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Positive Interpretation Training: Effects of Mental Imagery Versus Verbal Training on Positive Mood

Emily A. Holmes

Andrew Mathews

Tim Dalgleish

Bundy Mackintosh

Abstract

Therapists often assume a special association between mental imagery and emotion, though empirical evidence has been lacking. Using an interpretation training paradigm, we previously found that imagery had a greater impact on anxiety than did verbal processing of the same material (Holmes & Mathews, 2005). Although the finding of a differential impact of imagery versus verbal processing of negative material was replicated, findings did not extend to benign material. Results therefore left open the question of whether there may be a special association between imagery and positive emotion. The current experiment examined positive interpretation training. Numerous scenarios were presented with initial ambiguity as to positive outcome or not, with final information then yielding consistently positive resolutions. Participants were asked to either imagine these positive events or to listen to the same descriptions while thinking about their verbal meaning. Those participants in the imagery condition reported greater increases in positive affect and rated new descriptions as being more positive than did those in the verbal condition. Results suggest that positive training can be enhanced through imagery as opposed to verbal processing. This study also provides the first test of a standardized intervention using an 'interpretive bias training' paradigm to improve positive mood.

Positive Interpretation Training:
Effects of Mental Imagery Versus Verbal Training on Positive Mood

In cognitive behavioral therapies, relevant cognitive processes include both verbal thoughts and mental images. For example, distressing intrusive mental images have been reported across a range of psychological disorders, including post-traumatic stress disorder, agoraphobia, social phobia, body dysmorphic disorder and psychosis (Holmes & Hackmann, 2004). There has been a long held assumption in both clinical and experimental psychology that mental imagery has a privileged relationship to emotion (Holmes & Mathews, 2005). However, until recently there was little empirical evidence to support the assumption that mental images are associated with more emotion than are verbal thoughts about the same material.

Holmes and Mathews (2005) used an interpretation training paradigm to compare the processing of text stimuli with imagery versus verbal instructions. In this paradigm, the method used was similar to that used in other studies designed to investigate induced biases in emotional interpretation (Grey & Mathews, 2000; Mathews & Mackintosh, 2000; Mathews & MacLeod, 2002). Many everyday events are ambiguous and can be interpreted in a negative, benign, or positive way. For example, a friend walking past without acknowledgment might be assumed to be ignoring you (negative interpretation) as opposed to simply being preoccupied (benign interpretation). Negative (rather than benign or positive) interpretation biases are often thought to be an underlying cognitive mechanism in both anxiety and mood disorders. Experimental modification of such biases thus represents a promising new method that may find future application in the clinical domain. That is, similar methods can perhaps be developed for clinical use to modify underlying negative interpretation biases in a more positive direction.

In some previous interpretation training experiments (e.g. Mathews & Mackintosh, 2000), participants were asked to read about and imagine themselves in numerous situations. Depending on assignment to experimental group, the descriptions of each situation constrained participants to resolve the outcome of the situation (which initially appeared ambiguous) in either a negative or benign way. Results of these prior studies showed that, compared to participants in the benign condition, those in the negative resolution condition interpreted new ambiguous events more negatively and sometimes reported greater increases in state anxiety. These results supported the hypothesis of a causal link between interpretative bias and anxiety but did not provide a test of whether the instructions to imagine the situations were critical in producing emotional effects.

Holmes and Mathews (2005) contrasted imagery versus verbal processing instructions using a similar interpretation training method, with the novel modification that scenarios were presented in auditory form rather than as written text. In an initial experiment, participants either imagined unpleasant events (i.e., used imagery) or listened to descriptions of the same events while thinking about their meaning in verbal terms. Those in the imagery condition reported more anxiety and rated new ambiguous test descriptions as more emotional than did those in the verbal condition. This result suggested the possibility that type of processing can carry over and influence how new descriptions are encoded.

In a second experiment, four groups listened to either benign or unpleasant descriptions, again with imagery or verbal processing instructions. Anxiety again increased more after unpleasant (but not benign) imagery than after verbal processing; however, emotionality ratings for new ambiguous descriptions did not differ between groups after a 10-min filler task. This result suggested that the associated finding in Experiment 1 may have been due to mood. Overall, the findings of these two experiments provided support for the hypothesis that imagery of negative material has greater effects on self-reported anxiety than

does verbal processing of the same material. In contrast, there was no evidence of a parallel effect of imagery versus verbal processing with more benign material (i.e., significantly greater reductions of negative affect in the benign imagery condition), although the mean scores were in the predicted direction.

There are a number of possible explanations for this null finding with benign material. These include limitations in the measure of emotion employed—the "state" score of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983)—which was not designed to assess positive emotions. Furthermore, the benign descriptions were often not explicitly positive. The benign training material was designed to be identical to the negative training descriptions up until the last word (that resolved the ambiguity). This structure tended to have the effect of making the benign descriptions non-negative, rather than overtly positive. The upshot was that the benign material used probably did not provide an optimal test of whether imagery can produce greater positive emotional effects than verbal processing.

The results of Holmes and Mathews (2005) therefore supported the clinical assumption that there may be a special link between imagery and anxiety but left open the question of whether this conclusion also applies to other emotions, including positive affect. In clinical settings it is important to know whether positive emotions can be enhanced, for example, by modifying cognitive biases such as those involved in positive emotional interpretations. For this reason, the present experiment was designed to extend the findings reported in Holmes and Mathews (2005) by comparing interpretation training using imagery versus verbal processing of descriptions that could be resolved in a more clearly positive manner and by adding a better measure of positive affect. The current experiment thus included the total positive affect score from the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) in addition to the STAI measure of anxiety. One

hundred new positive training paragraphs were also created for this experiment in order to employ truly positive (rather than benign) training material.

The results of the second experiment by Holmes and Mathews (2005) failed to replicate one effect found earlier, that prior practice in imagery versus verbal processing increased emotionality ratings for new ambiguous test descriptions when they were presented after an intervening task. One possible explanation for this difference across experiments is that later emotional effects depend on spontaneous deployment of the practiced processing style (Hertel, 2002) and that this deployment was disrupted in the imagery condition by the verbal filler task. The current experiment therefore used a filler task designed to be less likely to discourage processing using mental imagery—listening to music and making pleasantness ratings. With this new filler task, we predicted that imagery training would have a more positive effect on emotionality ratings of ambiguous test scenarios than would verbal training.

In summary, the key hypotheses to be tested were that: (a) After positive interpretation training, participants in the imagery condition would show a greater increase in positive affect (on the PANAS) than would those in the verbal condition, with complementary reductions in anxiety (on the STAI). (b) Interpretive bias, assessed using emotionality ratings of ambiguous test scenarios (both positively and negatively resolvable) given pre-training and 10 min post-training, would become more positive in participants given positive imagery training than in those given positive verbally-focused training.

Method

Overview

In positive interpretation training, 100 scenarios were presented that, although initially ambiguous as to their outcome, subsequently yielded consistently positive resolutions. Participants were asked to either imagine these positive events or to listen to the same

descriptions while thinking about their verbal meaning. A mixed design was used, in which participants were randomly allocated to either imagery or verbal processing conditions, with both using the same positive interpretation training materials. A state anxiety measure and a positive affect measure were completed pre-training, immediately post-training, and after a further 10-min filler task. Emotionality ratings of two sets of repeated ambiguous test paragraphs (one set with potential negative resolutions and another with potentially positive resolutions) were completed pre-training and after the filler task. Participants were debriefed using questions designed to assess experimental demand and the effectiveness of the manipulation.

Participants

The 26 participants comprised 17 women and 9 men, with a mean age of 38.85 years (*SD* = 15.64). They were recruited through the department volunteer panel (a group of 2000 community volunteers) and were paid a small fee for participation.

Materials

Positive training paragraphs. One hundred descriptions were created for the experiment, each describing a situation having a positive emotional outcome. These descriptions were read aloud in the same female voice (each lasting approximately 10 to 13 s) and were digitally recorded using Cool Edit 2000 software (Phoenix; Syntrillium Software Corporation). They were presented stereophonically via headphones, using *E-Prime* software (Version 1.1.4.1, Pittsburgh; Psychology Software Tools Inc.).

The structure of the paragraphs was designed to be similar to those used in previous experiments in that the positive outcome only became clear in the last few words. Half the paragraphs began with a potentially negative situation being implied but were resolved in the final word(s) to have a benign or positive outcome. The remaining paragraphs began with a benign situation and ended even more positively. For example, one description of the former

type (possible negative resolved as benign) read as follows: “You are at home alone watching TV. You must have been dozing because you suddenly wake up. You have the impression that you heard a frightening noise and *then realize with relief that it was your partner returning home*" (resolution in italics). Note that the initial part of the scenario was designed to be ambiguous in the sense that it could imply a negative outcome (such as the noise being due to an unwanted intruder). An example of the second type (benign resolved as positive) was “It’s your birthday, and your partner reaches over to you with a present. You open it and *feel incredibly happy*” (resolution in italics). Despite being generally positive, the initial part of the scenario was still intended to be somewhat ambiguous in the sense that it could be resolved by outcomes less positive than “feel incredibly happy”, such as “feel pleased” or even “feel disappointed.” All the scenarios used had more than one possible outcome, and the aim of using the above structure was to train participants to generate positive resolutions of situations that could have developed in other and less desirable ways. The items were randomized throughout five training blocks, each of 20 paragraphs, within a program written using E-prime.

In order to focus participants on their assigned task, after each training paragraph they either rated vividness of imagery (“how vividly could you imagine the situation that was described?”) or their ability to comprehend the description (“how difficult was it to understand the meaning of the description?”), depending on condition (imagery vs. verbal). Both ratings were made on a 7-point scale anchored with “1 = not at all” and “7 = very.” In addition, reminders of the task instructions were given between blocks of 20 training paragraphs.

Filler items given after training. During the 10-min interval after training, participants performed an unrelated filler task of listening to music. The reason for including this interval was that we wanted participants’ mood to return to baseline levels prior to the post-training

test paragraphs in order to minimize the influence of any mood differences across groups on interpretation of these paragraphs. For the filler task, a series of classical music extracts was played, each extract lasting 40 s. Participants were asked to rate each extract for how pleasant they found it on a scale of 1 (extremely unpleasant) to 9 (extremely pleasant).

Ambiguous test descriptions. Twenty descriptions were used to test for generalization to new material and were presented both before and after the training phase, but without specific instructions as to encoding. These descriptions were ambiguous in that possible emotional outcomes were implied but not explicitly described. The same set of 10 negatively resolvable test paragraphs and 10 positively resolvable paragraphs were given as in Holmes and Mathews (2005). After each description participants were asked to rate "How emotional is this description?" using a 9-point scale from 1 (extremely unpleasant) to 9 (extremely pleasant). For example, one negatively resolvable description read as follows: "You are on a safety-at-work training day. They are showing videos of working in a factory. There is a shot of someone using a large saw machine to demonstrate the use of a safety guard. The shot pans in on the person's arm, which is *highlighted."* An example of a positively resolvable test description read "You buy a new outfit for a party. Other people's reactions show how you *look."*

Questionnaire measures. The STAI (Spielberger et al., 1983) was used to measure trait and state anxiety. The STAI Trait scale consists of 20 anxiety-related items for which participants rate "how you generally feel" on a 4-point scale: almost never, sometimes, often, or always. The STAI State scale consists of 20 anxiety-related items for which participants rate how they feel "right now, that is at this moment" on a 4-point scale: not at all, somewhat, moderately so, or very much so. These widely used measures are reported to have satisfactory reliability and validity (Spielberger et al., 1983). For example, administration of

the STAI State scale to samples of working adults and college students have reported alpha coefficients of above 0.90, indicating good internal consistency.

State positive affect was measured using all of the positive affect subscales of the PANAS (Watson et al., 1988) to calculate the total positive affect score. Negative affect items were excluded. The positive subscales include a total of 21 items, divided into the basic positive emotion scales (joviality, 8 items; self-assurance, 6 items; attentiveness, 4 items) as well as the serenity subscale (3 items), as detailed by Watson and Clark (1994). As these subscales were to be used as a repeated measure of state affect, the items were administered with the short-term time instructions ("Indicate to what extent you feel this way now / in the past few minutes"). Watson and Clark (1994) report that these subscales are sensitive to changing internal or external circumstances such as social activity, physical exercise and diurnal variation.

The tendency to use imagery in everyday life was measured using the Spontaneous Use of Imagery Scale (SUIS; Reisberg, Pearson, & Kosslyn, 2003). This questionnaire has 12 items, for example, *When I think about visiting a relative, I almost always have a clear mental picture of him or her* and *Before I get dressed to go out, I first visualize what I will look like if I wear different combinations of clothe*s. Each item is rated on a 5-point scale, anchored with the instructions "If a description is always completely appropriate, please write *5*; if it is never appropriate, write *1*; if it is appropriate about half of the time, write *3*; and use the other numbers accordingly." Reisberg et al. (2003) found that the mean score (average across all items) for 150 participants was 3.1, with a range of 1.2 to 4.7. These authors also found a significant relationship between scores on the SUIS and the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973), with high-vividness imagers reporting higher use of imagery than low-vividness imagers. The authors have classified mean scores below

2.5 as low imagery use and anything above 3.5 as high imagery use (D. G. Pearson, personal communication, September 23, 2003).

Subjective experience ratings. Questions were also given to assess the extent to which participants reported using imagery or verbal processing during the training phase and during the test phase. Each question was rated on a 9–point scale, ranging from 0 (not at all) to 8 (all the time).

Demand questions (impact predictions). Participants were asked to rate their expectation about how participating in each condition might influence their emotions (Baddeley & Andrade, 2000). One impact prediction was for the imagery condition and one for the verbal condition, yielding two scores (condition impact predictions) per participant. The questions were: *How much, if any, would you predict that imaging the sentences you heard rather than listening to them normally, would affect your feelings?* and *How much, if any, would you predict that focusing on the words and meaning of the sentences you heard rather than listening to them normally, would affect your feelings?* Both impact prediction ratings were made on a 21-point scale from – 10 (very much increase negative feelings) to + 10 (very much increase positive feelings).

Procedure

After giving their informed consent to the experiment, participants were randomly assigned to either the imagery or verbal condition. They first completed the STAI, SUIS, and PANAS. Then they put on headphones and listened to the first test set of 20 ambiguous descriptions, presented in random order; immediately after each description, they rated it for emotionality as described above (see *ambiguous test descriptions*).

The experimenter then read out instructions for the assigned condition. In the imagery condition, participants were given a brief practice task in which they were asked to imagine cutting a lemon in order to clarify what was meant by "using mental imagery." They were

then given four (non-emotional) example descriptions and asked to imagine each event as happening to themselves while describing their mental image out loud, with a final example administered using the computer. The experimenter explained that maintaining a focus on their images would help in answering the questions that followed.

In the verbal condition, participants were instructed to focus on the meaning of each description as they heard it. They were given a practice sentence about cutting a lemon in order to illustrate the task, and then four non-emotional descriptions as practice, with instructions to "concentrate on the words and meaning as the description unfolds." A final example was administered using the computer. The experimenter explained that focusing on the words and meanings of each description would help them to answer the questions that followed.

Participants were then given the 100 training descriptions in 5 randomized blocks of 20 each, with breaks allowed between blocks. For any participant, depending on their assigned condition, all descriptions were followed either by a vividness rating or a rating of confidence in their ability to understand the verbal content. The STAI and PANAS were repeated at the end of the training phase.

An interval of 10 min was allowed after the end of the imagery or verbal training phase and filled by a neutral task (as described above). The emotion measures (STAI and PANAS) were then re-administered at the end of the interval to check whether mood had returned to baseline. All participants then completed a second administration of the 20 ambiguous test descriptions, making the same emotionality ratings as before training. They then completed the subjective experience ratings to assess reported use of imagery and verbal processing during the training and test phase. Finally, they completed two ratings to assess perceived demand (impact predictions). Participants were then debriefed and thanked for their participation.

Results

Our key hypotheses were that practice using imagery, relative to verbal processing, would produce greater increases in positive affect and positive interpretations and reduce anxiety scores. Because these hypotheses were specific and directional, analyses that directly tested them employed one-tail tests. All other tests, when no directional hypothesis had been stated, used two-tailed tests.

Comparison of Participants in Imagery and Verbal Conditions

To check the comparability of participants in the imagery and verbal conditions, the groups were compared on the background measures (using independent *t* tests unless otherwise reported). These comparisons indicated that there was no significant difference between the two conditions in terms of gender, Fisher's exact test, $p = .69$. There were 4 men and 9 women in the imagery condition, and 5 men and 8 women in the verbal condition. The two conditions did not differ significantly according to age, trait anxiety, initial state anxiety scores, initial positive affect scores, the SUIS imagery questionnaire, emotionality ratings of negatively resolvable scenarios pre-training (for each measure, $t[24] < 1.0$), except for emotionality ratings of positively resolvable scenarios pre-training, $t(24) = 1.63$, $p = .12$. The mean age was 36.92 ($SD = 16.55$) in the imagery condition and 40.77 ($SD = 15.09$) in the verbal condition. Mean trait anxiety scores (STAI) were 33.46 ($SD = 7.28$) in the imagery condition and 31.77 ($SD = 5.26$) in the verbal condition. Table 1 shows means for pre-training state anxiety and positive affect scores, as well as for pre-training emotionality ratings of negatively and positively resolvable scenarios.

State Anxiety Pre and Immediately Post Training

We predicted that participants in the imagery condition would show greater reductions in state anxiety after training than would those in the verbal condition. This hypothesis was tested using a mixed model ANOVA with a grouping factor of condition

(imagery versus verbal) and a within-subjects factor of time (pre versus post training). For mean change scores per condition, see Figure 1. There was no main effect of time, $F(1, 24) = 0.12$, $p = .73$ and no main effect of condition, $F(1, 24) = 1.07$, $p = .31$. However, there was a significant interaction of time with condition, $F(1, 24) = 7.36$, $p = .012$, $\eta^2 = .24$, consistent with our hypothesis of greater reduction in anxiety following imagery training than following verbal training.

Our directional hypothesis was tested by comparing the reduction in anxiety scores seen in imagery with those in verbal processing groups using an independent samples *t*-test. This analysis confirmed the expected effect, with greater reductions seen in the imagery group, mean change = -4.38 ($SD = 8.37$) vs. +3.38 ($SD = 6.04$), $t(24) = 2.71$, $p = .006$, (one-tailed), $d = 1.06$. However, because this contrast could reflect an increase of anxiety in the verbal group as well as a decrease in the imagery group alone, we also tested these changes individually. On two-tailed paired-sample *t*-tests, there were non-significant trends for both a reduction in anxiety after imagery training, $t(12) = 1.89$, $p = .083$, $d = 0.54$, and an increase in anxiety in the verbal condition, $t(12) = 2.02$, $p = .067$, $d = 0.23$.

Positive Affect Pre and Immediately Post Training

The hypothesis that participants in the imagery condition would show greater increases in positive affect than those in the verbal condition was tested using a similar ANOVA to that described above (for mean change scores per condition, see Figure 1). There was no main effect of time, $F(1, 24) = 0.08$, $p = .79$, and no main effect of condition, $F(1, 24) = 0.56$, $p = .46$. However, as with anxiety, there was a significant interaction of time with condition, $F(1, 24) = 11.43$, $p = .002$, $\eta^2 = .32$, that was consistent with our hypothesis of a greater increase in positive affect following imagery training as compared to verbal training.

We again tested our directional hypothesis by comparing changes over time for the two groups, confirming that the imagery group reported a larger increase in positive affect,

mean change = +7.15 (*SD* = 10.30) vs. -6.08 (*SD* = 9.63), *t* (24) = 3.38, *p* = .001, one-tailed, *d* = 0.11 Again, because this result may have been due in part to an unexpected decrease in positive affect in the verbal group, changes in each group were analyzed separately. Both changes were significant: the imagery group showed a significant increase in positive affect, *t*(12) = 2.50, *p* = .028, *d* = 0.74, and positive affect significantly *decreased* in the verbal condition, *t*(12) = 2.27, *p* = .042, *d* = 0.42, (both two-tailed). These results indicate that, as predicted, participants in the imagery condition showed greater increases in positive affect after training than those in the verbal condition (see Figure 1). In addition, the verbal group showed an unpredicted significant decrease in positive affect.

State Anxiety and Positive Affect After the Filler Task

Participants were given a 10-min filler task after the training phase. The STAI-state and PANAS (positive affect subscales) were then administered for the third time. The aims were (1) to test whether participants' state anxiety reports had returned to baseline level and (2) to check that there were no remaining differences between groups in state anxiety prior to administration of emotionality ratings for the ambiguous paragraphs.

Return to baseline levels. Any differences between mood scores after the 10-min break with baseline scores were tested using mixed model ANOVAs. These had one within-subjects factor of time (pre training versus after the filler task) and a between-subjects factor of training condition (imagery versus verbal). Mean mood scores in each condition are shown in Table1.

For state anxiety, there were no main effects of time, $F(1, 24) = 0.76$, $p = .39$ nor of training condition, $F(1, 24) = 0.35$, $p = .56$. The interaction between time and training condition was also not significant, $F(1, 24) = 1.74$, $p = .20$, $\eta^2 = .07$. Similarly, for positive affect, there were no main effects of time, $F(1, 24) = 0.03$, $p = .86$ nor training condition,

$F(1, 24) = 0.04$, $p = .85$. Again, the interaction between time and training condition was not significant, $F(1, 24) = 2.38$, $p = .14$, $\eta^2 = .09$.

Group differences after the filler task. Differences between groups in mood prior to the emotionality ratings test were examined using a one-way ANOVA, with the between-subjects factor of training condition (imagery versus verbal). There were no significant differences between groups in either state anxiety, $F(1, 24) = 1.42$, $p = .25$, $\eta^2 = .06$, or positive affect, $F(1, 24) = .08$, $p = .79$ (for mean scores see Table 1). This result indicates that there were no significant differences in mood between the two groups after the 10-min interpolated task.

Change in Emotionality Ratings for Repeated Ambiguous Test Descriptions

Participants rated the emotionality of the two sets of 10 ambiguous paragraphs both before training and then 10 min after training. Set 1 consisted of negatively resolvable ambiguous paragraphs (negatively biased) and Set 2 of positively resolvable ambiguous paragraphs (positively biased). Since the data from the two sets sampled different valence domains, the negatively and positively resolvable ambiguous paragraphs were analyzed separately. Our second hypothesis was that, compared to participants given verbal training, those given imagery training would rate scenarios overall as more positive after training.

Negatively resolvable ambiguous paragraphs. Changes in emotionality ratings from pre-training to post-training were examined using a mixed model ANOVA in a similar analysis to that for state anxiety scores. There was no significant main effect of time, $F(1, 24) = 0.06$, $p = .81$, or condition, $F(1, 24) = 0.37$, $p = .56$. There was no interaction between time and training condition, $F(1, 24) = 0.16$, $p = .69$. Overall, the results therefore failed to support a differential effect of imagery versus verbal encoding conditions on emotional ratings for the negatively biased descriptions encountered after the filler task.

Positively resolvable ambiguous paragraphs. The same analysis as before revealed a non-significant trend for the main effect of time, $F(1, 24) = 3.71$, $p = .066$, $\eta^2 = .13$, but no main effect of condition, $F(1, 24) = 0.08$, $p = .77$. However, there was a significant interaction between time and training condition, $F(1, 24) = 8.09$, $p = .009$, $\eta^2 = .25$, that was consistent with our hypothesis that emotional ratings should change more in a positive direction following imagery than following verbal training.

Testing our directional hypothesis as before we compared the changes on ratings of positively resolvable items before and after training, confirming a significant difference between imagery and verbal groups, mean change = +1.28 (*SD* = 5.86) vs. -6.69 (*SD* = 8.25), $t(24) = 2.85$, $p = .0005$ (one tailed), $d = 1.13$. However, because this difference seemed to reflect mainly a decrease in the verbal group, we again tested for change in each group separately. Paired-sample *t* tests indicated that within the verbal condition emotionality ratings decreased significantly (i.e., became less positive) over time, $t(12) = 2.93$, $p = .013$, $d = 1.10$, but contrary to expectation, there was no significant increase in scores in the imagery condition, $t(12) = 0.80$, $p = .44$ (both tests two-tailed).

Impact Predictions About Each Condition

In order to check whether it was likely that the positive affect results could be accounted for by demand, participants were asked after the experiment to predict the impact of each separate experimental condition on mood (yielding two impact predictions, one about the imagery and one about the verbal task condition). If participants' predictions about each training condition were in line with the actual results, then it could be argued that demand may have driven the reported differences in positive affect. Potential demand effects were investigated using a mixed model ANOVA in which the group factor was condition (imagery versus verbal) and the within-subjects factor was condition impact prediction (prediction about imagery training versus prediction about verbal training). There was a main effect of

condition impact prediction, $F(1, 24) = 6.29$, $p = .019$, $\eta^2 = .21$. That is, overall, participants predicted that imagery training would have a greater effect on emotion, relative to listening 'as normal' (mean rating = 3.50, *SD* = 3.77) than would the verbal condition (mean = 0.88, *SD* = 3.09). There was, however, no significant interaction between condition impact prediction, and participants' actual training condition during the experiment, $F(1, 24) = 0.27$, $p = .61$; see Table 1.

The association between the condition impact predictions and actual changes in positive affect was investigated using correlations. Within each training condition, there were no significant correlations between anxiety change and impact predictions, although within the imagery condition the predicted impact of the imagery task showed a non-significant trend, $r(11) = 0.51$, $p = .075$. Otherwise the largest correlation, $r(11) = -.45$, $p = .12$, was for the predicted impact of the imagery task within the verbal condition.

Low sample sizes clearly limit the power of these tests, so that all that can be concluded is that the correlations between individual participants' predictions about the possible impact of either training condition (impact predictions) and the observed emotional effects are probably not very large. While we found no significant association between actual anxiety change and predicted effects, the trend in the imagery condition indicates that the possibility that demand may have had some influence cannot be excluded.

Subjective Experience of Listening to Training Paragraphs

At the end of the experiment, participants were asked questions about their subjective experience of listening to the training paragraphs. The ratings given in the imagery and verbal conditions were compared using independent *t* tests. There were several significant differences between conditions: participants in the verbal condition reported using more verbal processing of the descriptions during the training phase, Imagery $M = 3.62$ ($SD = 2.32$), Verbal $M = 6.12$ ($SD = 1.36$), $t(24) = 3.34$, $p = .003$, $d = 0.50$; and participants in the

imagery condition reported using more imagery during the training phase, Imagery $M = 7.77$ ($SD = 1.42$), Verbal $M = 4.77$ ($SD = 2.24$), $t(24) = 4.07$, $p < .001$, $d = 1.60$. These results indicate that participants reported that they were adhering to the appropriate condition instructions during the training phase, although this may reflect demand characteristics following the experimental instructions.

There was also some indication that at the test phase of hearing the ambiguous paragraphs post-training, participants spontaneously deployed a similar style of processing to the type they had received during training. That is, those in the verbal condition reported that they were verbally analyzing the meaning of the test sentences more than participants in the imagery condition, Imagery $M = 3.58$ ($SD = 1.83$), Verbal $M = 5.62$ ($SD = 2.09$), $t(24) = 2.72$, $p = .012$, $d = 1.04$. Conversely, those participants in the imagery condition were more likely to report that they were thinking in images than those in the verbal condition, Imagery $M = 7.33$ ($SD = 1.37$), Verbal $M = 4.77$ ($SD = 2.09$), $t(24) = 3.59$, $p = .002$, $d = 1.45$. Note that no instructions had been given as to the style of processing to be used during the test phase.

Discussion

Summary of Main Results

The current experiment used overtly positive training material to investigate the effects of imagery versus verbal interpretation training, in contrast to the use of benign material in Experiment 2 of Holmes and Mathews (2005). The present experiment also included a measure of positive affect to complement the measure of state anxiety used previously. The current results extended those previous findings and showed that participants in an imagery training condition reported greater increases in positive affect and greater decreases in state anxiety after positive interpretation training than did those in a verbal training condition. We also found an absolute increase in positive affect (and a trend for state anxiety to decrease) following imagery training. It is likely that either the improved positive

training material used here promoted a more powerful training effect or the measure of positive affect used here was more sensitive to training effects, compared with the material and measures used by Holmes and Mathews (2005; Experiment 2). We suggest that these findings provide initial support for the hypothesis that positive imagery can have greater effects on positive mood than does verbal processing of the same material. Needless to say, these results need to be replicated in the light of the relatively small sample size in the current study.

In addition to the predicted findings regarding mood change following training, there was also a reduction in positive affect (and a trend for an increase in state anxiety) from pre to post training in the verbal condition that had not been predicted. It may be that the task of doing the training trials was arduous, and that without the counteractive effect of positive training with imagery, this caused the relative decrease in positive affect. It is also possible that the verbal instructions and the focus on comprehending the paragraphs drew participants' attention to negative aspects of the training material. Half of the paragraphs were constructed to begin with potentially negative scenarios that were then disambiguated in a benign manner (negative to benign). Thus, participants in the verbal condition may have focused more on the negative components of the material. Future research could test this possibility by using only the "benign to positive" training material. However, it is also possible that even some of the 'benign to positive' material implied a degree of ambiguity that could have suggested a potential negative outcome. For this reason, in future research it would be of interest to include training material designed to be completely unambiguous ("positive to positive" scenarios).

The results for the positively-resolvable ambiguous test descriptions (a measure of interpretative bias administered after the 10-min filler) suggested that emotionality ratings decreased significantly in the verbal condition (i.e. became more negatively valenced) over

time. Further, contrary to what one might expect, there was no significant increase in emotionality scores in the imagery condition, though the results were in the expected direction (i.e. more positively valenced). No significant differences were found for the negatively-resolvable ambiguous test descriptions. Because there was no significant difference in mood measures between conditions after the 10-min filler, it is unlikely that persistent mood effects are sufficient to account for the difference in the emotionality ratings between conditions.

The finding of differences for the positively-resolvable rather than negatively-resolvable scenarios may be explained by the fact that training used specifically positive materials. However, it is also possible that the interaction found for ratings of the positively resolvable scenarios may depend in part on inflated ratings at pre training. Further, the ambiguous test descriptions used in the current experiment may have provided a less powerful index of interpretative bias than other measures of interpretative bias used in previous experiments, such as the recognition test used in Mathews and Mackintosh (2000) or the lexical decision task used in Hirsch, Clark, Williams, Morrison, and Mathews (2005). Finally, it could be argued that the method employed in this experiment and by Holmes and Mathews (2005) is unlike the 'training' used in other related studies. We used auditory presentation of complete scenarios rather than visual presentation of partial sentences that were disambiguated only by the final word. Although some transfer effects to ambiguous test items were found here, it could be argued the current method represents a mood induction technique as much as it does interpretive training. Regardless of this issue, the current method has at least demonstrated the important role of imagery in producing positive emotional change.

Similar transfer of training effects to new test paragraphs were found by Holmes and Mathews (2005) in a first experiment where the test paragraphs were given immediately post-

training, but not in a second experiment in which a verbal filler task (answering questions about a do-it-yourself home improvement manual) was interpolated between training and test. Because we had thought that the verbal nature of this filler task may have disrupted transfer of the trained processing style in the imagery condition, in the present experiment a non-verbal filler task was used. The current findings with this new filler task lend some support to this idea. However, since several variables were changed between the experiments (e.g. training material and measures as well as the filler task) strong conclusions cannot be drawn at this stage.

Overall Conclusions and Implications for Future Research

To date, much of the literature on the interpretation training paradigm has focused on the impact of negative training. In contrast, the positive effects of interpretation training have, as yet, received less research attention. The current experiment is therefore an important early step indicating the potential for positive training effects on mood. However, a major limitation of the current study is the small sample size used, which means that any conclusions drawn must remain tentative until replicated. The current experiment has however provided a new method to test the differential impact of imagery versus verbal instructions for positive interpretation training. New positive training material was developed, and a measure of positive affect included. Overall, we conclude that the results are consistent with the hypothesis that imagery may have a more powerful impact on emotional responses than verbal processing of the same material, and there is now initial support that this assumption applies to positive as well as negative affect (c.f. Holmes & Mathews, 2005). These findings indicate that emotional effects of imagery may be agnostic with regards to valence, rather than being valence specific. Future research should seek to replicate the results of this positive training experiment in order to establish the reliability of the findings. From a theoretical perspective, use of the interpretation training paradigm

provides only one method by which to test the overarching hypothesis that imagery may have a more powerful impact on emotional response than verbal processing of the same material. It is important to also seek convergent evidence for the current findings using alternative methodological paradigms.

Clinical Implications

The current findings, in conjunction with those of Holmes and Mathews (2005) provide an empirical justification for the use of imagery as a device to evoke—and perhaps also to modify—emotional responses in clinical conditions. From a clinical perspective, a key issue for further investigation is whether *reductions* in negative affect may best be promoted using imagery rather than verbal processing in clinical populations, and what types of imagery techniques could be used. If imagery has a special relation with emotion, then this suggests that a variety of therapeutic approaches might be useful in reducing the impact of negative imagery. Given that patients with clinical disorders have a negative bias that appears to cause vulnerability to anxiety (Mathews & MacLeod, 2002), then clinically it is of great interest to develop effective techniques to promote positive bias, such as computerized interpretation training. Imagery instructions may provide a useful tool by which to enhance such training techniques. Positive imagery training may help the relatively automatized production of benign or positive imagery when encountering novel stimuli. It would also be interesting to test whether similar training could be used to reduce negative bias associated with emotional disorders other than anxiety, such as major depressive disorder. Indeed this special edition reflects the current zeitgeist for clinical applications of experimental training paradigms. Further work examining the training of positive mood and positive biases in clinical populations is now needed.

A potentially important implication for the interpretation training literature is that typical training effects found on affect measures and measures of emotional bias

(emotionality ratings) were not achieved with verbal instructions alone. This finding underscores the importance of using imagery instructions, as these seem likely to be an active rather than incidental component of the original procedure developed by Mathews and Mackintosh (2000) in creating affect change. Further, whatever the explanation, the initial finding that verbal instructions led to a reduction in positive mood after exposure to positive information, and to more negative resolutions of ambiguous test material, may have interesting clinical implications. It is possible that in certain situations promoting verbal positive thoughts in cognitive therapy might not only have less impact than imagery in promoting positive mood, but even lead to a reduction in positive mood. Clearly, however, further research is needed before extrapolating such conclusions to a clinical setting.

A methodological step that could be useful for future studies is the instructions developed to increase participants' awareness of using mental imagery through the “imagine cutting a lemon” practice. Several participants were unsure of what was meant by ‘using mental imagery’ and the examples in the instructions provide a useful subjective illustration to add clarification and use of imagery. Holmes and Mathews (2005), along with the current experiment and Mackintosh, Mathews, Yiend, Ridgeway, and Cook (this issue), have been the first to deliver training scenarios in an auditory verbal format, rather than a written text-based format. Post experimental debriefing indicated that, despite the lengthy experimental session (approximately 2 hours), the participants maintained interest and concentration while listening to the stimuli. This observation appears to contrast with previous interpretation training studies (e.g., Mathews & Mackintosh, 2000) in which participants have reported that reading the volume of training material on the computer screen can be rather tedious. Auditory presentations of text based material may therefore be useful in developing future clinical applications and might also provide a more portable format for home use.

Informal observations indicate that while some clinicians have made sweeping claims about imagery in therapy, others—perhaps deterred by the lack of evidence—have focused mainly on verbal thoughts rather than images. However, we note that in Beck's original conception of cognitive therapy (Beck, 1976), the importance of assessing patients' images, as well as their verbal thoughts, was emphasized. Our impression is that this emphasis seems to have been neglected in much recent clinical practice and training, at least in Europe. For example, cognitive therapy techniques are typically taught through the use of verbally evaluating negative automatic thoughts and by keeping daily written diaries. This strategy can perhaps lead therapists and clients to focus on verbal thoughts and neglect the impact of imagery. A dominant focus on verbal thoughts can lead therapists and clients to miss other cognitive processes that may be causal in the maintenance of a given psychological disorder and perhaps key to successful treatment (e.g., Hackmann & Holmes, 2004; Hirsch, Clark, Mathews, & Williams, 2003). The current evidence for a special impact of imagery on emotion may serve to encourage therapists to consider using imagery techniques not just in those psychological disorders where their use is standard (such as posttraumatic stress disorder; e.g., Brewin & Holmes, 2003) but to consider using imagery in disorders where it has been less well explored (e.g., depression).

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Author Note

Emily A. Holmes, MRC Cognition and Brain Sciences Unit, Cambridge, UK; Andrew Mathews, MRC Cognition and Brain Sciences Unit, Cambridge, UK; Tim Dalgleish, MRC Cognition and Brain Sciences Unit, Cambridge, UK; Bundy Mackintosh, MRC Cognition and Brain Sciences Unit, Cambridge, UK and Open University, Walton Hall, Milton Keynes, UK.

Emily A. Holmes is now at the Department of Psychiatry, University of Oxford, Oxford, UK. Andrew Mathews is now at the Department of Psychology, University of California, Davis.

Correspondence concerning this article should be addressed to Dr Emily Holmes, Royal Society Dorothy Hodgkin Fellow, University of Oxford, Department of Psychiatry, Warneford Hospital, Oxford, OX3 7JX, United Kingdom. Email: emily.holmes@psych.ox.ac.uk

Table 1

Means and Standard Deviations for the Mood Measures (STAI and PANAS), Emotionality Ratings for Ambiguous Test Descriptions, and Impact Predictions

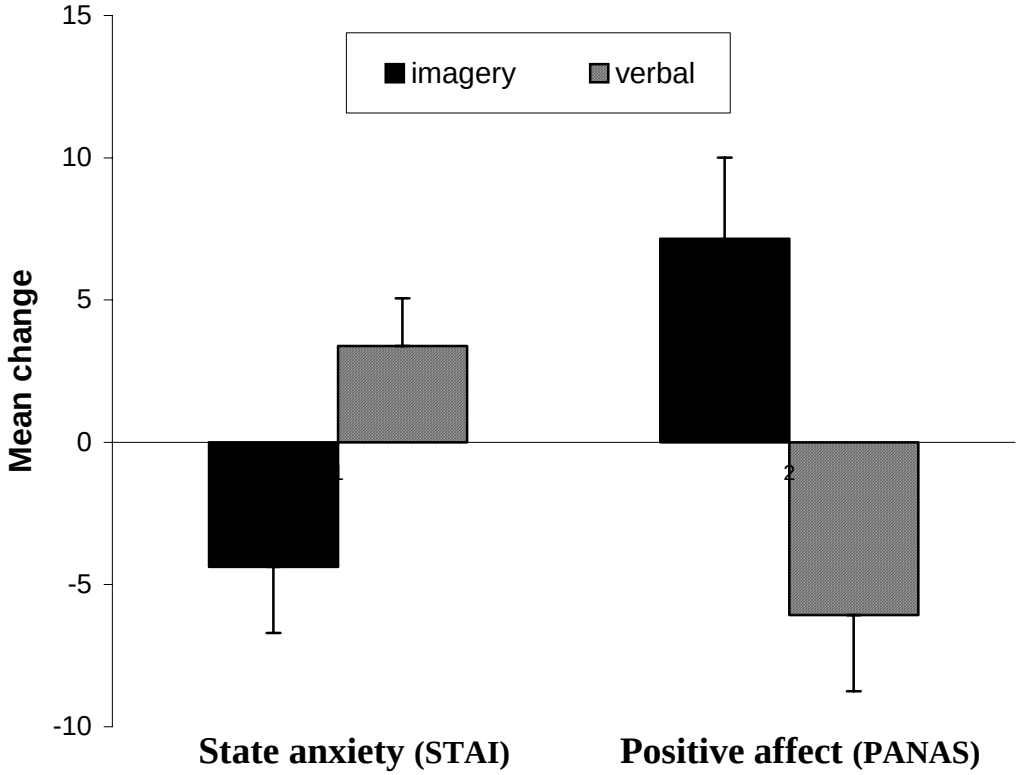
	Imagery condition $n = 13$		Verbal condition $n = 13$	
Measure	*M*	*SD*	*M*	*SD*
Mood measures				
State STAI, Time 1	29.77	10.07	30.46	15.64
State STAI, Time 2	25.38	4.50	33.85	13.96
State STAI, Time 3	26.77	4.57	31.08	12.23
PANAS, Time 1	67.62	10.67	70.92	15.42
PANAS, Time 2	74.77	8.42	64.84	13.70
PANAS, Time 3	70.23	12.48	68.84	13.36
Emotionality ratings (descriptions)				
Negatively resolvable, Time 1	3.46	1.06	3.25	0.80
Negatively resolvable, Time 3	3.38	0.55	3.27	0.62
Positively resolvable, Time 1	6.43	0.93	6.91	0.48
Positively resolvable, Time 3	6.56	0.83	6.24	0.71
Impact predictions				
Imagery task	4.31	2.81	2.69	4.49
Verbal task	1.15	1.82	0.62	4.05

Note: Time 1 = pre training, time 2 = immediately post training, and time 3 = after 10-min filler task post training. STAI = State-Trait Anxiety Inventory, PANAS = total positive affect score from the PANAS. Emotionality ratings for ambiguous test descriptions, 1 = extremely unpleasant to 9 = extremely pleasant. For task impact predictions (compared to having no

task), -10 = very much increase negative feelings, 0 = do nothing, + 10 = very much increase positive feelings.

Figure Caption

Figure 1. Mean changes in state anxiety and positive affect after positive imagery and positive verbal training. Error bars show one standard error of the mean.


15
10
5
0
-5
-10
Mean change
imagery
verbal
1
2
State anxiety (STAI)
Positive affect (PANAS)