Memory Updating in Sub-clinical Eating Disorder: Differential Effects with Food and Body-shape Words

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Abstract: The present study investigated how eating disorder (ED) relevant information is updated in working memory in people with high vs. low scores on a measure of eating disorder pathology (the Eating Disorder Examination Questionnaire, EDE-Q). Participants performed two memory updating tasks. One was a neutral control task using digits; the other task involved food words and words relating to body-shape, and provided measures of updating speed and post-updating recall. We found that high EDE-Q participants (1) showed no sign of general memory updating impairment as indicated by performance in the control task; (2) showed a general recall deficit in the task involving ED-relevant stimuli, suggesting a general distraction of cognitive resources in the presence of ED-related items; (3) showed a relative facilitation in the recall of food words; (4) showed quicker updating towards food words and relatively slower updating towards body-shape related words. Results are discussed in the context of cognitive theories of eating disorders.

1. Introduction

The psychopathology of eating disorders (ED) involves a self-evaluation overly influenced by weight and body-shape (Fairburn, Cooper, & Shafran, 2003). Cognitive theories of ED propose that dysfunctional attitudes and beliefs can lead to elaborate but inaccurate and maladaptive schemata around issues of eating, weight, and body-shape (Vitousek & Hollon, 1990). Schemata produce systematic biases in information processing, including attention and memory biases (e.g., Dobson & Dozois, 2004; Lee & Shafran, 2004; Hunt & Cooper, 2001; Legenbauer, Maul, Rühl, Kleinstäuber, & Hiller, 2010). These biases can reinforce dysfunctional attitudes and beliefs, rendering them resistant to change or modification (Baker, Williamson, & Sylve, 1995; Vitousek & Hollon, 1990).

The present study had two main aims. First, we set out to test *memory updating* in the context of ED. Previous research has focused on attention and memory biases, but we argue that a closer focus on memory updating in ED is warranted given the notion that cognitive biases can contribute to rigidity and change resistance, and the ability to update memory is a crucial basic process required for cognitive change (cf. Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012). In support, Tekcan, Taş, Topçuoğlu, and Yücel (2008) reported that ED patients show a disorder-specific impairment in disengaging from ED-related information.

Second, Lee and Shafran (2004) noted that previous research has largely failed to separate food and body-shape/weight related stimuli. Some studies have suggested that an attention bias is found specifically with food-related stimuli (Cooper & Todd, 1997; Lee & Shafran, 2004), but some have found biases with both types of stimuli (Dobson & Dozois, 2004). Sub-clinical studies have focused on food-related stimuli (e.g., Green & Rogers, 1993; Huon &

Brown, 1996). The present study thus set out to investigate how memory updating is affected in ED when the materials relate to either food or body shape.

On a general level, we hypothesized that sub-clinical ED participants would show better recall of and facilitated updating towards ED-relevant stimuli, but delayed updating away from ED-relevant stimuli. On a more specific level, we expected different effects for food and body-shape related words; specifically, we expected stronger effects for food words, speculating that ED participants might be reluctant to engage with body-shape items because of the inherent potential of threat (Dobson & Dozois, 2004).

2. Methods

We administered two memory updating tasks to people with high vs. low scores on the Eating Disorder Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994). A control task involving digits tested general updating abilities; an ED-updating task involved food and body-shape related words.

2.1 Participants

A sample of female[1] undergraduates ($N \approx 750$) were pre-screened using the EDE-Q. A total of $N = 96$ participants (age range 17-41; $M = 19.10$, $SD = 3.99$) were selected from the outer quartiles of the resulting distribution (scores > 2.7 and < 1.8 on 0-6 scale). The EDE-Q was re-administered on test day, given its temporal specificity. Seven participants met the inclusion criteria in the pre-screening but not the test-day assessment; these were excluded from analyses, leaving $n = 45$ participants in the high and $n = 44$ participants in the low EDE-Q group.

[1] We recognize that men also experience eating disorders, but given the higher prevalence rate we focused on females.

2.2 Stimuli

Thirty-two food words (e.g., *cream*, *bacon*) and 32 body-shape related words (e.g., *chubby*, *plump, skinny, thighs*) were selected for the ED-updating task from previous literature. We compiled two control lists of neutral words (not related to food or body-shape), matched on word length and frequency.

2.3 Procedure

Trials in the ED-updating task consisted of three phases: encoding, updating, and recall. Trials contained either neutral and food related, or neutral and body-shape related words. In the encoding phase of each trial, participants remembered three words presented concurrently for 2 s in a row of individual frames. The updating phase comprised a series of updating steps, each involving the substitution of one of the words (i.e., presentation of a new word in one of the frames while the other two frames remained blank). Following the paradigm of Kessler and Meiran (2008)[2], the new word remained on the screen until the participant indicated successful updating via key-press (or the 5s response deadline was reached); this updating RT was one dependent measure. The inter-stimulus interval was 2.5 s. The number of updating steps ranged from 1 to 21, with a constant stopping probability of .10. Words were randomly drawn from the target (food/body-shape) and matched neutral control word lists. Finally, there was a cued recall test of all words in the currently held memory set; this constituted the second dependent measure. There were 60 trials with a mean of 9 updating steps per trial, resulting in approximately 68 updating steps per design cell.

[2] In fact, we used a modified version of the paradigm proposed by Ecker, Lewandowsky, and Oberauer (2014). This paradigm involves the presentation of a "removal cue" for various intervals before presentation of the new items. This factor had no effect on the present data, hence design and data are reported without it.

Participants also completed a similar control updating task with single-digit numbers; updates involved the application of simple arithmetic operations. The dependent measure was cued recall of the digits; there was no updating RT measure (for a detailed description, see Lewandowsky, Oberauer, Yang, & Ecker, 2010).

3. Results

3.1 EDE-Q

EDE-Q scores ranged from 0-5.95; mean scores were $M = 4.04$ ($SD = 0.88$) for the high and $M = 0.62$ ($SD = 0.54$) for the low EDE-Q group, respectively. This was a significant difference, $t(87) = 22.14$, $p < .001$.

3.2 Control Updating Task Performance

This task was used to ensure that group differences in the ED-updating task were content-specific differences and not due to general memory updating deficits. Mean rates of recall accuracy for the high and low EDE-Q groups were .63 ($SD = .16$) and .65 ($SD = .17$), respectively. This was not a significant difference, $t < 1$.

3.3 ED-updating Task Performance

3.3.1. Recall accuracy. Overall recall accuracy was $M = .91$ ($SD = 0.07$; range = .59-.99). All scores, bar one, fell within 3 *SD*s of the mean; this outlier was excluded from the analyses. A three-way mixed-design ANOVA was run on the accuracy data (shown in Figure 1). Within-subjects factors were trial-type (food/body-shape) and word-type (target/neutral), and the between-subjects factor was EDE-Q group (low/high). There was no main effect of trial-type, $F(1,86) = 2.37$, $MSE = .002$, $p = .13$, but a significant main effect of EDE-Q group, $F(1,86) = 4.98$, $MSE = .016$, $p = .03$, $\eta_p^2 = .05$, suggesting poorer recall in the high EDE-Q group. There was a marginal interaction between EDE-Q group and trial-type, $F(1,86) = 3.65$,

MSE = .002, $p < .06$, $\eta_p^2 = .04$. A more specific interaction contrast compared high and low EDE-Q groups, contrasting the food/target condition against the other three pooled conditions (food/neutral, body-shape/target, and body-shape/neutral). This interaction contrast was significant, $F(1,86) = 6.32$, *MSE* = .002, $p = .01$, suggesting the EDE-Q group difference was smaller for food target words compared to the other three conditions. That is, the high EDE-Q group showed a recall deficit for all words but the food target words; an additional contrast confirmed that recall of food words did not differ between the two groups, $F < 1$.

3.3.2 Updating RT. Individual RTs less than 300 ms were removed, as were outliers 3 *SD*s from participants' individual means. Mean updating RT was *M* = 1.05 s (*SD* = 0.36). All individual mean scores, bar one, fell within 3 *SD*s of the grand mean, and the outlier was excluded from the analyses.

A 2 × 2 × 2 × 2 mixed-design ANOVA was run, with within-subjects factors trial-type (food vs. body-shape), replaced word (target vs. neutral), and updated word (target vs. neutral) and the between-subjects factor EDE-Q group (high vs. low). There was a main effect of updated word, $F(1,85) = 5.29$, *MSE* = .005; $p = .02$, $\eta_p^2 = .06$, qualified by an interaction between trial-type, updated word, and EDE-Q group, $F(1,85) = 4.24$, *MSE* = .004, $p = .04$, $\eta_p^2 = .05$ (see Figure 2). A contrast analysis showed that the high EDE-Q group was quicker to update to a food target word compared to either a body-shape target word (which showed the slowest updating RT numerically), $F(1,85) = 5.74$, *MSE* = .006, $p = .02$, or compared to all three other conditions, $F(1,85) = 7.47$, *MSE* = .006, $p < .01$. There were no condition differences in the low EDE-Q group, and no EDE-Q group differences, all $F < 1$.

However, a further analysis was run on group difference scores (i.e., the four group differences in Figure 2), calculated by randomly pairing participants from the two groups. A 2 ×

2 repeated measures ANOVA with factors trial-type (food vs. body-shape) and word-type (target vs. neutral) yielded a significant interaction, $F(1,42) = 4.55$, $MSE = .004$, $p = .04$, $\eta_p^2 = .10$. This suggests that the group difference was smaller for food target words and larger for body-shape target words than for neutral words, indicating that the high EDE-Q group was relatively fast to update to a food word and relatively slow to update to a body-shape word.

4. Discussion

The control updating task showed that high and low EDE-Q participants did not differ in general memory updating abilities. In the ED-updating task, however, high EDE-Q participants showed significantly worse recall than low EDE-Q participants. This deficit was not specific to target words, suggesting it resulted from the general presence of ED-relevant stimuli, which may have diverted cognitive resources away from the task and/or may have provoked more elaborate, self-referential processing in high EDE-Q participants (see Legenbauer et al., 2010). It follows from this rationale, however, that at least some ED-relevant items received *more* elaborate processing. In fact, whilst the high EDE-Q group exhibited poorer recall accuracy overall, this deficit disappeared for food target words, and high EDE-Q participants recalled food target words better than neutral and body-shape words.

The RT data of the ED-updating task showed a trend for a general updating delay in high EDE-Q participants. Again, we argue that this resulted most likely from the distraction created by the ED-relevant information. We found no evidence for a deficit in updating from a disorder-relevant word to a neutral word in high EDE-Q participants, that is, no deficit in disengaging from ED-relevant information. This is inconsistent with our prediction derived from Tekcan et al. (2008). In contrast, our hypothesis regarding the updating *towards* an ED-relevant word was supported. It was predicted that updating efficiency from a neutral to an ED-relevant word—in

particular to a food word—would be high in high EDE-Q participants, and this pattern was indeed found. The *opposite* pattern, however, was found for body-shape words. High EDE-Q participants were, relatively speaking, more efficient at encoding food stimuli and slower to encode body-shape stimuli during updating. Our results support the view that there is an attentional bias towards food stimuli in ED, and an attentional bias away from body-shape words (also see Smeets, Roefs, van Furth, & Jansen, 2008). The finding that high EDE-Q participants showed both superior recall of and more efficient updating towards food stimuli is consistent with theories of schema-congruent information processing and cognitive models of ED (Dobson & Dozois, 2004; Lee & Shafran, 2004; Vitousek & Hollon, 1990). By contrast, our finding that updating towards body-shape items is impaired points towards an avoidance of body-shape related information, which may be perceived as threatening.

Given the nature of our RT measure (i.e., a point measurement), it is possible that both food and body-shape stimuli show the same general processing trajectory (i.e., an initial bias towards their processing, with subsequent avoidance; cf. hypervigilance-avoidance hypothesis; e.g., Shafran, Lee, Cooper, Palmer, & Fairburn, 2007) but that the trajectory has a different time-course for food- and body-shape related items. Future research using response-deadline procedures or physiological measures should aim to investigate this potential explanation.

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Figure 1. Mean recall accuracy in the ED-updating task for target (food/body-shape) words and neutral words. Error bars indicate within-subject standard errors of the mean.

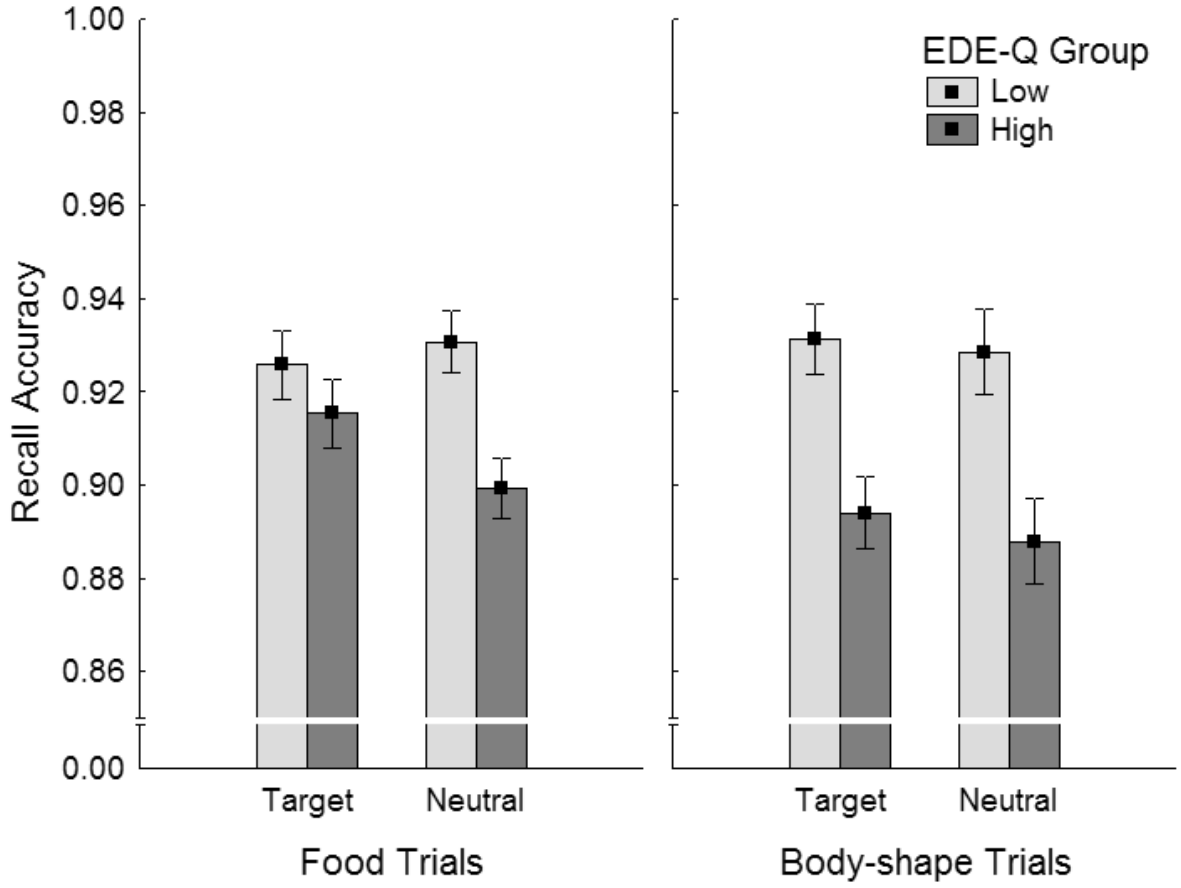

Figure 2. Mean updating response times in the ED-updating task, indicating the time taken to update towards a target (food/body-shape) word or neutral word. Error bars indicate within-subject standard errors of the mean.