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Future-oriented imagery rescripting facilitates conducting behavioral experiments in social anxiety

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ABSTRACT

Distressing mental images are common in anxiety disorders and can make it difficult for patients to confront feared situations. This study examined whether imagery rescripting focused on a feared social situation prepares participants to engage in a feared situation. Sixty healthy individuals were asked to formulate a behavioral experiment to test negative beliefs about a social situation they feared. They were assigned to one of two groups: imagery rescripting focused on the feared outcome of the behavioral experiment or no imagery rescripting (i.e., a break). All participants were then asked to complete ratings scales and to conduct the behavioral experiment. Before the behavioral experiment, the imagery rescripting condition, compared to the control condition, showed reduced anticipated probability and severity of the feared outcome, lower anxiety and helplessness levels, and increased willingness to conduct the behavioral experiment. Imagery-based interventions focused on feared outcomes seem promising to prepare anxious individuals to engage in treatment.

1. Introduction

The efficacy of cognitive behavioral therapy (CBT) for social anxiety disorder is well established (National Institute for Health and Clinical Excellence, 2011), and a core technique according to cognitive models is behavioral experiments (e.g., Clark & Wells, 1995). In behavioral experiments, patients test the validity of their dysfunctional negative beliefs in real-life situations (Bennett-Levy et al., 2004). It has been suggested that setting up exposure as a behavioral experiment can promote inhibitory learning (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). However, attrition rates for CBT in anxiety disorders are high; studies have found that 11–20% of patients drop-out before CBT starts, and another 20–24% drop out during treatment (Bentley et al., 2021; Carpenter et al., 2018; Fernandez, Salem, Swift, & Ramtahal, 2015).

One potential explanation for these high attrition rates is that patients are unwilling or unable to confront their fears during CBT (Benbow & Anderson, 2019). This may result from mental imagery about feared outcomes. Distressing mental imagery is common in anxiety disorders, including social anxiety disorder (Clark & Wells, 1995; Rapee & Heimberg, 1997; for a review, see; Ng, Abbott, & Hunt, 2014), in which it is commonly related to social memories (Hackmann, Clark, & McManus, 2000) and represents feared outcomes (e.g., 'looking foolish'; Hackmann, Surawy, & Clark, 1998). Such negative self-imagery appears to play a role in the maintenance of social anxiety disorder. Previous research has demonstrated that it increases anxiety, negative thoughts, and use of safety behaviors and decreases performance quality in social situations (Hirsch et al., 2003, 2004, 2006; Stopa & Jenkins, 2007; Vassilopoulos, 2005). Moreover, negative mental imagery may serve to maintain anxiety and avoidance behavior (Krypotos, Mertens, Leer, & Engelhard, 2020) and to impede extinction learning (Mertens, Krypotos, & Engelhard, 2020). Thus, updating such images is a promising approach to increase willingness to engage in behavioral experiments and perhaps also to reduce attrition rates.

One method to update negative or distressing memories is imagery rescripting. This intervention typically consists of three phases (Arntz & Weertman, 1999; Wild & Clark, 2011). In the first phase, patients are asked to relive a negative memory as their younger self. In the second phase, they are instructed to relive the memory again, but now as their adult self. They are instructed to imagine aiding the younger self in the memory and attending to their unmet needs. In the third phase, they are asked to relive the memory once again as their younger self, but now they also imagine previous phase's modifications. They can make more changes if they desire. Imagery rescripting is a promising treatment for

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social anxiety disorder (e.g., Frets, Kevenaar, & Van Der Heiden, 2014; Nilsson, Lundh, & Viborg, 2012; Norton & Abbott, 2016; Romano, Moscovitch, Huppert, Reimer, & Moscovitch, 2020; Wild, Hackmann, & Clark, 2007, 2008), and other anxiety-related disorders (for a meta-analysis see Morina, Lancee, & Arntz, 2017).

Imagery rescripting typically focuses on distressing memories of past events, but negative imagery in social anxiety disorder can also represent anticipated future threats. Such vivid and unpleasant "flashforwards" are a transdiagnostic process in anxiety disorders (see Brewin, Gregory, Lipton, & Burgess, 2010; Engelhard et al., 2011, 2010; Holmes & Mathews, 2010). Individuals with anxiety disorders tend to imagine negative future scenarios more vividly, and with higher associated distress and perceived likelihood than healthy participants (Morina, Deeprose, Pusowski, Schmid, & Holmes, 2011). In addition, compared to non-anxious persons, they report lower vividness ratings for positive future events and find it less plausible that these events will occur in their future. Thus, individuals with anxiety disorders perceive the future more negatively.

The capacity to imagine events that may occur in an individual's personal future is called episodic future thinking (Bulley, Henry, & Suddendorf, 2017; Miloyan & Suddendorf, 2015; Schacter, Benoit, & Szpunar, 2017). It influences anticipatory emotions (Barsics, Van der Linden, & D'Argembeau, 2016) and enables individuals to estimate the probability of different outcomes and associated costs, motivating goal-directed behavior to achieve long-term personal goals (Bulley et al., 2017; Miloyan & Suddendorf, 2015). Imagining positive future events can also increase motivation and actual undertaking of the imagined activities (Libby, Shaeffer, Eibach, & Slemmer, 2007; Renner, Ji, Pictet, Holmes, & Blackwell, 2017, 2019).

Applying imagery rescripting to future-related negative mental imagery may be a way to reduce avoidance of feared social situations. Previous research in social anxiety disorder found reduced attrition rates when standard CBT was combined with imagery enhancements, such as imagery rescripting and positive imagery of new core beliefs, compared to standard CBT (McEvoy, Erceg-Hurn, Saulsman, & Thibodeau, 2015). However, the results are limited by a lack of randomization to treatment, and it remains unclear whether specifically future-oriented positive imagery contributed to reduced attrition rates. Another study in individuals with fear of public speaking showed that a future-oriented positive mental imagery exercise reduced anticipatory anxiety and distress during virtual reality exposure compared to no intervention but it did not enhance exposure willingness (Landkroon, van Dis et al., 2021). Perhaps exposure willingness did not increase because this study used a standardized future-oriented positive mental imagery exercise, while episodic future thinking has a more substantial impact when personally relevant goals are imagined (Lehner & D'Argembeau, 2016). To conclude, these studies highlight the potential of adding future-oriented imagery rescripting to a CBT intervention to reduce anxiety and attrition rates.

The current study aimed to investigate in healthy participants whether personalized imagery rescripting focused on a feared social behavioral experiment, compared to no imagery rescripting, reduces fear of the behavioral experiment and increases willingness to carry it out. More specifically, we hypothesized that future-oriented imagery rescripting, compared to no imagery rescripting, would (1) decrease the anticipated probability and severity of the negative outcome of the experiment, (2) reduce anxiety and helplessness related to the experiment and (3) increase participants' willingness to conduct it. We explored whether imagery rescripting increased efficacy of the behavioral experiment by further reducing the anticipated probability and severity of the negative outcome, anxiety and helplessness levels, and increasing participants' willingness to conduct a similar behavioral experiment.

2. Methods

2.1. Participants

Recruitment took place at Utrecht University and via social media. Individuals were included if they scored within the normal range on the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998). Based on previous research, we set the cut-offs at $\geq$10 and $\leq$30 (Carleton, Collimore, & Asmundson, 2007; Voncken & Dijk, 2013). Individuals with high social anxiety were excluded from participation in case there would be adverse effects. A priori exclusion criteria were: self-reported serious medical condition (e.g., heart problems, respiratory difficulties or neurological symptoms), self-reported current psychological difficulties (measured with one item), and/or treatment by a psychiatrist or psychologist. Seventy-two participants enrolled in the study. During the study, 10 of them were excluded, because they could not formulate a behavioral experiment that could be immediately conducted on campus or because they rated their negative outcome probability and/or severity lower than 40% (these criteria were set beforehand). Two participants quit prematurely, because they were too upset during the experiment. The final sample that completed the experiment and was included in the analyses consisted of 60 participants. The sample size is in line with the a priori power analysis, which indicated that at least 60 participants were needed to detect a small to medium effect size using mixed ANOVAs with two measurements and two groups (f = 0.18; power = .80; α = 0.05). Participants were compensated with course credit or money (€2 per 15 min). All of them gave written informed consent. The Ethics Committee of the Faculty of Social Sciences from Utrecht University gave ethical approval (FETC15-080). The study was pre-registered (including the power analysis) on the Open Science Framework (https://osf.io/b745c/).

2.2. Measures

2.2.1. Main outcome measures

Anticipated negative outcome probability and severity of the behavioral experiment were measured with visual analog scales (VAS; 0 = *not at all likely/not at all*; 100 = *very likely/horrible*; see Craske, 2015). Three VASs were added to measure current anxiety and helplessness while thinking of the behavioral experiment and willingness to conduct the behavioral experiment (0 = *none/not at all willing*; 100 = *extreme/-extremely willing*).

2.2.2. Exploratory measures

First, we assessed how many participants actually completed the behavioral experiment in each group (*yes/no*). Second, the level of distress during the behavioral experiment was measured retrospectively on a VAS (0 = *none*; 100 = *extreme*; see Craske, 2015). Third, safety behavior was measured on two VASs to assess whether participants completed the behavioral experiment as planned and whether they used safety behavior (0 = *not at all*; 100 = *extremely well/a lot*). Finally, the experimenter guided participants to formulate a general conditional statement of what they were mostly worried about in social situations (e.g., "If I make a mistake, others will not like me"). The validity of this statement was measured on a VAS (0 = *not at all likely*; 100 = *extremely likely*) to examine whether imagery rescripting and the behavioral experiment influenced the validity of this general statement.

2.2.3. Imagery rescripting characteristics

To assess whether imagery rescripting was carried out well, participants were asked to rate on VASs whether their imagery script was easy to imagine, ended positively, and was credible (0 = *not at all easy to imagine/positive/credible*; 100 = *very easy to imagine/positive/credible*; Landkroon, van Dis et al., 2021). Additionally, they were asked to rate whether imagery rescripting had changed how they thought about conducting the behavioral experiment on a VAS (0 = *more negatively*; 50

= *no change*; 100 = *more positively*).

2.3. Questionnaires

2.3.1. Social Interaction Anxiety Scale (SIAS)

The SIAS consists of 20 items that assess social anxiety (Mattick & Clarke, 1998). All items were answered on a 5-point scale (0 = *not at all typical of me*; 4 = *very typical of me*). Three items were reverse-scored, and then all items were summed (range 0–80). A higher score reflects a higher level of social anxiety. Item 14 was changed from "I have difficulty talking to attractive people from the opposite sex" to "I have difficulty talking to people whom I feel attracted to". Internal consistency was poor in this study (α = 0.56).

2.3.2. Brief Fear of Negative Evaluation Scale (BFNE)

The BFNE consists of 12 items assessing whether someone fears negative evaluation from others (Leary, 1983). Items were scored on a 5-point Likert scale (1 = *not at all characteristic of me*; 5 = *extremely characteristic of me*). The BFNE was used to help individuals formulate their general conditional statement (see 2.5 'Behavioral experiment') and was not further analyzed.

2.4. Intervention phase

2.4.1. Imagery rescripting group

Participants were first asked to practice imagining a future neutral event as vividly as possible for 1 min (i.e., cutting a lemon), as if it was happening here and now. They were asked to close their eyes and focus on all sensory modalities and describe the situation. Then the imagery rescripting instructions followed. This procedure was based on the protocol of Frets et al. (2014), which was adapted to fit future scenarios by asking participants to imagine the whole scene as their current self and by omitting phase three (the 'compassionate' phase). In phase one, participants were asked to imagine the feared outcome of their behavioral experiment again for about 1 min. In phase two ('mastery'), they were instructed to intervene when the worst outcome was about to happen by ending the imagery positively in any way they wanted. The second phase lasted approximately 5 min. If participants finished the rescripting quickly, they were asked to repeat the mastery phase and were allowed to make changes to the scenario.

2.4.2. No imagery rescripting control group

Another experimenter pretended to complete a chore in the lab and explained that participants had a break until the original experimenter returned. During this time, participants were allowed to use their phones, read a magazine, or go to the bathroom.

2.5. Behavioral experiment

2.5.1. Designing behavioral experiment (part A)

Participants filled in the BFNE about situations they were worried about. The experimenter then guided them to formulate a general conditional statement based on their answers on the BFNE. Based on this statement, they were asked to formulate a behavioral experiment that could immediately be conducted to test their general conditional statement (following Bennett-Levy et al., 2004; OxCADAT Resources, 2020). Behavioral experiments were individually tailored. Examples included asking a stranger what time it was while standing in front of a clock, starting a conversation with a stranger, and asking classmates what time a lecture would start. Participants were asked to close their eyes and imagine their worst fear about what could happen during the behavioral experiment. Afterward, they were asked to describe the behavioral experiment on a record sheet (OxCADAT Resources, 2020) and rate their perceived probability and severity of the anticipated negative outcome.[1] If these ratings were not above 40%, then the behavioral experiment was adjusted (see for similar argument Engelhard et al., 2011). If the ratings were then still below 40%, the person was excluded from further participation.

2.5.2. Conducting behavioral experiment (part B)

Participants were asked to conduct the behavioral experiment immediately on the campus. The experimenter accompanied each participant to see whether they completed it. The experimenter was instructed not to speak with the participants during this time and to remain neutral during the procedure (i.e., without encouraging participants or providing feedback to them). During the behavioral experiment, the experimenter kept distance to ensure that other individuals were unaware that the experimenter was observing the participant.

2.6. Procedure

Participants were tested individually. After participants designed their behavioral experiment (part A), they completed the main outcome measures on a computer and rated the validity of the general conditional statement (t1), see Fig. 1. The experimenter then explained that she would consult a colleague to discuss the behavioral experiment and left the room.

Then, a second experimenter entered the lab to guide the intervention phase and ensure that the first experimenter guiding the behavioral experiment remained blind to condition. Participants were then randomly assigned to the imagery rescripting group or the no imagery rescripting control group (stratified for sex and SIAS score). The total duration of each intervention was approximately 11 min. After the intervention, participants were asked to complete the main outcome measures and rate the validity of their general conditional statement again (t2). Then, the second experimenter left the room.

The first experimenter re-entered the room and asked participants to conduct their behavioral experiment (part B). After conducting or refusing to complete the behavioral experiment, they were asked to imagine that they had to conduct the behavioral experiment again. They were then asked to complete the main outcome measures (t3), and to rate the validity of the general conditional statement, their distress during the behavioral experiment, and their use of safety behaviors (t3). In the imagery rescripting condition, participants were also asked to rate how they experienced imagery rescripting. Finally, all participants were debriefed and reimbursed.

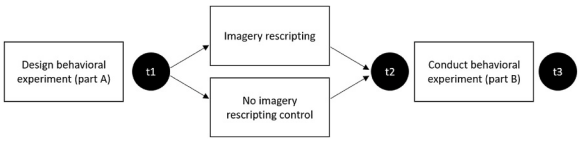

Fig. 1. Overview of the experiment. The circles represent the main outcome measurements.

[1] These measures highly correlated with the outcome measures assessed later on a computer. Moreover, the results of the analyses on the data of the behavioral experiment form were similar to the main outcome measures. Therefore, these data are not reported in the result section.

2.7. Data analyses

The data were analyzed within a Null-Hypothesis Significance Testing and a Bayesian framework (Krypotos et al., 2020; Landkroon, Salemink, & Engelhard, 2021). Within the Null-Hypothesis Significance Testing framework, confidence intervals for effect sizes were calculated using the MBESS package in R (Kelley, 2017). Within the Bayesian framework, Bayes factors were calculated that measure the amount of evidence the data provides for the alternative hypothesis relative to the null hypothesis using the default settings in JASP (JASP Team, 2020). A $BF_{10} = 3$ indicates that the data are three times more likely under the alternative hypothesis than the null hypothesis, while the opposite is true for $BF_{10} = 0.333$.

2.7.1. Randomization and imagery rescripting characteristics

To examine whether randomization was successful, independent samples *t*-tests on age and SIAS score and a chi-square test on sex distribution were used. Additionally, descriptive statistics of the imagery rescripting characteristics were studied to check whether imagery rescripting was carried out well.

2.7.2. Main analyses

To examine whether imagery rescripting, compared to no imagery rescripting, reduced the anticipated negative outcome probability and severity of the behavioral experiment, anxiety and helplessness levels, and increased willingness, separate 2 (time: pre vs. post intervention) x 2 (condition: imagery rescripting vs. control) mixed ANOVAs were done. Significant results were followed up by paired *t*-tests.

2.7.3. Exploratory analyses

First, we aimed to explore whether more participants in the imagery rescripting group conducted the behavioral experiment than in the control group. However, all participants completed the behavioral experiment, so this analysis could not be carried out. Second, to explore whether, relative to the control group, the imagery rescripting group reported lower distress and safety behaviors during the behavioral experiment, independent samples *t*-tests were used. Third, to explore whether the imagery rescripting group reported lower anticipated probability and severity of the negative outcome of the behavioral experiment, anxiety, and helplessness, and more willingness to conduct a similar behavioral experiment, two 2 (time: pre vs. post behavioral experiment and pre intervention vs. post behavioral experiment) x 2 (condition: imagery rescripting vs. control) mixed ANOVAs were conducted. The analysis from pre intervention to post behavioral experiment was not reported in the pre-registration. Significant results were followed up by paired *t*-tests. Finally, to explore whether the imagery rescripting group showed a decrease in the validity of the general conditional statement after the behavioral experiment compared to the control group, three 2 (time: pre vs. post intervention, pre vs. post behavioral experiment, and pre intervention vs. post behavioral experiment) x 2 (condition: imagery rescripting vs. control) mixed ANOVAs were conducted. Significant results were followed by paired *t*-tests. The analysis from pre intervention to post behavioral experiment was not reported in the pre-registration.

3. Results

3.1. Randomization and imagery rescripting characteristics

The imagery rescripting group was, on average, older than the control group (see Table 1).[2] Groups did not differ in SIAS scores or sex distribution.

Table 1
Means (standard deviations) and test statistics [95% confidence interval] of age (years) and social anxiety level (SIAS), and sex (frequency) for the two conditions.

	Imagery rescripting (n = 30)	Control (n = 30)	Test statistics
Age	22.60 (2.84)	21.40 (1.50)	$t(44.04) = 2.05$, $p = .046$, $d_s = 0.53$ [0.01, 1.04], $BF_{10} = 1.486$
Male/ female	6/24	7/23	$\chi^2(1) = .10$, $p = .754$, Cramer's $V = .04$ [0.00, 0.28], $BF_{10} = 0.388$
SIAS	19.80 (5.67)	19.57 (5.85)	$t(58) = 0.16$, $p = .876$, $d_s = 0.00$ [-0.50, 0.51], $BF_{10} = 0.265$

Note. SIAS = Social Interaction Anxiety Scale.

3.1.1. Imagery rescripting characteristics

The imagery rescripting group reported that they could vividly imagine the scenario ($M = 77.13$, $SD = 19.51$), and thought the scenario was credible ($M = 65.37$, $SD = 21.37$) and had a positive ending ($M = 89.03$, $SD = 8.94$). They also indicated that they thought more positively about the behavioral experiment after the imagery rescripting ($M = 73.20$, $SD = 17.79$). Overall, this indicates that participants carried out imagery rescripting well.

3.2. Main outcome measures

The separate mixed ANOVAs on the main outcomes from before (t1) to after the intervention phase (t2) showed a significant main effect of Time, $Fs > 6.56$, $ps < .014$, $\eta_p^2 s > 0.10$, 90% CI range[3] [0.01, 0.48], $BFs_{10} > 2.510$, but no main effect of Condition, $Fs < 1.73$, $ps > .193$, $\eta_p^2 s < 0.03$, 90% CI range [0.00, 0.13], $BFs_{10} < 0.621$, except for the severity of the expected outcome, $F(1, 58) = 17.27$, $p < .001$, $\eta_p^2 = 0.23$, 90% CI [0.09, 0.37], $BF_{10} = 214.895$, see Fig. 2. As predicted, all Time × Condition interactions were significant, $Fs > 6.86$, $ps < .012$, $\eta_p^2 s > 0.10$, 90% CI range [0.01, 0.52], $BFs_{10} > 4.208$. Paired samples *t*-tests for the imagery rescripting group demonstrated decreases from t1 to t2 for the anticipated probability of the negative outcome, anxiety, and helplessness, and increases for willingness to do the experiment, $ts > 2.87$, $ps < .008$, $d_z s > 0.52$, 95% CI range [0.14, 1.81], $BFs_{10} > 5.783$. These variables did not significantly change over time for the control group, $ts < 1.36$, $ps > .185$, $d_z s < 0.25$, 95% CI range [−0.35, 0.61], $BFs_{10} < 0.445$. Both groups showed decreases in the anticipated severity of the negative outcome, but this decrease was larger in the imagery rescripting group, $t(29) = 4.45$, $p < .001$, $d_z = 0.81$, 95% CI [0.39, 1.22], $BF_{10} = 227.233$, than in the control group, $t(29) = 2.99$, $p = .006$, $d_z = 0.55$, 95% CI [0.16, 0.93], $BF_{10} = 7.302$. These findings indicate that, compared to no imagery rescripting, imagery rescripting was successful in reducing the anticipated probability and severity of the negative outcome of the behavioral experiment as well as associated anxiety and helplessness, and in increasing willingness to engage in the behavioral experiment.

3.3. Exploratory analyses

3.3.1. Conducting the behavioral experiment

There were no group differences in self-reported distress during the behavioral experiment, compliance with the experiment, or safety behavior use (see Table 2).

3.3.2. After the behavioral experiment

Separate mixed ANOVAs from before (t2) to after the behavioral

[2] When age was entered as a covariate in the main outcome analyses, the ANOVAs still demonstrated the crucial significant Time × Condition interactions. Therefore, we report results without age as covariate.

[3] When test statistics are summarized, the CI range shows the lowest and highest bound of all summarized effect sizes.

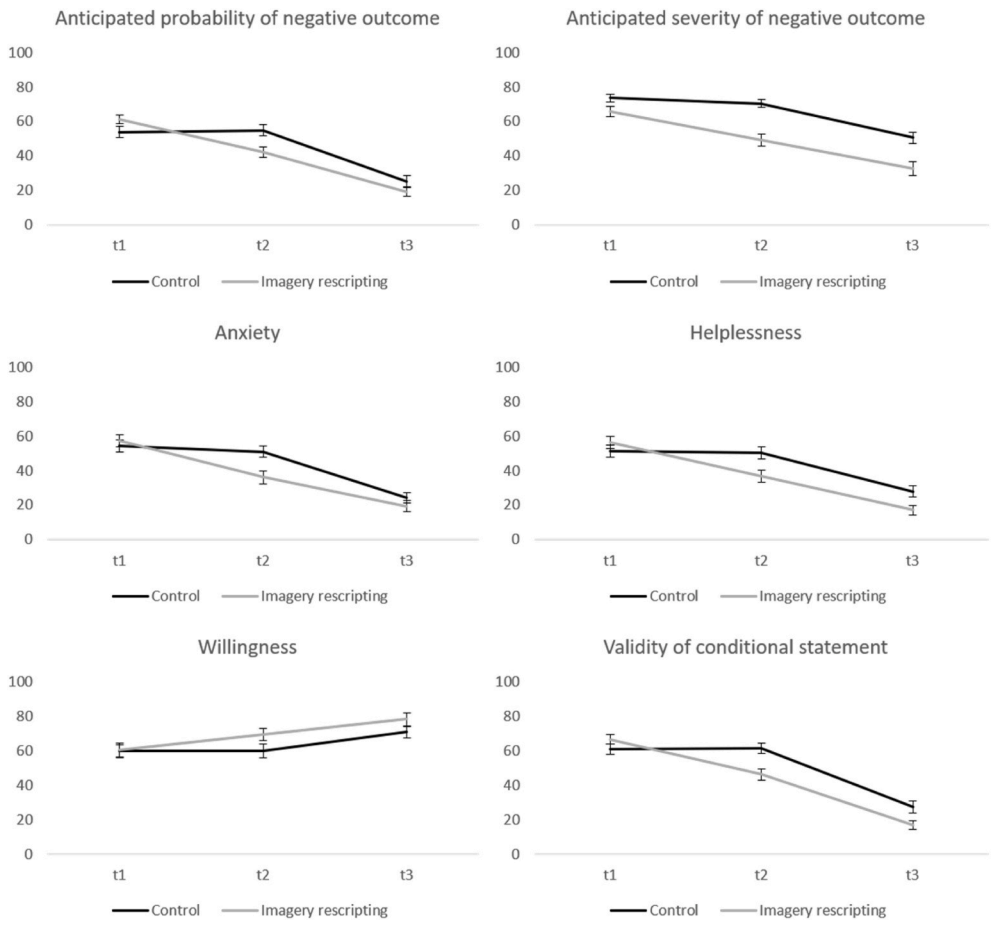

Fig. 2. Means for the main outcome measures and validity of the conditional statement before the intervention (t1), after the intervention/before the behavioral experiment (t2), and after the behavioral experiment (t3) in the no imagery rescripting control and imagery rescripting groups. Error bars represent standard error of the mean.

Table 2
Means (standard deviations) and test statistics [95% confidence interval] of distress during and compliance with the behavioral experiment, and use of safety behavior.

	Imagery rescripting (n = 30)	Control (n = 30)	Test statistics
Distress	48.80 (21.63)	50.53 (21.20)	$t(58) = 0.31$, $p = .755$, $d_s = 0.08$ [-0.43, 0.59], $BF_{10} = 0.273$
Compliance	85.10 (12.36)	83.30 (19.17)	$t(58) = 0.43$, $p = .667$, $d_s = 0.11$ [-0.40, 0.62], $BF_{10} = 0.284$
Safety behavior	37.63 (25.74)	34.07 (20.53)	$t(58) = 0.59$, $p = .555$, $d_s = 0.15$ [-0.36, 0.66], $BF_{10} = 0.304$

experiment (t3) demonstrated strong reductions over time in the anticipated probability and severity of the negative outcome, anxiety, and helplessness, and an increase in willingness, $Fs > 35.20$, $ps < .001$, $\eta_p^2 s > 0.37$, 90% CI [0.21, 0.75], $BFs_{10} > 69273.512$, see Fig. 2. This indicates that the behavioral experiment was successful in both groups. The Time × Condition interaction was only significant for anxiety, $F(1, 58) = 4.88$, $p = .031$, $\eta_p^2 = 0.08$, 90% CI [0.00, 0.20], $BF_{10} = 1.876$. Anxiety decreased in both groups, but this decrease was larger in the control group, $t(29) = 7.74$, $p < 001$, $d_z = 1.41$, 95% CI [0.90, 1.92], $BF_{10} = 856559.278$, than in the imagery rescripting group, $t(29) = 5.49$, $p < 001$, $d_z = 1.00$, 95% CI [0.56, 1.44], $BF_{10} = 3111.865$.

In addition, from before the intervention phase (t1) to after the behavioral experiment (t3), there was a significant main effect for Time, $Fs > 34.53$, $ps < .001$, $\eta_p^2 s > 0.37$, 90% CI range [0.21, 0.83], $BFs_{10} > 48975.124$, see Fig. 2. Interestingly, there was a significant Time × Condition interaction for the expected probability of the negative outcome and helplessness, $Fs > 6.77$, $ps < .013$, $\eta_p^2 s > 0.10$, 90% CI range [0.01, 0.28], $BFs_{10} > 4.348$. Although in both groups the expected probability of the negative outcome and helplessness decreased, there was a larger reduction in the imagery rescripting group, $ts > 10.92$, $ps < .001$, $d_z s > 1.99$, 95% CI range [1.37, 2.89], $BFs_{10} > 1.039 \times 10^9$, than in the control group, $ts > 5.90$, $ps < .001$, $d_z s > 1.07$, 95% CI range [0.62, 2.22], $BFs_{10} > 8815.773$. This reflects that imagery rescripting had an additional effect on reducing the anticipated probability of the negative outcome and helplessness levels, above and beyond the efficacy of the behavioral experiment.

3.3.3. *General conditional statement*

These data are in line with the results on the probability of the negative expected outcome and are reported in the Supplementary Materials.

4. Discussion

This study examined whether imagery rescripting focused on future negative mental imagery related to a behavioral experiment would reduce the fearful anticipation of the behavioral experiment. As hypothesized, the imagery rescripting group showed a lower anticipated probability and severity of the negative outcome of the behavioral

experiment, as well as less anxiety and helplessness, and more willingness to conduct the behavioral experiment, compared to the no imagery rescripting group. In sum, the imagery rescripting group showed reduced fearful anticipation of a behavioral experiment.

Previous research has demonstrated that imagery rescripting is useful to update distressing memories in social anxiety disorder (e.g., Wild et al., 2007, 2008) and anxiety-related disorders in general (Morina et al., 2017). Yet, negative mental imagery of future events, so-called flashforwards, are also common in anxiety disorders (Brewin et al., 2010; Engelhard, van den Hout, Janssen, & van der Beek, 2010; Holmes & Mathews, 2010) and may maintain anxiety and reduce extinction learning (e.g., Krypotos et al., 2020; Mertens et al., 2020; Mueller, Sperl, & Panitz, 2019). Several studies so far have examined how such future-oriented images that may prevent facing feared situations can be modulated, and they have shown that another mental imagery-based intervention, namely eye movement desensitization and reprocessing (EMDR), has great potential (see Engelhard, McNally, & van Schie, 2019; e.g., Engelhard et al., 2010). Additionally, imaginal exposure to feared future outcomes could be effective in social anxiety disorder (Huppert, Roth, & Foa, 2003), but this is an empirical question that awaits future research. To our knowledge, no prior studies have yet investigated imagery rescripting focused on future-oriented negative mental imagery. Our findings suggest that imagery rescripting is not only effective to modulate distressing memories (Morina et al., 2017), but also to modulate future-oriented mental imagery.

The basic premise of the violation of expectancy approach is that extinction learning is enhanced by the mismatch between expectancy and experience, which implies that strategies that reduce the expectancy prior to extinction can negatively impact extinction learning (by reducing the mismatch between initial expectancy and actual outcome; Craske, Treanor, Zbozinek, & Vervliet, 2022). Our results showed that the effects of the behavioral experiment were not reduced by adding imagery rescripting, but potentially were even enhanced because the anticipated probability of the negative outcome, helplessness levels, and the validity of the general conditional statement were reduced even further compared to a behavioral experiment alone. Accordingly, the imagery rescripting intervention could fit within an approach of gradual exposures that increasingly optimize the conditions during which violation of expectancies can occur (Craske et al., 2022). That is, our findings suggest that future-oriented imagery rescripting could be used as a lower-level exposure exercise when individuals are too anxious to confront feared situations immediately during treatment. Such an approach is similar to strategies that start with imaginal exposure (Heimberg, 2002; Huppert et al., 2003), or role play as rehearsal for real-life situations (Heimberg, 2002). An important next step is to investigate in (sub)clinical samples whether future-oriented imagery rescripting enhances patients' willingness to expose themselves to fear-provoking situations in treatment.

The working mechanisms of this future-oriented imagery rescripting intervention can be explained with insights on episodic future thinking (Schacter et al., 2017). Imagining future events that can occur in someone's personal future influences anticipatory emotions and the plausibility of outcomes of future events, and motivates behavior (Bulley et al., 2017; Miloyan & Suddendorf, 2015; Schacter et al., 2017). Similar to our findings, previous studies showed that imagining positive future events has positive effects. First, research has demonstrated that increasing specific details in positive episodic future thinking decreases anxiety and the plausibility of negative outcomes and increases the plausibility of positive outcomes (e.g., Boland, Riggs, & Anderson, 2018; Hallford et al., 2020; Jing, Madore, & Schacter, 2016). Second, previous work has shown that detailed positive mental imagery of future events increases perceived control over the future situation (Boland et al., 2018; Hallford, Austin, Takano, & Raes, 2018) and higher perceived coping when a bad outcome would occur (Jing et al., 2016). Finally, previous research has shown that positive mental imagery of future events can serve as a "motivational amplifier" and increase motivation to engage in activities (e.g., Holmes & Mathews, 2010; Renner, Murphy, Ji, Manly, & Holmes, 2019). An important avenue for future research is to elucidate the working mechanism of imagery rescripting. Additionally, future studies may use insights from cognitive science to optimize the intervention even further. For instance, imagining more specific details during imagery rescripting focused on future events (Jing et al., 2016) or repeating imagery rescripting may result in enhanced efficacy (Szpunar & Schacter, 2013; but see Boland et al., 2018).

It should be noted that we did not use an active no imagery rescripting control condition, which makes it difficult to ascertain whether the effects are a function of imagery rescripting per se and if so, what aspects of imagery rescripting were responsible for the effects. For instance, it is unclear whether imagery rescripting merely constituted a distraction from 'worrying' about the upcoming behavioral experiment or constituted a task that helped participants to focus their attention during the behavioral experiment. It is also unclear whether it is important that the imagery is related to the behavioral experiment or whether any form of positive mental imagery is sufficient. Recent findings suggest that a positive future thinking intervention can mitigate negative effects of a stressful event (Landkroon, van Dis et al., 2021; Montijn, Gerritsen, van Son, & Engelhard, 2022), but only if the intervention is related to the event (Montijn et al., 2022). Future imagery rescripting research with a more stringent control group is needed that also examines long-term efficacy (i.e., symptom reduction).

Several limitations of this study are noteworthy. First, as discussed, we did not use a no imagery rescripting (active) control condition. Second, a non-clinical sample of college students was tested, including 22 psychology students who potentially had some knowledge about the topic under investigation, which may limit generalizability of the findings to clinical samples. Additionally, the impact of these findings on manualized multi-session treatment is unknown. However, even non-clinical college students commonly experience social anxiety symptoms (Purdon, Antony, Monteiro, & Swinson, 2001), and both imagery rescripting and the behavioral experiment were individually tailored to target participants' fears. So, although approximately 14% of the participants could not formulate a behavioral experiment with strong negative anticipated outcomes, the included participants reported fear for the behavioral experiment. Third, participants' activities in the control group varied during the break. As a result, some participants may have used safety behavior during that period (e.g., asking friends for reassurance), which was not assessed. Fourth, outcome measures were subjective single-item self-report measures. Future studies could use measures with proven psychometric values or include observer ratings and physiological reactivity to mental imagery which can provide valuable additional information (e.g., Kearns & Engelhard, 2015). Finally, we did not assess imagery ability, which can influence the intervention's efficacy (McEvoy et al., 2015). Future research could examine whether individual differences in imagery ability affect imagery rescripting efficacy.

To summarize, this study extends prior research on imagery rescripting of distressing memories (Arntz, 2012; Strachan, Hyett, & McEvoy, 2020) to future-related distressing images. We found that the imagery rescripting group, compared to the no imagery rescripting group, showed reductions in threat beliefs, anxiety, and helplessness, and increases in willingness to conduct the behavioral experiment. Additionally, this study provided preliminary evidence that imagery rescripting combined with a behavioral experiment may be more effective than a behavioral experiment alone. Future research should replicate these findings and test the efficacy of this intervention in (sub) clinical samples. The results fit with a growing literature suggesting that imagery-based interventions have great potential to enhance standard CBT.

Declaration of competing interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.brat.2022.104130.

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