossophobia. An example of the 17 items on this scale is “giving a speech is terrifying”. The participant will rate each item with a mark between 1 (“not at all”) to 5 (“extremely”). 5 of the items on the PSAS scale are reverse-coded. The way the PSAS is measured is through the mean score of all individual items. The scale is known for exhibiting convergent viability, and high consistency in general.

Personal Report of Confidence as a Speaker (PRCS)

The PRCS is the second-most common method used for diagnosing and measuring glossophobia in the list of studies included. It presents 12 Likert-scale items that assesses the behavioural responses in individuals – items like "my posture feels unnatural" support that. It also assesses responses to public speaking situations, such as "I feel afraid and tense while speaking in front of a group of people all the time". The answer is presented in a true/false manner, where "true" is 1 and "false" is 2. The overall PRCS score is calculated through the mean score of all individual items, which is between 1 to 2 (the higher the score, the more confident the speaker is). The PRCS scale, too, is known for exhibiting convergent viability, and high consistency in general.

Self-Statements during Public Speaking Scale (SSPS)

The SSPS is a tool that evaluates self statements of people's behaviours of public speaking anxiety. This tool was developed by Hofmann & Dibartolo (2000) and comprises a positive and a negative subscale. Each subscale has 5 items that are to be answered on a scale from 0 to 5. This tool has a high internal consistency.

Liebowitz Social Anxiety Scale (LSAS)

The LSAS presents 24 Likert-scale items to assess the root cause for avoidance of social situations and where the fear stems from. This includes interactive situations like meeting a stranger for the first time, or performance situations, like taking a test, or eating by yourself in public. Each situation is assessed from 0 (no fear) to 4 (severe fear), and 0 to 3 (0 and 67-100% respectively) on frequency of avoidance. The overall LSAS score is the addition of individual items. This scale has 4 subscales: fear of social interaction, avoidance of social interaction, fear of performance, and avoidance of performance. This scale generally shows convergent viability, and good internal consistency.

Brief Fear of Negative Evaluation Revised Scale (BFNE)

The BFNE presents 12 Likert-scale items that are used to measure fear of negative evaluation, a very important component of glossophobia. This includes statements such as “I am always scared of others noticing my limitations”. All items are rated from 0 (“not at all”) to 4 (“extremely”), and the overall BFNE score is calculated by adding each individual item after reverse-coding positively-worded items. This scale generally shows discriminant viability, and good internal consistency.

Subjective Units of Distress Scale (SUDS)

The SUDS reliably measures subjective fear, and the intensity of your feelings (anxiety, anger, agitation, stress, etc.) It can be used to measure anxiety and arousal. Some of the sample questions would be “how anxious are you feeling at the moment” or “how aroused are you feeling right now”? Anxiety could be measured by trembling, feeling scared, breathing difficulty, dry mouth, increased heart rate, etc. Arousal could be defined as rigorousness or liveliness, and on the other side of the spectrum, sleepy, drowsy, or passive. Participants respond on a 0 (not at all) to 10 (very much) Likert scale.

Chapter 5: Results

5.1 Study Characteristics

Table 1 summarises the study characteristics of the ten papers used for this scoping review, and much can be gleaned from it. Of the ten, five of the papers used therapist-guided VRET, four used self-guided VRET, and one demonstrated the use of both therapist-guided and self-guided VRET.

Of the five therapist-guided VRET papers, two of them had single groups of participants who all took part in the experiment from beginning to end without any comparator groups. One of these two studies had a one-time VRET session (Kahlon et al., 2019), while the other involved a 4-week in-vivo transition (Lindner et al., 2021).
Two of the studies (Denizci Nazligul et al., 2019; Harris et al., 2002) included control groups to help track the difference in symptoms. The control group individuals were either left untreated or given literature on glossophobia and guidance to combat the symptoms. Zacarin et al. (2019), on the other hand, used two groups that both underwent repeated VRET sessions, but one group received 3 baseline VRET sessions, while the other received 5 VRET sessions.
Of the four self-guided VRET papers, two of them had single groups of participants who all took part in the experiment from beginning to end. Again, they had no comparator groups (Kahlon, 2022; Premkumar et al., 2021). Heuett L. & Heuett B. (2011) had their experiment split into two groups, one that was involved in the VRET experiment, while the other group was involved in a "visualisation" experiment. Sarpourian et al. (2022), on the other hand, had a specific control group that partook in a 90-minute group counselling session.

The number of treatment sessions across all ten papers was 51. Of these, 39 were therapist-guided VRET sessions, while the remaining 12 were self-guided VRET sessions. As evidenced, the number of therapist-guided VRET sessions were marginally higher than the self-guided VRET sessions, as most of the self-guided VRET experiments conducted were OST (one session treatments).

5.2 Participants

The total number of participants across all ten papers was 303. The average number of participants per paper was approximately 25, with one outlier – Kahlon (2022) had 100 participants. Of the total number of participants across all papers, 96 participated in therapist-guided VRET experiments, while the remaining 207 participants were involved in self-guided VRET experiments. Of the ten papers, two of them had participants aged between 14 and 16 years (Kahlon et al., 2019; Kahlon, 2022). The remaining eight studies all had participants aged above 18 years. The experiments conducted in the papers were performed in a variety of countries, i.e, not all experiments were conducted in English – the papers' experiments were conducted in Norway, Sweden, and Iran, where they mention translating the measuring methods in Norwegian, Swedish, and Persian respectively. The other papers do not explicitly mention what language the experiments were conducted in, therefore, it cannot be assumed.

5.3 VR Intervention Scenarios

The VR equipment and the visual stimuli used across all papers varied. The VR equipment used ranged from high-end Cardboard-type VR headsets to Oculus Rifts.

The stimuli presentation was not extremely different from one another. Each simulation was specifically designed to help the particular participant demographic – for instance, the visual stimuli for adolescents and young adults was either a classroom or an auditorium. Similarly, for a group of software engineers, the visual stimuli was designed as a conference room. Modifying the visual stimuli based on the demographic is extremely important, and can be witnessed in Kahlon et al. (2019), wherein the classroom environment had been modified to resemble a typical Norwegian classroom with the virtual avatars to be approximately 13-16 years old (the same age group as the participant). This helped the participants better envision the simulated environment as real, thereby improving their sense of presence and the perceived reality of the experience (refer sections 3.1.1 & 3.1.2)

Some additional elements that were noteworthy were Heuett L. & Heuett B. (2011) and Lindner et al. (2019) using amplifiers that enabled participants to hear their speeches after their presentations. The ability to manipulate the virtual audience is also rather intriguing, as it goes back to the basic blocks of glossophobia - the fear of negative evaluation. Being able to manipulate audience reactions and sizes help create a more life-like experience (thereby

increasing their sense of presence and perceived reality) and makes the overall experience worthy of its name.

Four of the five therapist-guided VRET experiments had this option, wherein the therapist could manipulate the audience reactions based on the level of the participant's ability to combat their catastrophic beliefs. Denizci Nazligul et al. (2019) has audience reactions such as texting and yawning that the therapist can manipulate as they please during the participant's performance. Harris et al. (2002) presents the therapist with an empty auditorium that they are permitted to fill in (i.e, manipulate the number of audience members), as well as their reactions. The audience starts clapping as soon as the participants steps onto the stage, encouraging the participant to start giving their speech. Zacarin et al. (2019) had some interesting audience reactions, like audience members leaving the room, smiling at the participant, answering their phones, etc.

The audience manipulation was not limited to therapist-guided VRET experiments; two of the four self-guided VRET experiments also had similar features. Premkumar et al. (2021) permitted participants themselves to navigate to the settings menu and change five elements of social threat (such as number of audience members, their reactions, their physical location and distance from the participant, etc.) Similarly, Sarpourian et al. (2022) included stressful stimuli, such as a phone ringing, or audience members leaving the room, but they could not be manipulated by the participant.

5.4 Therapists for therapist-guided VRET

Five of the ten papers are based solely on therapist-guided VRET, while one additional paper includes both therapist-guided and self-guided VRET treatments. Each paper that mentions the use of therapists had a slightly different description of their role. Kahlon et al. (2019) and Lindner et al. (2021) both had clinical psychologists who had experience in CBT treatments of social anxiety disorder and received four hours of protocol-specific training to conduct the specific experiments. Denizci Nazligul et al. (2019) and Harris et al. (2002) include cognitive behavioural therapists and clinical psychologists respectively, but there was no mention of either receiving protocol-specific training of any sort.

5.5 Therapist-Guided VRET Studies

While presenting the results across the ten papers, the following three main categories will be used, chosen based on the most common categories used across all ten papers:

1) **Effect Size:** This value denotes the practical significance of a study. A larger effect size value denotes a research finding of practical significance, while a smaller effect size indicates limited practical applications. The following values will help one evaluate the practical significance of the study:
    - 0.2 : low practical significance
    - 0.5: medium practical significance
    - Greater than 0.8: great practical significance

2) **P-values:** This value denotes the statistical significance of a study – it is the probability of a statistical measure (mean, standard deviation, etc.) of an assumed probability distribution being greater than, equal to, or less than the observed value.
    - $P < 0.05$
    - $P < 0.01$
    - $P < 0.001$

    Most authors refer to "statistically significant values" as $P < 0.05$ (less than 5 in a 100 chances of being wrong) and "statistically highly significant values" as $P < 0.001$ (less than 1 in a 1000 chances of being wrong).

3) **A-values:** This value denotes the significance level, which is the probability of rejecting the null hypothesis when true. For instance, an a-value of 0.05 denotes a 5% risk of concluding a difference exists when there is no actual difference.

The results of the five papers that use therapist-guided VRET will be presented here. The first two papers (Kahlon et al., 2019) and (Lindner et al., 2021) use PSAS as their primary outcome measure. Kahlon et al. (2019) shows us that the PSAS symptoms remained stable from screening to pre-treatment, however, took a major dip from pre-treatment to post-treatment by an average of 12.23 points; the standardised effect size (or Cohen's d) can be calculated as 1.53. What started at 62.81 as the mean PSAS on day 0 became 47.25 on the day of the 3-month follow up, with a steady decline of mean PSAS score over the 3-month period.

In the case of Lindner et al. (2021), the screening process started with a mean PSAS score of 74.9, and after a one-time session, a 3-week transition program, and a 3-month follow up, the mean PSAS score went down to 53. The effect size after the 3-hour one-time session was 0.77, which went up to 1.15 after the final transition program.

As can be seen from these two studies alone, a single session treatment (and as many transition sessions or follow-up sessions) made a difference in the participants' PSAS scores, which is promising.

Harris et al. (2002) had some interesting results as well – the primary measuring tool used was PRCS, and the mean PRCS pre-test was 22.63 while the mean PRCS post-test was 12.63. Using the standard deviation provided, Cohen's d was calculated to be 0.43.

In the paper by Denizci Nazligul et al. (2019), there were three VR environments – a classroom and two auditoriums with varying numbers of audience members. The primary measuring tool used here was SUDS, and the mean SUDS for all three environments was calculated to be at 75.48 right before the presentation, 81.66 at the peak point in the presentation, and at 60 immediately after the presentation. The secondary measuring tool used here was LSAS, and the mean anxiety levels at pre-testing was at 56.86 (Standard Deviation of 11.99), whereas post-testing was at 51.43 (Standard Deviation at 9.88) with $p < .05$.

Finally, Zacarin et al. (2019) study used SSPS as their primary measuring tool, which has a positive and a negative scale, but in their results they inverted the negative scale for consistency. The analysis shows a statistically significant difference for both subscales ($\alpha = .0001$). It further revealed a statistically significant difference ($\alpha < .05$) between the initial session compared to the closing session (a total of 10 sessions in between). There were, however, no statistically significant differences ($a > .05$) between consecutive sessions.

5.6 Self-Guided VRET Studies

The results of four papers that use solely self-guided VRET will be presented in this section.

The first paper (Kahlon, 2022) had six weeks of intervention: the first three were VR self-guided interventions, followed by another 3 weeks of an online exposure program. The study used PSAS as their primary measuring tool, which revealed an effect size > 0.8. At the end of the first three weeks, 28% of participants reported significant reliable change in glossophobia symptoms, which climbed up to 33% by the end of the next three weeks.

Premkumar et al. (2021) uses two main measuring tools – SATI (Speech Anxiety Thoughts Inventory) and PSAS. Their SATI scores (0 - 100) went from 96.65 (pre-sessions) to 71.18

(after the 1-month follow up session). This results in an effect size of 0.41 and a p-value < 0.001. The PSAS values were slightly lower than SATI values – on a scale of 0 - 5, the PSAS went from 4.29 (pre-sessions) to 3.54 (after the 1-month follow up session). This presents an effect size of 0.38 and a p-value < 0.001.

Heuett L. & Heuett B. (2011) had some very interesting results to display. Taking its primary measuring tool as PRCA, and having three individual groups to compare, the overall results of VRET pit against the other two groups (a visualisation group and a control group) were rather evident. Starting with the VRET group, their mean PRCA pre-test was 16.7 and went down to 13.1 by post-test. Given the number of participants and the standard deviations, the effect size was calculated to be 0.81. For the purpose of comparing, the PRCA values for both the visualisation group and the control group were calculated as well. The visualisation group started at a mean PRCA of 14.3 pre-test and went to 11.7 by post-test. The effect size for the visualisation group was at 0.58. And finally, the control group saw the least amount of change, wherein it started at a mean PRCA of 20.5 pre-test and only dipped to 19.6 by post-test. This saw an effect size of 0.32.

Sarpourian et al. (2022) takes a turn from the results displayed thus far, and goes to show that the effect size of the VRET group was actually less than the effect size of the group that underwent counselling. The VRET intervention group showed PRPSA mean values of 68.30 before the VRET session, which dipped to 60.28 post-session, while the control group that underwent counselling at the same time, showed PSPSA mean values of 71.13 before the session, and 58.49 immediately after. The effect size for the VRET group was calculated to be 0.33, while the effect size for the counselling group was 0.44.

5.7 Therapist-Guided VRET Vs Self-Guided VRET Study

The paper by Lindner et al. (2019) had some very interesting results as well, even though it is important to note that the paper did not aim to compare the two types of VRET interventions. This paper had two separate groups that underwent therapist-guided and self-guided VRET interventions respectively, and came out with similar results - both displaying reduced glossophobia symptoms.

For the therapist-guided group, the within-group PSAS difference was 15.09 (started at 71.32 and ending at 56.29). By the end of the in-vivo transition program, the effect size of the therapist-group was at 1.35 (as a result of increasing standard deviations). For the self-guided group, the effect size was calculated to be 1.67.

Chapter 6: Discussion

The purpose of this scoping review is to a) corroborate that VRET can be used as a clinical or psychological intervention to help combat glossophobia, and b) explore the two major types of VRET interventions, self-guided and therapist guided VRET, while pointing out their individual strengths and limitations, and helping individuals with glossophobia make an informed decision about which type of VRET intervention they might be better suited for. Provided it is not a simple "one fit for all" solution, much can be gleaned from the results stated above. Every one of the ten studies showed improved glossophobia symptoms – from one-session treatments (the minimum number of VRET interventions per study) to 13 intervention treatments (the maximum number of VRET interventions per study). The effect sizes, statistical significance values, and significance levels varied, however, all ten studies showed reduced anxiety levels and all studies that had control groups showed effect sizes of their respective VRET groups being higher in value, except for one – Sarpourian et al. (2022), in which the effect size for the control group was slightly higher than the VRET group.

One of the main purposes of focusing on the clinical effects of VRET for glossophobia was to present the solution to the individuals early on, preferably at adolescence when the signs of glossophobia typically start appearing. Virtual reality has already been demonstrated in health care in children when it comes to pre-operative anxiety (Dehghan et al., 2019), but the research in psychiatric disorders has been scarce. This is where the potential for VRET in glossophobia must be highlighted. This paper already talks about the pros of treating glossophobia in adolescents and young adults, and the cons of ignoring the symptoms until late adulthood. The question of what works for whom, and how one goes about finding their most suitable approach to VRET, however, is yet to be answered. There is limited research today into the personality characteristics that predict therapy success in VRET. Past studies have suggested that "absorption" (i.e, the capacity to become easily immersed into imaginal activities) plays a significant role in determining suitable recipients for VRET (Meyerbröker, 2021). One may hypothesise that introverted individuals are better suited for self-guided VRET methods, or that individuals with more severe symptoms of glossophobia need to be supervised by a therapist – but this is all speculation; there is no strong evidence to support the fact that certain personality traits can predict potential benefits. One approach to finding the more suitable means of VRET intervention would be to list out the main areas focused in VRET experiments with the strengths and weaknesses of each type of intervention.

6.1 Fear of negative evaluation

SAD is defined as the fear of negative evaluation in social situations, quickly followed by feeling humiliated (American Psychiatric Association, 2013). Since glossophobia is a subtype of SAD, It is important to target the participant's fear of negative evaluation when treating glossophobia - whether self-guided or therapist-guided. In the therapist-guided studies, the therapist communicates with the participant before each VR exposure session about their catastrophic beliefs and what to focus on during the presentation. They also communicate with the participant after each VR exposure session, discussing any changes they noticed in the participant's Subjective Units of Distress (SUDs) and in some cases, how to face the same challenge in a real-life situation (Kahlon et al., 2019). In some studies, the avatars used in the VR environment could be manipulated – they could be made to cough, text, or leave during the presentation – all factors that are controlled by the therapist (Denizci Nazligul et al., 2019; Lindner et al., 2021). In the same studies, the fear of negative evaluation was included as a secondary outcome measure: Brief Fear of Negative Evaluation (Denizci Nazligul et al., 2019; Lindner et al., 2021). All of these methods ensure that the fear of negative evaluation is targeted during the exposure sessions, and guidance for real-life social threatening situations is provided.

Fear of negative evaluation can also be seen in self-guided VRET interventions, wherein it was used as a secondary outcome measure (Premkumar et al., 2021), and the participants themselves could increase the number of participants in the audience and change the avatar reactions if they wanted. While the results of this study show an improvement in the fear of negative evaluation, it is hard to say whether it has the same effect when controlled by a qualified therapist. For one, the participant in the therapist-guided intervention would not know when the VR avatars would be triggered to react differently, and therefore the improved symptoms in fear of negative evaluation could possibly be more pronounced in a real-life situation. It can therefore be hypothesised that for individuals with glossophobia looking for a gradual improvement in terms of fear of negative evaluation, the more hand-held approach of VRET, i.e., therapist-guided VRET might be the more effective intervention.

6.2 Disproving catastrophic beliefs

An important component of VRET is the process of disproving catastrophic beliefs; in simpler terms, exactly what is it that scares the individual when they are expected to deliver a speech in front of an audience. This is an important part of the therapeutic process because it

helps one emphasise on the promotion of inhibitory learning through exposure, rather than physiological habituation, the main target in traditional exposure therapy (Craske et al., 2014). This is where therapist-guided interventions take the lead. They often start with rigorous sessions of identifying the participant's catastrophic beliefs. Once they have been established, the therapist can then help the participant work towards disproving them, one step at a time. This practice was evident in each of the five papers that focused on therapist-guided VRET intervention, as well as the therapist-guided section in the paper that included both types of intervention. For instance, Kahlon et al. (2019) had the participants exposed to speech scenarios that the therapists would come up with, targeting idiosyncratic catastrophic beliefs about their speech performance and physiological reaction. The same was done in the experiment conducted by Lindner et al. (2021), which was followed by the therapists helping transform these catastrophic beliefs into testable predictions. The main practice of disproving the catastrophic beliefs in three of the five studies was through objective feedback - by discussing specific parts of the speech, listening to audio recordings of the performance, or watching the video recording of the performance.

Therefore, if the individual seeking VRET methods to combat glossophobia are looking to get a deeper understanding of their fear and where it stems from, therapist-guided VRET might be the more appropriate option.

6.3 Trigger Exposure

One might consider the amount of trigger exposure to be one of the most crucial parts of VRET interventions. The trigger exposure is referred to as the number of audience members, the demographics of the audience members (age, gender, race, etc.), and the audience reactions. It is important to have a VR environment that can be manipulated according to the catastrophic beliefs of the participant, because otherwise they will not be able to adapt to the environment that causes them anxiety. For instance, if a participant has anxiety around a large audience group, exposing them to a VR environment with 5-6 audience members, and keeping this number constant throughout the VR exposure sessions will neither help them overcome the symptoms, nor be more confident in real-life situations similar to the VR environment.

One might consider a benefit of the therapist being in control of the intervention being the level of exposure – since the therapist gets a sense of the participant's catastrophic beliefs ahead of time, they know not to throw the participant in the deep end of the pool right away;

after all, many individuals are apprehensive about exposure therapy because it is about facing fears by exposing them to said fears. In the therapist-guided part of the study conducted by Lindner et al. (2019), the three-hour session began with 15 minutes of psychoeducation, followed by a sequence of exposure exercises of increasing intensity. Similarly, in Denizci Nazligul et al. 's study (2019), the therapist would steadily increase the number of virtual audience members depending on the anxiety levels of the participant (especially if the number of audience affects their catastrophic beliefs).

When it comes to self-guided VRET, trigger exposure is also a possibility. For instance, in the study by Sarpourian et al. (2022), stressful stimuli such as the ringing of a mobile phone, or the avatars entering and exiting the auditorium were baked into the VR scenario at random. On the other hand, Premkumar et al. (2021) demonstrated a scenario wherein the participant themselves could manipulate the elements of social threat. Some would argue having this control themselves would be effective as it is self-led – being in control could give them a sense of responsibility to work on their anxieties; but at the same time, it could also mean keeping the extreme anxiety-inducing scenarios at a safe distance.

With regard to which VRET intervention would be better suited for whom, it would depend on the severity of glossophobia symptoms, and what the individual is looking to get out of the experience: for instance, someone with absolutely no knowledge of their catastrophic beliefs or how severe their symptoms are may be better suited for a therapist-guided approach, whereas someone who has a good understanding of their glossophobia triggers and is looking for a self-help application, a self-guided approach could work.

6.4 The longevity

As great as one-session treatments are, and have proven to reduce glossophobia symptoms significantly (Denizci Nazligul et al., 2019; Heuett L. & Heuett B., 2011; Kahlon et al., 2019; Lindner et al., 2019; Premkumar et al., 2021; Sarpourian et al., 2022), one must consider the long-term effects of the VRET intervention. Each of the studies that have one-session treatments mention the lack of research into the longevity of the treatment, and even though the primary outcome measuring tool showed a decline in symptom severity, future investigations should determine the longevity of the improvement in symptoms. Studies that include follow-up sessions and transition programs months after the actual VRET interventions show that the symptoms continue on a steady decline (especially if the transition sessions happen right after the VRET interventions, such as a week or a month after).

However, a few with follow-up sessions, say 3 or 6 months after the VRET interventions show an initial spike back up in glossophobia symptoms, before going down again, such as in (Lindner et al., 2021). It is further important to note that some of the studies explicitly mention the low adherence to the transition programs (especially those online), and that it was to be expected as adherence was typically lower in effectiveness than the efficacy study. If the participant wishes to engage in a long-term VRET intervention that results in a steady decline of glossophobia symptoms and a steady build up of confidence, they must look out for an intervention program that has multiple stages included. For instance, in the study conducted by Zacarin et al., (2019), there are introductory sessions, baseline sessions, intervention sessions, and transition sessions. On the other hand, if they're looking for a quick one-time session to experiment with, one-session treatments would work just fine – whether they are therapist-guided or self-guided becomes a preferential factor here as the type of VRET intervention does not influence the longevity of the treatment.

Apart from these four factors that are involved in typical VRET sessions, there are two additional factors one must consider, especially if making the decision of the kind of intervention they would prefer.

6.5 The right VRET environment

In Kahlon et al. (2019), the results showed a large effect size of 1.53, which, as we know, represents great practical significance. Compared to another study, (Harris et al., 2002), who's effect size was 0.43, the effect size difference is noteworthy, especially because they both use similar practices to help students (the former being adolescents, and the latter being young adults), to combat glossophobia. The major difference between the two was Kahlon et al.'s (2019) use of VR stimuli, that was tailored specifically to help the students visualise the VR environment as a real-life environment by modifying the VR classroom in a culturally and age-appropriate manner, which Harris et al. has no indication of modifying (the paper mentions an "auditorium scene" as the VR environment). Even though this is, for the most part, speculation, there are fewer factors that differentiate both papers, and is a thought to be considered.

It is important – when it comes to building the VR environment – to take into account the fact that experiments designed to help combat symptoms of glossophobia must be designed in such a way that the individual feels present in the virtual environment. They must feel the

virtual environment takes dominance over the real world - i.e, *sense of presence*, which will help them respond to events the same way they would in the real world (Meyerbröker, 2021). The consequence of "immersion" in this case would be that the individual feels present in the virtual environment. This is what the VR environment designer should be aiming for when creating it, and the individual with glossophobia looking for the most suitable VR environment/ VR app to clinically help them should be seeking.

The more realistic the VR scenario, the better the chances of eliciting a physiological response in the individual – this could be in the form of increased heart rate for instance. This was evident in three of the ten papers that measured heart rates (Harris et al., 2002; Kahlon et al., 2019; Premkumar et al., 2021) – each presented results of individuals with increased heart rates upon being exposed to the respective virtual environments, which would suggest the environments were good representations of the real world. However, these increases were small. This could be in line with the finding of Lindner et al. (2019) that the VR environment for public speaking tends to elicit a weaker fear response than, say, VR scenarios for arachnophobia. Even so, one must consider whether there is a possibility to make changes to the VR scenario to make it more life-like, and therefore, more anxiety-inducing.

6.6 The importance of transition sessions

Only three of the ten studies selected for this scoping review actually had transition sessions at the end of the actual VR sessions (Kahlon, 2022; Lindner et al., 2019; Lindner et al., 2021), which is not the best, given the fact that symptoms saw a continuous decline after the actual VR sessions. Whether they were in-vivo transition programs, or online exposure programs, each of the three studies showed a steady decline of PSAS, SUDS, and LSAS values after the transition programs, which would suggest the importance of including them in all VR treatments (Gega, 2017). This is of particular importance because transition programs have often been neglected in past VR research. But its positive effect on VR treatments can be seen in all three papers.

An interesting factor in the paper by Lindner et al. (2019), shows us that the in-vivo exposure exercises (i.e., the transition program) was analysed to contribute towards an additional symptom decrease wherein individuals would plan one in-person exposure exercise per week. What was interesting was that even though both therapist-guided and self-guided groups in the study performed the transition programs, only the therapist-guided group actually saw a steady decline in glossophobia symptoms post-transition period. This points out a pitfall of

the self-guided VRET intervention, in that it doesn't prepare individuals with glossophobia for real-life exposure (as the interventions they've performed are all isolated). It is also important here to mention the lack of effects on "fear of negative evaluation" – something that the therapist-guided group would have covered as it is one of the major factors of glossophobia.

It can be inferred that virtual reality exposure therapy could enhance evidence-based treatments, given the high control of the virtual environment. VRET definitely bridges the gap here – in terms of allowing patients with glossophobia to take the first step within exposure – but it is important to note that VRET is not a magical instrument that enhances the effectiveness of empirically supported treatments (Meyerbröker, 2021). While the studies above support the notion that VRET reduces glossophobia and its symptoms, it will soon need to undergo head-to-head comparisons with proven treatments such as skills training, desensitisation, etc. in order to truly determine the validity of VRET as a well-rounded clinical treatment – especially since the question of individuals with glossophobia conducting these experiments self-sufficiently is in question.

As can be seen from this discussion, there is no one correct prescription for the type of VRET intervention an individual with glossophobia must select; it is very much dependent on the type of treatment the individual is seeking. It is important to note here that up until recently, glossophobia was not an easy fix in a traditional therapeutic setting, but with the innovative strides in consumer technology, VRET is becoming an attractive opportunity for all - whether it be used as tool for therapists in a clinical setting, or in the privacy of the individual's home. There is potential for scalability of VRET and great strides in this field are to be expected in the near future.

Chapter 7: Limitations

While the findings of this scoping review support the efficacy of VRET in reducing glossophobia, there are a number of limitations that must be considered while interpreting the results. To start off with, only published studies were included – this would suggest publication bias as more scientific journals publish studies that have positive results. While this positive publication bias may have affected the effect sizes calculated in this scoping review, recent studies show us that including unpublished literature has a minimal effect on effect sizes (Schmucker et al., 2017). Secondly, there is a lack of comparison between the VRET groups and control groups, as only five of the ten studies included control groups. This lack of comparison suggests that a change in catastrophic belief expectancy, or SUDS does not necessarily equate to symptom reduction. Thirdly, the use of self-report measures may point towards biased information, since the individuals themselves may not be able to fully assess their own anxiety levels. For this reason, it is suggested that future studies include physiological assessments, such as heart rate and skin temperature measuring tools. Even though the results show a large within-group effect size, the sample homogeneity and small size of each group would suggest caution should be exercised in generalising the findings of this scoping review to the larger population with severe glossophobia symptoms.

Chapter 8: Future Work

This scoping review shows the potential benefits of using VRET as a clinical (and non-clinical) intervention for treating glossophobia, but further high-quality studies are required to support the current evidence base. These studies should adopt a randomised controlled trial design, more reliable primary and secondary outcome measures of glossophobia, and transparent reporting. The sample sizes should be much higher, which would allow accurate estimates of effect size. Additionally, studies where both self-guided and therapist-guided interventions are standardised with identical parameters would help draw more robust comparisons between the two types of interventions. Further, treatment adherence should be taken seriously; in the current scoping review, of the five studies that included follow-up sessions after the VRET interventions, four of them had dropouts, which impacted the effect size of the studies.

Within the individual VRET interventions, including physiological measures like heart rate would corroborate the efficacy of the intervention. An interesting piece of feedback received in one of the ten studies mentions a participant informing the research team, "*I did a presentation last week. While I was still anxious and I found my heart pounding, I definitely noticed a difference! I didn't stutter and I was able to look my audience in the eyes. I'm definitely still anxious with presentations, but it's made me more able to face them."* Future studies should aim to examine emotion regulation and focus more on perceived control and sense of presence for the individual interacting with the VR environment (Premkumar et al., 2021).

Chapter 9: Conclusion

In conclusion, this is the first scoping review to investigate the efficacy of both self-guided and therapist-guided VRET as clinical and psychological interventions for treating glossophobia. The results showed significant effects on glossophobia compared to its control conditions, showing both therapist-guided and self-guided methods as effective VRET interventions, with their own strengths and weaknesses across clinical and non-clinical populations. By displaying the effects of even one-time treatment sessions of VRET (self-guided or therapist-guided), this scoping review hopes to point out the importance of identifying symptoms of glossophobia in its embryonic to early stages, and get it treated - either by a professional, or by themselves. With the current and predicted accessibility of VR tech in the future, being able to treat symptoms of glossophobia from the comfort of one's home is unavoidably impressive, and should be taken advantage of. Even though the findings of this scoping review are based on a small number of studies, they are promising, and add to the growing literature base for exploring VRET as a psychological intervention for glossophobia.

BIBLIOGRAPHY

Allen, M., Hunter, J. E., & Donohue, W. A. (1989). Meta-analysis of self-report data on the effectiveness of public speaking anxiety treatment techniques. *Communication Education*, *38*(1), 54–76. https://doi.org/10.1080/03634528909378740

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (Fifth Edition). American Psychiatric Association. https://doi.org/10.1176/appi.books.9780890425596

Anderson, P. L., Price, M., Edwards, S. M., Obasaju, M. A., Schmertz, S. K., Zimand, E., & Calamaras, M. R. (2013). Virtual reality exposure therapy for social anxiety disorder: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *81*(5), 751–760. https://doi.org/10.1037/a0033559

Aune, T., Juul, E. M. L., Beidel, D. C., Nordahl, H. M., & Dvorak, R. D. (2021). Mitigating adolescent social anxiety symptoms: The effects of social support and social self-efficacy in findings from the Young-HUNT 3 study. *European Child & Adolescent Psychiatry*, *30*(3), 441–449. https://doi.org/10.1007/s00787-020-01529-0

Beidel, D. C., Turner, S. M., & Dancu, C. V. (1985). Physiological, cognitive and behavioral aspects of social anxiety. *Behaviour Research and Therapy*, *23*(2), 109–117. https://doi.org/10.1016/0005-7967(85)90019-1

Bernátová, I., Bališ, P., Goga, R., Behuliak, M., Zicha, J., & Sekaj, I. (2016). Lack of Reactive Oxygen Species Deteriorates Blood Pressure Regulation in Acute Stress. *Physiological Research*, S381–S390. https://doi.org/10.33549/physiolres.933433

Blöte, A. W., Kint, M. J. W., Miers, A. C., & Westenberg, P. M. (2009). The relation between public speaking anxiety and social anxiety: A review. *Journal of Anxiety Disorders*, *23*(3), 305–313. https://doi.org/10.1016/j.janxdis.2008.11.007

Boeldt, D., McMahon, E., McFaul, M., & Greenleaf, W. (2019). Using Virtual Reality Exposure Therapy to Enhance Treatment of Anxiety Disorders: Identifying Areas of

Clinical Adoption and Potential Obstacles. *Frontiers in Psychiatry*, *10*, 773. https://doi.org/10.3389/fpsyt.2019.00773

Botella, C., Serrano, B., Baños, R., & García-Palacios, A. (2015). Virtual reality exposure-based therapy for the treatment of post-traumatic stress disorder: A review of its efficacy, the adequacy of the treatment protocol, and its acceptability. *Neuropsychiatric Disease and Treatment*, 2533. https://doi.org/10.2147/NDT.S89542

Bouchard, S., Dumoulin, S., Robillard, G., Guitard, T., Klinger, É., Forget, H., Loranger, C., & Roucaut, F. X. (2017). Virtual reality compared with *in vivo* exposure in the treatment of social anxiety disorder: A three-arm randomised controlled trial. *British Journal of Psychiatry*, *210*(4), 276–283. https://doi.org/10.1192/bjp.bp.116.184234

Brydon, S. R., & Scott, M. D. (2011). *Between one and many: The art and science of public speaking* (7th ed). McGraw-Hill.

Buchholz, J. L., & Abramowitz, J. S. (2020). The therapeutic alliance in exposure therapy for anxiety-related disorders: A critical review. *Journal of Anxiety Disorders*, *70*, 102194. https://doi.org/10.1016/j.janxdis.2020.102194

Card, N. A., & Little, T. D. (2016). *Applied meta-analysis for social science research* (Paperback edition). The Guilford Press.

Carl, E., Stein, A. T., Levihn-Coon, A., Pogue, J. R., Rothbaum, B., Emmelkamp, P., Asmundson, G. J. G., Carlbring, P., & Powers, M. B. (2019). Virtual reality exposure therapy for anxiety and related disorders: A meta-analysis of randomized controlled trials. *Journal of Anxiety Disorders*, *61*, 27–36. https://doi.org/10.1016/j.janxdis.2018.08.003

Craske, M. G., Treanor, M., Conway, C. C., Zbozinek, T., & Vervliet, B. (2014). Maximizing exposure therapy: An inhibitory learning approach. *Behaviour Research and Therapy*, *58*, 10–23. https://doi.org/10.1016/j.brat.2014.04.006

Dansieh, S. A., Owusu, E., & Seidu, G. A. (2021). Glossophobia: The Fear of Public Speaking in ESL Students in Ghana. *Language Teaching*, *1*(1), p22. https://doi.org/10.30560/lt.v1n1p22

Dehghan, F., Jalali, R., & Bashiri, H. (2019). The effect of virtual reality technology on preoperative anxiety in children: A Solomon four-group randomized clinical trial. *Perioperative Medicine*, *8*(1), 5. https://doi.org/10.1186/s13741-019-0116-0

Denizci Nazligul, M., Yilmaz, M., Gulec, U., Yilmaz, A. E., Isler, V., O'Connor, R. V., Gozcu, M. A., & Clarke, P. (2019). Interactive three‐dimensional virtual environment to reduce the public speaking anxiety levels of novice software engineers. *IET Software*, *13*(2), 152–158. https://doi.org/10.1049/iet-sen.2018.5140

Ebrahimi, O. V., Pallesen, S., Kenter, R. M. F., & Nordgreen, T. (2019). Psychological Interventions for the Fear of Public Speaking: A Meta-Analysis. *Frontiers in Psychology*, *10*, 488. https://doi.org/10.3389/fpsyg.2019.00488

El-Yamri, M., Romero-Hernandez, A., Gonzalez-Riojo, M., & Manero, B. (2019). Designing a VR game for public speaking based on speakers features: A case study. *Smart Learning Environments*, *6*(1), 12. https://doi.org/10.1186/s40561-019-0094-1

Fawcett, S. B., & Miller, L. K. (1975). Training public-speaking behavior: An experimental analysis and social validation1. *Journal of Applied Behavior Analysis*, *8*(2), 125–135. https://doi.org/10.1901/jaba.1975.8-125

Fehribach, J. R., Toffolo, M. B. J., Cornelisz, I., Van Klaveren, C., Van Straten, A., Van Gelder, J.-L., & Donker, T. (2021). Virtual Reality Self-help Treatment for Aviophobia: Protocol for a Randomized Controlled Trial. *JMIR Research Protocols*, *10*(4), e22008. https://doi.org/10.2196/22008

Ferreira Marinho, A. C., Mesquita De Medeiros, A., Côrtes Gama, A. C., & Caldas Teixeira, L. (2017). Fear of Public Speaking: Perception of College Students and Correlates. *Journal of Voice*, *31*(1), 127.e7-127.e11. https://doi.org/10.1016/j.jvoice.2015.12.012

Gallego, A., McHugh, L., Penttonen, M., & Lappalainen, R. (2022). Measuring Public Speaking Anxiety: Self-report, behavioral, and physiological. *Behavior Modification*, *46*(4), 782–798. https://doi.org/10.1177/0145445521994308

Gega, L. (2017). The virtues of virtual reality in exposure therapy. *British Journal of Psychiatry*, *210*(4), 245–246. https://doi.org/10.1192/bjp.bp.116.193300

Gramer, M., & Sprintschnik, E. (2008). Social anxiety and cardiovascular responses to an evaluative speaking task: The role of stressor anticipation. *Personality and Individual Differences*, *44*(2), 371–381. https://doi.org/10.1016/j.paid.2007.08.016

Grant, B. F., Hasin, D. S., Blanco, C., Stinson, F. S., Chou, S. P., Goldstein, R. B., Dawson, D. A., Smith, S., Saha, T. D., & Huang, B. (2005). The Epidemiology of Social Anxiety Disorder in the United States: Results From the National Epidemiologic Survey on Alcohol and Related Conditions. *The Journal of Clinical Psychiatry*, *66*(11), 1351–1361. https://doi.org/10.4088/JCP.v66n1102

Gulliver, A., Griffiths, K. M., & Christensen, H. (2010). Perceived barriers and facilitators to mental health help-seeking in young people: A systematic review. *BMC Psychiatry*, *10*(1), 113. https://doi.org/10.1186/1471-244X-10-113

Harris, S. R., Kemmerling, R. L., & North, M. M. (2002). Brief Virtual Reality Therapy for Public Speaking Anxiety. *CyberPsychology & Behavior*, *5*(6), 543–550. https://doi.org/10.1089/109493102321018187

Heuett L., B., & Heuett B., K. (2011). Virtual Reality Therapy: A Means of Reducing Public Speaking Anxiety. *International Journal of Humanities and Social Science*, *1*(16).

Hofmann, S. G., & Dibartolo, P. M. (2000). An instrument to assess self-statements during public speaking: Scale development and preliminary psychometric properties. *Behavior Therapy*, *31*(3), 499–515. https://doi.org/10.1016/s0005-7894(00)80027-1

Kahlon, S. (2022). *Virtual Reality Exposure Therapy for Adolescents with Public Speaking Anxiety* [University of Bergen, Norway]. https://bora.uib.no/bora-xmlui/bitstream/handle/11250/3015393/drthesis_2022_kahlon.pdf?sequence=2&isAllowed=y

Kahlon, S., Lindner, P., & Nordgreen, T. (2019). Virtual reality exposure therapy for adolescents with fear of public speaking: A non-randomized feasibility and pilot study. *Child and Adolescent Psychiatry and Mental Health*, *13*(1), 47. https://doi.org/10.1186/s13034-019-0307-y

Keith, C., & Turpin, Graham. (1996). *Physiological effects of public speaking assessed using*

a measure of palmar sweating. *10*(4), 283–290.

Lakin, J. (2018, September 24). *WHAT'S THE DIFFERENCE BETWEEN COGNITIVE-BEHAVIORAL THERAPY, EXPOSURE THERAPY, AND EXPOSURE WITH RESPONSE PREVENTION?* https://ocdandanxietycenterofcleveland.com/anxietyblog/2018/9/24/whats-the-difference-between-cognitive-behavioral-therapy-and-exposure-with-response-prevention-and-exposure-therapy

Lee, K. M. (2004). Presence, Explicated. *Communication Theory*, *14*(1), 27–50. https://doi.org/10.1111/j.1468-2885.2004.tb00302.x

Lindner, P., Dagöö, J., Hamilton, W., Miloff, A., Andersson, G., Schill, A., & Carlbring, P. (2021). Virtual Reality exposure therapy for public speaking anxiety in routine care: A single-subject effectiveness trial. *Cognitive Behaviour Therapy*, *50*(1), 67–87. https://doi.org/10.1080/16506073.2020.1795240

Lindner, P., Miloff, A., Bergman, C., Andersson, G., Hamilton, W., & Carlbring, P. (2020). Gamified, Automated Virtual Reality Exposure Therapy for Fear of Spiders: A Single-Subject Trial Under Simulated Real-World Conditions. *Frontiers in Psychiatry*, *11*, 116. https://doi.org/10.3389/fpsyt.2020.00116

Lindner, P., Miloff, A., Fagernäs, S., Andersen, J., Sigeman, M., Andersson, G., Furmark, T., & Carlbring, P. (2019). Therapist-led and self-led one-session virtual reality exposure therapy for public speaking anxiety with consumer hardware and software: A randomized controlled trial. *Journal of Anxiety Disorders*, *61*, 45–54. https://doi.org/10.1016/j.janxdis.2018.07.003

Loerinc, A. G., Meuret, A. E., Twohig, M. P., Rosenfield, D., Bluett, E. J., & Craske, M. G. (2015). Response rates for CBT for anxiety disorders: Need for standardized criteria. *Clinical Psychology Review*, *42*, 72–82. https://doi.org/10.1016/j.cpr.2015.08.004

Meyerbröker, K. (2021). Virtual reality in clinical practice. *Clinical Psychology & Psychotherapy*, *28*(3), 463–465. https://doi.org/10.1002/cpp.2616

Moreno-Peral, P., Conejo-Cerón, S., Rubio-Valera, M., Fernández, A., Navas-Campaña, D.,

Rodríguez-Morejón, A., Motrico, E., Rigabert, A., Luna, J. D. D., Martín-Pérez, C., Rodríguez-Bayón, A., Ballesta-Rodríguez, M. I., Luciano, J. V., & Bellón, J. Á. (2017). Effectiveness of Psychological and/or Educational Interventions in the Prevention of Anxiety: A Systematic Review, Meta-analysis, and Meta-regression. *JAMA Psychiatry*, *74*(10), 1021. https://doi.org/10.1001/jamapsychiatry.2017.2509

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, *18*(1), 143. https://doi.org/10.1186/s12874-018-0611-x

Öst, L.-G. (1996). One-session group treatment of spider phobia. *Behaviour Research and Therapy*, *34*(9), 707–715. https://doi.org/10.1016/0005-7967(96)00022-8

Powell, D. H. (2004). Treating individuals with debilitating performance anxiety: An introduction. *Journal of Clinical Psychology*, *60*(8), 801–808. https://doi.org/10.1002/jclp.20038

Premkumar, P., Heym, N., Brown, D. J., Battersby, S., Sumich, A., Huntington, B., Daly, R., & Zysk, E. (2021). The Effectiveness of Self-Guided Virtual-Reality Exposure Therapy for Public-Speaking Anxiety. *Frontiers in Psychiatry*, *12*, 694610. https://doi.org/10.3389/fpsyt.2021.694610

Rimer, E., Husby, L. V., & Solem, S. (2021). Virtual Reality Exposure Therapy for Fear of Heights: Clinicians' Attitudes Become More Positive After Trying VRET. *Frontiers in Psychology*, *12*, 671871. https://doi.org/10.3389/fpsyg.2021.671871

Riva, G., Malighetti, C., & Serino, S. (2021). Virtual reality in the treatment of eating disorders. *Clinical Psychology & Psychotherapy*, *28*(3), 477–488. https://doi.org/10.1002/cpp.2622

Ruscio, A. M., Brown, T. A., Chiu, W. T., Sareen, J., Stein, M. B., & Kessler, R. C. (2008). Social fears and social phobia in the USA: Results from the National Comorbidity Survey Replication. *Psychological Medicine*, *38*(1), 15–28. https://doi.org/10.1017/S0033291707001699

Sareen, J., & Stein, M. (2000). A Review of the Epidemiology and Approaches to the Treatment of Social Anxiety Disorder: *Drugs*, *59*(3), 497–509. https://doi.org/10.2165/00003495-200059030-00007

Sarpourian, F., Samad‐Soltani, T., Moulaei, K., & Bahaadinbeigy, K. (2022). The effect of virtual reality therapy and counseling on students' public speaking anxiety. *Health Science Reports*, *5*(5). https://doi.org/10.1002/hsr2.816

Schmucker, C. M., Blümle, A., Schell, L. K., Schwarzer, G., Oeller, P., Cabrera, L., Von Elm, E., Briel, M., Meerpohl, J. J., & on behalf of the OPEN consortium. (2017). Systematic review finds that study data not published in full text articles have unclear impact on meta-analyses results in medical research. *PLOS ONE*, *12*(4), e0176210. https://doi.org/10.1371/journal.pone.0176210

Slater, M. (2003). *A Note on Presence Terminology*. *3*(3), 1–5.

Slater, M. (2009). Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1535), 3549–3557. https://doi.org/10.1098/rstb.2009.0138

Stein, M. B. (1996). Public-Speaking Fears in a Community Sample: Prevalence, Impact on Functioning, and Diagnostic Classification. *Archives of General Psychiatry*, *53*(2), 169. https://doi.org/10.1001/archpsyc.1996.01830020087010

Stemberger, R. T., Turner, S. M., Beidel, D. C., & Calhoun, K. S. (1995). Social phobia: An analysis of possible developmental factors. *Journal of Abnormal Psychology*, *104*(3), 526–531. https://doi.org/10.1037/0021-843X.104.3.526

Wallach, H. S., Safir, M. P., & Bar-Zvi, M. (2009). Virtual Reality Cognitive Behavior Therapy for Public Speaking Anxiety: A Randomized Clinical Trial. *Behavior Modification*, *33*(3), 314–338. https://doi.org/10.1177/0145445509331926

Wang, P. S., Angermeyer, M., Borges, G., Bruffaerts, R., Tat Chiu, W., DE Girolamo, G., Fayyad, J., Gureje, O., Haro, J. M., Huang, Y., Kessler, R. C., Kovess, V., Levinson, D., Nakane, Y., Oakley Brown, M. A., Ormel, J. H., Posada-Villa, J., Aguilar-Gaxiola, S., Alonso, J., … Ustün, T. B. (2007). Delay and failure in treatment seeking after first

onset of mental disorders in the World Health Organization's World Mental Health Survey Initiative. *World Psychiatry: Official Journal of the World Psychiatric Association (WPA)*, *6*(3), 177–185.

Witmer, B. G., & Singer, M. J. (1998). Measuring Presence in Virtual Environments: A Presence Questionnaire. *Presence: Teleoperators and Virtual Environments*, *7*(3), 225–240. https://doi.org/10.1162/105474698565686

Wittchen, H.-U., Stein, M. B., & Kessler, R. C. (1999). Social fears and social phobia in a community sample of adolescents and young adults: Prevalence, risk factors and co-morbidity. *Psychological Medicine*, *29*(2), 309–323. https://doi.org/10.1017/S0033291798008174

Zacarin, M. R. J., Borloti, E., & Haydu, V. B. (2019). Behavioral Therapy and Virtual Reality Exposure for Public Speaking Anxiety. *Temas Em Psicologia*, *27*(2), 491–507. https://doi.org/10.9788/TP2019.2-14

Zainal, N. H., Chan, W. W., Saxena, A. P., Taylor, C. B., & Newman, M. G. (2021). Pilot randomized trial of self-guided virtual reality exposure therapy for social anxiety disorder. *Behaviour Research and Therapy*, *147*, 103984. https://doi.org/10.1016/j.brat.2021.103984

Zheng, R. Z. (Ed.). (2020). *Cognitive and Affective Perspectives on Immersive Technology in Education:* IGI Global. https://doi.org/10.4018/978-1-7998-3250-8