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Enhancing Virtual Reality Exposure Therapy (VRET) for the Treatment of Speech Anxiety: The Influence of Positive Affect Induction and Mental Health Self-Efficacy

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Abstract

Speech anxiety is one of the most common and impairing forms of social anxiety. This has led to increased interest in innovative treatment methods, with virtual reality exposure therapy (VRET) emerging as a cost-efficient and highly replicable alternative to in vivo exposure. However, the role of affective states and self-efficacy in VRET outcomes remains unclear. The present study examined whether inducing positive affect prior to VRET would enhance reductions in speech anxiety compared to negative affect induction, and whether baseline self-efficacy predicted short-term treatment outcomes. Thirty-one participants with moderate to high levels of speech anxiety completed a single VRET session following either a positive or negative affect induction. Speech anxiety levels were assessed before, immediately after, and one week following the intervention using the Personal Report of Communication Apprehension - Public Speaking Subscale (PRCA-PS). Baseline self-efficacy was measured using the Mental Health Self-Efficacy Scale (MHSES). Results showed the presence of a significant reduction in speech anxiety from pre- to post-intervention, which was maintained at the one-week follow-up. The affect induction condition did not significantly influence treatment outcomes, despite successfully altering participants' mood. Baseline self-efficacy was not significantly associated with short-term reductions in speech anxiety. Together, these findings suggest that a single session of VRET is effective in reducing speech anxiety, while positive affect induction and baseline self-efficacy may not provide additional benefits in this context. Future research should aim to assess multi-session interventions and the dynamic nature of self-efficacy to better understand individual differences in exposure outcomes.

Enhancing Virtual Reality Exposure Therapy (VRET) for the Treatment of Speech Anxiety: The Influence of Positive Mood Induction and Mental Health Self-Efficacy

When giving a speech or a presentation to an audience, many individuals experience some degree of anxiety, characterized by physiological symptoms such as a pounding heart, trembling hands, and racing thoughts (Bodie, 2009). This fear, referred to as *speech anxiety* or *glossophobia*, is recognized as one of the most prevalent forms of social anxiety (Hancock et al., 2009; Spyridonis et al., 2024). Supporting this, a large-scale survey study by Bodie (2010) consistently identified public speaking as one of the most commonly reported fears among adults.

Cognitively, an individual with speech anxiety is frightened of being judged, embarrassed, or rejected in public speaking situations (Bippus & Daly, 1999). While prevalence estimates vary widely depending on the definitions and severity thresholds, research suggests that a substantial proportion of individuals experience at least mild or situational speech anxiety at some point in their lives, whereas a smaller subset reports persistent and clinically impairing levels, estimated at 10-30% (Demir & Kan, 2025; Pull, 2011). Although many individuals do not meet the formal diagnostic criteria, even subclinical levels of speech anxiety can be highly distressing and interfere with daily functioning. Although speech anxiety can often occur in isolation, it is also recognized as a distinct symptom or subtype of Social Anxiety Disorder (SAD) (Blöte et al., 2008).

Speech anxiety affects diverse populations, including students, professionals, and people seeking mental health care. While it is more commonly seen in non-clinical settings, such as in academic environments where it can hinder students' performance, participation, and learning, it can also occur as part of broader social anxiety difficulties (Kankam & Boateng, 2017). For individuals with SAD, these fears are often more pervasive and debilitating, contributing to avoidance behaviors, distress, and causing impairment across multiple life domains (Alomari et al., 2022). Taken together, these findings show how speech anxiety represents a clinically relevant problem across varying levels of severity. Given its significant impact on both clinical and non-clinical populations, identifying effective intervention strategies is crucial.

One of the most widely researched and supported approaches for treating anxiety disorders is *exposure therapy*. Historically, exposure therapy was based on the principle of systematic desensitization, first developed by Joseph Wolpe in 1958. This approach combined

gradual exposure to feared situations with relaxation techniques, based on reciprocal inhibition, the idea that anxiety and relaxation are physiologically incompatible and therefore cannot co-occur (Wolpe, 1968). In systematic desensitization, an individual first learns relaxation techniques, such as progressive muscle relaxation. Then, they create an anxiety hierarchy and are gradually exposed to increasingly more anxiety-provoking situations while simultaneously applying relaxation techniques. Over time, it was believed that pairing relaxation with the feared situation would weaken and eventually eliminate the anxiety response (Wolpe, 1968).

Nevertheless, evidence suggested that the mechanism behind exposure therapy was not only due to this counterconditioning process. Later research demonstrated that fear reduction can occur even without relaxation training, suggesting that other mechanisms were responsible for the therapeutic improvements (Barlow, 1996). This finding led to the development of theories such as inhibitory learning models, which offer a more comprehensive explanation for the mechanisms underlying exposure therapy. According to this model, exposure does not erase the original fear association; instead, it fosters the formation of a new inhibitory association that competes with the original fear memory (Craske et al., 2014). This theory is critical because it helps explain why fear often returns after successful treatment through processes such as spontaneous recovery, renewal, or reinstatement (Zbozinek & Craske, 2016).

To better understand and improve exposure treatments, researchers investigated fear-related learning processes using controlled laboratory models. These models helped identify the mechanisms underlying acquisition, maintenance, and extinction of fear (Craske et al., 2014). The acquisition of fear, particularly in the context of speech anxiety, involves a previously neutral stimulus, such as speaking in front of a group of people (the conditioned stimulus, or CS), being repeatedly paired with an aversive outcome, such as negative evaluation or judgment (the unconditioned stimulus, or US) (Rabinak et al., 2016). Once this association is learned, public speaking alone can elicit physiological and cognitive anxiety responses, even in the absence of an objective threat.

In exposure therapy, the aim is to weaken this CS-US pairing through repeated exposure to the CS in the absence of the US (Storsve et al., 2010). For example, individuals are repeatedly asked to face a CS (e.g., public speaking) while the anticipated negative evaluation or judgment (US) does not occur. The discrepancy between what an individual expects and what happens is referred to as *expectancy violation* and is considered central to inhibitory learning. The mismatch

between expected and actual outcomes is believed to drive extinction learning, allowing individuals to form new associations in which the feared stimulus no longer predicts threat (Urcelay, 2012).

Importantly, extinction learning does not erase the original fear memory; instead, it results in the formation of a new inhibitory association that competes with the original fear memory (Zbozinek et al., 2015). Hence, understanding extinction as a process of new learning is important, as it explains why a fear can sometimes return even with successful treatment. Because the original fear association remains intact, fear responses can return under certain conditions, such as when the feared stimulus is encountered in a new setting (renewal), after the occurrence of an unrelated unpleasant event (reinstatement), or after the passage of time (spontaneous recovery) (Zbozinek & Craske, 2016).

Given the vulnerability of extinction learning and the risk of fear returning, the method by which exposure therapy is implemented is crucial. While in vivo exposure therapy (exposure therapy conducted in real-life situations) remains the primary method, it presents several limitations specific to speech anxiety. In the context of public speaking anxiety, it can be difficult to consistently find real audiences or suitable public settings for practicing the therapy. As a result, therapists may resort to assigning exposure exercises as homework, which lack adequate therapeutic supervision (McAleavey et al., 2013). Furthermore, for some individuals, in vivo exposure can be too intimidating or overwhelming, especially during early treatment sessions. This may lead some patients to entirely avoid the therapy, resulting in an increased dropout rate (Bentley et al., 2021).

A promising solution to these limitations would be to integrate Virtual Reality technology into exposure therapy. Virtual Reality Exposure Therapy (VRET) has gained increasing popularity over the past few decades for various psychological disorders (Carl et al., 2018). A growing body of research has demonstrated the efficacy of VRET in treating several anxiety-related disorders, with evidence suggesting that it can be as effective as in vivo exposure therapy (Horigome et al., 2020). VRET appears particularly beneficial for performance-related fears, such as speech anxiety, which, as mentioned earlier, can be difficult to induce with in vivo conditions (Fehlmann et al., 2023). Unlike in vivo exposure, VRET allows for the delivery of controlled and replicable exposure environments without the need for real audiences or complex

logistical arrangements. Furthermore, it may be especially beneficial for highly avoidant individuals, by enabling exposure in a gradual, less overwhelming manner (Walkom, 2016).

However, despite the additional benefits VRET provides to exposure therapy, it shares several limitations with traditional in vivo exposure, including relapse and variability in treatment outcomes. Additionally, there is considerable individual variability in fear extinction learning, which can substantially influence treatment effectiveness (Forcadell et al., 2017). Factors such as trait anxiety, motivation, self-efficacy, and memory have all been linked to individual differences in therapy outcomes (Böhnlein et al., 2019). There is a growing need to optimize exposure-based interventions, including VRET, with a focus on long-term retention and generalization of treatment effects. One emerging approach to enhancing exposure outcomes involves modifying the emotional context of exposure, specifically by increasing positive affect prior to exposure sessions (Zbozinek et al., 2015).

The Role of Affect in Virtual Reality Exposure Therapy

Inducing positive affect prior to exposure therapy has been proposed as a means to enhance exposure treatment outcomes. Zbozinek and Craske (2016) explored this concept by reviewing evidence suggesting that positive affect could influence extinction learning processes. This is because a positive mood can enhance various cognitive aspects, including attention, memory, and learning (Ashby et al., 1999). In addition to improving cognitive processing, positive affect can also act as a protective factor against the return of fear after exposure therapy. For example, it may help reframe the feared stimulus (CS+) in a less threatening and more neutral light, thereby reducing the likelihood of fear resurfacing later on. According to the inhibitory learning model, this reframing increases expectancy violation, which is essential for extinction learning (Zbozinek & Craske, 2016). Furthermore, positive affect has been proposed to improve the way extinction experiences are encoded in memory. To be exact, positive affect is proposed to promote deeper relational and semantic processing. This means that individuals process the extinction experience in a more elaborative manner, creating richer and more meaningful links between the new, safe association and their previous fear memories (Craske et al., 2014; Zbozinek et al., 2015). In other words, individuals are better able to integrate the knowledge that the feared situation no longer predicts harm with what they previously learned during fear acquisition. This allows for the development of stronger inhibitory memory

representations, which can therefore be more easily retrieved in the future (Zbozinek & Craske, 2016; Zbozinek et al., 2015).

Empirical studies have further supported the idea that enhancing attention to threat-relevant features during extinction can improve learning outcomes. For example, Barry et al. (2017) demonstrated that when participants were instructed to focus their attention on threat-relevant features of the CS during extinction, they showed significantly reduced return of fear compared to when their attention was directed to other stimulus aspects. Building on these findings, later studies have examined whether emotional states that naturally broaden attention, such as positive affect, can enhance extinction learning. In the study by Zbozinek et al. (2015), individuals in a positive mood induction condition exhibited reduced fear responses and lower fear reinstatement, compared to the control condition, indicating that a positive emotional state can enhance the effects of exposure therapy. Additionally, Taylor et al. (2023) conducted a randomized controlled trial with 152 individuals diagnosed with SAD. Participants underwent five group sessions of exposure therapy, and trait positive emotionality was measured at baseline. Their research found that higher baseline positive emotionality predicted faster and better improvements during exposure therapy for social anxiety.

Given these findings and the theoretical background suggesting that positive affect may enhance extinction learning by reducing the negative emotional value of feared stimuli and increasing resilience to relapse, it is important to explore ways to incorporate positive affect into exposure-based treatments. Therefore, the present study examines whether inducing Positive Affect prior to virtual reality exposure therapy (VRET) can improve treatment outcomes for individuals with speech anxiety. It is hypothesized that participants in the Positive Affect condition will show greater reductions in speech anxiety following VRET compared to those in the Negative Affect condition, both immediately after treatment and at the follow-up one week later.

The Predictive Role of Self-Efficacy in Virtual Reality Exposure Therapy

While emotional manipulations prior to exposure therapy may influence treatment outcomes, individual differences can also play a crucial role. One such individual factor is self-efficacy, a concept coined in Bandura's social cognitive theory, which suggests that individuals are more likely to approach feared situations when they believe they can successfully manage

them (Bandura, 1977). Through repeated exposure to feared situations, individuals gain corrective experiences, learning that they can cope and tolerate the anxiety and fear responses they previously perceived as catastrophic, and that these responses are harmless. Recognizing their ability to handle and manage fears increases their feelings of self-efficacy and can significantly influence long-term improvement. Higher levels of self-efficacy are associated with greater motivation and resilience when confronted with anxiety-provoking situations (Bandura, 1977). Within exposure therapy, self-efficacy is thought to facilitate approach behavior and support the modification of threat-related expectations, allowing them to form new, safer associations with the feared situation (Kampmann et al., 2019; Zlomuzica et al., 2015). With time, this process can strengthen inhibitory learning and reduce anxiety symptoms.

Following this theoretical perspective, empirical research has consistently supported the role of self-efficacy in exposure-based interventions for anxiety disorders. A meta-analysis by Breuninger et al. (2019) investigated the role of cognitive factors in exposure therapy across a range of anxiety disorders and found that increases in self-efficacy significantly mediated reductions in anxiety symptoms. This suggests that self-efficacy is not only a byproduct of symptom reduction but rather a key factor through which exposure therapy exerts its therapeutic effect. Evidence from other individual studies further supports this interpretation. For example, Kampmann et al. (2019) reported that higher baseline self-efficacy was associated with better outcomes in exposure therapy for social anxiety disorder, as well as greater willingness to approach feared social situations. Similarly, Zlomuzica et al. (2015) demonstrated that repeated success during exposure exercises can increase an individual's self-efficacy beliefs, which can subsequently reduce avoidance behaviors and facilitate long-term fear reduction. Taken together, these findings indicate that self-efficacy is, in fact, a dynamic construct that both develops through therapeutic experiences and reinforces engagement with exposure exercises, making it a relevant predictor of treatment response.

Given this evidence and the limited research examining self-efficacy specifically within virtual reality exposure therapy, it is important to better understand the role of this construct in newer treatment formats such as VRET. VRET has been shown to be a promising and effective alternative for in vivo exposure therapy. However, it remains unclear whether individual differences in self-efficacy are associated with outcomes in this context. Therefore, the present study will examine whether higher baseline mental health self-efficacy (MHSES) is associated

with greater reductions in speech anxiety following a single session of VRET. It was hypothesized that individuals with higher baseline MHSES would show greater reductions in speech anxiety, measured immediately before and after the intervention.

Hypotheses

This study tested the following hypotheses:

1. It was hypothesized that participants in the Positive Affect condition would show greater reductions in speech anxiety following virtual reality exposure therapy (VRET) compared to participants in the Negative Affect condition, both immediately after treatment and at the one-week follow-up.
2. It was hypothesized that higher baseline levels of mental health self-efficacy (MHSES) would be associated with greater reductions in speech anxiety following a single session of VRET.

Method

Participants

A total of 31 undergraduate students participated in the study. Of these, 25 identified as female and six as male. Participants' ages ranged from 19 to 26 years (M = 22, SD = 1.66). Through random assignment, 13 participants were allocated to the Negative Affect condition, while 18 were assigned to the Positive Affect condition.

Inclusion criteria required participants to be between 18 and 70 years of age, currently enrolled at a college or university, proficient in English, and comfortable using a keyboard, mouse, and touchscreen device. All participants were required to provide informed consent. For the second phase of the study, participants were additionally required to score equal to or above 18 on the *Personal Report of Communication Apprehension - Public Speaking Subscale* (PRCA-PS), indicating elevated speech anxiety. Exclusion criteria included previous participation. Participants received course credit for their participation.

Materials

Outcome Measures

The primary instrument used was the *Personal Report of Communication Apprehension - Public Speaking Subscale* (PRCA-PS), which measures the level of public speaking anxiety (McCroskey et al., 1985). The PRCA-PS is a six-item self-report questionnaire rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Total scores ranged from 6 to 30, with higher scores indicating greater levels of speech anxiety. A cutoff score of 18 or higher was used during prescreening to identify participants with moderate to high speech anxiety for inclusion in the study. The PRCA-PS was the primary outcome measure for evaluating changes in speech anxiety from pre-intervention to post-intervention and the one-week follow-up. The PRCA-PS is a subscale of the PRCA-24, a measure which has demonstrated excellent internal reliability ($\alpha = .97$; McCroskey et al., 1985).

The *Social Phobia Inventory* (SPIN) is a 17-item self-report scale assessing fear, avoidance, and physiological symptoms related to social anxiety disorder over the past week (Connor et al., 2000). Total scores ranged from 0 to 68, with higher scores indicating greater severity of social anxiety. The SPIN was administered at baseline and at the one-week follow-up to assess changes in overall social anxiety levels.

Speech valence was measured for exploratory purposes during prescreening (baseline), post-treatment, and at the one-week follow-up. Participants rated how positive or negative they perceived giving speeches on a scale ranging from -3 (extremely unpleasant) to +3 (extremely pleasant). These data were collected as part of a larger research project but were not analyzed in the present report.

Core Predictor Measures

Mood induction was assessed using the *Self-Assessment Manikin* (SAM), which consisted of three items measuring valence, arousal, and dominance levels immediately before and after mood induction (Bradley & Lang, 1994). Although all three questions were administered, only the valence rating was used as a manipulation check to verify the effectiveness of the affect induction. Ratings ranged from one (very pleasant) to nine (very unpleasant).

The *Mental Health Self-Efficacy Scale* (MHSES) was administered to assess the study's second hypothesis. The brief questionnaire consisted of seven items designed to assess

individuals' confidence in their ability to manage mental health and emotional regulation abilities. The MHSES evaluated individuals' perceived ability to accept distressing emotions, avoid maladaptive coping behaviors, and engage in health-promoting activities. Participants rated their confidence levels on a scale from 0% to 100%, with higher scores indicating greater mental health self-efficacy. In prior research, the MHSES demonstrated good internal reliability ($\alpha = .89$; Clarke et al., 2014)

Various additional self-report questionnaires were administered, including the *Trait Positivity Affectivity* (a subset from the NEO-FFI), the *Adult Hope Scale* (AHS), and the *Life Orientation Test-Revised* (LOT-R). However, these measures were not used in the present analyses.

Procedure

Screening and Baseline Assessment

Participants who expressed interest in the study via an online advertisement titled "Virtual Reality Task" were directed to an online survey hosted on REDCap. Before completing any questionnaires, participants reviewed the study information and provided electronic informed consent. The screening survey assessed demographic information, speech anxiety levels using the PRCA-PS, and included attention check items. Participants also completed the additional self-report measures as part of the study protocol. Individuals who met the inclusion criterion for speech anxiety (PRCA-PS $\geq$18) and passed the attention checks were invited to the in-person session via email. Participants were required to complete the prescreening survey within five days of initiating it. The screening assessment took approximately 30 minutes to complete.

In-Person Study Session

The in-person study lasted around 75 minutes and took place in the Erasmus Behavioral Lab (EBL) at Erasmus University Rotterdam. Randomization was conducted prior to participants' arrival to assign them to either the Positive Affect or Negative Affect condition. To maintain a standardized procedure, all instruction materials were read from a script so that identical information was provided to each participant.

Upon arrival, participants reviewed detailed information about the study, provided written informed consent, and were given the opportunity to ask questions. After providing consent, participants were introduced to the virtual reality (VR) headset and completed an initial VR orientation. This orientation consisted of briefly exploring a 360-degree nature scene while seated, allowing participants to become familiar with the VR environment. Participants were informed that they could remove the headset at any time if they felt uncomfortable.

Following the orientation, participants rated their current affect using the Self-Assessment Manikin (SAM). Participants then viewed one of the two five-minute affect induction videos corresponding to their randomly assigned condition (Positive Affect or Negative Affect) using the VR headset. The affect induction consisted of short video clips selected to elicit either positive or negative emotional states. The videos were presented within a 360-degree environment simulating the experience of sitting in a cinema and watching the video on a large screen. Participants were instructed to attend closely to the video content and to allow themselves to fully feel and experience any emotions elicited by the video. After viewing the video, participants rated their affect once more using the SAM as a manipulation check.

Virtual Reality Exposure Therapy (VRET)

Following the affect induction, participants viewed prerecorded instructional material from a virtual therapist, which provided an overview of social and speech anxiety as well as the exposure procedure. Participants were then given five minutes to prepare a short speech on the topic “something you are proud of.”

Participants then completed six speech anxiety exposure trials within a VR environment specifically designed to simulate real-life public speaking scenarios. The first three trials took place in a small conference room with six seated audience members, while the final three trials occurred in a large lecture hall with a seated audience. The behaviors of the audience varied across each trial, and included neutral, attentive, and disengaged/distracted responses (e.g., nodding, lack of eye contact, or looking at their phone) to more closely resemble real-world public speaking situations (Pertaub et al., 2002). Each exposure trial lasted three minutes.

Participants were instructed to begin speaking as soon as the audience appeared and were encouraged to continue speaking throughout the trial, with an emphasis on maintaining speech rather than content quality. If participants went silent for more than 10 seconds, they received a

standardized verbal prompt to encourage them to keep speaking. After each trial, the virtual therapist provided some positive feedback and provided a one-minute timer before the next exposure trial.

If the exposure became too overwhelming or caused significant discomfort, participants were informed that they could stop at any time. After completing all the exposure trials, the virtual therapist delivered a debriefing statement. Once the VR headset was removed, participants completed post-treatment self-report measures assessing speech anxiety and their perceptions toward public speaking. Participants were then thanked for their participation and received information regarding the follow-up assessment and course credits.

One-week Follow-up Assessment

One week after the intervention, participants were asked to complete a 15-minute follow-up survey assessing speech anxiety, social anxiety symptoms, and speech valence. They were instructed to complete the survey as soon as possible after receiving it. Participants received course credits as compensation for their time and participation only after all three phases were complete.

Data Processing and Statistical Analyses

An alpha level of .05 was used for all statistical analyses. To assess whether the mood induction was successful, a manipulation check was conducted. A mixed-design ANOVA was performed on the valence (pleasantness) ratings from the Self-Assessment Manikin (SAM), with *Time* (pre-induction, post-induction) as the within-subjects factor and *Condition* (Positive Affect vs. Negative Affect) as the between-subjects factor. The dependent variable was participants' self-reported valence (pleasantness). Assumptions of normality and homogeneity of variance were assessed and met. Because a significant *Time* x *Condition* interaction was found, follow-up paired-samples *t*-tests were conducted separately within each condition to examine changes in pleasantness from pre-induction to post-induction.

To test the effect of affect induction on speech anxiety, a mixed-design ANOVA was conducted with *Time* as a three-level within-subjects factor (pre-intervention, post-intervention, one-week follow-up) and *Condition* as a two-level between-subjects factor (Positive Affect vs. Negative Affect). Speech anxiety scores measured with the PRCA-PS served as the dependent

variable. Assumptions of normality, homogeneity of variance, and sphericity were assessed and met. Because the main effect of *Time* was significant, pairwise comparisons with Bonferroni correction were conducted to determine differences in speech anxiety across time points.

To examine whether self-efficacy was associated with short-term changes in speech anxiety, a linear regression analysis was conducted. Baseline self-efficacy scores measured with the MHSES were used as the predictor variable. The dependent variable was the change in speech anxiety, calculated as the difference score between pre-intervention and post-intervention PRCA-PS scores. Assumptions of linearity, normality, independence of errors, and homoscedasticity were assessed and met. All statistical analyses were conducted using *IBM SPSS Statistics* (Version 28).

Results

Descriptive statistics for speech anxiety (PRCA-PS) scores across time and condition are presented in *Table 1*.

Table 1

Descriptive Statistics for Speech Anxiety (PRCA-PS) Scores Across Time and Condition.

Time Point	Condition	M	SD	*n*
Pre-Intervention	Positive Affect	22.78	2.82	18
	Negative Affect	21.54	2.82	13
	Total	22.26	2.84	31
Post-Intervention	Positive Affect	18.61	3.62	18
	Negative Affect	18.23	4.07	13
	Total	18.45	3.75	31
One-Week Follow-Up	Positive Affect	19.56	3.07	18
	Negative Affect	18.77	4.21	13
	Total	19.23	3.55	31

Note. PRCA-PS = Personal Report of Communication Apprehension - Public Speaking Subscale. Means and standard deviations are presented by condition and time point.

Manipulation Check of Affect Induction

To assess whether the mood induction effectively altered participants' mood, a mixed ANOVA was conducted. *Time* (SAM ratings pre- vs. post- induction) was included as a within-subjects factor, and *Condition* (Positive Affect vs. Negative Affect) as a between-subjects factor. Lower SAM valence scores indicate greater pleasantness and were interpreted as increases in positive affect.

The analysis revealed a significant main effect of *Time,* F (1, 29) = 6.72, p = .015, η_p^2 = .19, showing that overall valence ratings changed significantly from pre- to post-induction. Additionally, there was a significant *Time* x *Condition* interaction, F (1, 29) = 42.25, $p < .001$, η_p^2 = .59, indicating that the change in valence was different between the Positive and Negative Affect conditions.

A follow-up paired-samples t-test revealed that in the Positive Affect group, valence ratings significantly decreased from pre-induction (M = 3.67, SD = 1.61) to post-induction (M = 2.28, SD = 1.02), t (17) = 3.13, p = .006, indicating that participants in the Positive Affect condition experienced an increase in pleasant mood following the induction.

Furthermore, in the Negative Affect condition, valence ratings significantly increased from pre-mood induction (M = 3.31, SD = 1.60) to post-mood induction (M = 6.54, SD = 1.27), t (12) = -5.69, $p < .001$, indicating a decrease in pleasant mood, as intended.

Speech Anxiety (PRCA-PS) Over Time by Affect Condition

A mixed ANOVA revealed that the main effect of *Time* was significant, F (2, 58) = 19.00, $p < .001$, η_p^2 = .40, which indicated a significant reduction in speech anxiety scores over time. Follow-up pairwise comparisons with Bonferroni correction showed that speech anxiety scores (PRCA-PS) significantly decreased from pre-intervention (M = 22.16, SE = .51) to post-intervention (M = 18.42, SE = .69), $p < .001$. Scores at the one-week follow-up (M = 19.16, SE = .65) also remained significantly lower than at pre-intervention, $p < .001$, indicating a maintained improvement. However, there was no significant difference between post-intervention and one-week follow-up scores, p = .790.

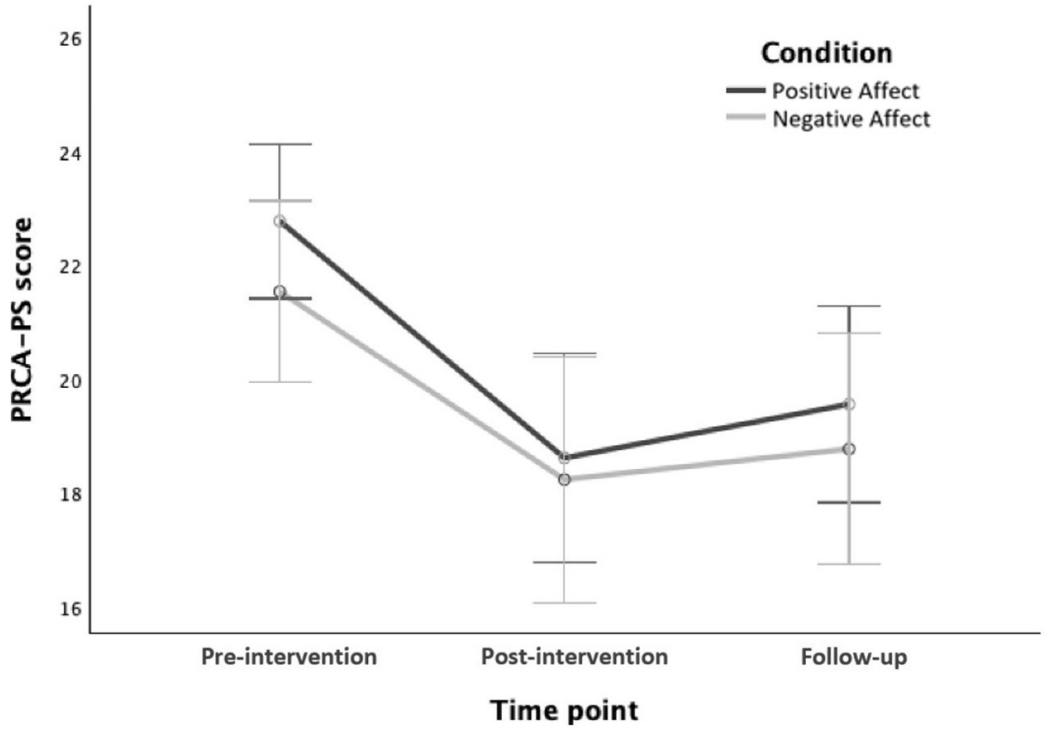
The main effect of *Condition* (Positive Affect vs. Negative Affect) was not significant, F (1, 29) = 0.64, p = .431, η_p^2 = .02, suggesting no overall differences in speech anxiety scores between groups. Similarly, the interaction effect of *Time* and *Condition* was not significant, F (2,

58) = .22, p = .800, η_p^2 = .01, meaning that the reduction in speech anxiety scores over time did not differ based on the type of affect induction.

As shown in *Figure 1,* PRCA-PS scores decreased over time in both affect induction groups, with no significant differences between groups. Although the Positive Affect condition consistently showed slightly higher mean scores at all time points, these differences were not statistically significant.

Figure 1

Mean PRCA-PS scores across time points (pre-intervention, post-intervention, and one-week follow-up) for the Positive Affect and Negative Affect conditions.



Note. Error bars represent 95% confidence intervals.

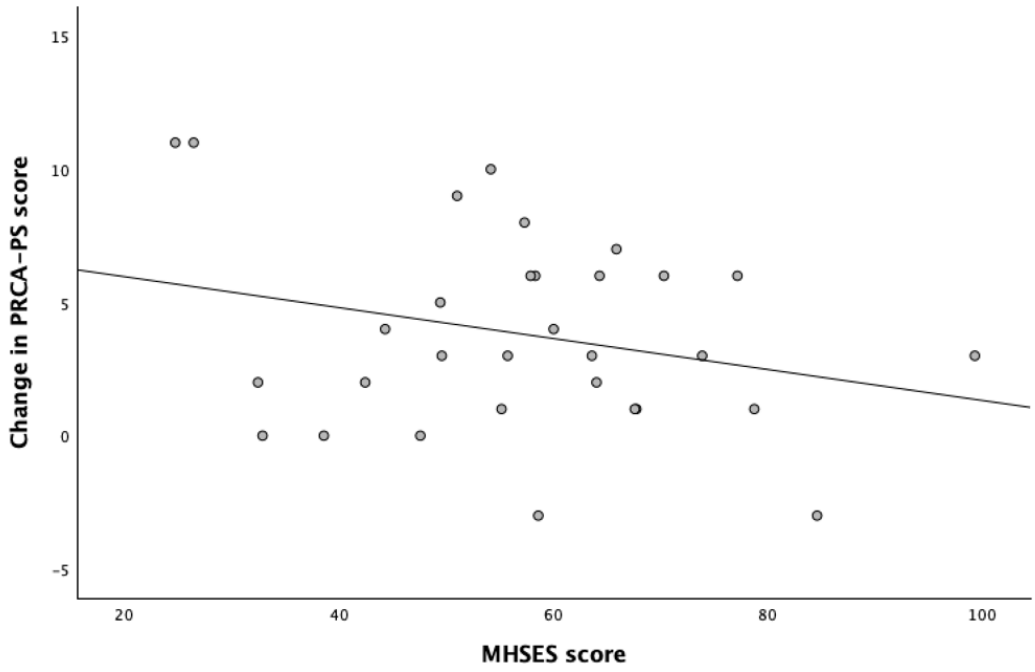
Predictive Role of Self-Efficacy (MHSES) in Short-Term Speech Anxiety Change

A simple linear regression was conducted to examine whether baseline mental health self-efficacy (MHSES) was associated with changes in speech anxiety following the intervention. The overall model was not statistically significant, F (1, 29) = 2.22, p = .147, indicating that baseline self-efficacy was not significantly associated with changes in speech anxiety. The model accounted

for 7.1% of the variance in PRCA-PS change scores from prescreening to post in-person session (R^2 = .071). The unstandardized regression coefficient for MHSES was B = -.06, SE = .04, with a standardized coefficient of β = -.27. This means that for each one unit increase in MHSES scores, there was a non-significant reduction of .06 points in speech anxiety scores from pre- to post-intervention, t (29) = -1.49, p = .15. A scatterplot illustrating this association is presented in *Figure 2.*

Figure 2

Scatterplot showing the association between baseline MHSES scores and change in PRCA-PS scores from pre-intervention to post-intervention.



Note. Regression line included for illustrative purposes. The association was not statistically significant.

Exploratory Analyses

Exploratory Pearson correlation analyses were conducted to examine the relationship between baseline self-efficacy (MHSES) and baseline speech anxiety (PRCA-PS). At baseline, self-efficacy was significantly negatively correlated with speech anxiety, r = -.45, p = .010. In contrast, the association between self-efficacy and post-intervention speech anxiety scores was

non-significant, $r = -.08$, $p = .654$. This indicates that while higher self-efficacy was associated with lower baseline speech anxiety levels, this association was no longer present after the intervention.

Discussion

The present study aimed to investigate two primary hypotheses. First, it examined whether participants in the Positive Affect condition would exhibit greater reductions in speech anxiety immediately after virtual reality exposure therapy (VRET) and at the one-week follow-up. The results showed that while speech anxiety scores significantly decreased from pre-intervention to post-intervention and remained significantly lower at follow-up, the induction condition (Positive Affect vs. Negative Affect) did not significantly influence these reductions.

Second, the study assessed whether individuals with higher baseline mental health self-efficacy (MHSES) were associated with greater short-term reductions in speech anxiety following VRET. Results from the linear regression indicated that baseline self-efficacy was not a significant predictor of short-term symptom reductions for speech anxiety following intervention.

Speech Anxiety (PRCA-PS) Over Time by Affect Condition

While there was a significant decrease in speech anxiety scores from pre-intervention to post-intervention, no further reductions were observed at the one-week follow-up. Importantly, there was also no return of fear, suggesting that the effects of VRET were not only immediate but also maintained over time. This absence of spontaneous recovery is notable, as it is often a primary limitation of exposure-based treatments.

Despite the manipulation check confirming that mood induction was successful, positive affect induction did not enhance treatment outcomes in the present study. This finding contrasts with prior empirical work suggesting that positive affect can enhance cognitive processes necessary to extinction learning, including memory consolidation, attention, and cognitive flexibility (Zbozinek & Craske, 2016). Barry et al. (2017) further demonstrated that focusing attention on threat-relevant features during extinction improved treatment outcomes. Additionally, Taylor et al. (2023) showed that higher positive emotionality was related to greater improvements in exposure therapy for individuals with social anxiety disorder.

One possible explanation for this is that the VRET intervention itself was sufficiently strong to produce substantial reductions in speech anxiety across participants. This may have resulted in a floor effect; whereby additional benefits of mood induction were difficult to detect due to already low post-intervention anxiety levels. In the present study, the structured nature of the exposure therapy, including clear guidance from both the researcher and the virtual therapist, likely facilitated expectancy violation and inhibitory learning. Previous research has shown that VRET can, on its own, produce large treatment effects (Horigome et al., 2020). The strength of the intervention may also account for the absence of spontaneous recovery observed at the one-week follow-up. This suggests that even a single, well-structured VRET session may help promote robust and lasting inhibitory learning and reduce the likelihood of fear returning.

One possible explanation for the absence of a positive affect advantage in the present study is the limited duration of the mood induction. Although the affect induction procedure was immersive, it used a VR headset to present videos within a 360-degree environment simulating a movie theater; the induced mood may not have been sustained long enough to meaningfully influence extinction learning processes. Prior research has shown that even when mood induction procedures successfully alter affect immediately following post-induction, these effects often decrease and vanish within the first few minutes (Gillies & Dozois, 2021). Gillies and Dozois (2021) found that induced negative mood effects did not persist longer than four to six minutes, regardless of the induction mechanism used, such as music mood induction, autobiographical memory recall, or a combination of both.

In the present study, the intervention process included an instructional phase from a virtual therapist, followed by five minutes of preparation time and then six exposure trials of three minutes each, separated by one-minute breaks. This means that the intervention lasted over half an hour, making it likely that participants' mood returned to baseline before extinction learning was fully consolidated.

On the other hand, previous studies have often employed more elaborate positive imagery induction methods or repeated inductions, which may help sustain positive affect over a longer period. For example, Zbozinek et al. (2015) used Positive Imagery Training (PIT), in which participants vividly recalled and imagined positive autobiographical memories. Participants were then instructed to focus on sensory details to generate stronger, more positive emotional responses. This mood induction approach may be more immersive and personally relevant compared to

watching a video, as it engages autobiographical memory processes and activates emotional circuits more strongly (Zbozinek et al., 2015).

Predictive Role of Self-Efficacy (MHSES) in Short-Term Speech Anxiety Change

In addition to assessing the effects of affect induction prior to VRET, the present study also explored whether individual differences influenced treatment response, as suggested by previous research (Bohnlein et al., 2019; Forcadell et al. 2017). One of these individual factors is self-efficacy, defined as the belief in one's ability to effectively manage difficult emotions and situations, which has been linked to symptom reduction in anxiety treatments, particularly exposure-based interventions (Bandura, 1977; Kampmann et al., 2019). It was therefore hypothesized that higher baseline mental health self-efficacy (MHSES) would be associated with greater short-term reductions in speech anxiety following VRET.

No significant association was observed between baseline self-efficacy and short-term reductions in speech anxiety (see Figure 2). This finding contrasts with prior research demonstrating that self-efficacy is often a strong predictor of anxiety reduction in exposure-based interventions. According to Bandura (1977), individuals with higher self-efficacy are more likely to approach feared situations, persist despite discomfort, and engage more actively in therapy. Consistent with this, empirical studies have shown that higher self-efficacy is associated with greater treatment engagement and symptom reduction in exposure therapy and cognitive behavioral therapy more generally (Kampmann et al., 2019; Zlomuzica et al., 2015).

One possible explanation for the absence of an association between baseline self-efficacy and short-term anxiety reduction is that changes in self-efficacy during treatment, rather than baseline levels, may play a more crucial role in facilitating fear extinction (Zlomuzica et al., 2015). Zlomuzica et al. (2015) suggested that self-efficacy is a highly dynamic process that increases through repeated mastery experiences during exposure, which may contribute to symptom reduction. Supporting this, Kampmann et al. (2019) examined individuals with social anxiety disorder undergoing either in vivo or VRET across multiple sessions. They found that increases in self-efficacy over the course of treatment, rather than the initial self-efficacy levels, were significantly associated with reductions in social anxiety symptoms. In their study, self-efficacy was measured repeatedly and developed through gradual exposure to feared situations.

Additionally, treatment outcomes may be influenced by the interaction of multiple cognitive factors. Kampmann et al. (2019) identified perceived social costs as a stronger predictor of treatment success than self-efficacy. Perceived social costs refer to individuals' expectations about how negative the consequences of feared social situations would be (e.g., being rejected, judged, laughed at). This suggests that other cognitive mechanisms may account for more differences in symptom change. Similarly, a meta-analysis by Breuninger et al. (2019) showed that changes in self-efficacy mediated treatment outcomes across cognitive-behavioral interventions for various anxiety disorders, further highlighting that changes within individuals might be more important than baseline trait levels.

In the present study, self-efficacy was measured only once and therefore may have failed to capture important within-person changes during treatment. Future research could benefit from measuring self-efficacy at multiple time points to better reflect its dynamic process.

Another important consideration is that the post-hoc exploratory correlation analysis revealed a significant negative correlation between baseline self-efficacy and pre-intervention speech anxiety, indicating that individuals with higher self-efficacy entered the study with lower levels of speech anxiety. In contrast, there was no significant association observed between self-efficacy and post-intervention speech anxiety scores, suggesting that following treatment, symptom levels were relatively similar across participants regardless of their self-efficacy scores.

This pattern indicates that participants with higher self-efficacy had less room for improvement, resulting in smaller difference scores and possibly contributing to the non-significant findings in the linear regression analysis. Because individuals with higher self-efficacy already reported lower levels of anxiety prior to the intervention, further reductions may have been constrained, possibly resulting in a floor effect that obscured the detection of an association between self-efficacy and treatment outcome. Given this, future research could benefit from more careful consideration of baseline speech anxiety levels or from investigating how self-efficacy changes during treatment to better understand this relationship.

In the present study, the Mental Health Self-Efficacy Scale (MHSES) was selected because it assesses a wide range of beliefs related to emotional regulation and anxiety management, both of which are theorized to play an important role in cognitive-behavioral interventions (Kampmann et al., 2019). The measure reflects psychological flexibility and confidence in managing mental health challenges, aligning with Bandura's (1977) theory of self-efficacy. Nevertheless, it is

possible that the MHSES was not sufficiently specific to capture the self-efficacy beliefs most relevant to performance-based fears, such as speech anxiety. While some items assess anxiety tolerance (e.g., “Accepting bodily sensations brought about by stress, over-breathing, or muscle tension as harmless normal reactions”), others focus on more general health behaviors (e.g., “Engaging in physical health-promoting behaviors such as exercise, yoga, meditation”). This broader scope may have limited the scale’s sensitivity in the present context, as many items reflect general coping confidence rather than beliefs specific to managing fears of evaluation or public speaking. Future research could therefore benefit from integrating domain-specific self-efficacy measures tailored to speech anxiety to more precisely examine how these beliefs influence VRET.

Clinical Implication

The findings of the present study have various implications for clinical practice, specifically for the treatment of speech anxiety and other performance-related fears. First, the observed reductions in speech anxiety following a single session of VRET, with effects maintained at the one-week follow-up, support the use of VRET as an effective intervention, even when delivered briefly. This suggests that VRET can serve as a time efficient and accessible treatment option, specifically in contexts where traditional, multi-session exposure therapy is not possible.

Due to its relatively low cost, high replicability, and limited demands on the therapist’s resources and time, VRET may help reduce the burden on mental health services. It could be used as a short-term intervention, or even as a preparatory step prior to in vivo exposure, or simply as an additional tool alongside other cognitive-behavioral therapies.

The lack of additional benefits from positive affect induction suggests clinicians might not need to prioritize mood manipulation before exposure when the exposure itself is already immersive and well structured. Instead, other important therapeutic components, such as repeated exposure, clear instructions, therapist support, and creation of strong expectancy violations, may play a more central role in treatment outcomes. This highlights the importance of optimizing the quality and structure of the exposure itself, rather than relying on additional intervention strategies that may offer only limited extra benefit.

Furthermore, the absence of a significant association between baseline self-efficacy and short-term symptom reduction indicates the importance of monitoring changes in self-efficacy throughout treatment rather than only relying on initial levels. This suggests that interventions

aimed at actively enhancing self-efficacy during exposure, such as providing feedback, encouraging reflection on successful experiences, and reinforcing the mastery of experiences, might be more beneficial than assessing self-efficacy only at baseline. Overall, these findings support the use of VRET as a useful intervention strategy for speech anxiety and highlight the importance of focusing on the exposure process itself in clinical practice.

Limitations

Several limitations were noted in this study. First, the sample size was small ($N = 31$), which may have limited the statistical power and reduced the ability to detect small to moderate effects. Additionally, the sample was relatively homogeneous, with participants ranging in age from 19 to 26 years and a strong gender imbalance (25 females, 6 males). This limits the generalizability of the findings to broader populations, including older individuals and male participants.

Second, the use of a single-session exposure design may have constrained the ability to observe more sustained effects of mood induction and self-efficacy on treatment outcomes. Extinction learning and self-efficacy are both thought to develop in a gradual manner through repeated exposure experiences, and therefore, a single session may not have been sufficient to capture these processes fully. Similarly, mood induction effects may have diminished over the course of the exposure session, limiting its potential impact on the participants of the present study.

Third, self-efficacy was measured only at baseline, despite evidence suggesting that changes in self-efficacy during the course of treatment may be more strongly associated with symptom reduction than initial levels (Kampmann et al., 2019). Furthermore, while MHSES assesses general mental health self-efficacy, it may not have adequately captured domain-specific self-efficacy beliefs related to public speaking. This may have reduced the sensitivity of the measure to detect associations between self-efficacy and change in speech anxiety.

Lastly, the study included only a short-term follow-up assessment at the one-week post-intervention and did not assess longer-term outcomes. As a result, conclusions regarding the long-term maintenance of treatment effects or possible delayed relapse cannot be determined. Future studies should aim to address these limitations by finding larger and more diverse

samples, incorporating multiple exposure sessions, using domain-specific and repeated measures of self-efficacy and affect, and including a longer-term follow-up assessment.

Conclusion

In conclusion, the present study aimed to examine whether positive affect induction prior to virtual reality exposure therapy (VRET) would enhance treatment outcomes for individuals with moderate to high levels of speech anxiety, and whether baseline mental health self-efficacy was associated with greater short-term symptom reduction. The findings showed that VRET significantly decreased speech anxiety levels from pre-intervention to post-intervention, with these reductions maintained at the one-week follow-up.

Although the affect induction procedure successfully altered participants' mood, it did not lead to enhanced treatment outcomes, possibly reflecting a floor effect where the VRET intervention itself produced substantial speech anxiety reductions. Additionally, baseline self-efficacy was not associated with symptom reduction in the present sample, suggesting that changes in self-efficacy over the course of treatment may be more informative than baseline levels alone. Future research should consider implementing multi-session interventions, further examining what makes affect induction methods more enduring and using more specific self-efficacy measures assessed at multiple time points.

Together, the findings of the present study highlight that VRET is a promising intervention for speech anxiety, while also showing that the effects of positive mood and self-efficacy on exposure outcomes likely depend on treatment context. Despite its limitations, this study contributes to a better understanding of how mood and individual factors may interact with VRET outcomes for individuals with speech anxiety.

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