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Future-Oriented Positive Mental Imagery Reduces Anxiety for Exposure to Public Speaking

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Exposure therapy is the recommended treatment for anxiety disorders, but many anxious individuals are unwilling to expose themselves to feared situations. Episodic simulation of future situations contributes to adaptive emotion regulation and motivates behavior. This study investigated whether future-oriented positive mental imagery reduces anticipatory anxiety and distress during exposure, and increases exposure willingness and duration. Forty-three individuals with moderate public speaking anxiety were randomized to a standardized positive mental imagery exercise about future public speaking or no-task. All participants were then asked to present in a virtual reality environment. Anticipatory anxiety reduced in the positive mental imagery group, but not in the control group. Additionally, the positive mental imagery group reported lower distress during exposure than the control group, but groups did not differ in exposure willingness. Due to limited variance, effects on exposure duration could not be tested. Future-oriented positive mental imagery is promising to prepare individuals for exposure to previously avoided situations.

Keywords: anxiety disorders; episodic future thinking; positive mental imagery; public speaking anxiety; virtual reality exposure therapy

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Exposure-based therapy is the treatment of choice for anxiety disorders (National Institute for Health and Clinical Excellence, 2011), which involves exposure to feared situations and stimuli. Although exposure-based therapy for anxiety disorders is generally effective, its effectiveness is limited by attrition rates. That is, previous research showed dropout rates before (11–20%) and during (19.6–24%) treatment for anxiety disorders (Bentley et al., 2021; Carpenter et al., 2018; Fernandez et al., 2015). One potential explanation for these attrition rates is that individuals may be too anxious or unwilling to confront feared situations (Benbow & Anderson, 2019), possibly due to negative expectations surrounding the event associated with negative mental imagery. It has been suggested that strategies focusing on enhancing motivation before treatment may reduce dropout rates (Bentley et al., 2021).

Negative mental imagery about feared outcomes of future situations is common in individuals suffering from anxiety-related disorders (Brewin et al., 2010; Engelhard et al., 2010; Holmes & Mathews, 2010; Saulsman et al., 2019). For example, some people with social anxiety may imagine that others think they are stupid and see themselves looking nervous, anxious, and embarrassed (Hackmann et al., 1998). These negative mental images are often linked to earlier aversive memories (Hackmann & Holmes, 2004). Negative mental imagery has a stronger impact on emotions than verbal processing of the same information (Holmes & Mathews, 2005), and it may maintain fear and avoidance behavior (e.g., Holmes & Mathews, 2010; Krypotos et al., 2020; Mertens et al., 2020). For instance, when socially anxious individuals held a negative self-image in mind that was related to a previous social situation in which they felt anxious, they reported more anxiety, safety behaviors, and negative thoughts during a new social situation than when they held a neutral self-image in mind (e.g., Hirsch et al., 2003, 2004; Makkar & Grisham, 2011). It has been suggested that engaging in positive mental imagery in anticipation of a feared event may counter automatic negative expectations and promote exposure willingness (Brunette & Schacter, 2021; Pictet, 2014; Saulsman et al., 2019).

Thus far, research on positive mental imagery interventions has mostly focused on memories of aversive events. For instance, during imagery rescripting, patients are asked to recall an aversive memory and imagine that the course of the event is changed into a more desired outcome (Arntz, 2012). This generally reduces anxiety symptomatology (Morina et al., 2017). In addition, previous research has shown that when socially anxious individuals hold a positive self-image in mind, they report lower anxiety, higher self-esteem, and enhanced performance during a social situation than when holding a negative self-image in mind (Stopa et al., 2012; Stopa & Jenkins, 2007; Vassilopoulos, 2005). Although these findings are promising, the differences between the positive and negative imagery groups may have been explained by increased fear in the negative imagery group instead of decreased fear in the positive imagery group. Indeed, a previous study in confident speakers has shown that differences between imagery type were mainly driven by the negative imagery (Hirsch et al., 2006). Therefore, to test whether positive imagery reduces fear-relevant responses and behavior, it is critical to compare a positive imagery group with a neutral or no-imagery control group. One study has compared negative, positive, and neutral self-imagery in individuals with social anxiety disorder and nonclinical participants, but unexpectedly found no differences between type of imagery (Ng & Abbott, 2016). The positive self-image was based on a previous social experience during which participants felt confident, assured, or at ease. However, socially anxious individuals can have difficulties retrieving detailed imagery of positive experiences (Moscovitch et al., 2011), so it may be more useful to generate positive mental imagery of future feared events to increase engagement in feared situations (see Pictet, 2014).

Using positive mental imagery of future events fits nicely with insights from cognitive science that suggest that positive episodic future thinking may be effective to prepare for exposure. Episodic future thinking refers to the ability to imagine events that may occur in someone's personal future (Schacter et al., 2017). People imagine emotional future-oriented events frequently (Barsics et al., 2016), which serves several adaptive functions (Bulley et al., 2017; Miloyan & Suddendorf, 2015). First, imagining emotional future-oriented events influences anticipatory emotions of these events (Barsics et al., 2016). Imagining more specific episodic details during future-oriented positive mental imagery of constructive behaviors can decrease anxiety towards feared events (Jing et al., 2016). In addition, future-oriented positive mental imagery can enhance positive affect (Schubert et al., 2020), and it can decrease later automatic responses to a stressful situation (Hagenaars et al., 2015). This suggests that future-oriented positive mental imagery may reduce anxiety before and during feared situations. Second, future-oriented mental imagery allows an individual to anticipate the likelihood of different outcomes, which motivates goal-directed approach and avoidance behavior (Bulley et al., 2017; Miloyan & Suddendorf, 2015). For example, imagining constructive behaviors with more specific episodic details improves problem solving, and is related to higher perceived plausibility of a positive outcome and decreased perceived difficulty to cope with a bad outcome (Jing et al., 2016). Also, in healthy participants and individuals with major depressive disorder, future-oriented positive mental imagery increased motivation and real-life engagement in these imagined activities (e.g., Libby et al., 2007; Renner et al., 2017, 2019). Likewise, imagining desired outcomes of future events can increase decision-making that contributes to achieving those outcomes (e.g., reduced caloric intake in overweight women wanting to improve eating habits; O'Neill et al., 2016).

Previous studies in anxiety indeed suggest that future-oriented positive mental imagery may reduce anxiety and increase exposure willingness (Hunt & Fenton, 2007; McEvoy et al., 2015), but they combined future-oriented positive mental imagery with other cognitive strategies, making it difficult to determine the specific effects of mental imagery. The current study investigates whether future-oriented positive mental imagery alone reduces anticipatory anxiety and increases willingness to engage in exposure in virtual reality (VR). VR-exposure for public speaking anxiety allows for standardization of the audience (Parsons, 2015; van Dis et al., 2021). In addition, VR-exposure generated comparable effects as exposure in vivo for various anxiety disorders (Carl et al., 2019; Emmelkamp & Meyerbröker, 2021), including social anxiety disorder (Emmelkamp et al., 2020) and public speaking anxiety (Reeves et al., 2021). Furthermore, the effects of VR-exposure generalize to real life in clinical samples (Morina et al., 2015).

More specifically, this study aimed to investigate whether a standardized future-oriented positive mental imagery exercise of a public speaking scenario would reduce public speaking anxiety before and during VR-exposure in individuals with moderate public speaking anxiety. First, we hypothesized that positive mental imagery, compared to no-task, would reduce anticipatory anxiety and increase exposure willingness. Second, we expected that it would decrease distress during exposure in VR and increase exposure duration. Finally, we explored whether positive mood changes may explain potential group differences, and whether positive mental imagery, compared to no-task, may improve participants' perception of their performance during exposure and reduce safety behavior during exposure (i.e., avoiding looking at the audience) because safety behavior can undermine exposure efficacy (e.g., van Uijen et al., 2018).

Methods

PARTICIPANTS

Native Dutch-speaking individuals were recruited via Utrecht University, Facebook, and an International Science ("InScience") Film Festival in Nijmegen, the Netherlands. They were asked to rate two items measuring anxiety and avoidance regarding giving a public presentation (0 = *none/never*; 8 = *extremely/always;* Culver et al., 2011). If they scored $\geq$ 5 on both items, they were screened on the exclusion criteria: self-reported medical complaints (e.g., cardiovascular, respiratory, or neurological difficulties), eyesight difficulty without glasses, nausea during 3D movies, and hearing difficulties. Previous research used $\geq$ 6 and $\geq$ 5 as cut-off score for anxiety and avoidance respectively (e.g., Niles et al., 2015), but the cut-off score for both items was set at $\geq$ 5 in the current study to increase feasibility in a naturalistic setting. Fifty-nine individuals completed the informed consent procedure and then the questionnaires. They were excluded from further participation (n = 5) if they had elevated scores on the Beck Depression Inventory (BDI-II; $\geq$ 18 and/or > 1 on suicidal ideation; Beck et al., 1996), because, given the naturalistic setting, it was not feasible to contact our sample after the study to find out whether depressive symptoms had worsened. In addition, participants were excluded from data analyses (n = 11) if they had relatively low anticipatory anxiety at t1 ($\leq$ 40, see main outcome measures; Engelhard et al., 2011). The final sample consisted of 43 participants, in line with the a priori power analysis indicating that at least 40 participants were needed to detect a medium effect size using mixed ANOVA with two measurements and two groups (f = .23; power = .80; α = .05). The Faculty of Social Sciences of Utrecht University gave ethical approval for this study (FETC19-121). This study is pre-registered on the Open Science Framework (https://osf.io/kap2w/).

MEASURES

Questionnaires

Personal Report of Confidence as a Speaker (PRCS). The PRCS is a 12-item self-report questionnaire that assesses public speaking anxiety (Hook et al., 2008). The 12-item version of the PRCS has good reliability, and convergent and divergent validity (Hook et al., 2008). An example item is "I am terrified at the thought of speaking before a group of people." The items were translated from English to Dutch and back-translated by independent researchers. Each statement is rated as true or false. All items endorsed as true are sum-scored. Higher scores reflect higher public speaking anxiety. Internal consistency was sufficient in this study (α = .66).

VR Experience Scale. The VR experience scale measures physiological complaints (nausea, headache, and dizziness), realness, immersion, and presence during the VR-presentation, and whether presenting in VR was as challenging as in real life, rated on a 5-point Likert scale (1 = *barely*; 5 = *very much*; van Dis et al., 2021). An example item is "The virtual reality environment looked real." Scores on physiological complaints were averaged.

Main Outcome Measures

Before VR-Exposure. Anticipatory anxiety ("How anxious would you be if you had to give a presentation in VR now?") and willingness ("How willing are you to give a presentation in VR now?") to present in front of a VR-audience were measured on two visual analog scales (VASs; 0 = *not at all*; 100 = *extremely*).

During VR-Exposure. At the start of the VR-exposure and at 1-minute intervals, participants rated distress on a 100-point Subjective Units of Distress scale (SUDS; 0 = *no distress*; 25 = *mild distress*; 50 = *moderate distress*; 75 = *severe distress*; 100 = *very severe distress;* Wolpe, 1990). Total VR-exposure duration was also measured.

Exploratory Outcome Measures

Mood. Mood was measured ("How do you feel now?") on a VAS (0 = *very unpleasant*; 100 = *very pleasant*).

Behaviors Checklist (BCL). The BCL is a self-report questionnaire with 18 items rated on a 9-point Likert scale assessing the quality of participants' behavior during their presentation (0 = *not at all*; 8 = *extremely*; Mansell & Clark, 1999; Stopa & Clark, 1993). We used a Dutch version that was translated and used in previous research (van Dis et al., 2021). Participants were asked to rate whether they displayed certain characteristics during VR-exposure. Example items are "confidence" and "quivering voice." Positive items were reverse-scored and a sum score was calculated. Higher scores reflect a more negative evaluation of participants' performance. Previous research demonstrated high internal consistency (van Dis et al., 2021; Vasey et al., 2012). Internal consistency was good in this study (α = .87).

Avoiding Looking at the VR-Audience. Participants rated whether they had looked at the audience during the presentation ("To what extend did you look at the audience during the presentation in the VR environment?") on a VAS (0 = *not at all*; 100 = *always*). A higher score was interpreted as lower use of safety behavior (i.e., avoidance of eye contact).

Intervention Characteristics

To check whether the positive mental imagery exercise was successful, participants rated whether the public speaking scenario was easy to imagine, was credible, had a positive ending, and changed appraisal regarding public speaking on VASs (0 = *not at all*; 100 = *very easy to imagine/credible/positive*). For changed appraisal, an extra anchor was used (0 = *negative change*; 50 = *no change*; 100 = *positive change*).

INTERVENTION PHASE

Positive Mental Imagery Exercise

The future-oriented positive mental imagery exercise was based on an imagery rescripting procedure (Frets et al., 2014), but was adapted to a future scenario. Participants were asked to close their eyes and listen to a 4-minute standardized audio script describing a public speaking scenario. They were instructed to imagine the scenario as detailed as possible from a first-person perspective, as if they were the person giving the presentation. The scenario started with negative thoughts and feelings of anticipatory anxiety (activation phase; e.g., "others will think I am stupid"; feeling anxious, racing heart). This activation phase lasted approximately 1.5 minutes. After the activation phase, anxiety dissipated, and the scenario ended positively (mastery phase; e.g., "I think I can do this"; heart rate slows, the audience is enthusiastic). The mastery phase lasted approximately 2.5 minutes.

No-Task Control

Participants in the no-task control condition immediately rated the main outcome measures again.

PROCEDURE

Participants were tested at InScience Festival 2019 (*n* = 23) and Utrecht University (*n* = 36; personal protective equipment was used [e.g., face mask] while testing 18 participants during the COVID-19 outbreak). Participants were told that the study was about presenting in virtual reality to minimize expectations for the positive mental imagery exercise and reduce potential placebo effects. Participants gave informed consent, completed BDI-II and PRCS, and provided demographic information (age, sex, educational level, occupation). After receiving instructions about the VR set-up and SUDS ratings, they practiced with SUDS ratings in a neutral VR environment. Then, participants rated their mood, willingness, and anticipatory anxiety (t1). Next, participants closed their eyes and were instructed to listen to an audio script with a neutral mental imagery exercise (i.e., grabbing a drink from the fridge) to practice mental imagery from a first-person perspective while trying to imagine as many details as possible. After random group assignment (stratified for age, sex, and employment status), they were asked to listen to the positive mental imagery exercise or continue with the measurements (i.e., no-task group). Then, all participants were asked to rate their mood, willingness, and anticipatory anxiety again (t2) and to undergo VR-exposure. They were instructed to present as long as possible or until they would be instructed to stop presenting (Culver et al., 2011). The maximum duration of the presentation was 5 minutes. They were also instructed that they could repeat themselves during the presentation. They chose a topic (climate change, smoking in public, or organ donation), rated its difficulty on a VAS (0 = *very easy*; 10 = *very difficult*), and prepared the presentation for 1 minute. Afterwards, they completed the BCL and rated their mood, willingness, anticipatory anxiety, avoidance of looking at the VR-audience, and VR experience (t3). Participants in the positive mental imagery condition rated how they experienced the exercise. Finally, all participants were debriefed and reimbursed.

Virtual Reality Environments

The neutral environment displayed a 360-degree picture of a living room. The speech environment depicted a 360-degree video of an audience in a meeting room with neutral to positive facial expressions (van Dis et al., 2021). Both environments were presented with an Oculus Rift headset.

Data Analyses

Confidence intervals (CI) were calculated for effect sizes using the MBESS package in R (Kelley, 2017). That is, 95% CI for Cohen's d and 90% CI for partial eta squared are reported (Lakens, 2013).

To test whether randomization was successful, independent samples t-tests were conducted for public speaking anxiety, age, VR experience, and speech topic difficulty. Similarly, potential group differences in sex, employment status, and educational level were assessed by chi-square tests. To determine how participants perceived the positive mental imagery exercise, descriptive statistics of the intervention characteristics were reported.

To determine whether the positive mental imagery group, relative to the no-task group, reported decreased anticipatory anxiety and increased exposure willingness, two separate 2 (time: pre-intervention vs. post-intervention) × 2 (condition: positive mental imagery vs. control) mixed ANOVAs were executed. Nearly all participants (91%) presented the maximum duration and completed all SUDS ratings (two dropouts in both groups). Therefore, to test whether the positive mental imagery group, relative to the control group, reported lower distress (SUDS) during VR-exposure, a 6 (time: SUDS) × 2 (condition: positive mental imagery vs. control) mixed ANOVA was conducted instead of analyzing the pre-registered max and mean SUDS scores. Paired or independent samples t-tests followed up significant ANOVAs. In addition, group differences in VR-exposure duration were not analyzed due to limited variance.

To explore whether anticipatory anxiety and willingness to present differed between groups after the VR-exposure, two separate 2 (time: pre-VR-exposure vs. post-VR-exposure) x 2 (condition: positive mental imagery vs. control) mixed ANOVAs were conducted. To explore whether mood differences over time might explain intervention effects, mood ratings were examined with mixed ANOVAs. Potential group differences in BCL scores and avoidance ratings were explored with independent samples t-tests.

Results

Randomization and Intervention Characteristics

There were no significant group differences in baseline characteristics, VR experience, and speech topic difficulty, indicating successful randomization (see Table 1).

Participants in the positive mental imagery condition generally indicated they could vividly imagine the positive mental imagery scenario (M = 73.27, SD = 19.41), found it credible (M = 71.09, SD = 23.05), and thought the ending was positive (M = 82.23, SD = 17.27). Moreover, they generally indicated that they experienced a positive change regarding their view of giving a presentation after the positive mental imagery exercise (M = 62.50, SD = 14.37). Collectively, this suggests that the positive mental imagery intervention was successful.

Before VR-Exposure

Anticipatory Anxiety

From before to after the intervention phase, anticipatory anxiety to give a presentation decreased (main effect time), $F(1, 41) = 4.14$, $p = .048$, $\eta_p^2 = .09$, 90% CI [.00, .24] (see Figure 1). Crucially, the Condition × Time interaction effect on anticipatory anxiety was not statistically significant, but there was a medium effect size, $F(1, 41) = 4.02$, $p = .051$, $\eta_p^2 = .09$, 90% CI [.00, .24]. Therefore, we further examined this interaction. Post-hoc analyses showed that anxiety decreased over time in the positive mental imagery group, $t(21) = 2.51$, $p = .020$, $d_z = 0.53$, 95% CI [0.08, 1.00], but not in the control group, $t(20) = 0.02$, $p = .981$, $d_z = 0.01$, 95% CI [-0.43, 0.44].

Table 1
Test Statistics for Group Comparisons of Randomization Variables: Means (Standard Deviations) for Age, PRCS, VR experience, and Speech Topic Difficulty, and Frequencies for Sex, Employment Status, and Education Level

	Positive mental imagery (n = 22)	Control (n = 21)	Test statistics
Age	32.40 (10.86)	30.53 (9.86)	$t(37) = 0.56$, $p = .577$, $d_s = 0.18$, 95% CI [-0.45, 0.80]
PRCS[†]	8.00 (2.62)	8.71 (1.90)	$t(41) = 1.02$, $p = .314$, $d_s = 0.31$, 95% CI [-0.29, 0.91]
Male/female	5/17	5/16	χ^2 (1) = .01, p = .933, Cramer's V = .01, 95% CI [.00, .23]
Student/employed	10/12	12/9	χ^2 (1) = .59, p = .443, Cramer's V = .12, 95% CI [.00, .42]
Education level			χ^2 (4) = 3.26, p = .515, Cramer's V = .28, 95% CI [.00, .48]
Secondary education	4	6	
Intermediate vocational education	4	2	
Applied university bachelor	7	4	
University bachelor	2	5	
University master	5	4	
VR experience			
Physical complaints	1.17 (0.30)	1.22 (0.46)	$t(41) = 0.47$, $p = .643$, $d_s = 0.14$, 95% CI [-0.46, 0.74]
Realness	3.50 (1.26)	3.24 (1.14)	$t(41) = 0.71$, $p = .479$, $d_s = 0.22$, 95% CI [-0.38, 0.82]
Immersion	3.55 (1.18)	3.48 (1.33)	$t(41) = 0.18$, $p = .857$, $d_s = 0.06$, 95% CI [-0.54, 0.65]
Presence	3.68 (1.17)	3.43 (1.29)	$t(41) = 0.68$, $p = .503$, $d_s = 0.21$, 95% CI [-0.39, 0.80]
VR as challenging as real life	2.95 (0.95)	3.38 (1.20)	$t(41) = 1.29$, $p = .203$, $d_s = 0.39$, 95% CI [-0.21, 1.00]
Speech topic difficulty	59.18 (14.80)	61.95 (20.01)	$t(41) = 0.52$, $p = .607$, $d_s = 0.16$, 95% CI [-0.44, 0.76]

Note. Age was missing for three participants (positive mental imagery, n = 2; control, n = 1). PRCS = Personal Report of Confidence as a Speaker, VR = virtual reality.
[†] There were no differences in PRCS scores between the testing sites.

Willingness
From before to after the intervention phase, there were no significant main or Condition × Time interaction effects on willingness to give a presentation, $Fs < 2.60$, $ps > .114$, $\eta_p^2s < .07$, 90% CI range [.00, .20] (see Figure 1).

DURING VR-EXPOSURE
There was a significant Condition × Time interaction effect on distress during VR-exposure, $F(2.45, 90.70) = 3.79$, $p = .019$, $\eta_p^2 = .09$, 90% CI [.01, .18] (see Figure 2). Post-hoc analyses demonstrated a linear decrease in SUDS during the VR-exposure in the positive mental imagery group, $F(1, 19) = 5.51$, $p = .030$, $\eta_p^2 = .23$, 90% CI [.01, .44], and an increase in the control group showing quadratic growth, $F(1, 18) = 13.31$, $p = .002$, $\eta_p^2 = .43$, 90% CI [.12, .60]. There were no main effects on SUDS, $Fs < 2.50$, $ps > .075$, $\eta_p^2s < .07$, 90% CI range [.00, .13].

Exploratory analyses

AFTER VR-EXPOSURE
From before to after the VR-exposure, anticipatory anxiety did not change in either group (no main effect time nor interaction effect), $Fs < 1.36$, $ps > .250$, $\eta_p^2s < .04$, 90% CI range [.00, .16] (see Figure 1). However, overall, the positive mental imagery group reported lower anticipatory anxiety than the control group (main effect condition), $F(1, 41) = 5.04$, $p = .030$, $\eta_p^2 = .11$, 90% CI [.01, .26]. From before to after the VR-exposure, there was no group difference on willingness to present (no main effect condition nor interaction effect), $Fs < 3.00$, $ps > .090$, $\eta_p^2s < .07$, 90% CI range [.00, .21], but willingness decreased in both

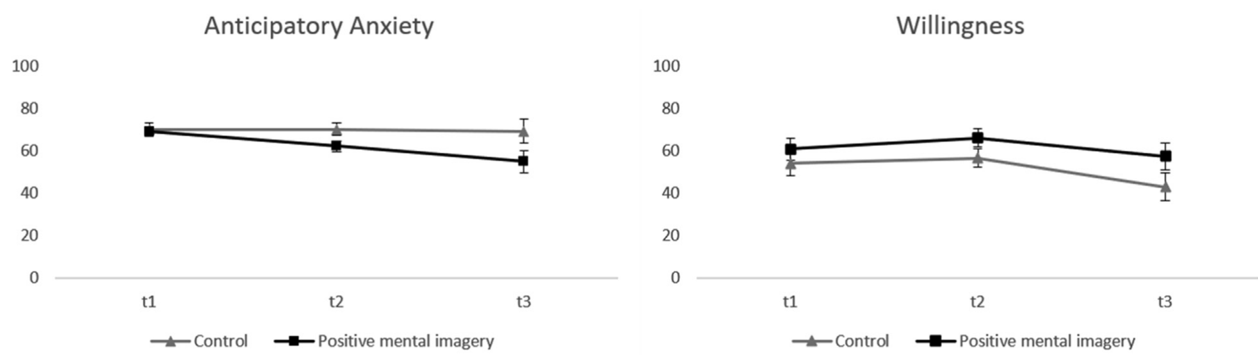

FIGURE 1 Anticipatory anxiety and willingness to give a presentation in virtual reality (VR) before the intervention phase (t1), after the intervention phase/before the VR-exposure (t2), and after the VR-exposure (t3) in the positive mental imagery and control groups. Error bars represent standard error of the mean.

groups (main effect time), $F(1, 41) = 9.60$, $p = .004$, $\eta_p^2 = .19$, 90% CI [.04, .35] (see Figure 1).

MOOD

From before to after the intervention phase, there was no group difference on mood (no main effect condition nor interaction effect), Fs < 0.34, ps > .567, η_p^2s < .01, 90% CI [.00, .10], but positive mood increased in both groups (main effect time), $F(1, 41) = 8.52$, $p = .006$, $\eta_p^2 = .17$, 90% CI [.03, .33] (see Table 2). From before to after the VR-exposure, mood became more negative in both groups (main effect time), $F(1, 41) = 42.47$, $p < .001$, $\eta_p^2 = .51$, 90% CI [.32, .63]. There was also a significant Condition × Time interaction effect on mood, $F(1, 41) = 7.31$, $p = .010$, $\eta_p^2 = .15$, 90% CI [.02, .31]. While there was no difference between groups in mood before the VR-exposure, $t(41) = 0.01$, $p = .994$, $d_s = 0.00$, 95% CI [-0.59, 0.60], mood was more negative in the control group than in the positive mental imagery group after the VR-exposure, $t(41) = 2.91$, $p = .006$, $d_s = 0.89$, 95% CI [0.25, 1.51]. This suggests that positive mental imagery reduced the increase in negative mood.

BCL

The positive mental imagery group rated their speech performance during VR-exposure more positively than the control group, $t(41) = 2.14$, $p = .039$, $d_s = 0.65$, 95% CI [0.03, 1.26] (see Table 2).

AVOIDING LOOKING AT THE VR-AUDIENCE

Groups did not differ in self-reported avoidance of looking at the audience, $t(41) = 0.43$, $p = .673$, $d_s = 0.14$, 95% CI [-0.47, 0.73] (see Table 2).

Discussion

This study investigated whether future-oriented positive mental imagery, compared to a no-task control condition, reduces anticipatory anxiety and increases exposure willingness in individuals with moderate public speaking anxiety. Positive mental imagery decreased anticipatory anxiety,

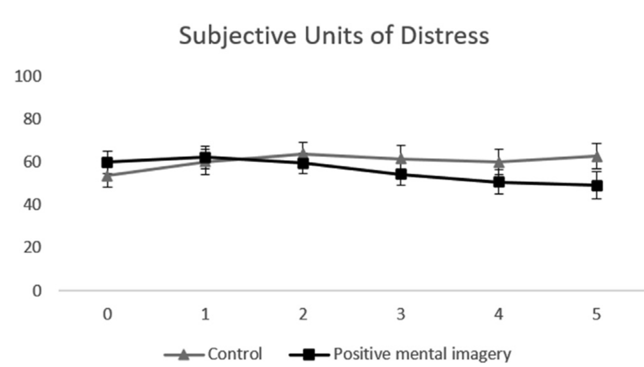

FIGURE 2 Subjective units of distress ratings during the VR-exposure at the start of the presentation and 1-minute intervals in the positive mental imagery and control groups. Error bars represent standard error of the mean.

Table 2
Means (Standard Deviations) of the Exploratory Variables Mood, Self-Reported Performance (BCL) and Avoidance of Looking at the VR-Audience

	Positive mental imagery (*n* = 22)	Control (*n* = 21)
Mood		
t1	49.45 (20.42)	53.29 (24.51)
t2	60.95 (17.49)	61.00 (21.40)
t3	47.95 (20.00)	29.57 (21.49)
BCL	85.63 (19.36)	97.81 (17.93)
Avoidance	74.45 (17.98)	77.38 (26.59)

Note. BCL = Behaviors Checklist, VR = virtual reality.

as predicted, but did not increase willingness to give a presentation in VR. Moreover, positive mental imagery reduced distress during exposure, which increased in the control condition. Finally, we could not examine differences in exposure duration due to a lack of variation. In sum, the study demonstrated that future-oriented positive mental imagery can decrease anticipatory anxiety and distress during actual exposure to a feared situation.

Positive mental imagery may have attenuated the emotional evocative power of negative mental imagery, which could encourage reappraisal of the feared event (Engelhard et al., 2019). It may induce episodic specificity of imagining constructive behaviors, which reduces anxiety and the subjective plausibility of negative outcomes (Jing et al., 2016). That is, imagining corrective information such as positive self-representations can result in reappraisal of the maladaptive beliefs that drive the negative outcome expectancies of the feared event (Arntz, 2012; Strachan et al., 2020). Similarly, positive mental imagery of future events can enhance perceived control over the situation (Boland et al., 2018; Hallford et al., 2018) and reduce the perceived difficulty of coping with a bad outcome (Jing et al., 2016). Thus, potentially due to reappraisal of the feared event, anticipatory anxiety and distress during VR reduced in the current study. Because we did not control for episodic specificity of the intervention, the mode of processing (e.g., imagery vs. verbal), or its valence, the exact working mechanisms of the intervention remain unclear. Also, although participants were not instructed about the actual aim of the study, placebo effects or demand characteristics may potentially have influenced the results. Future studies should examine these potential working mechanisms.

Next to the influence on emotion regulation, positive mental imagery of future events also influences motivation and decision-making to achieve long-term personal goals (Bulley et al., 2017; Schacter et al., 2017). Unexpectedly, future-oriented positive mental imagery did not increase exposure willingness in the current study. This may result from using a standardized script rather than an idiosyncratic script that is more personally relevant (Kearns & Engelhard, 2015; Lehner & D'Argembeau, 2016). Future research could examine ways to improve the efficacy of the intervention, such as by using an idiosyncratic script, or by investigating a potential benefit of repeatedly simulating the positive event rather than just once (Szpunar & Schacter, 2013; but see Boland et al., 2018). Additionally, knowing that presenting was part of the experiment might have resulted in a biased sample of participants that were more willing to present. This explanation is supported by the relatively high exposure willingness at the start of the study that remained stable during the intervention phase. It may be fruitful to investigate whether positive mental imagery enhances exposure willingness in individuals who are more reluctant to start exposure therapy, as well as its long-term efficacy.

Exploratory analyses showed that positive mental imagery did not increase positive mood compared to the no-task control group directly after the exercise. This suggests that the positive mental imagery exercise did not merely work through positive mood induction, which was also found in earlier imagery rescripting research (Hagenaars et al., 2015; Hagenaars & Arntz, 2012), but that the content of the mental imagery was important (Schacter et al., 2017). Furthermore, positive mental imagery resulted in a less negative mood after the VR-exposure (see also Schubert et al., 2020) and a more positive perceived speech performance than no-task control. These results corroborate previous findings that future-oriented positive mental imagery results in positively biased memories (Devitt & Schacter, 2018) and that positive mental imagery boosts task performance (e.g., Hirsch et al., 2003; Vassilopoulos, 2005). Although negative self-imagery increases safety behavior (Hirsch et al., 2004), we found no evidence that future-oriented positive mental imagery reduces (self-reported) avoidance of looking at the VR-audience in this study. Future research could include eye tracking as a more objective measure or investigate different safety behaviors (Cuming et al., 2009).

Several limitations are noteworthy. First, although the sample size was in line with the a priori power analysis, the study was underpowered to detect small effects. To aid the interpretation of our findings, we reported effect sizes and their confidence intervals. While *p*-values indicate whether an effect may rely on chance, it has been suggested that indicators of effect strength are more important than *p*-values (Cumming et al., 2012; Sullivan & Feinn, 2012). The effect sizes support the interpretation that the positive mental imagery exercise reduced anticipatory anxiety and distress during VR-exposure. Nonetheless, these findings await further replication, preferably with larger samples. Second, it remains unclear whether the findings generalize to clinical samples. Additionally, we did not collect information about participants' ethnic or cultural identification and socioeconomic status, which makes it difficult to determine generalization of the findings. Third, no objective ratings of automatic fear processing, such as psychophysiological outcomes (e.g., heart rate; Kearns & Engelhard, 2015), or speech performance (e.g., observer ratings) were used. Finally, nearly all participants completed the VR-exposure, so we could not examine potential group differences in VR-duration. This finding suggests that public speaking anxiety was not severe in the current sample. Indeed, SUDS were lower in the current sample than in previous research using VR-exposure (van Dis et al., 2021), and PRCS scores were moderate (50^{th} percentile; Heeren et al., 2013). The finding may also suggest that VR-exposure is not as challenging as exposure in vivo, although attrition rates for these interventions are quite similar (Benbow & Anderson, 2019) and SUDS were still quite high. Future research may examine whether a future-oriented positive mental imagery exercise reduces attrition in clinical samples and investigate potential differences between exposure in VR and in vivo. This study's strengths include using a standardized future-oriented positive mental imagery exercise and a standardized exposure session that can be easily applied in (online) interventions.

To conclude, the current study demonstrated that positive mental imagery of a feared situation reduced anticipatory anxiety and distress during the feared situation. It did not increase willingness to engage in the feared situation. Future studies should investigate ways to enhance their efficacy, especially for willingness to engage in and anxiety for exposure-based treatment. For now, the results are promising for individuals who are anxious to engage in feared situations.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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