Cognitive biases to healthy and unhealthy food words predict change in BMI

Author Note

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Abstract

The current study explored the predictive value of cognitive biases to food cues (assessed by emotional Stroop and dot probe tasks) on weight change over a one year period. This was a longitudinal study with undergraduate students (N=102) living in shared student accommodation. After controlling for the effects of variables associated with weight (e.g., physical activity, stress, restrained eating, external eating, and emotional eating), no effects of cognitive bias were found with the dot probe. However, for the emotional Stroop, cognitive bias to unhealthy foods predicted an increase in BMI whereas cognitive bias to healthy foods was associated with a decrease in BMI. Results parallel findings in substance abuse research; cognitive biases appear to predict behaviour change. Accordingly, future research should consider strategies for attentional retraining, encouraging individuals to reorient attention away from unhealthy eating cues.

Keywords: Cognitive bias to food cues, weight, BMI change, eating behaviour.

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A high Body Mass Index (BMI) is associated with a wide range of health problems (e.g., increased risk of cardiovascular disease, diabetes, cancer and arthritis (1)). A high BMI usually reflects a sedentary lifestyle and/or unhealthy eating habits (i.e. overeating or a tendency to eat high calorie foods). A range of variables are associated with overeating and the consumption of high calorie foods. These include eating style (2), stress (3) and sensitivity to reward (4). The aim of our research was to consider the role of cognitive biases: can cognitive biases for food-related information predict changes in BMI?

In the literature on eating pathology, associations between cognitive biases and behavioural outcomes (i.e., obesity) have already received some attention. Braet & Crombez (5), for example, found that, compared to normal weight children, obese children displayed a greater interference effect for food words on a food version of the Stroop task. Likewise, Soetens & Braet (6) found that overweight adolescents displayed a memory bias for high caloric foods whereas normal-weight individuals did not. Some investigators have suggested that there might be a causal role between such cognitive biases and the development and maintenance of eating pathologies (7-8). A related key question, and the focus of the present work, is whether food-related cognitive biases can predict changes in weight change (BMI).

To date, this issue has not been addressed in eating research, even though there have been promising parallel findings regarding other psychopathologies. Cox, Hogan, Kristian, and Race (9) showed that alcoholic patients in a treatment centre who displayed an increase in attentional bias during their four weeks of treatment were more likely to relapse three months later compared to those whose attentional bias remained stable during the four weeks. Cox, Pothos, and Hosier (10) also found that excessive drinkers with a lower attentional bias for alcohol-related information at baseline displayed a greater reduction in their frequency of drinking six months later, when compared to drinkers with a higher attentional bias. Such encouraging results have led some researchers to pursue cognitive-style interventions, that is, interventions for a substance abuse problem which work by attempting to reduce corresponding cognitive biases (11).

In appetite research there have been cross-sectional studies showing how the magnitude of attentional biases to food-related stimuli differ between individuals who adopt different eating styles (12-15). Eating styles have typically been measured using the Dutch Eating Behaviour Questionnaire (DEBQ (2)). For example, Francis et al. (13) reported that restrained eaters (individuals who restrict their food intake) displayed higher interference on a food version of the Stroop task than non-restrained eaters. However, attentional biases for food-related information have been very poor predictors of current BMI (16). This cognitive-behavioural association (or lack thereof) is in contrast to corresponding research on alcohol abuse. Accordingly, we consider whether food-related attentional biases will predict *future* changes in BMI. Given that eating style, stress, and physical activity are all possible determinants of BMI change (3, 17) we take account of these factors in assessing the predictive value of attentional biases for BMI change.

A controversial issue has been how to measure cognitive biases in psychopathology. Early studies employed the emotional Stroop task, in which slower reaction times for alcohol-related words relative to neutral words would indicate a processing bias for alcohol-related words *and* a difficulty in disengaging attention from such words. The dot probe task was proposed as a better measure in that (in principle) it would separate the effects of initial orientation and sustained attention (18). Competing stimuli (e.g., a food cue and a neutral cue) are simultaneously presented side-by-side on a computer screen. After the stimuli disappear, a dot appears in the location of one of the stimuli and participants are required to identify the location of the dot. The rationale is that participants will be faster to identify the dot when it appears in the attended location. However, the dot probe has not been without criticism, since inhibition of return effects often confound the interpretation of dot probe results (19) - indeed, many laboratories today employ the dot probe in conjunction with eye tracking.

Research into attentional or cognitive biases to food-related information has routinely employed either the dot probe (12) or the emotional Stroop (20). One may question whether the emotional Stroop and the dot probe are capturing the same underlying construct or reflect different aspects of food related information processing. Empirical evidence supports the latter possibility. Johansson, Ghaderi, and Andersson (14) found that participants classified as high versus low external eaters (i.e., those who have a strong versus a weak tendency, respectively, to noticing food cues) exhibited different patterns of attentional bias for food words (respectively directing attention away or toward cues) on a dot probe but showed no differences in cognitive bias captured by the emotional Stroop. Furthermore, Pothos, Calitri, Tapper, Brunstrom, & Rogers (21) have reported very low correlations between food versions of the Stroop and dot probe tasks.

Given that the Stroop and dot probe are likely to measure different aspects of cognitive bias it becomes difficult to decide on the most appropriate tool to employ. The emotional Stroop has been the only measure to demonstrate predictive ability with respect to behaviour change in excessive drinking (9-10). Moreover, its widespread adoption particularly in the addiction literature has led to a good understanding of the factors which may affect participants' performance (22, 23). Equally, the dot probe has been a commonly used alternative to assess more specific aspects of attentional biases related to substance abuse or related behaviours. Relevant research does not recommend suitable alternatives. Accordingly, we adopted an exploratory approach and tested participants with food versions of both the emotional Stoop and the dot probe.

Method

Pilot Phase

A pilot study was conducted using 25 participants (19 female, 6 male, M_{age} = 21 years, *SD* = 4). The purpose of the pilot was two-fold. Firstly, we sought to identify suitable healthy and unhealthy food words and appropriate control words for inclusion into the cognitive bias measures. Secondly, we wanted to establish important psycholinguistic information about the candidate words so that we could match the food and control words. Using the MRC Psycholinguistic Database, potential food and office (control) words were matched according to their length, Kucera-Francis written frequency, and number of syllables. A questionnaire was generated and the shortlisted matched food and office words were individually rated on their familiarity (participants expressed agreement with the statement: "this word is familiar to me": 1= strongly disagree, 6= strongly agree); whether the word belonged to the category of "things found in the office" (participants expressed agreement with the statement: "this word belongs to the category of things found in the office": 1= strongly disagree, 6= strongly agree); and whether the word belonged to the category of "food" (participants expressed agreement with the statement: "this word belongs to the category of food": 1= strongly disagree, 6= strongly agree). Subsequently, participants judged each food word and decided whether people in general think the food is healthy or unhealthy (-3= very unhealthy, 0= neither unhealthy or healthy, +3= very healthy). Participants also rated the valence of the category of "things found in the office" (-3= very negative, 0= neither negative or positive, +3= very positive). Office words were rated as neutral. An equal number of healthy and unhealthy foods were selected (see Appendix for stimuli).

We made the decision to distinguish between healthy and unhealthy foods as it was assumed that these food groups were likely to be linked with, respectively, decreases versus increases in BMI. Intuitively, diets high in fruits and vegetables and low fat proteins such as fish and lentils are likely to be associated with lower BMIs than diets high in saturated fats and sugars, such as cakes and kebabs. We recognise that some of our unhealthy items might be potentially categorised as ‘healthy’ foods depending upon the constituent ingredients. For example, kebabs or pizzas could have a high vegetable concentration and be low (or relatively low) in fats and sugars. However, as far as our sample was concerned these items provided clear examples of unhealthy foods.

Phase 1

Participants and procedure

One hundred and fifty one, first year students from a UK University (88 female, 63 male; M_{age}=19 years, SD=1), who identified themselves as living in shared student accommodation, native English speakers, and not colour-blind, were recruited to take part in the research for £10. Participants still living with their parents were not recruited since it was assumed such individuals would have less control over their diet. Prior to testing, participants were told that they would have to be tested again 12 months later. Testing involved the measures described below. Time 1 testing also included additional measures the results of which are reported elsewhere (21, 24). The other published results focus on cross-sectional data unique from the current research paper. One (21) focused mainly on comparing associations between different cognitive bias measures. The other (24) looked at predictors of a new measure of portion size preference. Here we report only measures relevant to our longitudinal analysis. Participants completed the food Stroop and the dot probe (the order of administration was counterbalanced between the two tasks) and then completed a booklet containing questionnaires relating to eating behaviour and lifestyle. Following this, participants had their height and weight measured (with shoes off).

Materials and measures

Cognitive Bias Measures. The visual display and response collection was controlled by SuperLab, software for presenting stimuli and recording reaction times. Participants responded using a Cedrus RB-730 7-button response box to ensure millisecond accuracy. Characters in the stimuli were approximately 5-7 mm tall.

Stroop. Participants were required to identify the colour of the word that appeared on the computer screen by pressing the corresponding button on the response box (red, blue, green, yellow). Each trial ran as follows: an initial fixation point ('+') appeared in the screen centre for 500 ms. Next the word was presented in the screen centre and remained there until participants made their response. There was a 1000 ms inter-trial interval. Participants first completed an introductory (12 trials) and a buffer block (4 trials) of number words to practice identifying ink colours. The experimental block consisted of 160 trials where each of the 20 food words (10 healthy and 10 unhealthy) and 20 office words were presented in each of the four colours. Following recommendations of Cox et al. (22) food and office words were blocked: participants responded to all food words first or all office words first; block order was counterbalanced. Words were presented in a random order within each block.

The average response latencies to the office words were subtracted from the average response latencies to the corresponding healthy and unhealthy food words. This resulted in two cognitive bias indices, one for healthy and one for unhealthy foods. Higher (more positive) scores indicated greater interference in colour naming and thus indicated more cognitive bias towards healthy or unhealthy foods.

Dot probe. Participants were required to identify the location of a dot ('.'). Each trial ran as follows: a fixation point ('+') appeared in the screen centre for 500 ms, followed by the word pair. The word pair remained on screen for either 500ms (in a version measuring initial orientation) or 1250ms (in a version measuring sustained attention). After it disappeared, a dot was presented in one of the word locations. The dot remained on screen until the participant responded. There was a 1000 ms inter-trial interval. Following an introductory (8 trials) and buffer (4 trials) block, participants completed the initial orientation block and the sustained attention block (the latter preceded by another 4 buffer trials).

The location of the food/office words and the dot probe was fully counterbalanced: on half of the trials the dot appeared in the same location as the food word and on the other half of the trials in the opposite location to the food word. Trials where a food word and the probe appeared in the same location are referred to as *congruent*. Trials where the food word and the probe appear in the opposite location are referred to as *incongruent*. Therefore, each of the 20 food words (10 healthy, 10 unhealthy) appeared 4 times (congruent top, congruent bottom, incongruent top, incongruent bottom), resulting in 80 experimental trials. All word pairs were presented in random order for each participant.

Attentional bias scores for healthy and unhealthy foods were computed by subtracting the mean response latencies for congruent trials from the mean response latencies for incongruent trials. Positive scores indicated attention toward the specific (healthy or unhealthy) food cues, with higher scores reflecting stronger bias.

Eating Styles. The Dutch Eating Behaviour Questionnaire (DEBQ (2)) consists of 33 items, 13 of which assess emotional eating (eating in response to emotions), 10 external eating (eating in response to food-related cues such as the sight or smell of palatable food), and 10 restrained eating (attempting to limit ones food intake). Each question was answered on a 5-item rating scale (never; rarely; sometimes; often; very often). Participant scores for each subscale of the DEBQ were computed following van Strien et al. (2). For all subscales, scores ranged between one and five with higher scores indicating higher levels of restrained, external and emotional eating.

Stress. Participants completed the 14 item stress scale taken from Lovibond & Lovibond's Depression, Anxiety and Stress Scale (25). The questions were answered on a 4 point scale (did not apply to me at all; applied to me to some degree, or some of the time; applied to me to a considerable degree, or a good part of the time; applied to me very much, or most of the time). A stress score was created for each participant by summing responses to each of the 14 items. Higher scores indicated greater levels of stress.

Physical Activity. Using the scale of Smith, Marshall, & Huang (26) participants recorded both the frequency of walking and moderate-intensity physical activity engaged in for 30 minutes or more (4-point scale: 5 or more times a week; 3-4 times a week; 1-2 times a week; none), and the frequency of vigorous-intensity physical activity engaged in for 20 minutes or more (3-point scale: 3-4 times a week; 1-2 times a week; none). Participant responses were reverse scored so that higher values represented greater physical activity. All items were reliably inter-correlated (*r*s from .43 to .73) and so were subsequently averaged to create a single index of physical activity.

BMI. BMI scores were computed as weight (kg)/height (m^2).

Phase 2

Participants

One year later (+/- 4 weeks) participants were asked to attend Phase 2 and 102 participants (67.5%) returned. There were 58 females and 44 males (mean age=19 years, *SD*=1 year). Participants received £4 for their time.

Measures & procedure

DEBQ measures, physical activity, and stress were all calculated in the same manner as at Phase1. All Phase 2 measures were highly, positively associated with their Phase 1 counterparts (emotional eating *r*=.79; external eating *r*=.81; .restrained eating *r*=.81; physical activity *r*=.59; stress *r*=.63) indicating that these psychological and behavioural characteristics were highly similar at both test phases). Accordingly, we averaged Time 1 and Time 2 scales together (scale reliabilities: emotional eating α=.95; external eating α=.91; restrained eating α=.96; physical activity α=.82; stress α=.94). Participants also had their height and weight measured, so as to compute the Phase 2 BMI.

Results

Data preparation and preliminary analyses

Dot probe. Following Mogg, Bradley, and Williams (27), latencies less than 100 ms or greater than 4000 ms were excluded. Latencies were log transformed and those more than two standard deviations above each participant's own mean were removed. Log scores were then retransformed back into a millisecond scale.

BMI. We examined whether there was sufficient variance in BMI between Phase 1 and Phase 2. Results of a paired-sample t-test revealed a modest yet significant increase in BMI, $t(101)=2.02$, $p=.05$ ($M_{BMI\ Phase\ 1}=23.32$, $SD=3.52$; $M_{BMI\ Phase\ 2}=23.64$, $SD=3.50$). Accordingly, a change variable was computed by subtracting participants' BMI at Phase 1 from their BMI at Phase 2. Higher scores indicated greater increase in BMI. Table 1 shows descriptive statistics for all study variables.

Main analyses

Our objective was to examine whether attentional bias at Phase 1 could predict BMI change across a 12-month period, taking into account (controlling for) additional possible predictors of BMI change. However, initially, we wanted to assess whether there was any zero-order association between each of the cognitive bias variables and BMI change prior to exploring partial relationships in a regression model. This was done to ensure that any possible correlation would not be overlooked. Accordingly, we explored the bivariate relationship between each of the six cognitive biases measures (emotional Stroop, initial dot probe x 2 for healthy and unhealthy foods, sustained dot probe x 2 for healthy and unhealthy foods) and BMI change. Results revealed that cognitive bias for unhealthy foods measured using the emotional Stroop was positively associated with BMI change (r= .23, p< .03. None of the other cognitive bias measures were reliably correlated with BMI change (emotional Stroop healthy, r= -.08, p> .43; dot probe initial orientation healthy, r= .15, p> .13; dot probe initial orientation unhealthy, r= .12, p> .22; dot probe sustained attention healthy, r= -.04, p> .69; dot probe sustained attention unhealthy, r= .10, p> .30).

However, these individual correlations can be misleading because of any possible interrelation between the healthy/unhealthy cognitive bias variables for each of the three tasks and also because BMI change in our sample is plausibly a function of variables other than cognitive bias as well. Accordingly, we next performed three multiple regression analyses, a separate one for each of the cognitive bias measures (Stroop, dot probe initial orientation, dot probe sustained attention). For each regression model, cognitive bias for healthy foods, cognitive bias for unhealthy foods, emotional eating, external eating, restrained eating, physical activity, stress, and gender were concurrently entered as predictors. BMI change was the dependent variable (see Table 2). Accordingly, each model provided an estimate of the contribution of each predictor variable to BMI change, in the context of a range of other possible predictors of BMI change. The only model that reliably predicted BMI change better than chance was the model containing the emotional Stroop. This model accounted for 18% of the variance in BMI change. Cognitive bias for unhealthy foods and cognitive bias for healthy foods and stress were the only significant predictors of BMI change (that is, they were the only predictors in the model with a significant coefficient). A bias for unhealthy foods was associated with an increase in BMI whereas a bias for healthy foods and stress were both associated with BMI decrease.

Discussion

Understanding the factors that lead to BMI change is an issue of considerable practical importance. For the first time, we have demonstrated that cognitive biases for healthy and unhealthy foods predict BMI change across a 12 month period. This finding closely parallels analogous results in alcohol abuse (10). Our research allows a number of important additional conclusions: First, cognitive biases had predictive utility when measured by the emotional Stroop task but not when measured by the dot probe (capturing either initial or sustained attention). There has recently been considerable controversy regarding the relative merits of the emotional Stroop and dot probe paradigms when applied to health psychology or substance abuse. Our research shows that in the context of eating behaviour the former has more predictive power. Second, cognitive biases for healthy and unhealthy foods could account for more variance in BMI change, compared to a range of other possible predictors, such as physical activity, stress, and emotional, restrained, and external eating. Additionally, the pattern of associations between Stroop cognitive biases and BMI was compelling: a bias for unhealthy foods was linked with an increase in BMI whereas a bias for healthy foods was actually linked with a decrease in BMI. These finding underwrite the importance of cognitive biases for food-related information in eating behaviour.

These findings need to be considered in the light of two key issues. Firstly, the effect sizes associated with cognitive biases to healthy and unhealthy food words and BMI change are, at best, modest. This is particularly the case when the proportion of variance accounted for by cognitive bias toward unhealthy and healthy food words are considered in isolation (both account for less than 5% of the variance in BMI change). Secondly, as the sample included only young college students the results should not be generalised to other populations. Accordingly, for this population, it is likely that there are additional key predictors of BMI change.

One way to understand our findings is with the Cognitive Theory (CT) approach in eating pathology. CT asserts that thinking is organised into knowledge structures which guide information processing. These knowledge structures are assumed to reflect an over-concern with weight-, shape-, and food–related information (7). Accordingly, selective attention (5) or memory biases (6) for food-related information are likely consequences of the activation of these knowledge structures. Cox and colleagues (e.g., 10) have proposed an analogous hypothesis in a motivational framework, according to which pre-occupation with an issue, such as alcohol consumption, would lead to cognitive biases for related information.

We expected that measures of eating behaviour (e.g., the DEBQ indices) would predict BMI change. For example, according to Fairburn and Wilson (28) it is restrained eating which leads to food-related attentional biases: Concerns about body weight, lead to restriction of food, greater feelings of hunger, increased pre-occupation with food and associated attentional biases. DEBQ indices have been used to successfully predict current BMI in other research (16) and previous studies have found that measures of restrained eating prospectively predict weight gain (29-31). These results were not replicated in our research. It is possible that eating style (as measured by the DEBQ) is a less important predictor for BMI change in our particular population sample (which consisted mostly of early 20s university undergraduates).

Instead, our results are consistent with other attempts to use eating style in order to predict BMI change. For example, Lowe et al. (32) found that whereas a history of dieting and weight suppression predicted weight increase in students in their freshman year, none of the traditional eating style measures such as emotional eating (measured by the DEBQ), cognitive restraint and disinhibition (both measured by the Three Factor Eating

Questionnaire: TFEQ) and restrained eating (Restraint Scale) were associated with weight gain. Also, De Lauzon-Guillain et al. (33) found that restrained eating (measured by TFEQ) could not predict BMI over a two year period.

Overall, the relationship between stress, eating behaviour (DEBQ), and food intake (and so presumably BMI changes) is not straight forward. Some investigators have reported that in a laboratory setting female participants scoring high on measures of restrained eating consume more food after an ego-threatening task, when offered either a single food (34) or a variety of foods (35). Survey results of Wallis and Hetherington (36) showed that females who scored high on measures of emotional eating were more likely to consume high fat snacks in response to stress. However, a laboratory manipulation, by the same investigators, in which participants were presented with both a high fat and a low fat food led to somewhat conflicting results. Participants high on restraint consumed less of the low fat food after an ego threatening Stroop task (which involved words like ‘worthless’), compared to low restrained participants and there was no corresponding effect in relation to emotional eating. Such results highlight a complex relationship between stress, the DEBQ characteristics of eating behaviour, and the type and range of food available. It is possible that the limited resource model of self-control offers some insight (37, 38). This literature suggests that self-regulatory abilities are important for a range of behaviours and cognitive processes including behavioural control (e.g., resisting tempting foods), emotion regulation (such as stress reduction) and attentional control (as is required by Stroop and dot probe tasks). However, according to this model self-regulation is a limited resource. As such, an individual who has depleted their self-regulatory resources on, for example, emotion regulation, may have less resources available for other behaviours requiring self-control, such as resisting tempting foods.

From a practical point of view, if higher cognitive biases for food-related information can predict an increase in BMI, one can ask whether (artificially) reducing the cognitive bias would *prevent* the BMI increase. Cognitive-style interventions are currently being enthusiastically pursued in alcohol abuse. Such interventions typically involve training excessive drinkers to reorient their attention away from alcohol-related information (39). Preliminary results from such efforts have been encouraging and offer the promise for a relatively cost-effective intervention, to supplement more clinically-oriented approaches. Similar attentional retraining might be useful for individuals demonstrating food-related attentional biases. However, Dejonckheere, Braet, and Soetens (40), found an interference effect for sweet words after the suppression of thoughts about sweets. Therefore, ironically, if deliberate attempts at cognitive avoidance of unhealthy food cues enhance corresponding attentional biases, then, as our results show, this may lead to weight gain! Clearly, interventions against weight change need to be designed with great care.

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Appendix

Stroop practice words (word colour in parentheses): One (red), Two (red), three (blue), Five (green), Thirteen (green), Ninety (yellow), Six (red), Ten (blue), Eight (blue), Nine (green), Fourteen (yellow), Thirty (yellow). *Stroop buffer words* (colour in parentheses): Four (red), Eighteen (blue), Nineteen (blue), Zero (yellow). *Dot Probe practice words*: One-Six, Two-Ten, Three-Eight, Five-Nine, Thirteen-Fourteen, Ninety-Thirty, Fifteen-Sixteen, Fifty-Sixty. *Dot Probe buffer words*: Four-Zero, Eighteen-Nineteen, Twelve-Twenty, Seven-Forty. *Stroop & Dot Probe Healthy Foods* (with matched office words): Spinach-Stapler, Apples-Pencil, Salad-Paper, Lentils-Scanner, Vegetables-Calculator, Fish-Lamp, Carrot-Webcam, Peas-Pins, Broccoli-Calendar, Grapes-Stamps. *Stroop & Dot Probe Unhealthy Foods* (with matched office words): Cake-Desk, Sugar-Ruler, Doughnut-Scissors, Hamburger-Envelopes, Chips-Files, Caramel-Monitor, Crisps-Blinds, Kebab-Memos, Pizza-Table, Cream-Books.

Table 1. Descriptive statistics for all study variables.

Study Variables	Mean	SD
Stroop: Healthy Foods	12.40	55.02
Stroop: Unhealthy Foods	18.96	53.28
Dot Probe (IO): Healthy Foods	2.36	32.22
Dot Probe (IO): Unhealthy Foods	3.75	27.51
Dot Probe (SA): Healthy Foods	-1.65	33.62
Dot Probe (SA): Unhealthy Foods	-150.56	44.77
Emotional Eating	2.38	.66
External Eating	3.28	.58
Restrained Eating	2.41	.81
Physical Activity	2.43	.60
Stress	9.79	6.70
BMI Change	.32	1.59

Note: IO=Initial Orientation; SA=Sustained Attention.

N=99-102.

Table 2. Three multiple regression models predicting BMI change

Study Variables	Model 1		Model 2		Model 3	
	(N=102)		(N=100)		(N=99)	
	β	t	β	t	β	t
Cognitive Bias: Healthy Foods	-.32	-2.50**	.14	1.28	-.08	-.78
Cognitive Bias: Unhealthy Foods	.46	3.56***	.14	1.33	.19	1.72
Emotional Eating	.12	.88	.15	1.06	.16	1.08
External Eating	-.07	-.56	-.19	-1.55	-.22	-1.78
Restrained Eating	.01	.12	-.03	-.21	-.01	-.05
Physical Activity	-.02	.84	.02	.19	.04	.33
Stress	-.22	-1.95*	-.17	-1.33	-.17	1.39
Gender	.17	1.42	.11	.86	.09	.74
ANOVA	$F(8,93)=2.59$**		$F(8,91)=1.19$		$F(8,90)=1.12$	
R^2	.18		.10		.09	

The cognitive bias measures in Model 1 relate to the emotional Stroop, in Model 2 to the dot probe (initial orientation), and in Model 3 to the dot probe (sustained attention).
β, standardized β coefficient.
*$P \leq 0.05$, **$P \leq 0.01$, ***$P \leq 0.001$.