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Ameliorating intrusive memories of distressing experiences using computerized reappraisal training

Marcella L. Woud,

Behavioural Science Institute, Radboud University Nijmegen, NL

Emily A. Holmes,

Department of Psychiatry, University of Oxford, Oxford, UK

Peggy Postma,

Cambridgeshire and Peterborough NHS Trust, Peterborough, UK

Tim Dalgleish, and

Medical Research Council Cognition and Brain Sciences Unit, Cambridge, UK

Bundy Mackintosh

School of Medicine, Health Policy and Practice, University of East Anglia, Norwich, UK; Medical Research Council Cognition and Brain Sciences Unit, Cambridge, UK

Abstract

The types of appraisals that follow traumatic experiences have been linked to the emergence of post-traumatic stress disorder (PTSD). Could changing reappraisals following a stressful event reduce the emergence of PTSD symptoms? The present proof-of-principle study examined whether a non-explicit, systematic computerized training in reappraisal style *following* a stressful event (a highly distressing film) could reduce intrusive memories of the film, and symptoms associated with posttraumatic distress over the subsequent week. Participants were trained to adopt a generally positive or negative post-stressor appraisal style using a series of scripted vignettes after having been exposed to highly distressing film clips. The training targeted self-efficacy beliefs and reappraisals of secondary emotions (emotions in response to the emotional reactions elicited by the film). Successful appraisal induction was verified using novel vignettes and via change scores on the Post Traumatic Cognitions Inventory. Compared with those trained negatively, those trained positively reported fewer intrusive memories of the film during the subsequent week in a diary, and lower scores on the Impact of Event Scale (a widely-used measure of posttraumatic stress symptoms). Results support the use of computerized, non-explicit, reappraisal training after a stressful event has occurred and provide a platform for future translational studies with clinical populations that have experienced significant real-world stress or trauma.

Correspondence concerning this article should be addressed to: Emily A. Holmes, University of Oxford, Department of Psychiatry, Warneford Hospital, Oxford, OX3 7JX, UK. emily.holmes@psych.ox.ac.uk Tel +44 (0)1865 223 912; Fax +44 (0)1865 793101. Marcella L. Woud is at the Behavioural Science Institute, Radboud University Nijmegen, NL. Emily A. Holmes is at the Department of Psychiatry, University of Oxford, Oxford, UK. Peggy Postma is with the Cambridgeshire and Peterborough NHS Foundation Trust, Cambridge, UK. Tim Dalgleish is in the Emotion Research Group, MRC Cognition and Brain Sciences Unit, Cambridge, UK. Bundy Mackintosh is at School of Medicine, Health Policy and Practice, University of East Anglia, Norwich, UK and MRC Cognition and Brain Sciences Unit, Cambridge, UK.

Keywords

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There is a broad consensus within philosophy (e.g. Solomon, 1993), affective science (e.g. Lazarus, 1982; Ochsner & Gross, 2008; Scherer, Schorr, & Johnstone, 2001), and abnormal psychology (e.g. Power & Dalgleish, 2008) that the emotional impact of stressful events is principally determined by how those events are appraised or interpreted. These initial event-related appraisals are frequently the starting point for iterative cycles of appraising and reappraising that extend beyond the events themselves to encompass their emotional, cognitive and practical implications (Gross & Thompson, 2007; Lewis, 1996). The nature of these appraisal cycles seems to drive not only how we feel about events but other aspects of cognitive processing such as how well the events are remembered (see Gross, 2002) and the frequency with which such memories intrude into awareness (e.g. Schartau, Dalgleish, & Dunn, 2009). For example, we know from the literature on traumatic stress reactions to highly emotive events that appraising the self as culpable for such events or as chronically psychologically damaged by them (e.g. 'I have permanently changed for the worse'; 'The event happened because of the way I acted') is associated with increases in debilitating intrusive recollections of those events and one's role in them (Foa, Ehlers, Clark, Tolin, & Orsillo, 1999; Grey & Holmes, 2008). The very presence of these intrusive experiences can itself then become the subject of further appraisal (for example 'Having this flashback must mean I'm going mad'). Again, the nature of such appraisals appears to drive both further intrusive phenomenology and other symptoms of post-event distress, including in severe cases posttraumatic stress disorder (PTSD; Bryant & Guthrie, 2005; Ehlers & Clark, 2000; Meiser-Stedman, Dalgleish, Glucksman, Yule, & Smith, 2009).

A core feature of this broad cognitive appraisal model of the genesis of event-based emotions and their concomitants is that appraisals vary in the extent to which they reflect the 'reality' of a given situation. This is important, because appraisals with a low 'truth value' can then be the target for attempts at appraisal change, or reappraisal (Gross, 2002), designed to reduce associated distress and other symptoms. So, for example, appraising oneself as culpable for a negative event (as above) may well lead to significant distress and intrusive recollections, but if the evidence suggests that self-blame is misdirected then targeted re-scripting of such appraisals into a more adaptive form has the potential to down-regulate distress and intrusive reexperiencing (e.g. intrusive memories) of the event. There is now an impressive body of laboratory research looking at the beneficial effects of reappraisal as a broad emotion-regulation strategy in healthy participants (Gross, 2002) and exciting preliminary findings in those with emotional disorders (e.g. Carthy, Horesh, Apter, Edge, & Gross, 2010; Ehrling, Tuschen-Caffler, Schnulle, Fischer, & Gross, 2010; see Aldao, Nolen-Hoeksema, & Schweizer, 2010). These extant studies have a number of prototypical characteristics. First, they tend to focus on modifying appraisals occurring relatively early in the appraisal cycle; i.e. on reappraising the event itself rather than its downstream implications or one's responses to it. Although this is clearly important, for a significant number of real-world situations opportunities to reappraise will occur after the

events in question have already happened. In these circumstances, although it is of course possible to interpret retrospectively aspects of the event itself, modifying appraisals of the event's implications and/or one's responses to it are a potentially tractable regulation strategy that could be applied more broadly regardless of event content. The primary aim of the current study was therefore to examine the effects of reappraisals applied *following* the experience of an emotive event, as opposed to prior to or during the event, and directed at the implications of the event for the person and his/her responses to it, as opposed to the actual content of the event experience.

A second feature of existing studies is a focus on the impact of reappraisal on emotions rather than on concomitants of the cognitive-affective response such as memory intrusions (although a number of studies have looked at memory for the event itself; see Gross, 2002). This makes sense when looking at reappraisal in the local context of the event itself. However, when reappraisal efforts are employed post-event, and thus less directly targeted at event content, alternative outcome variables should be considered. Consequently, the present study examined the effects of post-event reappraisals on intrusive and distressing memories for events and attempts to avoid them. A final characteristic of some existing studies that is worth noting (though perhaps of less importance) is that they often have not involved systematic reappraisal *training*, relying instead on single (or a limited number of) attempts to apply a reappraisal strategy. We contend that reappraisal efforts are likely to reap richer benefits following more comprehensive training. In the present study we therefore sought to train participants systematically into a more adaptive appraisal style following event exposure.

We based our training protocol on methods developed within the Cognitive Bias Modification (CBM) literature (e.g. MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002; Mathews & Mackintosh, 2000; MacLeod, Koster, & Fox, 2009). CBM involves the presentation of multiple trials in which participants are guided to respond in a systematically biased manner. CBM can therefore be used to train people out of bad 'cognitive habits', such as tendencies to attend selectively to threat or to interpret ambiguous situations in a negative manner. CBM has also been successfully deployed to alter participants' appraisals (CBM-App training) (e.g. Lang, Moulds, & Holmes, 2009; Schartau et al., 2009). Hence, we sought here to extend CBM-App training to explore the possibility of modifying appraisal style following stressor event exposure. A feature of the CBM-App training used in the present study that differs from typical (non-CBM) reappraisals studies, is its non-explicit nature: In CBM-App, as used here, participants' appraisal styles are modified through repeated practise but participants are not explicitly informed as to the purpose of the manipulation or encouraged to make such changes explicitly.

In line with prior studies within both the reappraisal literature and the psychological trauma literature we employed a series of highly emotive film clips as the distressing event (see Holmes & Bourne, 2008; Rottenberg, Ray, & Gross, 2007). Such clips reliably induce significant levels of emotion as well as intrusive memories of the film over the subsequent weeks. They therefore provide an ideal test-bed to evaluate the efficacy of post-event CBM-App training. Consistent with the emotion-regulation literature on reappraisal which routinely compares reappraisal to an unhelpful regulation strategy (e.g. rumination or

expression suppression; see Gross, 2002), we sought to compare a putatively adaptive strategy – training in positive reappraisals – with a likely unhelpful strategy – training in negative reappraisals.

We defined what is a positive or helpful versus negative or unhelpful reappraisal based on the extensive literature on appraisal styles in the wake of traumatic events (see Dalgleish, 2004). That is, after psychological trauma people can have vastly different appraisals of the same event – one person my escape from a fire relieved to be alive, another feeling guilty and that it could be their fault. Specifically, we drew on prospective work by Bryant and Guthrie (2005; 2007) who assessed a group of trainee firefighters before trauma exposure using a measure of appraisals called the Posttraumatic Cognitions Inventory (PTCI; Foa et al., 1999). They then followed them up over four years to see which pre-trauma appraisals were associated with later trauma symptoms. Interestingly, negative appraisals about the self (e.g. the event happened to me because of the sort of person I am), rather than appraisals about the world, predicted later PTSD. The authors suggested that techniques to help people engage in more adaptive appraisals might help people better prepare for, or cope with, potentially traumatic events. Based on the encouraging data from Bryant and colleagues, we used the PTCI (Foa et al., 1999) as the source for our training materials.

The training itself involved repeatedly guiding participants via a computerized paradigm towards either positive versus negative appraisals (dependent on experimental condition) across a large set of scripted vignettes. After training, participants kept a one week diary recording any intrusive memories of the film. At one week they completed a questionnaire (the Impact of Event Scale-Revised, IES-R; Weiss & Marmar, 1997) measuring post-traumatic intrusive, avoidance, and hyperarousal phenomena associated with the film.

Our two hypotheses were, first, that CBM-App training would successfully induce either a functional or dysfunctional stressor-related appraisal style (dependent on training condition and without explicit instruction). We tested this via post-training appraisals of novel ambiguous sentences and post-training scores on the PTCI. We did not expect there to be differences in the magnitude of emotional response to the film since the reappraisal target was the self-efficacy beliefs and reappraisal of secondary emotions (emotions in response to the emotional reactions elicited by the film) over a longer time period rather than immediate response to the film per se. Second, we predicted that training condition would influence the number of intrusions of the stressor film over one week and IES-R scores at one week, with training focused on functional appraisals leading to fewer intrusions and lower IES-R scores, compared with training focused on dysfunctional appraisals.

Method

Participants

The 76 healthy participants (39 women) were recruited through advertising at the University of East Anglia. Participants were 18-60 years and fluent in written English. All participants received a small honorarium.

Materials

Stressor film—The 20 minute distressing film was a compilation of 1-3 minute clips. These clips reliably elicit acute distress and subsequent intrusive memories in healthy volunteers (see Holmes & Bourne, 2008). To verify that engagement with the film was comparable across conditions, participants rated attention to the film, using a 10-point Likert-scale (see Holmes & Steel, 2004). The film content comprised clips drawn from earlier studies (e.g. Bourne, Frasquilho, Roth, & Holmes, 2010; Holmes, James, Kilford, & Deeprose, 2010; Schartau et al., 2009) with scenes displaying content relevant to the DSM-IV criteria for a traumatic event; for example, footage from the 9/11 World Trade Center terrorist attack, motor vehicle accidents such as a car on fire and a sinking car, a bomb exploding, and a rampaging elephant injuring people. To enhance self-relevance, participants were asked to view the film “as if they were there, a bystander at the scene of the events, and to pay attention to the film as later there may be questions about film content”.

Reappraisal training (CBM-App)

Training phase: Training comprised processing a series of reappraisal-related scripted vignettes that appeared to participants as a sentence completion task (note that explicit instructions to actively reappraise were not used). Each sentence ended in a to-be-completed word fragment such that the meaning of the sentence remained ambiguous until the final word fragment was resolved. The participant’s task was to finish each sentence by completing the word fragment. Word fragments were designed such that only one possible solution could complete the sentence’s meaning, and these words produced an outcome consistent with either a functional or dysfunctional reappraisal depending on training condition (positive or negative). Themes from the ‘Self’ subscale of the PTCI were used to develop CBM-App materials given the association of these themes with later post-stressor intrusions and distress (Bryant & Guthrie, 2005; 2007). Such items include ‘If I think about the event, I will not be able to handle it’ and ‘I can’t deal with even the slightest upset’. As a further example, there are PTCI items related to “trusting oneself to act appropriately in future” this theme was used to create the following training sentences: (1) ‘*In a crisis, I predict my responses will be h-lpf-l / u-el-ss*’ (Resolved as ‘*useless*’ in the negative CBM-App condition or ‘*helpful*’ in the positive) and: (2) ‘*When faced with a crisis, I now believe that I will react in a way which is r-l-able / unr-l-able*’. To encourage thorough processing of the sentence’ meaning, a comprehension question was included after just under half of the sentences (e.g. for the first example ‘Do you believe you will be able to respond in a useful way when there is a crisis?’). Questions were designed such that ‘yes’/‘no’ answers occurred equally often, with error feedback for incorrect responses. It is important to reiterate that the training was deliberately not targeted at reappraising the content of the film.

In this way, 72 training sentences and 32 comprehension questions were created, along with 8 emotionally neutral filler sentences giving a total of 80 sentences presented in blocks of 10. Blocks were presented in the same order for each participant but the sentences’ order within each block was individually randomized.

A trial sequence was as follows: The sentence was displayed via computer screen without the final word fragment. Participants were instructed to proceed by pressing the 'advance' key when they had read the sentence(s). After the key press, the text disappeared revealing the final word fragment. Participants typed the first missing letter of the fragment as quickly as possible. The completed correct word then appeared on screen. Either a comprehension question followed or a new sentence was presented.

Measuring induced reappraisal bias: Induced bias was assessed following CBM-App training using a two-phase procedure involving an initial encoding stage, followed by a later surprise recognition stage (Mathews & Mackintosh, 2000). During encoding, participants were presented with ten novel ambiguous sentences in random order, also based on PTCI items. Each sentence was introduced with a distinctive title and, unlike the former training items, remained ambiguous (see Appendix Table A1 for an example). After each, participants were required to imagine themselves vividly in the situation and rate this using a 10 point scale.

In the surprise recognition phase the original 10 encoding-phase sentence titles, each followed by a set of 4 related sentences, were presented in turn. Participants rated, on a 4 point scale, how close in meaning each new sentence seemed to the original sentence. Of the four new sentences, two represented a possible positive and a negative interpretation of the original sentence (positive and negative *target* sentences). Two more sentences, with a general positive / negative meaning respectively, had content broadly similar to the original sentence, but not an actual resolution of the ambiguity (positive and negative *foil* items; see Appendix 1).

Intrusion diary—Participants were given a diary to record any intrusions of film content during the 7 days following the experimental session. Participants were advised (both verbally and via written instructions in the diary) that intrusions were defined as “any memory of the film (or part of the film) that appeared apparently spontaneously in their minds. Do not include any memories of the film that you deliberately or consciously bring to mind”. The diary was similar to that used in our previous studies (Hagenaars, Van Minnen, Holmes, Brewin, & Hoogduin, 2008; Holmes & colleagues, 2004, 2009, 2006; Krans, Näring, Holmes, & Becker, 2009; Stuart, Holmes & Brewin, 2006). Participants were asked to record all intrusions immediately after they occurred (whenever possible) and to set aside a regular time slot each day to check that their diary was up-to-date as a way of ensuring intrusions were not omitted if it had been impractical to write an intrusion down immediately. If participants had experienced no intrusions during any period they were also asked to make this explicit in the diary. Participants were also given instructions about the different forms intrusions can take: “What goes through our minds can either take the form of words and phrases ('verbal thoughts'), or it can be like mental images. Although mental images often take the form of pictures they can actually include any of the five senses, so you can imagine sounds or smells too.” Participants were therefore asked to specify in their diary whether each intrusion experienced was a thought or image intrusion and to describe its content (e.g. “a fireman carrying a baby”) so as to ensure that the intrusion related to the film. The diaries were then reviewed with participants at the start of the follow up session to

resolve any uncertainties. A summary score of the number of intrusions of any type reported in the diary was produced for each participant.

Diary compliance rating: Following Davies and Clark (1998), participants were asked to rate their diary completion in comparison with the statement, ‘I have often forgotten (or have been unable) to record my intrusive thoughts or images in the diary’, on a scale ranging from 0 (*not at all true of me*) to 10 (*completely true of me*).

State and Trait Anxiety Inventory (STAI-S, STAI-T; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983)—The STAI-S and STAI-T were used to measure state and trait anxiety, respectively. Both subscales comprise 20 anxiety related statements describing anxiety symptoms that participants rate for occurrence and frequency. The STAI has good internal consistency, .89. The test–retest reliability of the STAI-T is .88, and .70 for the STAI-S (Barnes, Harp, & Jung, 2002).

Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996)—The BDI-II was administered to assess depressive symptoms. Participants respond to 21 depression related questions with respect to the way they felt during the past 2 weeks. The internal consistency is high with an alpha level of .90, and the test–retest reliability is also high .93 (Beck et al., 1996).

Posttraumatic Cognitions Inventory (PTCI; Foa et al., 1999)—The PTCI is a self-report measure comprising 36 statements which reflect appraisals surrounding distressing or traumatic experiences (e.g. ‘I can’t trust that I will do the right thing’). It contains three subscales: negative cognitions about Self (21 items), negative cognitions about the World (7 items) and Self-Blame (5 items). Each item is rated using a 7 point Likert scale ranging from 1=“totally disagree” to 7=“totally agree”. Cronbach’s α has been reported at .97 for the Self scale, .88 for World, and .86 for Self-Blame. Test–retest reliability has been reported at .75 and higher (Foa et al., 1999). The PTCI was presented 3 times: pre-training, immediately post-CBM-App training and at 1-week follow-up, to examine changes in appraisal style.

Impact of Event Scale-Revised (IES-R; Weiss & Marmar, 1997)—The IES-R is a self-report measure assessing current intrusion, avoidance and hyperarousal phenomena tied to a stress-inducing event. The 22 items were adapted to reflect experiences linked to the stressor films (e.g. avoidance: ‘I tried not to think about the film’) as in Lang et al., (2008). Internal consistency has been reported at .97 for the Total score, .86 for the Intrusion subscale, .82 for Avoidance, and .85 for Hyperarousal. Test–retest reliability has been reported at .87 for the Total score, .89 for the Intrusion scale, .79 for Avoidance, and .82 for Hyperarousal (Sundin & Horowitz, 2002). The IES-R was administered 1-week post CBM-App training to measure those post-traumatic phenomena tied to the film over that week.

Visual analogue mood rating scales (VAS mood scales): Participants completed mood ratings before and after viewing the film to assess its emotive impact. Participants rated four mood states (happiness, depression, anger, anxiety) using 11 point scales from 0=“not at all” to 10=“extremely” (Davies & Clark, 1998). Scores across the 4 scales were averaged

(happiness reverse scored) to provide a single index of mood at each time point. Cronbach's α was .71 for the first mood rating, and .80 for the second mood rating.

Procedure

Prior to viewing the stressor film, participants completed a number of widely-used, standardized self-report measures assessing variables putatively involved with stress-related reappraisals. These data enabled us to check comparability on these variables across CBM-App conditions and comprised the: Trauma History Checklist (THC; Holmes et al., 2004) – a short measure of trauma history; STAI-S and STAI-T, and BDI-II. Participants then completed the first VAS mood ratings and PTCL. Participants were left alone to watch the stressful film projected onto the white wall of a darkened testing room to maximize impact, followed by the attention to film rating and the second mood rating.

The CBM-App training and bias assessment were presented next, followed by the third mood rating and second PTCL. Finally, the diary was distributed with instructions as to its completion during the following week.

One week later participants returned for completion of the third PTCL, IES-R and a review of their diary to ensure that subsequent analysis only included intrusions categorized as being related to the film clips. They were then debriefed, thanked and paid for their participation.

Results

Participant Characteristics, baseline measures and compliance checks

Data from two participants who did not comply with instructions (the were unable to watch the film clips) were set aside (according in advance to standardised laboratory protocols such as refusing to watch the stressful film and pressing the same key press throughout the training phase without reading the computer screen), leaving a final sample of 74 participants (37 women; mean age=22.47, $SD=5.96$). There were no significant between-group (CBM-positive vs. -negative) differences on demographics or baseline measures: age, $t(72)=1.31$, $p=.19$; THC, $t(72)=1.44$, $p=.16$, STAI-S, STAI-T, and BDI, and baseline mood, t 's <1 , nor for attention paid to the film t 's <1 , or diary compliance, $t(72)=1.18$, $p=.24$ (see Table 1).

Effects of film on mood

A mixed-model ANOVA with Time (pre vs. post film) as a within-subjects factor and Group (negative vs. positive CBM-App) as a between-subjects factor on the combined mood scores (see Table 1), showed a significant main effect of Time, $F(1,72)=95.59$, $p<.001$, $\eta_p^2=.57$, but no significant effect of Group, nor a Time $\times$ Group interaction, F 's <1 , revealing that both groups experienced strong and comparable increases in negative mood post-film.

Hypothesis 1: Modification of reappraisal bias and changes in PTCL scores

The raw data from the test/recognition phase were converted into an index of bias, that is the degree to which ambiguous sentences had been appraised as having a positive (or negative)

meaning by subtracting the mean ratings for negative targets from positive targets. This 'Bias Index' yields a positive score for a positive bias and negative score for a negative bias. A between-group comparison of the 'Bias Index' confirmed a significant difference $t(72)=8.33, p<.001, d=1.96$, (positive group: $M=1.54, SD=.83$; negative group $M=-0.55, SD=1.28$), with each group yielding a mean bias significantly different from zero in the anticipated direction (negative: $t(36)=2.63, p<.02, d=.43$ positive: $t(36)=11.30, p<.001, d=1.86$), indicating that biases had been successfully induced in both directions.

PTCI change (see Table 1) was explored, again using a mixed model ANOVA. There was a significant interaction between Training group and Time, $F(2,71)=4.63, p<.02, \eta_p^2=.06$, and a main effect of Time $F(2,71)=5.49, p<.01, \eta_p^2=.07$. Follow-up analysis indicated that the positive group were significantly improved (lower scores), relative to baseline, both immediately after training $t(36)=2.70, p<.02, d=0.26$, and at one week, $t(36)=4.73, p<.001, d=.56$. No significant changes were noted for the negative group, $t's < 1$.

Hypothesis 2: Film intrusions over 1-week and IES-R scores

In total 69 participants reported intrusions. As anticipated, intrusions were rated as generally distressing in both conditions (negative, $M=38.10, SD=20.00$; positive, $M=41.80, SD=18.17$). Critically, participants receiving positive CBM-App training reported less frequent intrusions, $t(72)=2.06, p<.05, d=0.49$, and the mean number of intrusions (4.3 vs 6.4 in the positive and negative groups respectively), are in line with those found in earlier studies using similar film material (e.g. Bourne et al, 2010; Holmes et al, 2009). In addition, those trained positively reported lower IES-R scores, indicative of lower levels of post-film symptomatology, than those trained negatively, $t(72)=2.15, p<.04, d=.51$ (Table 1).

Discussion

Our aim was to investigate whether systematic computerized training in positive and functional reappraisals (positive CBM-App) *following* the experience of a distressing event (an emotive set of film clips), and unrelated to the specific content of that event, could reduce intrusive memories of that event and other associated symptomatology (e.g. avoidance) compared with training of dysfunctional appraisals (negative CBM-App). CBM-App training successfully modified appraisal styles in the intended directions as assessed by independent vignettes immediately post-training (both groups) and by scores on the PTCI (positively trained group) both post-training and at one week. Most importantly, participants who received positive CBM-App training reported significantly fewer intrusions of the distressing film over the subsequent week and lower scores on the IES-R for that period, compared with those who received negative training.

The findings are encouraging. They demonstrate, in principle, that reappraisal interventions can successfully be applied *following* an experimental event, as opposed to during that event (or just prior), and can modify intrusive re-experiencing of that event. This is in line with recent psychophysiological work on reappraisal by Sheppes, Catra, and Meiran (2009) highlighting the success of targeting appraisals subsequent to, rather than in advance of, an emotional situation. Furthermore, this particular post-event strategy (even though at a preliminary phase) has the advantage of not tying reappraisal to specific event content, but

to broader appraisals about for example, self and symptoms that straddle different types of stressful events. The data, though still at an early stage, therefore have clear translational possibilities for assisting individuals who are emotionally troubled by events in their past to which they have attached dysfunctional appraisals. To that extent, the current CBM-App protocol could be regarded as a computerized instantiation of aspects of Cognitive Behavioural Therapy (CBT) as provided to survivors of distressing events such as trauma and bereavement who are suffering from clinical distress, including PTSD. However, CBT is time consuming, expensive, requires a professional therapist, and the event survivors must first identify themselves as needing help. The further and careful translational development of computerized CBM-App could ultimately provide individuals with the facility to undergo the training at home, with minimal professional support. This might provide a flexible and motivating approach for a computer literate generation. There is now a clear need for *incremental* follow-on studies focussing on replication *in the laboratory* and extension to survivors of real-life, as opposed to analogue, distressing events, and with a greater focus on individual differences variables that may modulate training effects (e.g. habitual use of reappraisal as an emotion regulation strategy).

There are limitations regarding the present study that merit discussion. Our design did not include an additional control group who received for example neutral or no training. Therefore, it is not clear what produced the observed effects, i.e. whether the negative appraisal training lead to more intrusions, whether the positive appraisal training reduced the intrusions, or whether both effects occurred. Adding a neutral control group would have enabled us to draw more precise conclusions. The lack of such a control group is less important for the bias modification checks (on PTCI) as we had pre-training or ‘no bias’ baseline for this measure. It would also have been interesting to examine whether the way that participants appraised new stressful experiences following training (e.g. a second film) had been altered.

In sum, we show that functional reappraisal training (relative to dysfunctional training) following an emotive experience can reduce intrusive memories and other associated symptoms over the following week. This provides proof-of-principle support for exploring the translational potential of such reappraisal training for use following real world stressors.

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Appendix

Table A1
Examples of stimuli used to measure induced reappraisal bias including Title, Ambiguous Encoding Sentence, and Recognition Sentences used to assess induced bias following bias modification. Each recognition sentence was rated for similarity to the original titled sentence using a four point scale ranging from 1 (very different in meaning) to 4 (very similar in meaning)

<i>Title</i>	<i>“Aftermath of events.”</i>
Encoding sentence	“People come to terms with the aftermath of these types of events in many different ways. My reactions are very indicative of the way I seem to be dealing with it.”
<i>Recognition sentences</i>	
Negative target	“People come to terms with the aftermath of these types of events in many different ways, but my reactions mean my coping skills are poor.”
Positive target	“People come to terms with the aftermath of these types of events in many different ways, but my reactions mean my coping skills are healthy.”
Negative foil	“People come to terms with the aftermath of these types of events in many different ways, but my reactions mean my coping skills are suspicious.”
Positive foil	“People come to terms with the aftermath of these types of events in many different ways, but my reactions mean my coping skills are trustworthy.”

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Table 1
Demographic Data, Self Report Questionnaire, Mood and Diary Data of the Sample

Measure	Negative group (<i>n</i> = 37, 19 female)		Positive group (<i>n</i> = 37, 18 female)		t-test
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Age	21.57	3.80	23.38	7.47	$t(72) = 1.31, p = .19$
THC	2.05	1.68	1.57	1.19	$t(72) = 1.44, p = .16$
STAI-S	31.62	6.84	33.22	8.04	$t(72) = 0.92, p = .36$
STAI-T	36.67	8.09	38.62	9.23	$t(72) = 0.92, p = .36$
BDI-II	6.62	4.13	7.49	5.75	$t(72) = 0.74, p = .46$
Pre-film mood	1.64	1.08	1.73	1.22	$t(72) = 0.33, p = .74$
Post-film mood	3.99	2.08	3.74	1.90	$t(72) = 0.54, p = .59$
Attention to film	9.41	.69	9.24	.80	$t(72) = 0.94, p = .35$
Diary compliance	1.70	.81	1.46	.96	$t(72) = 1.18, p = .24$
No of intrusions in 7 day diary	6.43	5.10	4.32	3.60	$t(72) = 2.06, p < .05$
PTCI Time 1	86.30	31.12	84.24	29.00	$t(72) = 0.29, p = .77$
PTCI Time 2	88.05	35.66	77.30	25.41	$t(72) = 1.49, p = .14$
PTCI Time 3	85.73	33.28	69.62	24.21	$t(72) = 2.38, p < .04$
IES-R	23.57	19.15	15.68	11.47	$t(72) = 2.15, p < .04$

Note. THC=Trauma history checklist; STAI-S/T= Spielberger State-Trait Anxiety Inventory-State/Trait version; BDI-II=Beck Depression Inventory-II; PTCI=Posttraumatic Cognitions Inventory; IES-R=Revised Impact of Event Scale