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Computer-Based Perspective Broadening Support for Appraisal Training:
Acceptance and Effects

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ABSTRACT

Post-traumatic stress affects millions of people worldwide. Appraisal training is an intervention that has been used to decrease the negative effects of a traumatic event. In two studies, the acceptance and effects of technology in supporting appraisal was studied. Study 1, a descriptive study, examined the response to and acceptance of a workshop on perspective broadening with technological support among soldiers and firefighters. Results revealed that both groups evaluated the training as useful and feasible, and both favoured the full version of the tool. Study 2 investigated the effect of the support tool among a student sample in comparison to the paper-based training. Participants followed the training individually. Comparisons between the two groups revealed no significant differences on multiple outcome measures. Behaviour observed during the training suggests that shorter sessions might prove more effective. The findings indicate acceptance of the technology supported training but gives no indication that the effects of the training are improved by technological support.

KEYWORDS

Behavior Change Support, Cognitive Appraisal, Computerized Training, Technology Acceptance, Trauma, Video Annotation

INTRODUCTION

Most people experience one or more traumatic events during their lifetime (Kessler et al., 1995; Perkonigg et al.., 2000). Exposure to traumatic events can lead to the development of post-traumatic stress disorder (PTSD) and other mental health problems. PTSD is a mental disorder that can occur after experiencing traumatic events. PTSD symptoms include repeated intrusive memories or distressing dreams, avoiding reminders of the event that might bring on distressing memories, increased arousal and reactive symptoms, and negative cognitions and emotions (American Psychiatric Association, 2013). Furthermore, PTSD can co-occur with other mental health problems such as depression, suicide, or substance abuse (Kilpatrick et al., 2003; Morina et al., 2013; Pietrzak et al., 2011). Along with the great cost on a personal or familial level, this disease is a high cost to society.

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Psychological interventions can effectively treat PTSD (Bisson et al., 2013; Morina et al., 2016). Current approaches to treatment include but are not limited to exposure therapy, cognitive behavioral therapy, eye-movement desensitization and reprocessing, and psychopharmacotherapy (Bisson et al., 2013). However, these often reach only a limited number of individuals with PTSD, and at this point - after the fact - the individual has already suffered greatly. Interventions aiming at preventing PTSD before experiencing the trauma may prevent subjective suffering and reduce societal costs related to PTSD.

A possible approach to addressing these limitations is through providing individuals with the cognitive tools, through appraisal training, before experiencing a traumatic event. Lazarus and Folkman (1984) described coping as a person's thoughts and behaviors that manage the demands of a situation that is appraised as stressful. Changing the way you feel by changing the way you think is a powerful coping strategy. This thought process is referred to as reinterpretation or reappraisal and is a form of emotion regulation (John & Gross, 2004).

Boden et al.'s (2013) study among military veterans being treated for PTSD showed use of cognitive reappraisal to be associated with lower symptom severity for PTSD. Similar conclusions have been drawn from an earlier study with trainee fire fighters (Bryant & Guthrie, 2005) that found that a tendency to appraise situations negatively is a risk factor for developing PTSD. Tugade and Fredrickson (2004) found that resilient individuals use positive emotions to find positive meaning in stressful situations, and that an important factor that contributes to psychological resilience is appraisal. Achieving healthy reappraisals can be aided through trainings in, for example, benefit finding (Sears et al., 2003), positive meaning making (Tugade & Fredrickson, 2004), and perspective broadening (Schartau et al., 2009). This paper focuses on exploring the role technology can play in a reappraisal training following films about distressing topics.

In line with Benjamin Franklin's axiom "an ounce of prevention is worth a pound of cure", new research is emerging to investigate whether such a training can be beneficial prior to a traumatic event, or more broadly prior to dealing with stressful situations. For example, Woud, Postma, Holmes, and Mackintosh (2013) found that positive or negative reappraisal training prior to watching a trauma film resulted in congruent appraisal styles afterwards, and those trained in positive reappraisal reported less stress with regard to intrusive memories of the film in the week after. Furthermore, Schartau et al. (2009) conducted four studies that demonstrated that a cognitive bias modification training in perspective broadening (similar to 'cognitive reframing'; Aldwin & Yancura, 2004) reduced subjective measures of horror and distress in response to distressing films. The training provided individuals with four themes which served as a template for creating specific functional appraisals in response to negative experiences (as opposed to dysfunctional appraisals, e.g. "things are never going to get better"), guiding their thoughts towards thinking about positive aspects of the event and focusing on the bigger picture. The themes included every cloud has a silver lining, broader perspective, time heals, and bad things happen. Their results indicated that participants that systematically practiced appraising with the learned themes had a greater reduction of self-reported emotional reactivity in response to distressing films at post-test. The two studies described in this article build on Schartau et al.'s (2009) training by investigating whether a technological support tool might enhance the outcome of a reappraisal training.

Current preventive interventions are embracing the opportunities that technology may provide. For example, virtual reality allows for immersive experiences in a controlled environment and is incorporated into trainings such as pre-deployment stress inoculation training and multimedia stressor environment (Hourani et al., 2011), stress resilience in virtual environments (Rizzo et al., 2011), immersion and practice of arousal control training (Bouchard, Bernier, Boivin, Morin, & Robillard, 2012), and physiology-driven adaptive virtual reality simulation for prevention and treatment of stress related disorders (Ćosić et al., 2010). The aforementioned trainings focus on cognitions and behavior during the traumatic experience, with little regard for cognitive processing after the event. The current study aims to determine whether and how technology can play a role in a preemptive reappraisal

training. With a focus on cognitive processing after the event (Schartau et al., 2009; Beer, Neerincx, Morina, & Brinkman, 2017), acceptance is an important precondition for a training to be implemented.

Some populations, such as soldiers and firefighters, might have a culture where emotions and mental health are not spoken about openly. Technology-based interventions can help increase openness for and acceptance of psychological interventions. Vakili, Brinkman, Morina, & Neerincx (2014) investigated the role of technology in the field of stress-resilience training and identified several key requirements and recommendations for developing such a training in a military context. Requirements included: change (cognitive, affective or behavioral) to enhance resilience, personalization to individuals, transferability between domains, durability and measurability of effects, cultural relevance, economy, safety, engagement, and addressing the entire life cycle.

With these requirements in mind, three video labeling tools were developed. The labeling tool allows for personalizing content, i.e. film selection accommodating different personal experiences, moments in the life cycle, contexts, and professions. As for the requirement of the training being engaging and motivating – the addition of the labeling tool appeals to the interactivity of the training as it encourages reflection.

We conducted two studies to investigate various aspects of the developed training. The first study was descriptive in nature and focused on the target population, investigating the perceived acceptance of such a training and responses to three different versions of the video labeling tool. In the second study the effects of the training on an individual basis in a controlled setting were investigated, comparing the training containing technology-mediated (interactive) practice with one containing mental practice. Based on the aforementioned research by Vakili et al. (2014) the technology mediated training is expected to be received positively by the target populations, as technology is appealing. Furthermore, Hasler, Kersten and Sweller (2007) showed that learner-controlled pacing can show higher test performance, thus the labeling tool was expected to enhance the effects of the training as it aims to reduce cognitive load in comparison to the training without the tool, and provides individuals with more learner control by allowing them to appraise when it suits them (i.e. pacing), as well as expand on their thoughts by writing about them.

Study 1

Study 1 is a descriptive study investigating the response of the target population to the training with technological support. Additionally, as a secondary outcome measure questions were asked regarding tool preference. As our research might prove valuable to professions with a high risk of trauma exposure (Kleim & Westphal, 2011), we targeted soldiers and firefighters in the Netherlands. The researchers had the unique opportunity to do this study among soldiers as a small part of a bigger study (Hart & Sassen, 2016), which meant there were some constraints as to the design of the experiment. The main constraint was that all participants had to undergo the same training, ruling out the possibility of varying conditions and counterbalancing for order effects. This acceptance study was integrated into a workshop on perspective broadening supported by video player applications. In particular, this study aimed at addressing the following two questions: Do soldiers and firefighters accept the workshop as a valuable training, and do they favour one tool over the other?

METHOD

Design

This study is descriptive in nature, examining the response to the workshops within the target populations. A small part of the study involved analysis of the different versions of the tool, which could be seen as a within-subjects design, where responses to questionnaires as well as behavior during the training session are measured. Ethical approval for work with firefighters was obtained at the Delft University of Technology Ethics Committee, and for work with the soldiers at the local (TNO) ethical committee (Toetsingscommissie Proefpersoonexperimenten, TCPE).

Participants

58 non-commissioned officers in training (NCOs) with no experience and 17 professional firefighters with a range of 6 to 34 years of experience voluntarily joined the workshop. The mean ages of the two professions differed significantly $t(16.37) = -9.33$, $p < .001$. The mean age of NCOs was 19.7 ($SD = 1.8$), whereas the firefighters' mean age was 40.94 ($SD = 9.3$). Participation was voluntary. For the NCOs, the workshop was embedded into a bigger research project on mental resilience training. They were thus not actively recruited for this workshop as it was an optional part of the training schedule (specifically in the module on practical applications of coping strategies; Hart and Sassen 2016) at the Dutch Royal Military School (KMS) provided by the Netherlands Organization for Applied Scientific Research (TNO). As the workshop was offered as a stand-alone event for firefighters, they were recruited via flyers, posters, and a posting on the organization's intranet site. As only one female participated in the study, gender differences were not taken into account.

Materials

Schartau, Dalgleish, and Dunn (2009) expressed a necessity to differentiate between appraising during the film (Study 1) and in a one-minute thought break directly after the film (Study 2 and 3). Therefore, two versions of the labeling tool were developed to reflect this distinction: "real-time labeling" and "labeling after." Additionally, a "full annotation" version with more functionalities than the aforementioned was developed to provide participants with more control and interactivity, and to allow for a more extensive reflection of the video and appraisals. Interactive video in an e-learning setting has been shown to improve performance and learner satisfaction (Zhang, Zhou, Briggs, & Nunamaker, 2006). All versions were embedded into a video player. With the "label after" version participants indicated the themes they would apply after having watched the entire video by ticking checkboxes (Figure 2). The "real-time labeling" version allowed for real-time labeling of the themes by ticking checkboxes while the video played out (Figure 3). The "full annotation" version depicted in Figure 1 was the tool with the most functionalities: participants actively placed labels

Figure 1. Full annotation version of the tool[1]

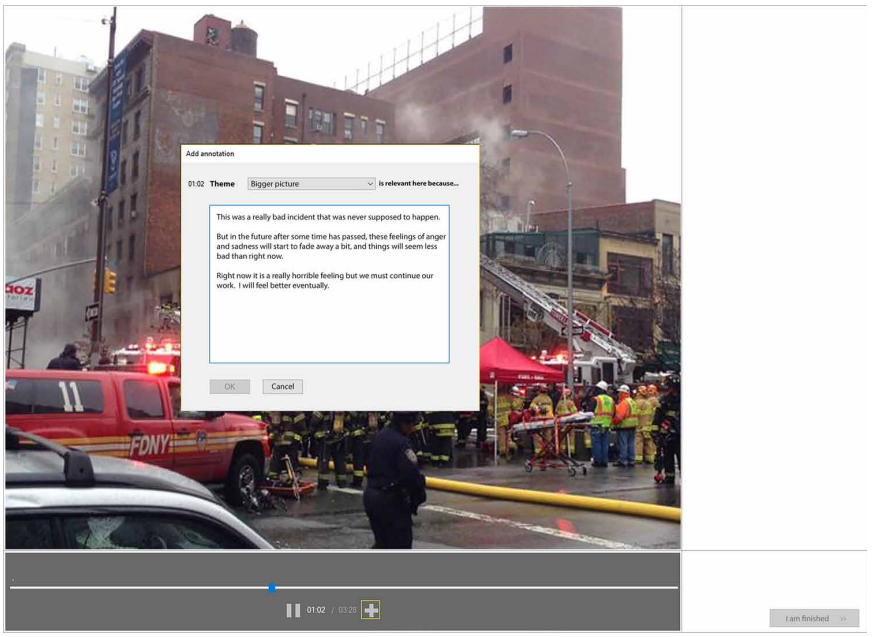


Figure 2. Labeling after version of the tool

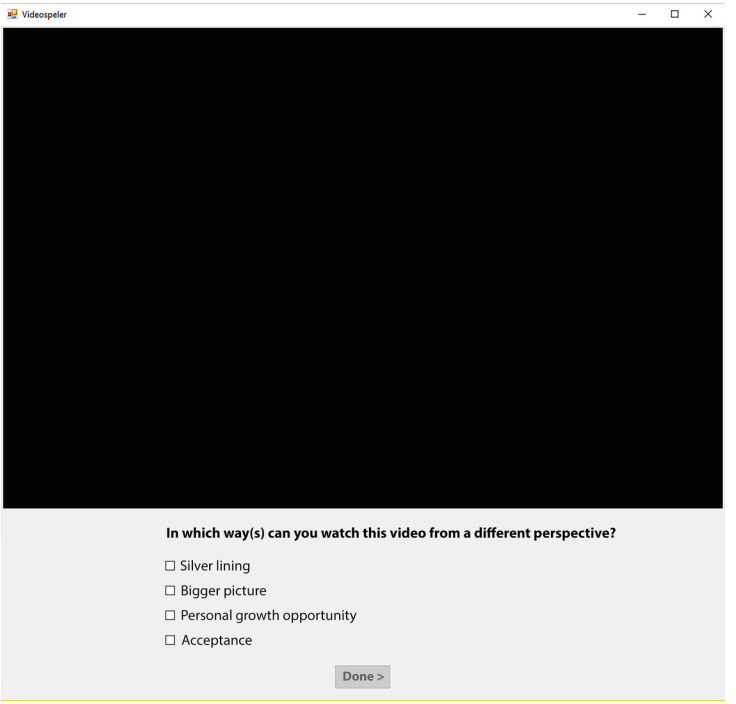
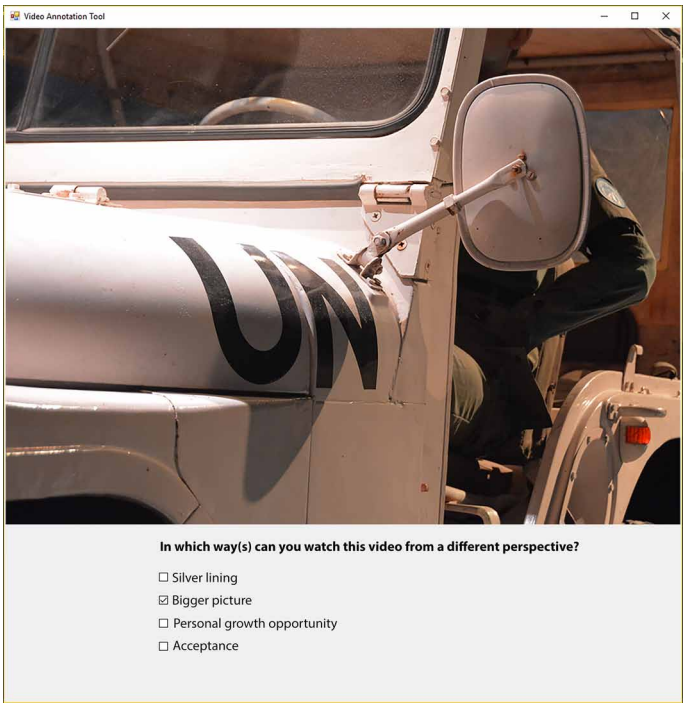


Figure 3. Real-time labeling version of the tool



on the timeline of the films, indicating which theme they would apply and annotating how or why they would apply that theme. Additionally, they could pause, rewind and edit their annotations with this version of the tool.

Each tool had a different video assigned to it as it was not possible to randomly assign videos to tools due to the classroom setting of the workshops (i.e. exercises and videos are introduced by the instructor). The video content differed between the NCOs and firefighters, to provide applicable situations for each profession, with some overlap. Videos for the NCOs were approved by domain experts at TNO and a military psychologist involved in the program. These videos included news coverage of hurricane Katrina, the Rwandan genocide and a child abuse case in the Netherlands. Videos for the firefighters were approved by the social worker of the fire department and included news coverage of a passenger flight that crashed near Amsterdam, a fire in a football stadium and the Rwandan genocide.

Appraisal themes were provided to encourage participants to interpret a negative event from a broader (more positive) perspective, i.e. 'looking at things differently'. Each theme was explained and supported with an example. For the NCOs, four appraisal themes were chosen by domain experts at TNO and in consultation with the military psychologist involved in the program. A domain expert and social worker from the fire department chose the same themes as those used for the NCOs. This resulted in the following four themes for both professions:

1. **Positive point of view (silver lining):** I can see there are positive aspects to this situation;
2. **Giving meaning (bigger picture):** I can see that this situation or event serves a higher purpose or goal;
3. **Personal growth opportunities:** I can learn from this experience;
4. **Acceptance:** I have to accept this situation as it is.

Measures

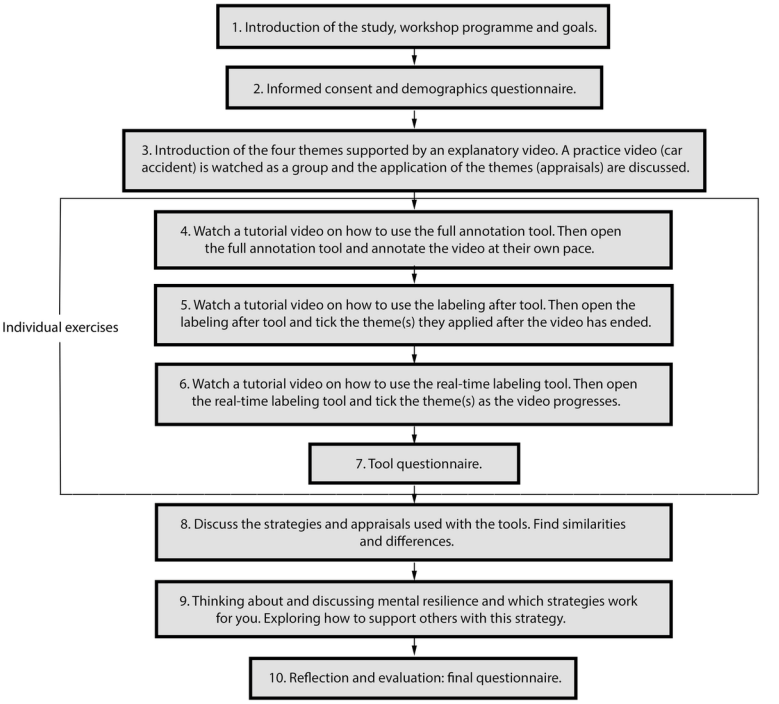
Questionnaires containing 5-point Likert scale statements (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree), two ordering questions, two questions on a 10-point scale, and an open question were administered. The questionnaires contained items pertaining to the themes, labeling tools, video content, tool preference, and an overall assessment of the workshop. To determine engagement with the tools, log files recorded participants' responses, including which themes they used and at what point in time, and in the case of the full version of the tool, also their annotations.

Procedure

Figure 4 shows the different steps in the study. The workshop for the firefighters was presented by the first author and facilitated by the in-house trainer of the fire department. To keep in line with regular military training standards, the NCOs were instructed by military instructors who were trained to give the training. This was done not only because it had to fit within the existing military training programme, but also because the training focused on topics they generally find difficult to discuss (Vakili et al., 2014). Talking openly about emotions and feelings is something that was expected to be more acceptable when it is coming from a senior officer. Note that this decision meant that the order of the video content was not randomized, but the same for all participants within the training.

After participants gave consent, the instructor provided an introduction and explanation of PTSD, appraisal and the four appraisal themes. This was supported by an explanatory video containing real-world examples. A practice video about the aftermath of a car accident was shown and possible appraisals were discussed in the group. This was done without the tool as it was important to first understand the concept of reappraisal and also to make participants more comfortable with talking openly about their thoughts. Participants then started the individual

Figure 4. Flow chart of the procedure of the study



exercises using the tools (the order of the tools was consistent across all participants). Each tool was preceded by an instructional video on its use. After the three exercises with the different tools were completed, the first questionnaire about the tools was filled in. Group discussions followed. Finally, a general questionnaire was administered at the end of the workshop for the firefighters and during the week-long resilience training for the NCO's.

ANALYSIS AND RESULTS

Responses to questionnaires as well as the log files generated by the tools (including themes used and length of annotations) were analyzed in R version 3.3.2. Data sets, R script, and output can be found online[3]. Table 1 shows the subjective responses to questionnaires for NCO's, firefighters as well as both professions combined. Differences between soldiers and firefighters in Table 1 were not significant, as determined by Mann-Whitney U tests ($p > .1$) with the exception of the Enjoyable (to do) item that approached significance level of .05 ($W = 263$; $p. = .051$, power = .52). One sample Wilcoxon signed ranked tests were performed on the subjective Likert scale measures to determine deviance from a neutral response.

Primary Outcome Measures

Assessment of Coping Strategy

The coping strategy "looking at things differently" was positively received by respondents as results showed scores above neutral, indicating agreement, for all three items: "I found the four themes useful" ($v = 1132.5$, $p < .01$), "I can judge whether this strategy suits me" ($v = 929$, $p < .01$) and "I understand the benefits of this strategy" ($v = 1368$, $p < .01$).

Table 1. Military and firefighter's subjective assessment[a]

	Military			Firefighter			Combined		
	Mdn	**Freq.**	**IQR**	**Mdn**	**Freq.**	**IQR**	**Mdn**	**Freq.**	**IQR**
Coping strategy: reappraisal									
Utility	4	51%	1	4	71%	0	4	55%	1
Suitability	4	65%	1	4	53%	1	4	62%	1
Benefits	4	72%	0	4	59%	1	4	68%	0
Tools									
Utility	4	52%	1	4	76%	1	4	57%	1
Experience	4	53%	1	4	59%	1	4	55%	1
Future use	3	36%	2	3	63%	0	3	41%	2
Ease of use									
Video player 1 (full)	4	66%	0	4	93%	0	4	71%	0
Video player 2 (after)	4	75%	0	4	71%	0	4	73%	0
Video player 3 (real-time)	4	50%	1	4	67%	0	4	57%	1
Video content: how distressing									
Video 1	4	44%	1	3	18%	2			
Video 2	4	37%	1	4	47%	2			
Video 3	4	44%	2	4	41%	2			
Workshop									
Enjoyable (to do)	4	65%	1	4	59%	1	4	63%	0
Personal relevance	4	60%	0	4	82%	0	4	67%	0
Active involvement	4	63%	1	4	71%	0	4	65%	0
Grasp of subject	4	60%	1	4	53%	1	4	58%	1

a Each column of the table represents median (Mdn), frequency of the median (freq.) and interquartile range (IQR).

Assessment of Tools

Most respondents agreed that the labelling exercises are a useful way to practice applying the themes ($v = 1248.5$, $p < .01$). Respondents also claimed to have gained good experience with applying the strategy ($v = 829.5$, $p < .01$). As for the perceived contribution of the labeling exercises to future disturbing events, most participants were neutral on its utility ($v = 525.5$, $p = .48$), which might indicate that people are not capable of assessing the utility or effectiveness of using the themes in future situations. Furthermore, this is a measure of face validity from the users and can be considered as an integral part of acceptance.

Ease of Use

All three of the labeling tools were considered easy to use, with most responses being 'agree' (full version, $v = 2262$, $p < .01$; label after, $v = 764.5$, $p < .01$; label real-time, $v = 554.5$, $p < .01$).[2]

The "full annotation" version was ranked as the easiest to use by 52% of the participants, while 9% considered the "real-time labeling" version easiest, and 39% found the "label after watching" version easiest. A Chi-square test revealed that the distribution is significantly different from random $\chi^2(2) = 19.7$, $p < .001$. The difference can be attributed to the "real-time labeling" version

because when this tool is removed from the analysis then there is no difference between the other two $\chi^2(1) = 1.33$, $p = .25$. This is not the case when removing the other two versions from the analysis (remove "full annotation" version $\chi^2(1) = 12.5$, $p < .001$, remove "label after watching" version: $\chi^2(1) = 20.5$, $p < .001$).

When asked whether labelling during the videos was distracting them from watching the videos, participants responded that this was not the case ("real-time labeling" version, $Mdn = 2$, $v = 70$, $p > 0.01$; "full annotation" version, $Mdn = 2$, v = 264.5, $p > 0.01$).

Workshop

Some general questions about the workshop as a whole (i.e. including instruction, examples, practice and discussion) also scored above neutral, they were whether the workshop was "enjoyable" to do ($v = 1184$, $p < .01$), whether it was informative/relevant ($v = 1378$, $p < .01$), whether the participant felt actively involved ($v = 1519.5$, $p < .01$), and whether they found they have a good grasp of the subject matter ($v = 889.5$, $p < .01$).

Secondary Outcome Measures

Tool Preference

Additionally, participants indicated which tool they deemed best for learning to use the themes. Here the "full annotation" version was favored by 51% of the participants, the "labelling after" version by 35%, and the "real-time labelling" version by 14%. A Chi-squared test revealed that this distribution deviated from random $\chi^2(2) = 13.65$, $p = .001$. The difference can be attributed to the real-time labeling version because when removing the "real-time labeling" version, no deviation from random is found $\chi^2(1) = 2.05$, $p = .15$. This is not the case when removing the other two versions from the analysis (remove "full annotation" version $\chi^2(1) = 5.77$, $p < .05$, remove "label after watching" version: $\chi^2(1) = 13.89$, $p < .001$).

Film Check

The films were sourced from news items that were available to the general public, providing us with enough confidence that the participants would understand the content. A check was done whether the participants found the content disturbing. The majority of participants agreed that all of the videos had disturbing content, only the firefighters were less agreeable on their first video (Crash Turkish Airlines) being disturbing, with 7 scores below neutral and 10 scores at or above neutral. Between-group differences were not considered here because the firefighters and soldiers had different videos. Furthermore, the Spearman rank-order correlation analysis determined there were no correlations between the content of the videos and scores related to the themes and ease of use ($p > .05$), which is important when trying to rule out or diminish the effects of the video content as a confounding variable with regard to the assessment of the labeling tool.

Engagement With Tools

In addition to the above, the behavior of participants while using the tools was investigated. Overall, the average number of themes applied per tool were as follows: 1.76 for both the "full annotation" version and the "real-time labelling" version, and 1.46 for the "label after" version. Soldiers applied significantly fewer labels in the "full annotation" version: soldiers (M=1.56, SD= 0.76) and firefighters (M= 2.41, SD= 1.50); $t(70)$= -3.11, $p < .05$.

An independent samples *t*-test was conducted to compare the total amount of words written by soldiers and firefighters. No significant difference for soldiers ($M = 30.2$, $N = 55$, $SD = 13.45$) and firefighters ($M = 42.8$, $N = 17$, $SD = 28.33$) was found, $t(18.28) = -1.78$, $p > .05$; however, these two groups had different films so no conclusions can be drawn.

Participants were asked whether they immediately started labeling as the film started or first watched the entire film and then went back to labeling, which half of the respondents did (soldiers 52%, firefighters 41%), no difference between soldiers and firefighters was found, $\chi^2(1) = 0.59$, $p > .05$. Also, there was no correlation between having first watched the entire film and a) the number of themes applied $r(71) = .02$, $p = .20$ nor b) the number of words typed $r(71)=-.14$, $p = 0.23$.

DISCUSSION

This study investigated soldier and firefighters' responses to and use of a technologically supported training in re-appraisal. The primary question this study aimed to answer was whether participants were accepting the training. The secondary question was which tool was favoured. The results suggest that both firefighters and soldiers alike found the themes useful and the labeling tools a helpful learning exercise. Participants evaluated all the tools as easy to use. When asked to rate which of the tools was easiest to use, the real-time labeling version was rated lowest, which could be explained by dual-task interference (Pashler, 1994) as they had to perform two tasks simultaneously. The "full annotation" version was rated higher than the "labeling after" version, but this difference was not significant. Questions regarding the workshop overall also revealed positive responses, which can be seen as indication of general acceptance of the training.

The relatively low scores for expected use of the themes in the future could be explained by a variety of things. One possible explanation could be that participants were not convinced of the effectiveness of appraisals as a coping mechanism. Alternatively, perhaps the themes were too obvious or just not specific enough. Another possible explanation could lie in the Health Belief Model (Janz & Becker, 1984), which poses that an individual's perceived susceptibility, severity, benefits, and barriers together will determine their health behavior. Although the training in the current study included information on PTSD, participants might be missing the link to the real-world, perhaps underestimating their susceptibility and the severity of PTSD.

All themes were applied with the tools and participants selected more than one theme for each tool, with firefighters applying slightly more themes than soldiers. Still, word counts from the "full annotation" version revealed no difference between firefighters and soldiers. As the group used different films, it is difficult to draw clear conclusions at this point.

The soldier population was part of a larger study in which it was essential that all participants got the same treatment. Working with this constraint meant that all participants watched the films in same order with the same tool version. This meant that in this setup the effect of the film content, order, and tool version cannot be separated. This internal validity limitation, however, has to set against the external validity gained by collecting data from individual of the actual target population within actual training setting. This might have affected the perception and use of the tool, however, both professions showed the same trend while having different videos. Additionally, there was no correlation between the video rating and the tool rating. Notwithstanding these limitations, the results of Study 1 demonstrated that both the soldier and firefighter populations accepted the training, encouraging us to continue with further investigation into the effects of the technology-supported training. The next step was to determine whether the tool provided actual added value when compared to a training without the tool support.

Study 2

In Study 2, rather than testing whether the training has an effect on affect, which Schartau and her colleagues have already showed, we aimed at determining the added value of the labeling tool when integrated into such a training. Accordingly, our research question was whether the labelling tool improves appraisals post-training. To determine this added value, Study 2 took place in a more controlled setting, individually, among university students. Participants' responses to distressing test

films, as well as their behavior during the training were compared. This study compares the paper version and the technology-supported version of the training.

The set-up of this study closely resembles Schartau et al.'s (2009) second study, with two substantial differences: instead of a watch group this study makes use of a tool group and, instead of focusing on emotion as the outcome, this study focus on the appraisals themselves, which is reflected in the video selection as well as the development of the "full annotation version" and the analysis. Emotions are included in the study as a check for possible negative side effects of the training, but as posed by Beer et al. (2017), the focus should be on the appraisals themselves as an indication of the effectiveness of a training, rather than the emotional response. As posited in the introduction, the missing element in current interventions is giving people tools to aid them with reflection after the fact.

The first hypothesis of Study 2 was that the training will improve the ability to find diverse ways of looking at a situation from a positive perspective, and that this effect is enhanced by the addition of the technological support, i.e. technology will enhance the effect of the training on the number and quality of written appraisals in response to post-training test films. We also expected that the video labeling tool would facilitate the use of more appraisals during the training phase by providing the opportunity to stop the video and work out related thoughts, reducing cognitive load in comparison to mentally appraising.

METHOD

Design

This study, a between-subjects design, investigates pre and post training measures between an experimental condition in which the participants completed the training with the labeling tool, and a control condition in which participants did the training without the support of the labeling tool. Participants were asked to report, among others, their mood, processing style and re-appraisals in response to a test film clip before and after the training. In the week following the training an intrusion questionnaire was filled in to examine potential negative side effects. Ethical approval was obtained by the Delft University of Technology Human Research Ethics Committee.

Participants

A total of 64 university students, with a mean age of 21.98 ($SD = 2.16$), were recruited via posters, flyers and personal invitation. The informed consent form contained part of the screening. By signing it participants indicated they do not suffer from uncorrected vision problems, autism spectrum disorders, emotional problems, anxiety and depression. Additionally, the Hospital Anxiety and Depression Scale (HADS; Bjelland et al. 2002) was administered, with cutoff scores of ≥ 8 (n=4 did not pass). Of the 60 students who passed the screening, 32 (n[female] = 16, n[male]=16) were randomly assigned to the control group. The remaining 28 participants (n(f) = 13, n(m)= 15) were assigned to the experimental group.[3]

Materials

Appraisal Themes

Participants were presented with a text providing four appraisal themes, which encourage participants to interpret a negative event from a broader (more positive) perspective, i.e. 'looking at things differently'. Each theme was described and supported with an example. The following themes were chosen, based on Schartau et al.'s (2009) training:

1. **Bad things happen:** Bad things happen in the world and I need to put them behind me and move on;
2. **Silver lining:** There are usually some good aspects to every situation, and it is important to focus on these;

3. **Broader perspective:** Bad events are rare overall and lots of good things are happening all of the time;
4. **Time heals:** In the (near) future, this will not seem anywhere near as bad as it does now.

Labelling Tool

The full annotation version of the video player was chosen for this study, as it provided the most functionalities and scored highest in Study 1.

Films

A fundamental difference between this study and that of Schartau et al. was that in this study we chose to focus more on the appraisals themselves rather than solely the emotional response, therefore films with distressing topics (i.e. films about distressing events) were selected, whereas the aforementioned, in accordance with the trauma film paradigm (Holmes & Bourne, 2008), made use of films that are chosen on the basis of how distressing they are to watch (i.e. films chosen to incite distress).

Two test films were selected and counterbalanced for the pre- and post- training measurements. One of these films was news coverage of the shooting on a small island in Norway ('Utoya'; 2:17 min), the other was news coverage of a fire in a bar in a small town in the Netherlands ('Volendam'; 2:24 min). Both of these incidents involved the death and injury of unsuspecting groups of young adults. For the training phase, 6 films were selected depicting news footage of various traumatic events, from mass genocide to shootings, aggression, abuse, and terrorist attacks (between 1 and 5.5 minutes in length). The training films were presented in the same order for all participants. All films were preceded by a short text, which gave a context or role to take on while watching the films, aimed at developing empathy for the characters in the films.

Primary Outcome Measures

Appraisals for Test Films

Participants were asked whether they successfully applied at least 1 theme (yes/no) to the test films. They were then encouraged to reflect in writing on how they could/would apply the themes to the situation depicted in the film. Reflections were compared pairwise and given a quality score in relation to its counterpart on a 6-point scale from -3 to 3. This score was subjective, encompassing the following criteria: how thoughtful or specific to the situation the appraisals were, how original the appraisals were compared to the examples, and overall positivity. Also, the number of appraisals was counted for each reflection. See section 'Analysis & data preparation' for more detailed information on this process.

Secondary Outcome Measures

Affect

The Dutch translation of the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was administered to determine the mood of participants at baseline, after watching the pre-training test film and after the post-training test film. With this scale, participants rate 10 positive and 10 negative adjectives on a 5-point Likert-type scale. Differences between conditions were not expected, yet this measure was included to gain insight into PTSD-related symptoms as well as a control for the intensity of the films.

Behavior During Training

During the training, the type of appraisal themes used were recorded. Participants in the control condition indicated which themes they applied in their head, and for those in the tool condition this information was recorded in log files.

Compliance

As in Schartau et al.'s (2009) study, we asked participants to indicate on a 100-point visual analogue scale (as a percentage of time) how much they paid attention to the film, were distracted from the film, actively thought about different ways of looking at it (i.e. applying the themes), and how much they appraised or suppressed their emotions. As a control, participants were asked to briefly describe the video they had just watched and whether they had seen it before. They were also asked to rate (5-point scale) how well they could empathize with the people in the film.

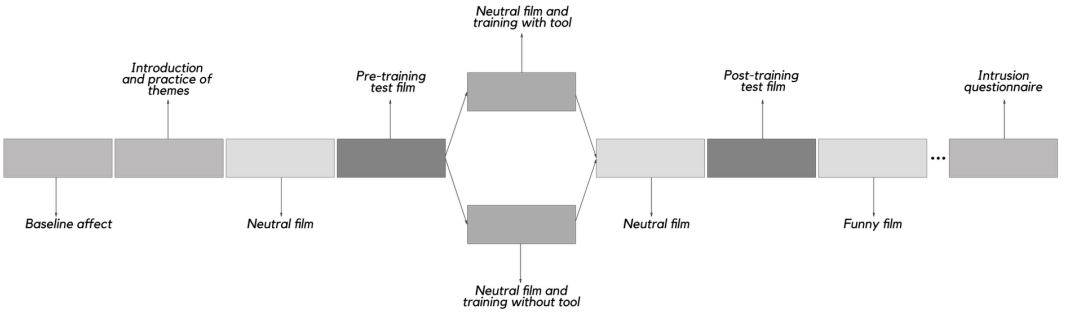
Intrusions

As a measure of whether this training caused any negative side-effects, intrusions were recorded. Many studies on post-traumatic stress measure intrusions as a symptom of PTSD and therefore regard it as an outcome measure (e.g. Holmes & Bourne, 2008; Morina et al., 2013). Intrusive memories after a traumatic event are not exclusive to people suffering from PTSD, however more frequent and prolonged intrusions are a classic symptom of PTSD (Jones & Barlow, 1990). This training was built with the aim to prevent PTSD, thus including intrusions as a secondary measure could provide insight into any possible side-effects the training may have. However, as the primary nature of our films is not to induce horror nor distress, but rather portray events that could induce these emotions, a negative result or null result on the training's effects on intrusions was hoped for. In the week after completing the training, participants were asked to fill in the Intrusions Questionnaire (Ehring et al., 2008). This questionnaire comprised of four questions: how many intrusions they had in the week since the training, how vivid and how distressing these intrusions were (0-100; not at all - extremely), and which films the intrusions pertained to.

Procedure

Figure 5 depicts a timeline of the procedure of the study. After passing the screening, participants completed a short demographics questionnaire (including age, gender, education) followed by a

Figure 5. The timeline of the procedure of the study



baseline measure of their affect. Participants were then presented with a written explanation of appraisals, their use, and the four themes, including examples for each. They watched a distressing film to practice using the themes in their head followed by example appraisals for that film. A neutral film was then presented to return affect to baseline. For the pre-training test film (which was counterbalanced with the film used for the post-training test) participants were instructed to appraise the film in their heads as they watched, followed by a questionnaire measuring mood, compliance and reappraisal. Subsequently, for the training session participants appraised six training films (either with or without the tool). Those in the tool condition watched a short tutorial film on how to use the tool prior to the first training film, those in the control condition watched a neutral film during this time.

After the training films a neutral film was presented to return to baseline, followed by the post-training test film and the same questionnaire as the first test film. To return affect to baseline the session was concluded with a funny film. Participants were awarded a small non-monetary compensation for their time. In the week following the training a questionnaire was e-mailed to enquire about intrusive memories they may have had since the training.

Analysis and Data Preparation

Statistical analysis was done using R version 3.2.4 (R Core Team, 2016). Data sets, R script and output files can be found online (Beer, Neerincx, Morina, & Brinkman, 2017). A multilevel approach was taken for the analysis of the primary outcome measures as the design includes repeated measures with dependent data and dependent residuals. Four models were created with participants as the random intercept and with each successive model containing an additional fixed coefficient. The models were as follows: Model 0 was a null model without any fixed variables, Model 1 included the fixed variable time (pre-/post-measurement), Model 2 included time as well as condition (with or without tool), and Model 3 included time, condition and the interaction between time and condition. These models were run on all dependent measures of interest. Log likelihoods of each successive model were compared to determine which model had a better fit.

Pre- and post-training appraisals were given a score for quality, with negative scores indicating they got worse over time. The quality and number of appraisals of the reflections were scored by the first author and a project-independent coder. Coders were given pairs of pre- and post-training reflections of participants and compared each pair, giving them a single quality score on a 6-point scale ranging from -3 to 3, with a negative value indicating a lower score for post-training measures. See the appendix (available in the online repository) for an example of a high scoring appraisal and a low scoring one. Pairs were presented in random order, and coders were blind to whether appraisals were obtained at pre- or post-training. After realignment of the appraisal scores (i.e. placing pairs in the same order), a good degree of reliability was found between coders´ quality measurements. The intra class correlation (ICC) was 0.73 (with a 95% confidence interval from 0.55 to 0.84, ($F(59, 60) = 3.7, p < 0.001$)), therefore the mean scores of the two coders were used for analysis. As these scores do not include a time variable, a simple linear regression was used. Additionally, the coders counted the number of appraisals written for each reflection. Again a high degree of reliability was found between coders' appraisal counts for pre-training (ICC = 0.95, with a 95% confidence interval from 0.92 to 0.97, ($F(59, 60) = 20, p < 0.001$)) and post-training reflections (ICC = 0.96, with a 95% confidence interval from 0.93 to 0.97, ($F(59, 60) = 24, p < 0.001$)). The means of the two coders were used for analysis.

To measure the behavior of participants during the training, frequency counts were made of which themes were applied for each of the 6 training films, as gathered from log files for those using the tool and from a form for participants appraising in their heads. This measure is distinctive from number of appraisals used, which can be more than one per theme. As this count data was not normally distributed (i.e. descending), a multilevel analysis with a random intercept quasi-Poisson distribution was performed. Goodness of fit measures such as the log Likelihood, AIC and BIC are not provided by this analysis, therefore only the full model was analyzed. Further, two sets of simple effects analyses were done to break down the interaction terms, one that looks at each of 6 points in time individually and the other for the two conditions individually.

RESULTS

Primary Outcome Measures

Quality of Appraisals

Quality scores did not differ significantly between conditions ($p > 0.05$). Altogether, the majority of scores were negative (i.e. the raters scored the quality measure higher at pre-training than at post-

training; $b = -0.89$, $SE = 0.27$, $t(58) = -3.28$, $p < 0.01$), indicating that quality of appraisals decreased after the training.

Number and Length of Appraisals

Table 2 provides the results of the number of appraisals as well as the number of words per reflection. The addition of condition (tool versus no tool) did not improve the models for either measure (number

Table 2. Multilevel analysis results of primary outcome measures

Model 1	Number of Appraisals		Word Count	
	B	***SE***	***B***	***SE***
Intercept	5.30**	0.27	98.75**	5.74
Time	-0.99**	0.24	-27.65**	5.42
	$\chi^2(1)$	***p***	$\chi^2(1)$	***p***
Model 0 vs 1	15.23	< 0.01	21.91	< 0.01

of appraisals $\chi^2(1) = 0.03$, $p > 0.05$; word count $\chi^2(1) = 2.05$, $p > 0.05$), indicating that differences between conditions were not found. The addition of possible covariates (i.e. PANAS) also did not improve the models for either measure and were thus not included in the analysis. Therefore, only a comparison of the null model and Model 1 were included in the results.

Secondary Outcome Measures

Mood

Table 3 provides the results of the PANAS scores. No differences between conditions were found for either of the PANAS scales (PA, $\chi^2(1) = 0.02$, $p > 0.05$; NA, $\chi^2(1) = 0.15$, $p > 0.05$). The effect of

Table 3. Multilevel analyses results of PANAS

Model 1	Positive Affect		Negative Affect	
	B	***SE***	***B***	***SE***
Intercept	14.05**	0.75	10.15**	0.76
Time	-1.96**	0.47	-0.55	0.64
	$\chi^2(1)$	***p***	$\chi^2(1)$	***p***
Model 0 vs 1	15.35	< 0.01	0.74	0.39

time (pre- versus post-training) on total score for positive affect showed a significant effect, $\chi^2(1) = 15.35$, $p < 0.01$, $b = -1.97$, $t(58) = -4.14$, $p < 0.01$. The negative gradient indicates that positive affect was lower at post-training compared to pre-training. Zooming in on the specific aspects of positive affect, paired samples t-tests indicated that 5 of the 10 positive attributes, namely excited, strong, alert, attentive, and active showed significant decline over time, as shown in Table 4. These affect items did not, however, improve models of primary outcome measures when added as covariates. Total scores of negative affect did not show any significant effects of time. Baseline PANAS data

Table 4. Positive affect items that showed decline over time (i.e. pre- to post-training)

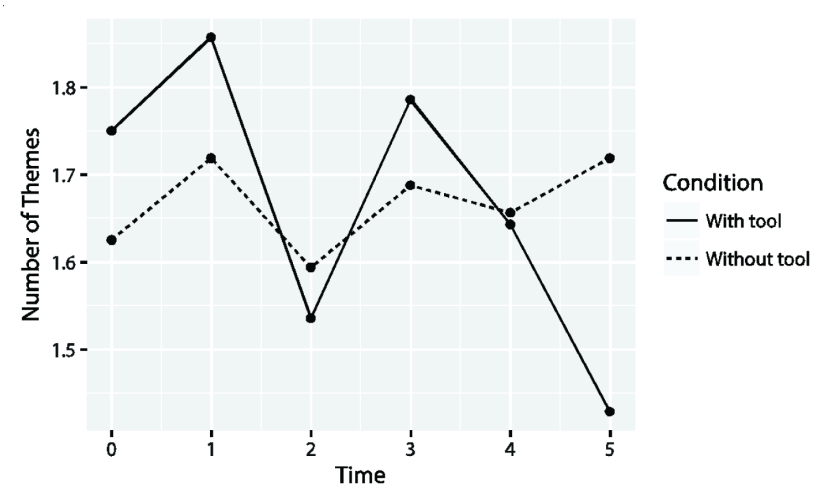
Variable	Time	*M*	*SD*	t	df	Sig.
Excited	pre	.43	.70			
	post	.27	.52	2.32	59	0.024
Strong	pre	1.43	1.08			
	post	1.17	1.18	2.13	59	0.038
Alert	pre	2.45	1.02			
	post	2.13	1.20	2.18	59	0.034
Attentive	pre	2.93	0.88			
	post	2.57	1.02	3.64	59	0.001
Active	pre	0.95	0.95			
	post	0.68	0.88	2.35	58	0.022

was not included in the analysis (i.e. as a covariate) as there were no correlations of these scores with the outcome variables.

Behavior During Training

Figure 6 shows that those in the tool condition apply fewer themes over time during the training in comparison to the no tool condition, which was more stable. The interaction between condition and

Figure 6. The mean number of themes participants used per condition



time was a significant predictor of number of themes. The analysis revealed a negative relationship between number of themes applied and time, and a non-significant negative relationship between number of themes and condition, as depicted in Table 5.

Six simple effects analyses showed that at each time point (film number) no significant differences between conditions were found ($p > 0.05$). When analyzing the simple effects across the conditions

Table 5. Results of the quasi-Poisson multilevel analysis on number of themes used during training

Parameter	Estimate	Std. Error	*df*	*t*-Value	*p*
Intercept	0.57	0.06	298	9.59	< 0.001
Time	-0.03	0.01	298	-2.51	0.01
Condition	-0.1	0.08	58	-1.19	0.24
Time*Condition	0.04	0.02	298	2.15	0.03

only the tool condition showed a significant decrease in number of themes used over time ($b = -0.03$, $t(139) = -2.69$, $p < 0.01$). This indicates that the no tool condition was stable over time, while the tool condition shows a decrease over time.

Instruction Compliance

Results showed that participants were positive about how well they could sympathize with the people depicted in the test films ($M = 3.74$, 95% CI[3.55, 3.94]), 57% and 48% of the participants reported not having seen the test films before in pre and post measurements. Furthermore, there were no significant differences between conditions for reports of the percentage of time spent paying attention ($M = 88.71$, 95% CI[86.63, 90.78), being distracted ($M = 8.96$, 95% CI[7.13, 10.79), appraising ($M = 40.04$, 95% CI[34.49, 45.58), and use of suppression ($M = 17.17$, 95% CI[12.34, 21.99) while watching the test films.

Intrusions

In the week following the session, 73% of participants completed and submitted the intrusion questionnaire ($N = 44$). Of these respondents, 19 participants reported experiencing intrusions. Independent samples t-tests were conducted comparing the number of intrusions recorded as well as their realness and how distressing they were between the tool and no tool conditions. There was not a significant difference in number of intrusions for the tool ($M = 0.67$, $SD = 0.97$) and no tool ($M = 0.78$, $SD = 0.95$) conditions; $t(42) = -0.4$, $p > .05$. Reported maximum vividness of the intrusions did not differ significantly between the tool condition ($M= 34$, $SD= 28$) and the no tool condition ($M =30$, $SD =15$); $t(18) = -0.46$, $p > 0.05$. Also, maximum distress ratings of intrusions did not differ significantly between the tool condition ($M = 30$, $SD = 31$) and no tool condition ($M = 18$, $SD = 19$); $t(18) = -1.09$, $p > 0.05$).

DISCUSSION

In this second study, the technology-supported training was compared to the same training done on paper. Analysis of the primary outcome measures showed no indication that either the quality or the number of appraisals increased after the training. Furthermore, the results indicated that the tool condition did not lead to improved outcome when compared to the control condition.

Zooming in on what happened during the training phase, there is an apparent decrease in the number of themes applied in the tool condition over time, whereas the control condition was more stable. Participants using the tool are arguably mentally and physically more engaged with elaborating their appraisals at the beginning of the training and thus they might become more fatigued over time.

Time might have played an important role in the results overall. Pre- and post-training measures revealed that participants' appraisal performance on all counts (number and quality of appraisals, word counts) decreased at post-training accompanied by a decrease in positive mood, regardless of condition. A decrease in positive mood is no surprise, as one does not expect repeated exposure to pain and suffering to increase positive mood. However, as Schartau et al. (2009) found, we expected

to also see a decrease in negative mood, and perhaps more so for those who had used the tool. Various factors could contribute to this result; on the one hand, perhaps the duration of the experiment was too long (1.5 hours). Sheppes, Catran and Meiran (2009) demonstrated that there is a physiological cost of emotion inhibition when reappraisal is applied late during a sadness inducing film. Study 2 did not measure at what point in the emotional evolvement reappraisals were applied, nor the physiological response, so the applicability of such an explanation is questionable, but it is possible that the current results are due to participants becoming fatigued from such extensive and intense emotion regulation. However, these factors do not explain why those using the tool had equally diminished scores over time as opposed to the group that did not use the tool.

One needs to consider the choice of population for this study. This research was aimed at preparing individuals to cope with potential trauma in the future, such as soldiers going in 'green' on their first deployment. Therefore, we did not include individuals who had experienced trauma in the past. It could be argued that soldiers are more aware of the fact that they risk experiencing traumatic events than students. Nevertheless, Read, Ouimette, White, Colder, and Farrow (2011) found that 66% of a large sample of students had been exposed to traumatic events (e.g. life-threatening illness, sudden death of a loved one, accident/natural disaster/fire, violence, or sexual assault) and 9% of them met criteria for PTSD. Further, recent studies show that there has been an increase of severe mental disorders among student populations in the US (Hunt & Eisenberg, 2010), including anxiety and depression. This disparity between the two populations could be a reason why this experiment did not show large effects.

We recognize a null-effect in this study. There is not an apparent effect that using the tools is better than doing the exercises on paper. If there were a large effect of the presence of the tool, that effect would have emerged despite the limitations of the present study. Despite the null effect, an important finding is that we did not discover any negative side-effects (in the form of intrusions) of participating in such a training.

GENERAL DISCUSSION

The descriptive nature of study 1 indicated that the training with the incorporated tools was well received among soldiers and firefighters. As these populations are known for their closed off culture, the proposed training is a step towards an environment where emotions can be recognized and discussed in a safe environment. Technology-assisted interventions may make interventions more interactive and perhaps lowers the threshold to opening up relevant discussions.

The first study resulted in positive responses about the tools and the workshop in general, indicating that the target population (soldiers and firefighters) accept the tools and workshop within their domain. Vakili et al. (2014) posed that incorporating technology into a resilience training is an important factor for the acceptance of a new resilience training among soldiers. Any kind of training containing sensitive topics can be difficult to implement among the soldier population, but technology can be positively received by soldier-trainees and stakeholders. Without the acceptance of this tool by the soldier population, such training ran the risk of unsuccessful implementation. Study 1 confirmed acceptance for not only soldier-trainees but also for firefighters. This is an important finding because it shows that this particular training can be implemented in the preparation of professionals likely to be exposed to traumatic events.

In the second study the focus shifted from the descriptive nature of the acceptance of the target population to a controlled setting in the lab. Here, to determine the effect of the tool, students followed the training either on paper or with the full annotation tool.

When determining whether the addition of the tool to an individual-based training has an effect on post-training measures, no significant differences between tool versus no tool were found. The addition of the tool might not improve the effects of the training, but it also does not appear to work as a distraction from the training. A valuable finding from participants' behavior during the training

phase was that the training may have been too long, possibly having led to fatigue, which is why it is advisable that future trainings with the support tool be shorter than that of the current study.

Limitations of the studies include the lack of randomly presenting films in the training phase. For the first study, this limitation was handled in the questionnaire, where the content and distress of films were rated and were not found to correlate with other scores. In the second study, any confounding issues related to the video content or order would be expected to reveal itself in both conditions, which was not the case. An additional limitation is that we did not include a control condition in which no training was provided at all. We chose not to do so because Schartau et al. (2009) already indicated that the appraisal training is effective. Furthermore, Beer et al. (2017) recently showed that multiple sessions of this training, supported by a virtual coach, was significantly effective in improving appraisal skills. Their study did not include a control group, and also pose that this could prove to be a very valuable addition to future research.

Additionally, the current training did not provide participants with feedback about their performance. Feedback, particularly knowledge of results can be beneficial, i.e. enhance performance (Matthews, 2000). Future work could benefit from some form of feedback to guide and support participants in coming up with new or more qualitative appraisals.

To sum up, from Study 1 one can conclude that with the implementation of a technological tool one can expect acceptance in populations of professionals who are at risk of getting exposed to traumatic experiences. However, Study 2 suggests that the tool as applied in the current study is not effective. The low reports of intrusions (in line with findings of Beer et al., 2017) was an important finding, indicating that there are no obvious negative side effects of taking part in the training. Future research might need to consider shorter durations of the appraisal trainings, not only because of impact of appraisal in general (i.e. regardless of technology support), but also because of the more intense and possibly more tiring quality that the tool has. Furthermore, applying the training a few times over several days may increase its efficacy (Denny & Ochsner, 2014).

To conclude, the contributions of this research include that we created a training that appeals to soldiers and firefighters. Technology is accepted by the target population but it may not be more effective in building appraisal skills than a paper-based training. Our research does not indicate that technology works better than paper, yet this result needs to be further investigated in the future. Furthermore, it is important to report these null effects so others can make a proper evaluation of this technology. Technology is often accompanied by additional monetary cost, and paper could be a cheaper option. However, as shown by Vakili et al. (2014), technology has its appeal, and Beer et al. (2017) showed that a completely digitized training of multiple sessions shows significant improvement in appraisal. In a situation where the training is not mandatory the appeal of technology can improve the chances of people voluntarily joining the training.

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ENDNOTES

[1] For publication purposes Figures 1-3 have been edited and translated.

[2] For these three items responses of 30 NCO's were omitted due to distribution of an erroneous questionnaire, deeming these responses invalid.

[3] Due to an administrative error these two groups are not equal in size.

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