

Special Issue

## Distraction versus training attention away from threat: How to best wait for the dentist?

Omer Horovitz,<sup>1</sup> Brachali Roitburd,<sup>1</sup> Rany Abend,<sup>2</sup> Daniel Ziskind,<sup>3</sup> and Tomer Shechner<sup>1</sup>

<sup>1</sup>Psychology Department, University of Haifa, Haifa, <sup>2</sup>School of Psychological Sciences, Tel-Aviv University, Tel-Aviv, and

<sup>3</sup>Private Dental Clinic, Jerusalem, Israel

### Abstract

**Objective:** Attention Bias Modification Training (ABMT) is a promising novel treatment for anxiety disorders. However, no randomised controlled trial has examined ABMT effects on anxiety in a real-world fear-provoking context. The current study examined the immediate effects of ABMT in reducing state anxiety among healthy participants awaiting dental treatment. **Method:** Seventy-one healthy participants seeking treatment in a dental clinic were randomly assigned to either (1) Dental ABMT; (2) Attention Control Condition (ACC); or (3) Neutral Distraction. The study used a modified dot-probe task consisting of dental and neutral words. In the ABMT condition, participants were trained to shift attention away from the dental words, whereas in the ACC, the same stimuli were presented, but attention was not trained in any specific direction. The Neutral Distraction task consisted of a casual video game. State anxiety was measured before and after completing the tasks while in the dentist's waiting room and immediately following the dental treatment. **Results:** Results indicated a significant interaction between time and condition on anxiety levels. The Neutral Distraction group showed a significant reduction in anxiety levels from pre- to post-task (before dental treatment), but neither the ABMT nor the ACC group showed this trend. Following dental treatment, only the ACC group demonstrated a decrease in anxiety levels, while no change was reported by either the ABMT or the Neutral Distraction group. **Conclusion:** Findings from this exploratory study suggest that distraction tasks have a better immediate effect than ABMT in alleviating state anxiety in non-anxious individuals who are expecting a relatively unpleasant experience.

**Key words:** attention bias modification treatment, dental anxiety, non-clinical population, RCT, threat-related attention biases

### What is already known about the topic?

1. Threat related attention biases are implicated in the etiology and the maintenance of anxiety and stress-related disorders.
2. Attention Bias Modification Training (ABMT) is a novel computer-based task that has been found to be effective in reducing anxiety.
3. A small set of studies also suggests the potential efficacy of ABMT in other chronic conditions such as depression, addiction and eating disorders.

### What this topic adds?

1. The current study is the first randomised controlled trial examining the effects of ABMT on state anxiety among a non-clinical sample while waiting for a dental procedure.
2. ABMT was compared to two control conditions: an Attention Control Condition (ACC) and a Neutral Distraction task.
3. Contrary to our expectations, only individuals who played a casual video game (Neutral Distraction Condition) showed reductions in state anxiety before the dental procedure. Moreover, state-anxiety levels remained high in the ABMT condition even after the dental treatment was completed.

Correspondence: Dr. Tomer Shechner, Psychology Department, University of Haifa, Mt. Carmel, 3498838, Haifa, Israel.  
Email: tshechner@psy.haifa.ac.il

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Attention Bias Modification Training (ABMT) is a promising novel treatment for anxiety disorders (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Hakamata et al., 2010; Linetzky, Pergamin-Hight,

Pine, & Bar-Haim, 2015). A number of studies also suggest its potential efficacy in treating other chronic conditions, such as mood disorders (Beevers, Clasen, Enock, & Schnyer, 2015), eating disorders (Renwick, Campbell, & Schmidt, 2013), addictions (Boffo, Pronk, Wiers, & Mannarini, 2015; Cox, Klinger, & Fadardi, 2015), and chronic pain (Sharpe, 2012; Sharpe *et al.*, 2012). To this point, however, no randomised controlled trial (RCT) has examined the degree to which ABMT reduces anxiety in a real-world fear-provoking context among a non-clinical population. The current RCT study begins to fill this gap by providing the first set of data on the immediate effects of ABMT in reducing anxiety levels among healthy participants awaiting dental treatment.

Dental treatments are perceived as anxiety provoking by almost 25% of the general population (Oosterink, de Jongh, & Hoogstraten, 2009; Smith & Heaton, 2003). Dental anxiety has been associated with decreased frequency of dental visits (Pohjola, Lahti, Vehkalahti, Tolvanen, & Hausen, 2007), poor oral health, and hygiene (Liu *et al.*, 2015) and negative quality-of-life reports (Crofts-Barnes, Brough, Wilson, Beddis, & Girdler, 2010), making this a major health problem. Interventions targeting dental anxiety, including cognitive behavioural therapy (Davies, Wilson, & Clements, 2011) and pharmacological interventions (Coldwell *et al.*, 2007; Willumsen, Vassend, & Hofart, 2001), are currently available. However, these interventions are typically time-consuming and expensive and have shown limited efficacy, even with highly anxious individuals (Carter, Carter, Boschen, AlShwaimi, & George, 2014). Therefore, its efficacy for milder forms of dental anxiety is unknown. The lack of efficacious treatments for dental anxiety urges the development of new treatment methods for dental anxiety that are feasible, potent, and easy to disseminate among the general population.

Here, ABMT shows promise, notably its ability to target threat-related attention biases associated with heightened anxiety (Bar-Haim, 2010; Hakamata *et al.*, 2010; Linetzký *et al.*, 2015). ABMT has emerged from information-processing theories that view anxiety disorders as associated with biases at different levels of cognitive processes, for example, attention biases. These particular biases result in an increased tendency to attend to threatening cues in the environment. Extensive research has demonstrated the relevance of threat-related attention biases in the aetiology and maintenance of anxiety disorders (Cisler & Koster, 2010; Van Bockstaele *et al.*, 2014; Yiend *et al.*, 2015). Because higher levels of state anxiety are associated with attentional biases to threatening stimuli even among non-clinical samples (Keogh, Ellery, Hunt, & Hannent, 2001; Mogg, Bradley, de Bono, & Painter, 1997), the use of

ABMT to reduce anxiety in a non-clinical sample seems reasonable. Specifically, dental treatment involves some aspects of possible physical discomfort or pain. In addition, the treatment length and magnitude are uncontrollable by and unpredictable to the subject, and contrary to common stressors used in the laboratory, patients attending a dental clinic are most often waiting their turn, during which time they are exposed to explicit cues of the upcoming stressor. This makes dental treatment a suitable real-life context to examine ABMT in a non-clinical sample.

ABMT procedures typically employ the dot-probe task to train attention away from threat-related stimuli. The task involves a series of trials in which pairs of threat-related and neutral stimuli (e.g., words) are presented simultaneously on a computer screen for a relatively short time (e.g. 500 ms). These stimuli are followed by a target; participants are asked to identify the target as quickly as possible without compromising accuracy. Unlike the classical dot-probe task, in which the target appears in equal proportions behind the neutral stimulus ('incongruent condition') and the threatening stimulus ('congruent condition'), in ABMT, the target always appears behind the neutral stimulus; thus, training individuals to shift their attention away from threat (Shechner *et al.*, 2014). Previous studies have demonstrated the efficacy of ABMT as a stand-alone treatment in reducing anxiety (Britton *et al.*, 2013; Eldar *et al.*, 2012; Hakamata *et al.*, 2010). Therefore, we expected similar therapeutic benefits in such an anxiety-provoking context. Specifically, we expect training to shift attention away from a threat prior to dental work will elevate anxiety during treatment.

The present RCT study was designed to explore the efficacy of ABMT as an immediate intervention for reducing state anxiety among non-clinical participants while they are waiting for a dental procedure at a clinic and to assess whether anxiety subsides during subsequent potentially stressful experiences. To this end, we modified the typical ABMT task to include pairs of neutral and dental-related words, with the aim of training attention away from the dental words, which, in this context, constitute anxiety-provoking stimuli. ABMT was compared to two control conditions: an Attention Control Condition (ACC) task and a Neutral Distraction task. We hypothesised that ABMT would result in a reduction in state anxiety immediately before dental treatment compared to the other conditions. At the same time, we hypothesised that state anxiety would decline in pre- to post-dental treatment under all three conditions, with a greater reduction in anxiety expected among the ABMT group. Finally, we expected lower levels of anxiety before the dental treatment to be associated with better overall subjective evaluation of the experience following the dental treatment.

## METHOD

### Participants

Participants were 73 adults seeking treatment in a private dental clinic. All volunteered and signed a consent form agreeing to participate in the study. The experiment's design and procedures were approved by the University Institution Review Board (IRB). Two participants were excluded because of pathological dental anxiety (Modified Dental Anxiety Scale (MDAS) score > 19; see below for details). Seventy-one participants (mean age = 47.89 years, SD = 17.49 years) were randomly assigned to one of three conditions: (1) Dental ABMT ( $n = 23$ ); (2) ACC ( $n = 25$ ); and (3) Neutral Distraction ( $n = 23$ ). Sample demographics and clinical indices are presented in Table 1. A consolidated standard of reporting trials diagram is depicted in Fig. 1.

### Materials and Tasks

#### Modified dental anxiety scale

The MDAS is a valid and reliable questionnaire assessing the severity of dental anxiety (Humphris, Morrison, & Lindsay, 1995). It consists of five questions, each with a 5-category rating scale, ranging from 'not anxious' (1) to 'extremely anxious' (5), and yielding an overall sum ranging from 5 to 25. A cut-off score of 19 indicates extremely high levels of dental anxiety. Cronbach's alpha in the current sample was .78.

#### State-trait anxiety inventory

The State-Trait Anxiety Inventory (STAI) is a commonly used measure of state and trait anxiety (Spielberger, 1983). It consists of 20 items assessing state anxiety and 20 assessing trait anxiety. Items on the state anxiety scale assess intensity of feelings 'at this moment' on a 4-point scale,

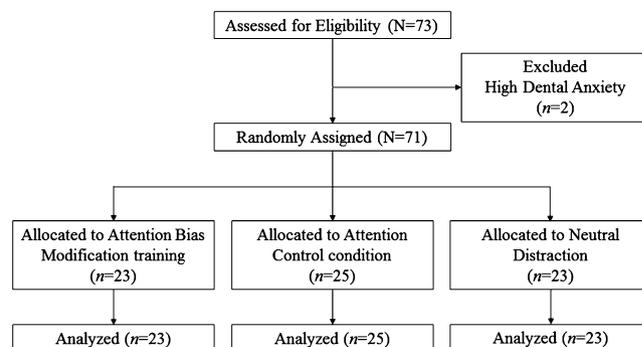
from 'not at all' (1) to 'very much so' (4). It has been found to be valid and reliable (Spielberger, 1983). Cronbach's alpha for the STAI-trait items ( $t_0$ ) was .86. Cronbach's alphas for the STAI-state items were .90 ( $t_0$ ), .91 ( $t_1$ ), and .92 ( $t_3$ ).

#### Overall subjective evaluation scale

In the study, we used a single question with a 7-point scale to assess the participant's overall experience during treatment. The scale ranges from a 'very positive experience' (1) to a 'very negative experience' (7). Higher scores therefore indicate greater *negative* subjective experience during dental treatment.

#### Dentist assessments

A single dentist performed all types of dental procedures according to the patient's dental needs. For each patient, the dentist completed a series of assessments, including treatment complexity on a scale from 'quite easy' (1) to 'very complex' (5); previous visits to the clinic ('yes/no'); and the need for a follow-up visit to the clinic ('yes/no').



**Figure 1** Consolidated standard of reporting trials (CONSORT) diagram. A schematic representation of participants' recruitment, exclusion, and conditions allocation.

**Table 1** Sample demographics, psychological, and clinical (dental) indices

	ABMT		ACC		Neutral distraction		Total		<i>p.v.</i>
	$n = 23$		$n = 25$		$n = 23$		$N = 71$		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Demographic									
Age (years)	50.61	15.99	46.48	19.24	46.64	17.38	47.89	17.49	.67
Gender (% females)	43.47		84		59.09		62.85		.02
Psychological									
MDAS( $t_0$ )	9.56	2.95	10.24	3.30	9.47	2.44	9.77	2.91	.62
STAI-trait ( $t_0$ )	37.25	8.22	35.19	6.46	32.67	6.84	35.04	7.33	.10
STAI-state ( $t_0$ )	33.91	8.69	32.72	9.24	29.98	7.98	32.22	8.70	.29
Clinical (dental)									
Treatment complexity	1.87	1.25	2.17	1.12	1.70	1.25	1.91	1.21	.41
Previous dental clinic visit (% yes)	86.96		88.00		86.96		87.32		.99
Follow-up visit to the clinic (% yes)	60.86		72.00		52.18		61.97		.37

Note. ABMT = Attention bias modification training; ACC = Attention control condition; MDAS = Modified dental anxiety scale; STAI = State trait anxiety inventory.

### Demographic information

We asked a series of demographic questions for descriptive and comparative purposes (e.g., age, gender).

### ABMT and ACC tasks

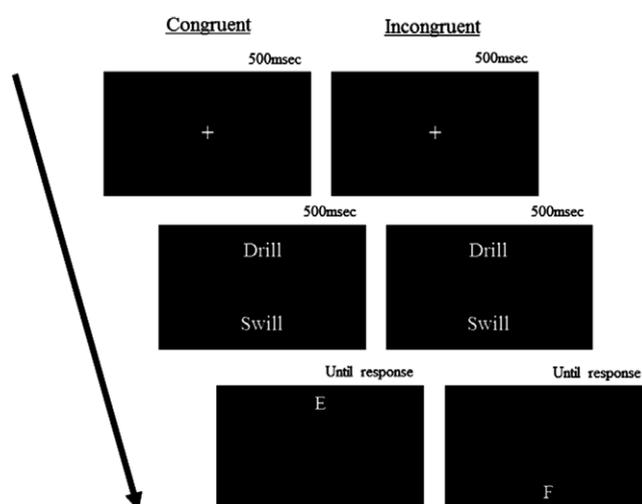
We used a modified dot-probe task consisting of aversive dental and neutral words (partially adapted from Shechner et al., 2014). Aversive dental words were chosen based on a preliminary survey conducted among healthy volunteers ( $n = 31$ ). In this survey, words were rated on a 7-point scale (e.g., from 'highly positive' (1) to 'highly negative' (7)). Words with an average rating of 4.5 or higher were subsequently included in the ABMT and ACC tasks (e.g., root-canal, filling). Words in each pair were matched according to number of letters. This step was conducted to affirm that people find specific dental-words aversive, making these words suitable to serve as threats in the ABMT task.

A trial began with a fixation cross (20 × 20 mm) in the centre of the screen for 500 ms, followed by a pair of words displayed for 500 ms. Distance between the centre and word pairs was 2.5 cm. Words were, on average, 6.5 cm long, creating a visual angle of ~6.20. Each task featured 22 pairs of dental–neutral words and 11 pairs of neutral–neutral words, with the words in each pair presented vertically and equidistant from the central fixation position. Each dental–neutral pair was presented eight times, and each neutral–neutral pair was presented four times, with the location of the words (i.e., top/bottom) alternating but counterbalanced. The tasks comprised of 220 trials in total.

Following the word display, a target probe appeared in one of the locations vacated by the words; it remained on the screen until a response was given by the participant. The target probe consisted of either the letter 'E' or the letter 'F'. Participants were required to determine which letter appeared on the screen and to press the relevant pre-specified button on the mouse using their dominant hand. They were told it was important to perform the task as quickly as possible without compromising accuracy. In the ABMT task, the target always appeared behind the neutral word ('incongruent' trials), thereby training participants to shift their attention away from the threatening dental words. In the ACC task, the same stimuli were presented, but in this case, the target probes appeared with equal probabilities at the locations of the dental and the neutral word (50% 'dental-congruent' and 50% 'dental-incongruent' trials). A schematic visual description of the ABMT task is presented in Fig. 2.

### Neutral distraction task

The Neutral distraction task consisted of a 'bubble shooter' game, a casual video game with elements of a puzzle and a shooter game. The screen of the game consists of a grid of



**Figure 2** Dental dot probe task. A modified dot probe task consisting of aversive dental-related and neutral words. A trial began with a fixation cross, followed by a pair of words displayed for 500 ms. Words were presented in dental–neutral or neutral–neutral pairs, vertically (500 ms). Following the word display, a target probe (the letter 'E' or the letter 'F') appeared in one of the locations vacated by the words. Participants were required to determine which letter appeared on the screen and to press a relevant pre-specified button on the mouse using their dominant hand.

cells, filled with rows of coloured balls. The colour scheme of the balls varies depending on the complexity of the game. The player sees the current ball and the next ball to shoot. The trajectory of the ball shot changes by moving the cursor; the task is to clear the playing field by forming groups of three or more like-coloured marbles. The goal is to get the highest possible score. As in the dot-probe tasks, we used a 15" laptop.

### Procedure

Upon arrival at the dental clinic, participants completed demographic, MDAS, and STAI questionnaires ( $t_0$ ). They were then randomly assigned to one of three experimental conditions: (1) ABMT; (2) ACC; or (3) Neutral Distraction. After completing the assigned task in the waiting room and before the dental treatment, a second STAI assessment was conducted ( $t_1$ ). At the end of the dental treatment, a third STAI assessment was conducted ( $t_2$ ). In addition, participants completed the overall subjective evaluation scale, and the dentist assessed the type of treatment performed, treatment complexity level, level of dental plaque, level of oral hygiene, and level of overall cooperation.

### Statistical analysis

We compared demographics, psychological indices at baseline, and treatment characteristics across the three treatment conditions using analyses of variance (ANOVAs) and chi-square tests.

State anxiety was the main dependent variable used to examine differences in task efficacy in terms of anxiety reduction across the three conditions. We used a mixed linear model (MLM; Singer, 2003) with the SAS GLIMMIX procedure (SAS, 9.2) to test for time and condition effects of the task, along with their interaction. Time ( $t_0, t_1, t_2$ ), condition (ABMT, ACC, Neutral Distraction), and the interaction of the two factors were included as fixed effects. We defined the random intercept separately for each experimental group and used restricted maximum likelihood to estimate model parameters.

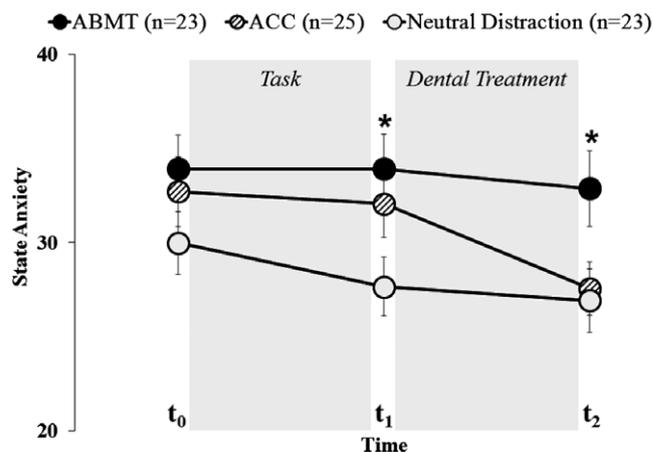
In addition, we examined group differences across the three conditions using one-way ANOVA in each time point, followed by a least significant difference (LSD) post hoc test. Finally, we tested the association between STAI scores at different time points and the overall subjective evaluation of experience post-treatment using the Pearson correlation.

All statistics were computed in SAS 9.2 and SPSS 21. All data are presented as group means and SEMs. Significant effects were detected at  $\alpha < .05$ , and all tests were two-sided.

## RESULTS

As depicted in Table 1, participants in the three conditions were similar in age. However, the proportion of female participants in the ACC condition was higher than in the ABMT or Neutral distraction conditions,  $\chi^2_{(4)} = 12.098$ ,  $p = .017$ . Gender differences were therefore examined in the analysis as detailed below. No other differences emerged between the groups in either the psychological measurements at baseline (trait anxiety, state anxiety, MDAS) or the dental procedures (treatment complexity, previous visit to the clinic, follow-up visit) (all  $ps > .12$ ).

MLM analysis of state anxiety levels revealed a significant interaction between time ( $t_0, t_1, t_2$ ) and condition (ABMT, ACC, Neutral Distraction),  $F_{(4, 135)} = 2.36$ ,  $p = .037$ . This interaction is presented in Fig. 3. Follow-up comparisons revealed that the Neutral distraction group showed a significant reduction in anxiety levels from pre- to post-task (and before dental treatment),  $t_{(135)} = 2.09$ ,  $p = .038$ ; neither the ABMT nor the ACC group showed this trend (all  $ps > .695$ ). Next, only the ACC group demonstrated a significant decrease in anxiety levels from post-task to post-treatment,  $t_{(135)} = 3.33$ ,  $p = .001$ ; no change in state anxiety was reported by either the ABMT or the neutral distraction conditions (all  $ps > .428$ ). Finally, a significant decrease in state anxiety from  $t_0$  to  $t_2$  was obtained for neutral distraction,  $t_{(135)} = 2.33$ ,  $p = 0.022$ , and ACC,  $t_{(135)} = 3.67$ ,  $p = .001$  conditions. Additional MLM analysis of anxiety levels with the interaction between time ( $t_0, t_1, t_2$ ) and condition (ABMT, ACC, neutral distraction), controlling for participant's gender, was conducted but did not reveal a



**Figure 3** Effects of time and condition on state anxiety. A significant interaction between time ( $t_0, t_1, t_2$ ) and condition (ABMT, ACC, Neutral Distraction) on state anxiety emerged,  $F_{(4, 135)} = 2.36$ ,  $p = .037$ . Only participants in the Neutral Distraction condition reported lower anxiety levels following the task. In addition, levels of state anxiety in the ABMT condition remained elevated following the dental procedure. ABMT = attention bias modification training; ACC = attention control condition.

significant effect for gender,  $F_{(1, 66)} = 3.65$ ,  $p > .06$ . Moreover, all other interaction effects did not change.

MLM analysis also yielded a main effect of time,  $F_{(2, 135)} = 8.08$ ,  $p = .001$ , and a marginally significant trend for task,  $F_{(2, 38)} = 3.09$ ,  $p = .052$ .

To complement these analyses, we compared anxiety levels of the three conditions at each time point ( $t_0, t_1$ , and  $t_2$ ) using one-way ANOVA. Baseline state anxiety levels before the task ( $t_0$ ) did not differ between the groups,  $F_{(2, 68)} = 1.249$ ,  $p = .293$ , indicating comparable initial levels of state anxiety.

Levels of state anxiety following the task and before the dental treatment ( $t_1$ ) were different across the groups,  $F_{(2, 67)} = 3.314$ ,  $p = .042$ . Contradicting our major hypothesis, post hoc comparisons indicated that participants in the neutral distraction group reported lower state anxiety ( $M = 27.65$ ,  $SD = 7.49$ ) than those in the ABMT group ( $M = 33.91$ ,  $SD = 8.93$ ),  $p = .015$ , and a similar trend was observed when neutral distraction was compared to ACC ( $M = 32.07$ ,  $SD = 8.95$ ),  $p = .076$ .

Following the dental treatment ( $t_2$ ), significant group differences emerged in state anxiety,  $F_{(2, 67)} = 3.535$ ,  $p = .035$ . Post hoc comparisons showed that participants in both the neutral distraction ( $M = 26.91$ ,  $SD = 8.04$ ) and the ACC ( $M = 27.56$ ,  $SD = 7.15$ ) groups reported lower state anxiety score than those in the ABMT ( $M = 32.87$ ,  $SD = 9.53$ ) group,  $ps < .031$ . The Neutral Distraction and the ACC groups did not differ ( $p = .787$ ).

Finally, there was a positive correlation between post-task state anxiety ( $t_1$ ) and the overall subjective evaluation

reported at the end of the dental treatment ( $t_2$ ),  $r = .352$ ,  $p = .005$ .

## DISCUSSION

The twofold aim of this RCT study was, first, to test the immediate effects of a single-session ABMT in reducing state anxiety among a non-clinical population while waiting for a dental procedure and, second, to assess whether this training would result in anxiety reduction following dental treatment. Three major findings emerge. First, countering our hypothesis, the group that performed the Neutral Distraction task reported lower state anxiety before the dental treatment relative to the ABMT and ACC groups. Second, state anxiety for those in the ABMT group remained elevated even after the dental treatment was completed. Finally, anxiety levels immediately before the dental treatment were associated with the overall subjective evaluations of participants following the dental treatment.

In contrast to our main hypothesis, only the Neutral Distraction task yielded a significant reduction in anxiety before the dental procedure. Specifically, although anxiety levels were similar at baseline, participants who completed this particular task reported lower anxiety levels than those in the two other conditions (ABMT and ACC) following the task and immediately before the dental treatment. Implementation of distraction relative to exposure techniques may explain this result. Several previous studies have used computer games as an acute distraction to reduce intrusive memories and cognitive rumination during anxiety-provoking tasks (e.g., Holmes, James, Coode-Bate, & Deerprouse, 2009). Video games are potent distractors even in stressful contexts. They provide immediate feedback on participants' performance and are therefore engaging and intrinsically rewarding (Boendermaker, Prins, & Wiers, 2015; Green & Bavelier, 2003). As such, they may provide an effective and easily implemented means to alleviate dental anxiety. Conversely, the task in the two other conditions (ABMT and ACC) included explicit threat cues (dental words) that might have maintained phasic fear responses to the imminent threat (dental procedure) (Craske *et al.*, 2009), regardless of the direction of the attention training.

Interestingly, despite its established effect in reducing anxiety and stress vulnerability, the levels of state anxiety in the ABMT condition were not only higher before the dental treatment, but they remained elevated following the dental procedure compared to the two other conditions. ABMT is believed to alleviate anxiety by having specific effects on threat bias patterns, namely, reducing anxiety symptoms by training individuals to shift attention *away* from threats (MacLeod & Mathews, 1988; Mogg & Bradley, 1998). However, there is considerable evidence that in

anxiety-provoking contexts, attention mechanisms are inherently biased *away* from threats, thereby assisting mental coping with the hardships of acute stress. For example, threat avoidance was found in a field study of non-anxious individuals in a life-threatening context (Bar-Haim, 2010), among soldiers exposed to stressful combat drills (Wald *et al.*, 2013), and in several laboratory studies using mild threat-induction protocols (Constans, McCloskey, Vasterling, Brailey, & Mathews, 2004; Helfinstein, White, Bar-Haim, & Fox, 2008; Shechner, Pelc, Pine, Fox, & Bar-Haim, 2012). These data suggest that patterns of attention bias are context-dependent and more complex and varied than originally conceptualised. In this vein, the dentist's waiting room, where awaiting patients can hear, smell, and often see cues of the imminent aversive experience, could be considered an anxiety-provoking context. Hence, patients are likely to exhibit a tendency to avoid the dental-related threatening words in the attention tasks. The relatively high anxiety reports even after the completion of dental treatment may suggest that strengthening the avoidance bias by training subjects to shift their attention farther away from threats might worsen the situation. Future studies may consider training towards threat in these acute and mildly stressful conditions.

Participants in the ACC who allocated attention towards and away from threat with equal frequency exhibited a reduction in anxiety levels following the dental treatment. This finding supports the suggested link between threat avoidance and elevated anxiety post-treatment. Individual differences in the magnitude and direction of attention bias have been extensively documented (for a review, see Shechner, Britton *et al.*, 2012; Van Bockstaele *et al.*, 2015). We did not tailor a specific training programme for each individual based on bias measurements at baseline, so it is not surprising that shifting attention in equal probability toward or away from a threat did not affect state anxiety before the dental treatment (expectancy effect). That said, similar to other studies (Badura-Brack *et al.*, 2015; Shechner *et al.*, 2014), deploying a task that does not encourage attentional bias in any specific direction could be beneficial when coping with an imminent fear-provoking stressor.

Attention bias was not assessed in this study because it took the form of a single-session intervention, and previous research has suggested that a pre-training bias measurement task might interfere with subsequent learning processes during training (Abend *et al.*, 2013). Therefore, it is impossible to determine the precise reason for group differences across conditions. Furthermore, although others have reported the applicability of a single-session ABMT in reducing attention bias to threat, it remains unclear whether the single and relatively short ABMT session in our study was sufficient to induce the intended pattern of selective attention away from a threat. This is critical as data from several

ABMT studies consistently show that when ABMT successfully modifies attention bias, it also mitigates anxiety disposition of dysfunction. However, clinical effects are usually absent when studies fail to achieve successful change in attention bias (for a comprehensive review, see MacLeod & Clarke, 2015).

Although differences among groups emerged in the opposite direction than expected, we observed a positive correlation in the entire sample between state anxiety before the dental treatment and the overall subjective evaluation of the experience when it was over. This finding supports the need to develop psychological interventions aiming to reduce negative expectations before dental treatment and corroborates previous studies, indicating that the reduction of aversive dental expectations buffers the effect of cognitive vulnerability (i.e., dangerousness, unpredictability, and disgustingness) on dental fear in both adults and youth (for example, see: Carrillo-Díaz, Crego, Armfield, & Romero, 2013).

The study's results should be viewed in light of some limitations. First, participants in the current sample did not perceive dental treatment as anxiety provoking. Therefore, lack of effect could be attributed to a floor effect. Indeed, the efficacy of ABMT has been demonstrated mainly in clinical samples or in situations that elicit strong fearful behaviours. Hence, examining the clinical effects of dental ABMT among dental phobics or before complicated dental procedures that more strongly elicit fear could yield different results. Second, as mentioned previously, a major limitation of the study derives from the lack of attention to bias measurement. Without an established association between attentional vigilance to threat and dental fear, it is unclear whether we can expect this specific ABMT away from threat to reduce state anxiety. Given the stressful context associated with a dental office, future studies should examine attention bias and dental fear inside and outside the dental clinic. In addition, it is difficult to know if the dental ABMT task successfully modified selective attention. This is particularly relevant to the current study because of the relatively short ABMT task that was only delivered once. Although some studies have found that a single short ABMT session can result in less attention bias to threat and lower levels of anxiety during a public-speaking challenge than ACC (Amir, Weber, Beard, Bomyea, & Taylor, 2008), most ABMT studies use more than one training session with a higher number of trials (Hakamata et al., 2010; MacLeod & Clarke, 2015). Given the possible undermining effect of a measurement task on subsequent attention training, future studies may consider other type of bias assessment than the dot-probe task. Third, due to the relatively small sample size in each condition, randomisation does not guarantee comparable attention biases across the conditions at baseline. Again, without a measurement of attention bias, this possible limitation remains speculative.

Despite these limitations, this exploratory study adds to the growing ABMT literature, providing data on the potential therapeutic application of ABMT in a real-world anxiety-provoking context. Our findings suggest distraction tasks have a better immediate effect in alleviating state anxiety than attention training tasks in non-anxious individuals who are expecting a relatively unpleasant experience.

## ACKNOWLEDGEMENTS

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