



This is the originally submitted pre-review manuscript of:

May, J., Andrade, J., Willoughby, K. & Brown, C. (2012) An attentional control task reduces intrusive thoughts about smoking. *Nicotine & Tobacco Research*, 14(4), 472-478. doi: 10.1093/ntr/ntr238

The published version differs from this copy so please do not treat this as definitive.

## Body scanning reduces intrusive thoughts about smoking

Journal:	<i>Nicotine &amp; Tobacco Research</i>
Manuscript ID:	Draft
Manuscript Type:	Original Investigation
Date Submitted by the Author:	n/a
Complete List of Authors:	May, Jon; University of Plymouth, School of Psychology Andrade, Jackie; University of Plymouth, School of Psychology Willoughby, Kimberley; University of Plymouth, School of Psychology Brown, Christopher; University of Plymouth, School of Psychology
Keywords:	Attention, Addiction, Mindfulness, Craving

SCHOLARONE™  
Manuscripts



## Body scanning reduces intrusive thoughts about smoking

Jon May

Jackie Andrade

Kimberley Willoughby

Chris Brown

School of Psychology,

University of Plymouth

Contact Author:

Professor Jon May, [jon.may@plymouth.ac.uk](mailto:jon.may@plymouth.ac.uk)

School of Psychology

University of Plymouth,

Drake Circus

Plymouth

UK- PL4 8AA

Declaration of interest: This research was supported by the University of Plymouth. We declare no conflicts of interest.

Keywords: Attention, addiction, mindfulness, craving

Running Head: Body scanning reduces intrusive thoughts

Abstract: 236 words

Word Count: 3100

Tables: none

Figures: 2

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Body scanning reduces intrusive thoughts

2

Abstract

**Introduction:** Body scanning and isometric exercise instructions have been shown to reduce smoking cravings, apparently by reducing stress (Ussher *et al.*, 2009). Related work based upon Elaborated Intrusion theory (Kavanagh, Andrade & May, 2005) has shown that attentional control instructions can reduce hungry participants' spontaneous food-related thoughts (May *et al.*, 2010). This study tests the effect of body scanning upon smoking related thoughts, as well as craving.

**Method:** 27 smokers took part in two counterbalanced sessions, on different days. In each session they followed audio instructions for three ten minute blocks, during which their thoughts were probed ten times. In the first and third blocks, they were instructed to let their mind wander; during the second block of the control session they also let their mind wander but in the experimental session they followed body scanning instructions. *Smoking thought frequency* was assessed using thought probes; *Craving* was measured using Factor 1 of the Questionnaire of Smoking Urges (Tiffany & Drobes, 1991).

**Results:** In the body scanning block participants reported fewer smoking related thoughts and lower smoking cravings; intrusions and craving rebounded above baseline for both sessions in the final period of mind wandering.

**Conclusions:** Body scanning reduces cravings through reducing the frequency or shortening the duration of smoking thoughts. If the cognitive mechanism by which body scanning reduces intrusive thoughts can be identified, attentional control strategies may form a useful part of future smoking cessation practices.

Body scanning reduces intrusive thoughts

3

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Introduction

Quitting smoking is very hard to do: without any help, around 3-6% of smokers succeed in a quit attempt; the most successful interventions, group therapy or prescription of Bupropion, double it – but around 90% still fail (Lemmens, Oenema, Knut, & Brug, 2008). Smokers often report that their attempts to abstain are defeated by severe cravings (Killen & Fortman, 1997; Zhou, Nonnemaker, Sherrill, *et al.*, 2009). Urges to smoke increase in the days leading to relapse and can occur long after any physiological effects of nicotine withdrawal have ceased (Shiffman, Engberg, Paty, *et al.*, 1997), and severity of craving is associated with relapse (West, Hajek & Belcher, 1989). This paper reports a cognitively-motivated approach to smoking cessation, based upon Elaborated Intrusion theory (Kavanagh, Andrade & May, 2005).

Many approaches to smoking cessation include behavioural change techniques alongside medication, but often with weak theoretical motivation (West, Walia, Hyder, Shahab & Michie, 2010). A meta-analysis of randomized controlled trials indicated that teaching strategies to control cravings can be helpful (U.S. Department of Health and Human Services, 2008). The incentive-sensitization theory of addiction also indicates that behavioural approaches to addiction ‘may offer the best hope for addicts today’ (Robinson & Berridge, 2000, p.S109), given the apparently irreversible neural sensitization effects of addictive drugs.

One such approach evaluated by Ussher, Cropley, Playle, Mohidin & West (2009) involved asking abstaining smokers to follow ten minutes of audio instructions to engage in isometric exercises (contracting specific muscle groups while seated, without actively moving around) or body scanning (directing attention towards specific parts of the body while remaining motionless, and without any muscular demands). These both reduced desire to smoke for up to 30 minutes following the intervention, and were also effective when self-administered by participants outside the laboratory. The rationale for the intervention was that stress is likely to exacerbate the desire to smoke, and that physical exercise is known to reduce stress: isometric exercises and body scanning might reduce smoking cravings by reducing stress. In a review paper, Taylor, Ussher & Faulkner (2007) had found that 12 studies that compared a bout of exercise with a passive condition reported a positive effect on cigarette cravings, withdrawal symptoms and smoking behaviour, and argued that the effects did not appear to be due to distraction or arousal, but occurred through a reduction of stress and negative affect. Ussher, West, Doshi and Sampuran (2006) had found that a brief session

1 Body scanning reduces intrusive thoughts

4

2  
3 of isometric exercises (tensing muscle groups while seated, but without actively moving)  
4 reduced cigarette cravings, relative to a passive control, but that a body scanning exercise had  
5 intermediate effects, differing neither to the control nor the exercise group. The body  
6 scanning task had been intended to be a control task similar to the isometric exercises but  
7 without muscular exertion: the lack of difference with the isometric condition was  
8 unexpected. Participants had been instructed at the start of the session to focus their attention  
9 to five different parts of the body in turn, and Ussher *et al* (2006) note that is not possible to  
10 tell whether their participants were able to comply with this task for the full ten minutes,  
11 whereas it is possible to observe participants engaging in the isometric exercises. Although  
12 the findings from this early study were inconclusive, it did raise the possibility that body  
13 scanning might actually be having an unexpected effect in reducing cravings. Ussher *et al.*  
14 (2009) appear to have enhanced the effectiveness of the body scanning condition by guiding  
15 their participants through the scanning with regular audio instructions about the locations to  
16 which to focus their attention.  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28

29 We reported a related study, albeit with a different rationale and in the domain of  
30 appetite (May, Andrade, Berry, Batey & Kavanagh, 2010). In two experiments, we asked  
31 undergraduates who had delayed a meal to follow audio instructions engaging them in various  
32 mental tasks. Self-directed and guided imagery, body scanning, and thought suppression all  
33 reduced the proportion of food-related thoughts reported by hungry participants (although the  
34 effects did not carry through to a reduction in food craving). The rationale for this study was  
35 drawn from our Elaborated Intrusion Theory of Desire (Kavanagh, Andrade & May, 2005),  
36 which argues that craving for addictive and non-addictive substances begins with unconscious  
37 mental activation, which may give rise to the intrusion into conscious awareness of a desire-  
38 related thought. Apparently spontaneous intrusive thoughts are known to be linked to cravings  
39 for smoking, alcohol and eating (May, Andrade, Panabokke & Kavanagh, 2004). Depending  
40 upon task demands, this initial intrusion may be followed by cognitive elaboration, and in  
41 particular visual imagery of the target. A number of studies have now shown that interfering  
42 with this visual imagery can reduce craving in abstaining smokers (May, Andrade,  
43 Panabokke, & Kavanagh, 2010; Versland & Rosenberg, 2007), dieters (Kemps, Tiggemann,  
44 Woods, & Soekov, 2004) and undergraduates induced to crave food or chocolate (Kemps &  
45 Tiggemann, 2007).  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58

59 Elaborated Intrusion theory predicts that approaches targeted at intrusive thoughts will  
60 also be effective in reducing craving-driven substance use. Suppressing unwanted thoughts is

Body scanning reduces intrusive thoughts

5

1  
2  
3  
4 a natural but often counter-productive strategy (e.g., Salkovskis & Reynolds, 1994).  
5 instructions to ignore thoughts have been shown to be effective in reducing snacking  
6 (Achtziger, Gollwitzer & Sheeran, 2008), but whether the effect is mediated by effects on  
7 craving has not been tested. Mindfulness-based techniques, such as body scanning, potentially  
8 offer a way of reducing the occurrence and elaboration of intrusive thoughts by encouraging  
9 awareness of a wide range of competing thoughts and sensations. The studies by Ussher *et al.*  
10 (2006), Ussher *et al.*, (2009) support this prediction from Elaborated Intrusion theory by  
11 showing that guided body scanning, in which participants' compliance is enhanced by the use  
12 of regular instructions, is effective in reducing smoking cravings. May *et al.* (2010) did not  
13 find an effect of body scanning upon craving for food, but did find an effect upon food related  
14 thoughts. It is possible that the effectiveness of the body scanning condition upon smoking is  
15 also due to a reduction in smoking related thoughts. In this paper, we replicate the findings of  
16 Ussher *et al.* by showing that the body scanning instructions used by May *et al.* also reduce  
17 smoking cravings, and extend it by showing that they do so by reducing intrusive thoughts  
18 about smoking, in line with the predictions of Elaborated Intrusion theory.  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32

### 33 Method

34 This study received ethical approval from the University of Plymouth School of  
35 Psychology Ethics Committee. 27 volunteers (mean age 29 years; 11 Male) took part in two  
36 individual sessions, on different days, each lasting 45 minutes. Twelve were recruited from  
37 the general population and received no incentive; 15 were undergraduate psychology students  
38 who each received a participation point that they could use to reward participants in their own  
39 research. All volunteers were regular smokers who reported smoking at least 10 cigarettes a  
40 day. Before taking part in the first session, each participant read a briefing form explaining  
41 the purpose of the experiment, and gave signed consent.  
42  
43  
44  
45  
46  
47  
48

49 Participants were asked to abstain from smoking for at least two hours before attending  
50 a session. At the start of both sessions, participants' breath CO was measured using a Bedfont  
51 Micro-Smokerlyser (Bedfont Scientific Ltd., Rochester UK). They then completed a  
52 questionnaire about their smoking habits and gave their packet of cigarettes to the  
53 experimenter, who placed them out of sight in a drawer for the duration of the session. This  
54 procedure was intended to increase the likelihood of smoking related thoughts during the  
55 session.  
56  
57  
58  
59  
60

Body scanning reduces intrusive thoughts

6

1  
2  
3  
4 Each session then consisted of three blocks, during which participants listened to a ten  
5 minute recording, containing statements every twenty seconds. Ten of the statements were  
6 followed after a brief interval by a bell, cueing participants to report in a word or two  
7 whatever had been passing through their mind when they heard the bell. This was transcribed  
8 by the experimenter and, at the end of the session, categorised by the participant as related or  
9 unrelated to smoking. Following each block, participants completed the 15 items comprising  
10 Factor 1 from the Questionnaire on Smoking Urges (QSU; Tiffany & Drobes, 1991), rating  
11 each item on a scale ranging from 1 (strongly disagree) to 7 (strongly agree).  
12  
13  
14  
15  
16  
17

18 The recordings in the first (Baseline) and third (After) blocks in each session consisted  
19 of 'mind wandering' instructions (May *et al* 2010, Appendix B3), for example. "Following  
20 any thought that comes along. Just watching thoughts drift through your mind. Thinking  
21 about anything your mind wants to. Let your mind wander wherever it will go". The middle  
22 (During) block of the control session also used the mind wandering instructions, but in the  
23 experimental session a set of body-scanning instructions was used (May *et al* 2010, Appendix  
24 B1). Participants were instructed to direct their attention around their body, becoming aware  
25 of any sensations, for example, "Now directing your attention to the toes of your feet. Tuning  
26 into sensations in your toes, noticing how they feel. Noticing whatever sensations are here,  
27 right now. Now on an out breath, letting go of the toes, moving your focus to the bottom of  
28 your feet, the soles, and heel. Staying here, paying attention to any sensations you find". The  
29 order of sessions was counterbalanced over participants.  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41

## 42 Results

43 The maximum recorded breath CO was 16 ppm ( $M = 9.00$ ,  $SD = 5.3$ ), indicating that  
44 participants had complied with the abstinence instructions. Overall, participants reported a  
45 mean of 3.7 smoking related thoughts ( $SD = 2.5$ ) during a ten minute block, and a mean  
46 craving of 5.9 ( $SD = 1.1$ ) at the end of a block.  
47  
48  
49  
50

51 A Multivariate ANOVA (SPSS 18.0) with the within-subject factors of Session  
52 (Control, Experimental) and Block (Baseline, During, After) was conducted on the number of  
53 smoking related thoughts occurring during each block of the two sessions, and upon the mean  
54 QSU craving score at the end of each block. Overall there was a main effect of Block (Mult  
55  $F(4, 25) = 12.39$ ,  $p < .001$ ,  $\eta^2 = .683$ ) and an interaction of Block x Session (Mult  
56  $F(4, 23) = 2.81$ ,  $p = .049$ ,  $\eta^2 = .328$ ). Univariate ANOVAs repeated this pattern for both  
57 Smoking related thoughts (Block:  $F(2, 52) = 20.54$ ,  $p < .001$ ,  $\eta^2 = .441$ ; Block x Session:  $F(2,$   
58  
59  
60

Body scanning reduces intrusive thoughts

52) = 4.55,  $p = .015$ ,  $\eta^2 = .149$ ) and Craving (Block:  $F(2, 52) = 13.29$ ,  $p < .001$ ,  $\eta^2 = .338$ ;  
Block x Session:  $F(2, 52) = 3.94$ ,  $p = .026$ ,  $\eta^2 = .132$ ).

Inspection of the means indicated that smoking related thoughts remained level during the three blocks of the control session, but fell during the body-scanning recording in the experimental session (Figure 1 shows the frequency of smoking related thoughts occurring in each block, and Figure 2 the craving ratings following each block). To validate this interpretation, separate repeated measures ANOVAs were conducted upon the number of thoughts and craving ratings from each session, with planned polynomial contrasts on the levels of Block (Baseline, During, After; significant Linear contrasts indicate that the measures were higher during or after the final mind-wandering block than the initial block; significant Quadratic contrasts that the measures were lower during or after the middle block than the other two.)

During the Control session, there was no effect of Block upon thought frequency ( $F(2,52) = 1.69$ ,  $p = .194$ ,  $\eta^2 = .061$ ), but there was upon craving ( $F(2,52) = 10.02$ ,  $p < .001$ ,  $\eta^2 = .278$ ). For craving, the Linear contrast was significant ( $F(1,26) = 11.92$ ,  $p = .002$ ,  $\eta^2 = .314$ ), but the Quadratic contrast was not ( $F < 1$ ). Thus no change in smoking related thoughts was detectable, but craving rose throughout the control session.

During the Experimental session, there were significant effects of Block upon both thought frequency ( $F(2,52) = 17.36$ ,  $p < .001$ ,  $\eta^2 = .400$ ) and craving ( $F(2,52) = 8.78$ ,  $p = .001$ ,  $\eta^2 = .252$ ). The Quadratic contrast was also significant for both measures (thought frequency:  $F(1,26) = 22.48$ ,  $p < .001$ ,  $\eta^2 = .464$ ; craving:  $F(1,26) = 8.16$ ,  $p = .008$ ,  $\eta^2 = .239$ ), as was the Linear contrast (thought frequency:  $F(1,26) = 7.85$ ,  $p = .009$ ,  $\eta^2 = .232$ ; craving:  $F(1,26) = 10.11$ ,  $p = .004$ ,  $\eta^2 = .280$ ). Thus both thoughts and craving were reduced during the intervention block, but rebounded above Baseline after the intervention.

To compare the rise in thought frequency and craving from the baseline to after blocks over sessions, further ANOVAs were conducted omitting the middle 'during intervention' block. Now there were main effects of Block for both measures (thoughts:  $F(1,26) = 6.75$ ,  $p = .015$ ,  $\eta^2 = .206$ ; craving:  $F(1,26) = 17.87$ ,  $p < .001$ ,  $\eta^2 = .407$ ) but no effects of Session or any interaction. Thus the rise in thoughts and craving found in the body scanning session was not significantly larger than that occurring in the control session.



1 Body scanning reduces intrusive thoughts

8

2  
3  
4 Discussion

5  
6 Our results indicate that thoughts about smoking were reduced during the body  
7 scanning block, and craving also decreased. During the subsequent ten minutes of mind-  
8 wandering, smoking thoughts and craving rose above baseline in both the control and body  
9 scanning sessions, but did so equally. Thus the reduction in thoughts and craving caused by  
10 the body scanning did not persist into the following ten minute period, but neither did it  
11 exacerbate the rise in both measures that occurred in the control session.  
12  
13  
14  
15  
16

17 This paper advances our understanding of craving as a general phenomenon of  
18 motivated behaviour by linking research in the domains of tobacco addiction and eating  
19 disorders, and strengthens the argument that it has a cognitive basis, triggered by  
20 physiological and affective cues. The abuse of addictive substances is often attributed to basic  
21 physiological changes, and to the pharmacological or neurological effects of psychoactive  
22 substances, with cognitive processes or resources having a limited, epiphenomenal role.  
23 Eating disorders, in contrast, are seen as essentially psychodynamic, as a response to  
24 irresolvable trauma or issues of control and self worth. Elaborated Intrusion theory argues that  
25 cognitive processing is crucial in both, mediating the link between situational, cognitive or  
26 physiological cues and the moment to moment conscious experience and desires of the  
27 individual. Interventions that address the individual's experience of and response to intrusive  
28 thoughts about a problematic behaviour offer a focussed way of moderating a wide range of  
29 apparently compulsive activities, and perhaps also of inciting positive health related  
30 behaviour.  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41

42 There are a number of further avenues of research that arise from this paper. As in May  
43 *et al* (2010), we have here shown that body scanning is an effective way of temporarily  
44 reducing spontaneous craving-related thoughts, and as in Ussher *et al.* (2009), there was an  
45 immediate reduction in craving. If the craving were causing the thoughts, then this would not  
46 be surprising, but May *et al.* (2010) did not find a reduction in food cravings, and so this does  
47 not seem to be the explanation. Evidence that intrusive thoughts occur when limited-capacity,  
48 executive processing demands are low comes from Antrobus's (1968) demonstration that  
49 participants reported more intrusive thoughts during a tone detection task with slower  
50 presentations or fewer tones. Teasdale and colleagues extended this research by comparing  
51 the incidence of such thoughts under conditions of verbal or visual task loads. Their studies  
52 showed that it was the amount of information to be held in working memory, rather than the  
53 modality of that information, that determined intrusion rate (Teasdale, Proctor, Lloyd &  
54  
55  
56  
57  
58  
59  
60

Body scanning reduces intrusive thoughts

9

1  
2  
3  
4 Baddeley, 1993), and concluded that such thoughts only reached awareness if they were able  
5 to access central executive resources. By engaging the individual in a focused task, with  
6 frequent cues to reorient them to the task, the audio instructions used in our experiments and  
7 by Ussher *et al.* (2009) might occupy central executive resources and so leave no opportunity  
8 for task-irrelevant thoughts to reach awareness; any thoughts that do occur may not be  
9 followed by elaboration due to the high imagery load imposed by the primary task, and so  
10 may be of briefer duration. Thought probe measures cannot distinguish between a true  
11 reduction in thought frequency and a change in the duration of thoughts: if the same number  
12 of thoughts occur, but are all shorter in duration, then they are less likely to be in awareness  
13 when a probe occurs (in much the same way as a pedestrian crossing a railway bridge several  
14 times a day will notice more slow freight trains than the faster but more frequent express  
15 trains). Other approaches to measuring intrusive thought frequency are even more prone to  
16 bias, however: retrospective reports cannot record brief thoughts that are not recalled; and  
17 asking participants to monitor their own thoughts increases intrusions (Wegner, 1989).  
18 Resolving this issue may well require a new approach to measuring intrusive thoughts,  
19 perhaps using probes that are contingent upon some measure of mental activity, from EEG or  
20 cortical blood-flow.  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33

34 This study did not measure participants' mood, whereas Ussher *et al.* had found that  
35 body scanning also reduced irritability, restlessness and difficulty concentrating compared to  
36 control, so it is possible that the reduction in intrusive thoughts is also partly due to reductions  
37 in negative affect, which is specified by Kavanagh, Andrade and May (2005) as being one of  
38 the triggers for intrusions. An obvious extension of this work would be to explore further  
39 attentional control paradigms that do not involve mood changes.  
40  
41  
42  
43  
44

45 Further studies on attentional control and intrusive thoughts could seek ways to resolve  
46 the relative contributions of affect, imagery, and executive load as ways of reducing the  
47 frequency and duration of smoking related thoughts. As a component of quit-smoking  
48 techniques, any cognitive strategy for reducing the impact of intrusive thoughts upon  
49 behaviour has the advantage that it requires no equipment and can be carried out privately,  
50 when and where the individual feels at risk of experiencing cravings. Techniques that require  
51 a high central executive load, however, will also interfere with a wide range of other  
52 concurrent tasks, and so may not be practical for everyday use. However, previously reported  
53 relationships between mindfulness and reactions to intrusive thoughts, including craving  
54 (Berry, May, Andrade & Kavanagh, 2009) suggest that habitual awareness of one's  
55  
56  
57  
58  
59  
60

1 Body scanning reduces intrusive thoughts

10

2  
3 environment and bodily sensations may help reduce craving. Future research should test  
4 whether training in mindfulness, or components of mindfulness such as body scanning, can  
5 have lasting effects on craving (as the Ussher *et al.* results suggest) without the cognitive load  
6 imposed by body scanning when it is still a novel task for participants.  
7  
8  
9

10  
11 Our findings provide a theoretical motivation for data suggesting that body scanning  
12 may be a useful addition to the repertoire of cognitive techniques taught to smokers who wish  
13 to quit, and by doing so open up the way for future research to refine and widen the  
14 applicability of such techniques.  
15  
16  
17

18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## References

- Achtziger, A., Gollwitzer, P. M., & Sheeran, P. (2008). Implementation intentions and shielding goal striving from unwanted thoughts and feelings. *Personality and Social Psychology Bulletin*, *34*, 381-393. doi:10.1177/0146167207311201
- Antrobus, J. (1968). Information theory and stimulus independent thought. *British Journal of Psychology*, *59*, 423-430. doi:10.1111/j.2044-8295.1968.tb01157.
- Berry, L.-M., May, J. Andrade, J. & Kavanagh, D. (2009) Emotional and behavioural reaction to intrusive thoughts. *Assessment*. *17(1)*, 126-137. doi:10.1177/1073191109344694
- Kavanagh, D. J., Andrade, J. & May, J. (2005). Imaginary relish and exquisite torture: The elaborated intrusion theory of desire. *Psychological Review*, *112*, 446-467. doi:10.1037/0033-295X.112.2.446
- Kemps, E., & Tiggemann, M. (2007). Modality-specific imagery reduces cravings for food. An application of the elaborated intrusion theory of desire to food craving. *Journal of Experimental Psychology: Applied*, *13(2)*, 95-104. doi:10.1037/1076-898X.13.2.95
- Kemps, E., Tiggemann, M., Woods, D., & Soekov, B. (2004). Reduction of food cravings through concurrent visuospatial processing. *International Journal of Eating Disorders*, *36*, 31-40. doi: 10.1002/eat.20005
- Killen, J. D., & Fortmann, S. P. (1997). Craving is associated with smoking relapse: Findings from three prospective studies. *Experimental and Clinical Psychopharmacology*, *5*, 137-142. doi:10.1037//1064-1297.5.2.137

Body scanning reduces intrusive thoughts

11

1  
2  
3  
4 Lemmens, V., Oenema, A., Knut, I.,K., Brug, J. (2008). Effectiveness of smoking cessation  
5 interventions among adults: a systematic review of reviews. *European Journal of*  
6 *Cancer Prevention*, 17 (6), 535–44. doi: 10.1097/CEJ.0b013e3282f75e48

7  
8  
9  
10 May, J., Andrade, J., Batey, H., Berry, L.-M. & Kavanagh, D. (2010) Less food for thought:  
11 Impact of Attentional Instructions on Intrusive Thoughts about Snack Foods. *Appetite*,  
12 55(2), 279-287. doi:10.1016/j.appet.2010.06.014

13  
14  
15 May, J., Andrade, J., Panabokke, N. & Kavanagh, D. (2004) Images of Desire: Cognitive  
16 Models of Craving. *Memory*, 12(4), 447-461. doi:10.1080/09658210444000061

17  
18  
19 May, J., Andrade, J., Panabokke, N. & Kavanagh, D. (2010) Visuospatial tasks suppress  
20 craving for cigarettes. *Behaviour Research and Therapy*, 48, 476-485.  
21 doi:10.1016/j.brat.2010.02.001

22  
23  
24  
25 Robinson, T. E., & Berridge, K. C. (2000). The psychology and neurobiology of addiction: an  
26 incentive-sensitization view. *Addiction*, 95, S91–S117.  
27 doi:10.1080/09652140050111681

28  
29  
30  
31 Salkovskis, P. M., & Reynolds, M. (1994). Thought suppression and smoking cessation.  
32 *Behaviour Research and Therapy*, 32(2), 193–291. doi:10.1016/0005-7967(94)90112-0

33  
34  
35 Shiffman, S., Engberg, J., Paty, J., Perz, W. G., Gnys, M., Kassel, J., et al. (1997). A day at a  
36 time: predicting smoking lapse from daily urge. *Journal of Abnormal Psychology*, 106,  
37 104–116. doi:10.1037//0021-843X.106.1.104

38  
39  
40  
41 Taylor, A.H., Ussher, M.H. & Faulkner, G. (2007). The acute effects of exercise on cigarette  
42 cravings, withdrawal symptoms, affect and smoking behaviour: a systematic review,  
43 *Addiction*, 102, 534–543. doi:10.1111/j.1360-0443.2006.01739.x

44  
45  
46  
47 Teasdale, J. D., Proctor, L., Lloyd, C. A. & Baddeley, A. D. (1993). Working-Memory and  
48 Stimulus-Independent Thought: Effects of Memory Load and Presentation Rate.  
49 *European Journal of Cognitive Psychology*, 5, 417-433.  
50 doi:10.1080/09541449308520128

51  
52  
53  
54 Tiffany, S. T., & Drobes, D. J. (1991). The development and initial validation of a  
55 questionnaire on smoking urges. *British Journal of Addiction*, 86, 1467–1476.  
56 doi:10.1111/j.1360-0443.1991.tb01732.x

1 Body scanning reduces intrusive thoughts

12

2  
3  
4 U.S. Department of Health and Human Services. (2008). *Treating tobacco use and*  
5 *dependence: 2008 update of clinical practice guidelines*. Rockville, MD. Retrieved  
6 6/6/2011 from <http://www.ncbi.nlm.nih.gov/books/NBK12239/>  
7  
8

9  
10 Ussher, M., Cropley, M., Playle, S., Mohidin, R., & West, R. (2009) Effect of isometric  
11 exercise and body scanning on cigarette cravings and withdrawal symptoms. *Addiction*,  
12 *104*, 1251-1257.  
13  
14

15 Ussher, M., West, R., Doshi, R. & Sampuran, A.K. (2006). Acute effect of isometric exercise  
16 on desire to smoke and tobacco withdrawal symptoms. *Human Psychopharmacology:*  
17 *Clinical & Experimental*, *21*, 39–46. doi:10.1111/j.1360-0443.2009.02605.x  
18  
19

20  
21 Versland, M., & Rosenberg, H. (2007). Effects of brief imagery interventions on craving in  
22 college student smokers. *Addiction Research and Theory*, *15*(2), 177–187.  
23 doi:10.1080/16066350701200582  
24  
25

26  
27 Wegner, D. M. (1989). *White bears and other unwanted thoughts: Suppression, obsession,*  
28 *and the psychology of mental control*. New York: Viking/Penguin.  
29  
30

31 West, R.J., Hajek, P. & Belcher, M. (1989) Severity of withdrawal symptoms as a predictor  
32 of outcome of an attempt to quit smoking. *Psychological Medicine*, *19*, 981-985.  
33 doi:10.1017/S0033291700005705  
34  
35

36  
37 West, R., Walia, A., Hyder, N., Shahab, L., & Michie, S. (2010) Behavior change techniques  
38 used by the English Stop Smoking Services and their associations with short-term quit  
39 outcomes. *Nicotine & Tobacco Research*, *12*(7) ,742–747. doi:10.1093/ntr/ntq074  
40  
41

42  
43 Zhou, X., Nonnemaker, J., Sherrill, B., Gilsenan, A. W., Coste, F., & West, R. (2009).  
44 Attempts to quit smoking and relapse: factors associated with success or failure from  
45 the ATTEMPT cohort study. *Addictive Behaviors*, *3*, 365–373.  
46 doi:10.1016/j.addbeh.2008.11.013  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

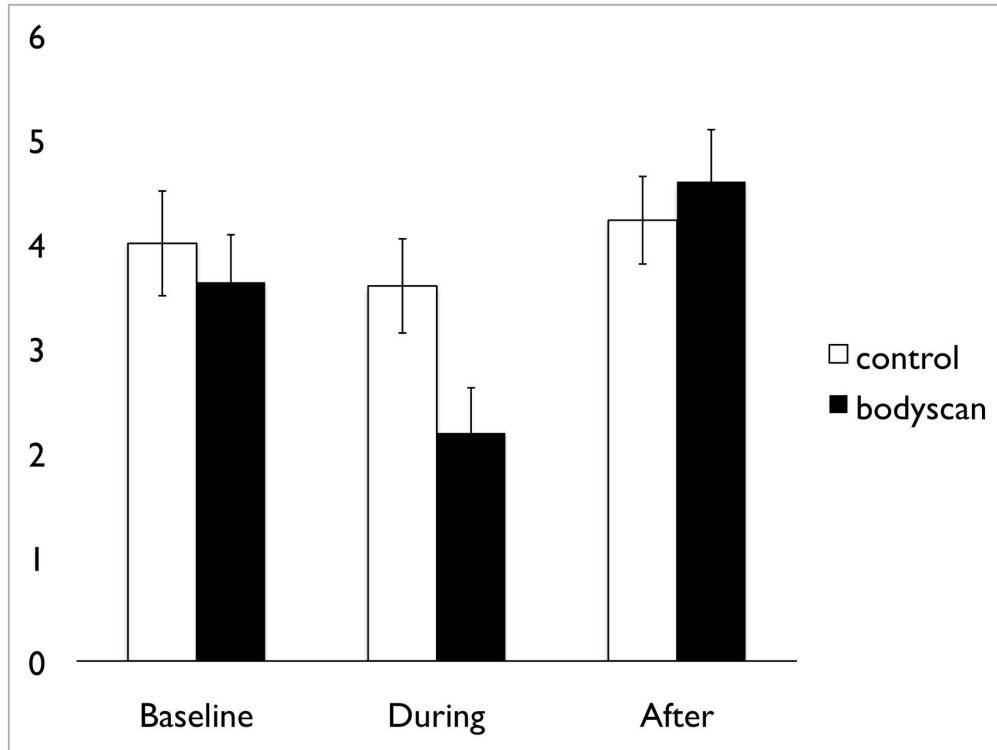
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Figure 1: In the Experimental session, smoking related thoughts dropped during the bodyscan recording and then rose again, but they remained at the same level throughout the control session (bars represent 95%CI).

Figure 2: Craving rose steadily throughout the control session; although it started off at a higher level in the experimental session it dropped during the bodyscan recording (bars represent 95%CI).

For Peer Review

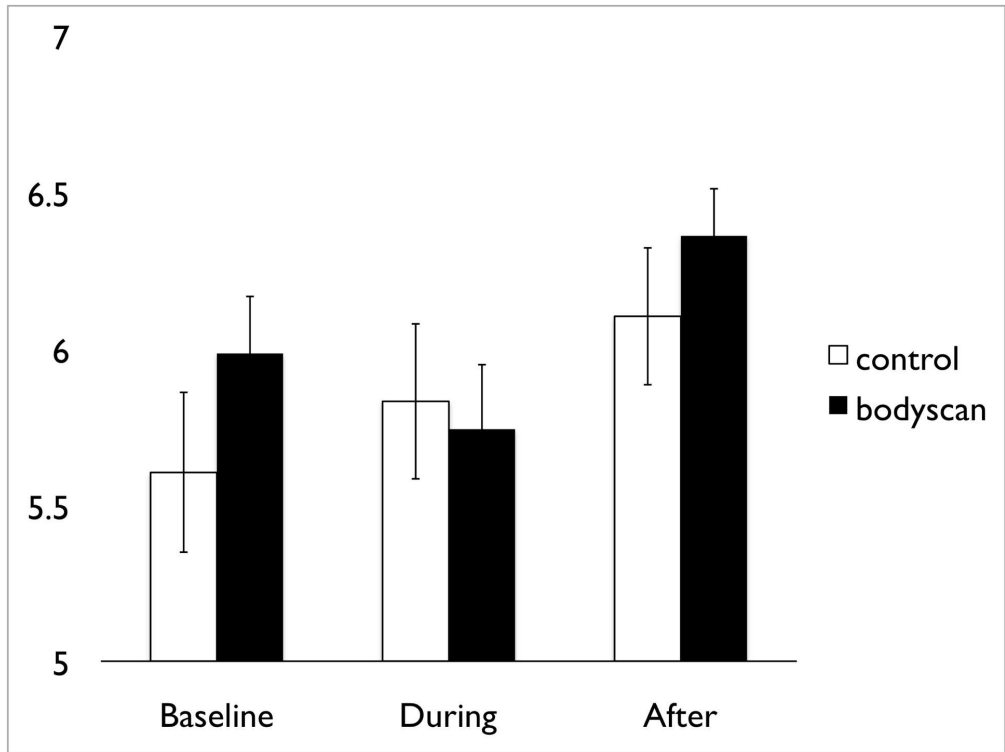
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



675x508mm (72 x 72 DPI)

review

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



680x512mm (72 x 72 DPI)

review