**Title page**

Targeting binge eating in bulimia nervosa and binge eating disorder using inhibitory control training and implementation intentions: A feasibility trial

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**Supplementary Materials 1: Reasons for drop out**

Of the 16 participants who did not complete the post-intervention assessment, 13 had dropped out of the trial. Of these, eight participants stopped responding to emails and five reported personal struggles interfering with research engagement. The 11 participants who did not complete the follow-up questionnaire stopped responding to emails and did not provide a reason for the drop-out.

**Supplementary Materials 2: Go/no-go task performance and reaction time**

*Methods*

To ensure that stimulus-response learning had taken place during the training task (manipulation check), differences in reaction times and commission errors between 100% predictive (food) and 50% predictive (clothing filler) stimuli were assessed using two repeated measures ANOVAs. Evidence of stimulus-response learning would require that participants exhibited quicker reaction times and made a lower number of errors to 100% predictive versus 50% predictive stimuli (as observed in Lawrence et al., 2015).

*Independent samples t-tests were conducted to compare reaction time and task performance (i.e. commission and omission errors) among participants taking psychiatric medication and participants not taking psychiatric medication.*

*Results*

A main effect of stimulus type was observed for the reaction times of “go” stimuli [F (1,59) = 131.14, p = .000], with faster reactions to predictive versus non-predictive go stimuli (see supplementary table S1). A stimulus type x intervention group interaction was also found [F (1,59) = 4.76, p = 0.03], indicating that the difference between 100% and 50% predictive stimuli was greater in the food-specific intervention group compared to the general intervention group. No main effect of intervention group was found (p > .05). A main effect of stimulus type was found for commission errors on “no-go” trials [F (1,59) = 7.75, p = .007]. Both groups made fewer errors to 100% predictive than 50% predictive stimuli. Consistent with previous studies, (Lawrence et al., 2015; Stice et al., 2017), no main effect of intervention group or stimulus type x intervention group interactions were found (p > .05). See supplementary table S1.

*There was no significant difference in task performance [t (59) = -.409, p = .684] or reaction time [t (59) = .074, p = .743] between participants taking psychiatric medication and participants not taking psychiatric medication.*

Table S1. Manipulation Check

Descriptive statistics of commission errors and reaction times in response to 50% predictive and 100% predictive stimuli.

|  |  |  |
| --- | --- | --- |
|  | 50% Predictive StimuliM (SD) | 100% Predictive StimuliM (SD) |
| Commission Errors (number/out of 36) |
| Food-Specific Intervention | 3.2(2.1) | 1.8(1.5) |
| General Intervention | 3.4(2.0) | 2.3(4.7) |
| Reaction Time (ms) |
| Food-Specific Intervention | 552(91) | 523(85) |
| General Intervention | 530(90) | 510(79) |

**Supplementary Materials 3: Analysis of acceptability**

*Methods*

Feedback form*.*The feedback form included questions relating to the two sections of the intervention (go/no-go training and if-then planning). For each section, participants rated the extent to which they: 1) understood the rationale, 2) felt motivation, 3) found it effortful to complete, 4) perceived benefit, 5) perceived worthwhileness, and 6) would recommend to others. Responses were given on a visual analogue scale from 0-100, with 0 indicating “not at all” and 100 indicating “very much so”. Acceptability of the combined intervention across the two intervention groups was assessed using independent samples t-tests (and related effect sizes).

Focus Groups*.*The focus groups included six open-ended questions, including:

1) “Which aspect of the computerized training and goal setting guidance was the most/least helpful?”, 2) “Can you please tell us about any practical problems receiving the computerized training and/or goal setting guidance?”, 3) “What changes to the protocol do you believe would have made your involvement more simple or less effortful?”, 4) “In what ways could the research team have facilitated your engagement, offered more support, or made the intervention more accessible?”, 5) “Did you like the one-to-one format, or do you feel like some elements could have been delivered as a group intervention?”, and 6) “Can you tell us in what ways the intervention met or did not meet your expectations?”.

*Statistical analyses*

The quantitative data of the feedback form were analysed using independent samples t-tests,for each of the six outcomes, and Cohen’s d effect sizes were derived using the recommendations of Lakens (2013). For qualitative analysis of focus groups responses, a thematic analysis was carried out. Two independent researchers (PM and JK) coded the responses and then discussed discrepancies. Initial codes were then generated and incorporated into meaningful clusters of data and entered into Nvivo (Nvivo Computer Software).

*Results*

Feedback form

The quantitative data of the feedback form are described in supplementary table S2 and presented as means, standard deviations and effect sizes for the go/no-go training and implementation intentions separately.

Table S2. Quantitative feedback on the intervention.

Data are provided separately for the go/no-go training and if-then planning, for each intervention group, and are expressed as means (M), standard deviations (SD) and between-group effect sizes (Cohen’s ds and 95% confidence intervals – CI).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Food-Specific Intervention (N = 18) M (SD)  | General Intervention (N = 16) M (SD)  | Cohen’s ds Effect Size (95% CI) |
| Go/no-go training |
| Understanding Rationale | 71.1 (18.8) | 63.7 (26.9) | 0.33 (-0.36, 0.99) |
| Motivation to Complete | 76.7 (19.4) | 64.4 (28.5) | 0.51 (-0.19, 1.18) |
| Effort  | 55.6 (21.5) | 55.6 (22.2) | 0.00 (-0.67, 0.67) |
| Perceived Benefit  | 50.6 (27.3) | 46.0 (25.0) | 0.17 (-0.50, 0.85) |
| Perceived Worthwhileness  | 66.1 (21.2) | 53.1 (24.7) | 0.57 (-0.13, 1.24) |
| Likelihood of Recommending to Others | 63.9 (25.0) | 51.3 (29.0) | 0.47 (-0.23, 1.14) |
| Implementation intentions (If-then planning) |
| Understanding Rationale | 77.6 (22.2) | 63.3 (22.3) | 0.64 (-0.06, 1.32) |
| Motivation to Complete | 67.2 (22.2) | 61.1 (23.9) | 0.26 (-0.42, 0.94) |
| Effort | 53.3 (21.4) | 57.3 (18.3) | 0.20 (-0.48, 0.87) |
| Perceived Benefit  | 56.7 (28.3) | 47.3 (24.0) | 0.35 (-0.33, 1.03) |
| Perceived Worthwhileness  | 60.0 (26.1) | 54.0 (23.8) | 0.24 (-0.44, 0.91) |
| Likelihood of Recommending to Others | 61.1 (23.0) | 53.6 (29.2) | 0.29 (-0.40, 0.96) |

Focus groups

Ten participants were included in the focus groups, including six participants who had taken part in the food-specific intervention and four participants who had taken part in the general intervention. Intervention-related acceptability, difficulties and suggestions for improvement were evaluated in the focus groups.

* **Acceptability:** included all aspects of the intervention that participants deemed acceptable and helpful. Five of ten participants (three from food-specific and two from general intervention group) mentioned acceptable aspects related to the study (e.g. “*I viewed it as a game with a score I was trying to beat so enjoyed it*”; “*I think that I’m more conscious of the choices I am making and now I reward my self with more caring behaviour*”).
* **Difficulties:** included any aspects of the intervention that were deemed unhelpful and/or problematic in the participant’s experience. Seven of ten participants (four from the food-specific and three from the general intervention group) discussed problematic or unhelpful features of the intervention (e.g. *“I* *personally did not find the mentoring that helpful*”; *“I sometimes found the computerised training a challenge as I didn’t always have easy access to a laptop, and my routine is a bit topsy-turvy”; “I found the mentoring to be a lot of back and forth emails and before I knew it the time was up before I think I fully grasped how it was helpful. I think emails made it morelong winded”).*
* **Intervention development:** included proposals for potential improvements to the intervention in future research. Four of ten participants (all from food-specific intervention group) described how they believed the intervention could be improved (e.g. *“It would have been nice to have a longer term point of contact with the mentor”; “Being able to do the training on your phone would be extremely helpful!”).*

**Supplementary Materials 4: Changes in secondary clinical outcomes**

*Methods*

The following secondary clinical outcomes were assessed:

* Weight*.* This was measured using a digital scale
* Self-regulation of eating behaviour*.* The *Self-Regulation of Eating Behaviour Questionnaire* (SREBQ; Kliemann, Beeken, Wardle, & Johnson, 2016) is a 5-item questionnaire of self-regulatory capacity. In this study, the reliability of the SREBQ was moderate (α = 0.62).
* Food valuation*.* The *Food Rating Test* (Lawrence *et al*., 2015) is a computerized measure that requires rating liking of different food images on a 100mm visual analogue scale ranging from 0-100. Participants rated 27 pictures of foods in a random order, including nine low energy-dense ‘go’ foods from the training task, nine high-energy dense ‘no-go’ foods from the training task, and nine novel foods that were not included in the training.
* Food approach behaviour.The *Adult Eating Behaviour Questionnaire (*AEBQ; Hunot et al., 2016*)* is a 35-item questionnaire that measures two dimensions of eating behaviour: Food Approach and Food Avoidance. The present study has examined the Food Approach Subscale, which includes hunger, food responsiveness, emotional over-eating, and enjoyment of food. In this study, the reliability of the Food Approach Subscale was high (α = 0.82).
* Depressive symptoms*.* The PHQ-9 (Kroenke *et al*., 2001) is a nine-item measure of depressive symptoms over the two weeks prior to completion. Responses are given on a 4-point Likert scale ranging from ‘not at all’ to ‘nearly every day’. In this study, the reliability of the PHQ-9 was high (α = 0.91).
* Anxiety symptoms*.* The GAD-7 (Spitzer *et al*., 2006) is a seven-item measure of anxiety symptoms over the two weeks prior to completion. Responses are given on a four-point Likert scale ranging from ‘not at all’ to ‘nearly every day’. In this study, the reliability of the GAD-7 was high (α = 0.88).

*Results*

Changes in secondary outcomes are shown in Table S3. Overall, the changes in high energy-dense food valuation, self-regulation of eating behaviour, and depression were greater in the food-specific intervention group compared to the general group at four weeks. Participants in the food-specific intervention group had moderate-to-large-sized reductions in high energy-dense food valuation (dz = 0.69, 95% CI [0.27, 1.10]), while those allocated to the general intervention group showed small-moderate size reductions in this outcome (dz = 0.41, 95% CI [0.01, 0.81]). Participants in the food-specific intervention group showed small-to-moderate size improvements in self-regulation of eating behaviour (dz = 0.38, 95% CI [0.00, 0.73]), while the general group showed negligible/no change in this outcome (dz = 0.01, 95% CI [-0.35, 0.38]). Participants in the food-specific intervention group showed small reductions in depression (dz = 0.21, 95% CI [-0.14, 0.56]), while participants in the general group only showed negligible changes in depression (dz = 0.04, 95% CI [0.00, 0.26]). Both groups showed small-to-moderate reductions in food approach (food group: dz = 0.39, 95% CI [0.34, 1.13]; general group: dz = 0.60, 95% CI [-0.34, 1.17]), weight (food group: dz = 0.25, 95% CI [-0.12, 0.61]; general group: dz = 0.17, 95% CI [-0.22, 0.55]), low energy-dense food valuation (food group: dz = 0.03, 95% CI [-0.00, 0.18]; general group: dz = 0.02 95% CI [0.00, 0.12]), and anxiety (food group: dz = 0.03, 95% CI [0.00, 0.17]; general group: dz = 0.11, 95% CI [-0.26, 0.47]).

From baseline to follow-up (eight weeks), the food specific intervention group showed small-to-moderate greater changes in self-regulation of eating behaviour (food group: dz = 0.32, 95% CI [0.00, 0.70]; general group: dz = 0.13, 95% CI [0.00, 0.51]) and depression (food group: dz = 0.70, 95% CI [0.21, 1.17]; general group: dz = 0.38, 95% CI [-0.10, 0.86]). Both groups showed small sized reductions in food approach (food group: dz = 0.35, 95% CI [-0.04, 0.75]; general group: dz = 0.23, 95% CI [-0.17, 0.63]) and anxiety (food group: dz = 0.35, 95% CI [-0.04, 0.75]; general group: dz = 0.24, 95% CI [-0.22, 0.71]).

Table S3. Changes in secondary outcomes from baseline to post-intervention (four weeks) and from baseline to follow-up (eight weeks) in the two study groups. Data is expressed as means (M), standard deviations (SD), mean differences and between-group effect sizes (ds and 95% confidence intervals-CI).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Food-Specific Intervention M (SD)  | General Intervention M (SD) | Mean Difference (95% CI) | Between-group Cohen’s ds ES (95% CI) |
|  | Baseline | Post-Intervention | Difference Score | Baseline | Post-Intervention | Difference Score |
| Weight (Kg)N = 30 | N = 28 | 84.17 (28.54) | 84.17 (28.54) | 0.64 (2.58) | 84.54 (28.96) | 84.10 (28.45) | 0.44 (2.60) | 0.20 (-1.19, 1.59) | 0.08 (-0.44, 0.59) |
| High Energy-Dense Food ValuationN = 28 | N = 26 | 67.48 (13.55) | 58.81 (17.17) | 8.67 (12.53) | 74.24 (14.84) | 69.82 (15.69) | 4.42 (10.77) | 4.25 (-2.15, 10.65) | 0.36 (-0.18, 0.90) |
| Low Energy-Dense Food ValuationN = 28 | N = 26 | 62.78 (17.75) | 63.03 (17.62) | -0.25 (8.88) | 63.41 (11.90) | 63.59 (12.73) | -0.18 (9.94) | -0.07 (-5.21, 5.07) | 0.00 (-0.54, 0.53) |
| Self-Regulation of Eating BehaviourN = 32 | N = 29 | 2.62 (0.65) | 2.83 (0.52) | -0.21(0.57) | 2.67 (0.56) | 2.66 (0.45) | 0.01 (0.54) | -0.22 (-0.50, 0.06) | 0.40 (-0.12, 0.90) |
| Food ApproachN = 32 | N = 29 | 3.82 (0.54) | 3.69 (0.45) | 0.14 (0.35) | 3.74 (0.60) | 3.60 (0.52) | 0.14 (0.24) | -0.00 (-0.16, 0.15) | 0.01 (-0.50, 0.50) |
| DepressionN = 32 | N = 29 | 10.68 (5.85) | 9.53 (6.61) | 1.16 (5.38) | 12.59 (6.27) | 12.76 (6.69) | -0.17 (4.42) | 1.33 (-1.21, 3.87) | 0.27 (-0.24, 0.77) |
| AnxietyN = 32 | N = 29 | 8.94 (5.50) | 9.03 (6.36) | -0.09 (3.66) | 9.69 (6.52) | 9.34 (6.34) | 0.34 (3.24) | -0.44 (-2.22, 1.34) | 0.13 (-0.38, 0.63) |
|  | Baseline | Follow-up | Difference Score | Baseline | Follow-up | Difference Score |  |  |
| Self-Regulation of Eating BehaviourN = 26 | N = 25 | 2.62 (0.68) | 2.82 (0.45) | -0.20 (0.63) | 2.71 (0.58) | 2.79 (0.46) | -0.08 (0.60) | -0.12 (-0.47, 0.23) | 0.19 (-0.36, 0.74) |
| Food ApproachN = 26 | N = 25 | 3.89 (0.49) | 3.70 (0.47) | 0.19 (0.36) | 3.71 (0.60) | 3.50 (0.70) | 0.20 (0.32) | -0.02 (-0.21, 0.17) | 0.05 (-0.52, 0.58) |
| DepressionN = 21 | N = 18 | 12.10 (5.21) | 9.05 (5.21) | 3.05 (4.36) | 11.17 (5.23) | 10.06 (5.55) | 1.11 (2.91) | 1.94 (-0.51, 4.39) | 0.51 (-0.13, 1.14) |
| AnxietyN = 21 | N = 18 | 10.67 (5.23) | 8.86 (5.11) | 1.81 (5.14) | 9.33 (5.86) | 8.61 (5.39) | 0.72 (2.97) | 1.09 (-1.70, 3.88) | 0.26 (-0.38, 0.88) |

**Supplementary Materials 5: Moderator Analysis**

*Methods*

The PROCESS V3.3 SPSS macro Hayes (2012) was used to perform moderated regression analyses and examine whether training effects on binge eating frequency and eating disorder psychopathology were moderated by number of training tasks completed and engagement with if-then planning. The Johnson-Neyman procedure (Johnson & Fay, 1950) was performed to explore the significance level of interactions (intervention group x adherence) across different levels of intervention adherence in cases of moderator significance (p-value) ≤ .1.

*Results*

There was no significant interaction between intervention group and number of trainings predicting binge-eating frequency at four weeks [F (3, 58) = 2.38, p = .079, R2 = .11]. The Johnson-Neyman analysis revealed that the general intervention group had smaller reductions in binge eating frequency than the food-specific intervention group when participants completed fewer than 8 training sessions. There was no significant interaction between intervention group and number of trainings completed in relation to eating psychopathology [F (3, 56) = 1.34, p = .27, R2 = 0.07]. No significant interactions between intervention group and if-then engagement were found for binge-eating frequency [F (3, 58) = 1.61, p = .22, R2 = .07] or eating disorder psychopathology [F (3, 56) = 1.51, p = .22, R2 = .07].