EATING BEHAVIORS AND THE GATING OF FOOD AND NON-FOOD INFORMATION FROM WORKING MEMORY

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ABSTRACT

Prior research has suggested that biased attention towards food cues in the environment may contribute to the onset and maintenance of binge eating. Here, we examine whether individuals who report high levels of binge eating also have difficulty keeping task-irrelevant food-related information out of working memory (WM). To investigate this, we used the *contralateral delay activity* (CDA), a neurophysiological measure reflecting the amount of information held in WM. Experiment 1 confirmed differences in behavioral performance and CDA amplitude when holding one versus two items in WM and between stimulus type (food vs. non-food). Experiment 2 replicated these behavioral findings but not the CDA results. Furthermore, we found no significant differences in filtering efficiency as a function of distractor type (food vs. non-food) or self-reported binge eating frequency, contrary to our hypotheses. Future work could benefit from adopting a behavioral measure of filtering efficiency or examining filtering cost.

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LIST OF ABBREVIATIONS

WM	Working Memory
AN	Anorexia Nervosa
fMRI	Functional Magnetic Resonance Imaging
BN	Bulimia Nervosa
BED	Binge Eating Disorder
EEG	Electroencephalography
ERP	Event-Related Potential
CDA	Contralateral Delay Activity
EOG	Electrooculogram
ICA	Independent Component Analysis
EDDS-V	Eating Disorder Diagnostic Survey for DSM-V
BDI	Beck Depression Inventory
STAI	State-Trait Anxiety Inventory

1. INTRODUCTION

Eating disorders are experienced by approximately thirty million Americans within their lifetime (National Eating Disorder Association, 2022) and are estimated to have an economic cost of $64.7 billion per year (Streatfeild et al., 2021). Individuals with eating disorder pathology experience disrupted eating habits accompanied by disordered cognitive processing. These individuals often also experience distorted body image and have significant health concerns including thinning of bones, multi-organ failure, and tooth decay (National Institute of Mental Health, 2016). In our modern Western society, food cues consistently surround us, from restaurants and stores, to advertisements, magazines, and social media. Although the abundance of food cues is not in itself a problem, increased attention to such cues has been shown to enhance motivation to eat and is associated with several eating disorders (Field et al., 2016).

The current literature on eating disorders and eating-related pathology suggests that an over-attentiveness to food and body-related images is a potential contributor to the onset and maintenance of eating-related pathology (Stojek et al., 2018; Stott et al., 2021). Further, research in healthy adults has shown that attention to environmental stimuli is mediated by holding the sought-after information in working memory (WM), a limited capacity workspace where information that is no longer present in the environment is actively maintained, manipulated, and used to flexibly guide behavior (Desimone & Duncan, 1995; Higgs & Spetter, 2018). Thus, biased attention to food and related stimuli could be promoted by difficulty in keeping such information out of WM. Recent work has shown that food is preferentially represented in WM and that WM-based guidance of attention from food is stronger than guidance from neutral stimuli (Rutters et al., 2015). However, no research to date has looked at whether individuals with significant eating-related pathology have greater difficulty than healthy controls in keeping food-related information out of WM.

In the sections that follow, I will review the literature related to the prevalence of attentional biases towards, or away from, disorder-salient stimuli in individuals with eating disorders. Additionally, I will review research focused on assessing the role of WM in eating-related behaviors and the extent to which disrupted WM functioning is implicated in the patterns of disordered eating observed in eating disorders. This review of the literature will motivate the experiments that follow.

1.1. Literature Review

1.1.1. Attention Bias

Attention bias refers to the tendency, common among individuals with different psychiatric disorders (e.g., anxiety, depression, substance use disorder, etc.), to overfocus on disorder-salient environmental cues (Aspen et al., 2013). For example, individuals with anxiety have been shown to exhibit biased attention towards threat-related (e.g., faces with fearful expressions) versus neutral stimuli (Bradley et al., 1998; Cisler & Koster, 2010), and individuals with substance use disorders tend to overfocus on drug-related stimuli (e.g., cigarettes, alcohol, drug paraphernalia, etc.; Field et al., 2016; Littel et al., 2012). Similarly, a large number of studies have suggested the presence of an attention bias towards food- and body-related stimuli in individuals with elevated eating-related pathology (see review in Stott et al., 2021).

Studies examining attention biases in the domain of eating disorders have used various experimental tasks including modified versions of the Stroop task (Redgrave et al., 2008; Stojek et al., 2018), spatial cuing paradigms such as the dot-probe task (Blechert et al., 2010; Stott et al., 2021), and visual search tasks during active eye-tracking (Giel et al., 2011; Bauer et al.,2017).

The modified food-related Stroop task involves measuring the time it takes participants to name the color of food or weight-related (e.g., pizza, fat, snack, etc.) versus neutral (e.g., scent, post, let, etc.) words. Using this paradigm, Redgrave and colleagues (2008) found that patients with anorexia nervosa (AN) exhibited slower color naming for words denoting both over- and under-weight conditions (e.g., fat, heavy, thin, petite, etc.), suggesting prolonged processing of disorder-salient versus neutral words. Using functional magnetic resonance imaging (fMRI), they also found unique patterns of brain activation between different conditions; in particular between conditions involving thin, but not fat, versus neutral words. However, findings have been more mixed in other eating disorder subtypes. For example, Van den Eynde and colleagues (2013) reported conflicting results in food Stroop studies in patients with bulimia nervosa (BN), with some studies reporting an attention bias towards food-related words in BN versus healthy controls and others finding no difference (Davidson & Wright, 2002). However, results in BN have consistently showed an attentional bias towards body-related words (Davidson & Wright, 2002; Lokken et al., 2006).

Another task that has been widely used to examine attention bias is the dot-probe paradigm (Stott et al., 2021). During the dot-probe task, participants are asked to maintain fixation on a central fixation cross while two images are presented at fixed locations to the left and the right of fixation. Following the onset of the two images, a dot appears on one side of the screen and the participant responds as quickly as possible, indicating which side the probe appeared on. In food versions of the task, stimuli typically consist of either high-calorie (e.g., pizza) or low-calorie (e.g., a bunch of grapes) foods or neutral images (e.g., household items), whereas other studies have used thin/fat body types and weight-related words and images as stimuli. A study by Shafran and colleagues (2007) using this approach revealed that individuals with a diagnosis of binge eating disorder (BED) exhibited faster reaction times when the dot appeared on either high-calorie foods or negative shape/weight stimuli compared to neutral images, suggesting an automatic allocation of attention to these disorder-salient stimuli. Interestingly, results also showed that the BED group had slower reaction times when the probe appeared at the location of positive eating images (such as low caloric foods), suggesting that attention was shifted away from these stimuli. Using a similar paradigm, Blechert and colleagues (2010) revealed that, compared to controls, individuals with AN showed an attention bias towards images of their own versus other participants' bodies. Moreover, the magnitude of this bias was correlated with the participant's self-reported body dissatisfaction. Results also revealed the opposite tendency for individuals with BN, who exhibited an attention bias towards other participants' bodies.

Beyond the Stroop and dot-probe tasks, other studies have adopted methods that afford more direct assessment of the allocation of attention during stimulus viewing. For example, concurrent eye-tracking during stimulus viewing allows researchers to directly measure engagement and disengagement with stimuli during visual search or free viewing tasks, which is not possible with the modified Stroop and dot-probe tasks (Stott et al., 2021). For example, an experiment by Giel and colleagues (2011) used an eye-tracking paradigm to investigate attentional processing in individuals with AN versus two healthy control groups, one who completed the task an hour after a meal and another who completed the task after eight hours of fasting. While their eyes were tracked, participants were instructed to freely view a pair of images, one that featured food and one that featured common household items. Results revealed an attention bias toward food images in the control participants who fasted for eight hours versus one hour, and attentional avoidance of food images in the AN versus control groups. Another study conducted by Bauer and colleagues (2017) investigated attentional allocation in adolescents with eating disorders (restrictive AN, BN, and binge-purge type AN). Results showed that all three eating disorder groups exhibited an attention bias towards self-identified unattractive body areas within images of their own and other peer bodies. In particular, the restrictive AN subgroup spent significantly more time looking at unattractive body parts than did the other eating disorder groups and healthy control participants.

In summary, findings regarding attention bias toward disorder-salient stimuli have been somewhat mixed, particularly for AN and BN samples, with some studies showing an attention bias and others not. A possible exception to this pattern is studies of attention bias to food cues in BED. According to a recent systematic review and meta-analysis by Stojek and colleagues (2018), studies using a range of methods have consistently observed attention biases toward food cues in individuals who engage in elevated levels of binge eating. For example, using a visual search task, Schmidt and colleagues (Schmidt et al., 2016) found that individuals who engage in binge eating exhibited shorter latencies to detect food versus non-food targets compared to weight-matched controls. Additionally, in a free viewing task with concurrent eye-tracking, Popien and colleagues (Popien et al., 2015; see also Kim et al., 2016; Schag et al., 2013) observed that individuals who binge eat fixated earlier and for a longer total duration on high-calorie foods versus neutral images compared to controls (see also, Svaldi et al., 2010 for similar findings using EEG). These findings suggest that people who binge eat exhibit an initial attention bias to food-related stimuli and have difficulty disengaging from these stimuli compared to controls.

1.1.2. Working Memory and Eating Behaviors

Although various studies have highlighted attention biases towards food and other disorder-salient stimuli among individuals with an eating disorder, little is known about the underlying mechanisms that give rise to them. A possible mechanism has been suggested by research in the field of cognitive psychology, where it has been shown that holding an item in WM modulates attention in a top-down fashion (Soto et al., 2006). Specifically, Soto and colleagues showed that holding an item in WM caused attention to be involuntarily drawn towards a matching stimulus presented in a subsequent search display. Critically, this effect was only found in the WM condition, highlighting that this effect is not due to bottom-up priming caused by the mere presentation of the stimulus. In light of these results, it has been hypothesized that attention biases towards food cues may be mediated, in part, by the storage of food-related information in WM, which subsequently guides the allocation of attention towards food-related information in the environment.

To explore this possibility, Higgs and colleagues (2012) looked at whether attention was drawn to food items specifically when that food item was held in WM in a sample of normal weight, healthy adults. Following the appearance of a cue stimulus, which they were instructed to either hold in WM or merely attend to, participants searched for a target item (a circle) placed next to one of the images in a two-item search display. On valid trials, the target circle appeared next to a picture matching the cue, on neutral trials, neither of the images in the search display matched the cue and the target appeared at random next to one of the two images, and on invalid cue trials, the target appeared next to a distractor image instead of the cue-matching image. Results showed that, relative to a condition in which non-food stimuli served as cues, food items held in WM exerted a strong effect on attention on both the valid and invalid cue trials (i.e., when the food cue appeared in the search display). Specifically, response times to detect the target circle were faster if the target was placed next to the cue-matching image (valid trials) and slower if it was placed next to the distractor image (invalid trials), compared to neutral trials. This finding suggests that attention was automatically drawn to the image matching the cue held in WM.

In a subsequent study, Rutters and colleagues (2015) used electroencephalography (EEG) to investigate the neural representation of food versus non-food information in WM using the same task used in the study above (Higgs et al., 2012). EEG is a relatively low-cost, non-invasive procedure that involves recording electrical activity produced by neurons in the brain through electrodes placed on the scalp (Schomer & da Silva, 2018). Critically, EEG possesses high temporal resolution, capturing this neural activity nearly instantaneously. When the EEG record is time-locked to an event of interest (e.g., memory test display), a series of systematic voltage changes (i.e., positive and negative deflections) create a patterned waveform of voltage over time, and this waveform is called the event-related potential (ERP). ERPs capture multiple signals, called ERP components, that can be used to distinguish between distinct neurocognitive processes occurring within milliseconds of one another (Luck, 2014).

Results from Rutters and colleagues (2015), replicated the finding that holding a food cue in WM led to the automatic allocation of attention to a matching stimulus. Results further suggested that ERP measures of attention and WM — specifically the P300(P3), the late positive potential (LPP), and the sustained posterior contralateral negativity (SPCN), also known as the contralateral delay activity (CDA) — were larger when participants were holding food items, versus neutral items, in WM. Taken together, these findings suggest that food is preferentially represented in WM and exerts a greater top-down influence on attention than does non-food information, even in individuals without any type of eating-related pathology. Whether these effects are more pronounced in individuals who either exhibit, or later develop, elevated eating-related pathology has not been investigated, to our knowledge.

Other work has suggested a more direct relationship between WM and eating. For example, a study by Ward and Mann (2000) revealed increased consumption of high-calorie foods during the performance of a high cognitive-load task that consumed limited WM capacity (Ward & Mann, 2000). The authors propose that cognitive load may increase eating by limiting the ability to monitor the dietary consequences of excessive eating. In keeping with this possibility, food intake has been found to increase when attention is drawn away from the act of eating to another activity, such as watching TV (Braude & Stevenson, 2014). Additionally, individuals with higher WM capacity have been shown to satiate faster than those with lower WM capacity, presumably because they are better equipped to monitor their eating (Nelson & Redden, 2017). Findings such as these suggest that WM likely plays an important role in food intake and satiation.

1.1.3. Working Memory and Eating Disorders

Although previous studies have suggested a relationship between WM and eating behaviors, much of the research in eating disordered individuals has focused on assessing general impairments of WM—e.g., increased (Dahlen et al., 2022) or decreased WM capacity (Weider et al., 2015)— in this group, and the results of this research have been somewhat mixed. For example, it has been hypothesized that individuals with restricting-type eating disorders characterized by excessive self-control, such as AN, may have increased WM capacity compared to binge eaters, or otherwise healthy controls. Consistent with this possibility, several studies have revealed higher WM capacity for neutral stimuli (e.g., phonological information) in AN versus controls (see, e.g., Brooks et al., 2012; Dahlén et al., 2022; Israel et al., 2015). However, other studies have shown either worse WM (Weider et al., 2015) or no difference (Fowler et al., 2006) in WM performance between these groups.

Research in other eating disorder domains (e.g., BED and BN) has produced similarly mixed evidence for general WM dysfunction. For example, a study by Duchesne and colleagues (2010) investigated different aspects of executive function, including WM, inhibitory control, and selective attention, within individuals with BED versus healthy controls. To examine WM, they used a digit span task in which participants are presented with a small number of digits (1-9) that they are asked to repeat back to the researcher in order following a brief delay. In another condition, participants were presented with a series of digits and were instructed to repeat them backwards to the researcher. Results showed that BED individuals had a deficit in WM compared to BMI-matched controls specifically when asked to repeat the series backwards. Similarly, a study by Eneva and colleagues (2017) revealed disrupted WM performance in BED vs controls using the NIH Toolbox list-sorting and picture sequence WM tasks. However, other research has shown deficits in some aspects of executive function, such as set-shifting and problem-solving, but not in WM as measured by the N-back task in BED versus overweight controls (Manasse et al., 2015).

The causes of these discrepancies may be due to a number of factors, including heterogeneity of the tasks used to examine WM, differences in diagnosis, age of participants (adolescent versus adult), small sample sizes, and possibly others. However, one important factor may be an overreliance on WM tasks that feature neutral (i.e., digits, neutral words, images, etc.) rather than disorder salient stimuli. As mentioned above, individuals with an eating disorder have a tendency to over-focus on food-related information in the environment (Aspen et al., 2013;

Stojeck et al., 2018), and basic science research has shown that attended stimuli are more likely to gain access to WM (Schmidt et al., 2002). Perhaps not surprisingly, the few studies that have examined WM for disorder-relevant stimuli (e.g., high-caloric foods, bodies, etc.) have revealed enhanced memory for these stimuli and increased interference from task-irrelevant food-related distractors in individuals with eating disorders. For example, Brooks and colleagues (2012) assessed WM for disorder-salient stimuli in individuals with AN. This study used a backward-masking n-back procedure to assess a potential subliminal interference effect of food-related images. Each trial in the task began with the brief presentation of a single image from one of three stimulus groups (food, neutral, or aversive), followed immediately by a pattern mask that rendered the previous image imperceptible. Each pattern mask had a letter superimposed on top of it, and the participants' task was to press a button if the letter was the same as the previous letter or the letter shown two letters back. Results suggested that individuals with AN performed better on the n-back task than healthy controls, but their performance was compromised when food images, but not neutral or aversive images, were presented, despite the fact that they could not consciously reporting seeing these items.

In another study, Svaldi and colleagues (2014) examined cognitive interference from food vs. non-food distractors in BED individuals using a modified n-back task and a recent probe task. For the n-back task, food and neutral words were presented one at a time at a fixed rate and participants were asked to respond if the current word was identical to the word that was presented two items back in the sequence. The task also included lure trials in which the tested word was presented three items back but not two. Results showed an increased rate of interference from food-related, but not neutral, lures on performance in the n-back task. The recent-probe task started with a blank fixation rectangle containing four words (food vs neutral) that they were instructed to memorize. This was followed by a simple filler task and a memory test in which a single test word was presented, and the participant indicated whether it matched or did not match one of the words presented at the beginning of the trial. Results revealed that BED participants exhibited increased proactive interference than vs. controls from high caloric food words presented on previous trials. This finding suggests that eating-related information was involuntarily stored in WM across trials and interfered with performance of the primary task, in keeping with cognitive theories of eating disorders (Vitousek & Hollon, 1990; Vitousek & Orimoto, 1993).

1.1.4. Summary of Studies of Attention Bias and Working Memory

Research reviewed in the previous sections suggests that individuals with an eating disorder or elevated eating-related pathology exhibit an attention bias toward disorder-relevant environmental cues, including food- and body-related information, an effect that is particularly consistent in individuals with BED (see reviews in Aspen et al., 2013; Stojek et al., 2018). Moreover, research in non-eating disorder samples suggests that such biases may be promoted by the storage of food-related information in WM. In keeping with this possibility, research has shown that food-related information is preferentially represented in WM and exerts an outsized influence on attention compared to non-food information. Although these phenomena have not been studied in eating disorder samples, preliminary evidence has suggested that food-related items may be more likely to be involuntarily stored in WM and to interfere with ongoing behavior and cognition in eating disordered versus healthy participants. These findings suggest that future research in this area could benefit from an increased focus on WM for disorder-relevant stimuli, with emphasis on potential difficulties eating disordered individuals may have in keeping this information out of WM.

1.2. The Present Study

The present study focuses on the ability to filter out disorder-salient stimuli from WM. Although this issue has not been examined in relation to eating-disorder pathology, it has been studied in the domain of anxiety disorders. Specifically, Stout and colleagues (Stout et al.,2013; Stout et al., 2015) investigated the ability of individuals high in dispositional anxiety to filter out threat-related information from WM. To get at this, they developed a paradigm that required participants to encode and remember some items and to filter other items out of WM (see modified version of this paradigm in Figure 2). Specifically, this approach requires participants to hold a small number of face stimuli in WM over a brief blank delay, and to indicate whether the faces in a test display presented a short time later are the same as or different than the faces in the original display. Face stimuli consisted of pictures of individuals with either a fearful or neutral expression. Each trial began with a fixation-cross followed by a pair of arrows cuing participants to remember the images on either the left or right side of the display. Next, a memory display with either two or four images was presented, with each image surrounded by either a yellow or a red border. The participants' task was to attend to the items on the cued side of the screen that were surrounded by a particular-colored border (e.g., red) while ignoring a distractor image surrounded by a different colored border (e.g., yellow). Images on the uncued side of the screen were to be ignored in all cases.

To assess filtering ability, they used a well-validated neurophysiological measure of the amount of information held in WM, known as *contralateral delay activity* (CDA; Vogel & Machizawa, 2004). The CDA is a lateralized, negative-going event-related potential (ERP) observed at posterior electrode sites contralateral to the location of a to-be-remembered stimulus. The CDA onsets ~400 ms following stimulus presentation and persists throughout the delay period of WM tasks (typically ~ 1-2 seconds), growing more negative as the number of items held in mind increases (see Figure 3). To get at filtering ability, Stout and colleagues (2013) compared the amplitude of the CDA observed across three conditions in which participants were instructed to remember either one neutral target, one neutral target and one threat target, or one neutral target in the presence of one threat distractor. This design allowed them to compute a filtering efficiency score by calculating the difference in the CDA in the Neutral Target + Fear Target condition, in which two items had to be remembered, versus the Neutral Target + Fear Distractor condition, in which one item needed to be remembered and one item ignored. Identical CDAs between these two conditions would suggest that the participant was unable to filter out the fear distractor; because the CDA in each case would suggest that two items were being stored. Regression analysis was then used to assess the relationship between filtering efficiency scores and self-reported anxiety symptoms. Results revealed that self-reported anxiety was negatively associated with filtering efficiency scores; high anxious individuals had more difficulty than low anxious individuals filtering out threatening distractors. An identical analysis focused on filtering efficiency for neutral distractors revealed no relationship with anxiety. On the basis of these results, they proposed that involuntary storage of threat-related information in WM may be the mechanism underlying the propensity to experience anxious states, even in the absence of threatening stimuli in the immediate environment.

In the present study, we adapted the methods of Stout and colleagues (Stout et al., 2013; Stout et al., 2015) to assess whether individuals with elevated eating-related pathology have difficulty keeping food-related stimuli out of WM (see modified task design in Figure 2). Failure to filter such information out of WM could contribute to attention biases towards similar stimuli in the environment and, in turn, promote increased consummatory behaviors in this population.

To get at this, we ran two different experiments. The first experiment was a pilot experiment aimed at confirming the presence of a difference in the CDA when holding one versus two food- or non-food items in WM. Having confirmed this, Experiment 2 assessed whether individuals with high levels of self-reported eating related pathology have difficulty filtering out food-related, task-irrelevant stimuli from WM.

2. EXPERIMENT 1

As noted above, the goal of Experiment 1 was to assess participants' memory for food- and non-food related information and to confirm that the finding of an increased amplitude CDA as the number of items held in WM is increased from one to two applies to these stimuli. This experiment also allowed us to examine whether food-related information is stored more readily in WM. Specifically, this experiment tested the following hypotheses:

Hypothesis 1: We hypothesized that, for both stimulus conditions, the amplitude of the CDA will be greater in the set-size two versus set-size one conditions.

Hypothesis 2: We further hypothesize that the CDA for food-related stimuli will be greater than for non-food related stimuli held in WM, suggesting enhanced storage for food-related stimuli in WM.

2.1. Methods

2.1.1. Participants

For Experiment 1, we recruited a total of twenty-one participants between the ages of 19 and 30 (mean age of 22.55, 8 females) from North Dakota State University who participated for monetary compensation ($15 per hour). All participants reported normal or corrected to normal visual acuity and the absence of mental illness or neurological conditions known to involve impairments of attention and/or working memory (e.g., schizophrenia, attention-deficit hyperactivity disorder, Parkinson's disease, traumatic brain injury, etc.). Study protocols were approved by the NDSU Institutional Review Board, and all participants provided written informed consent prior to participation.

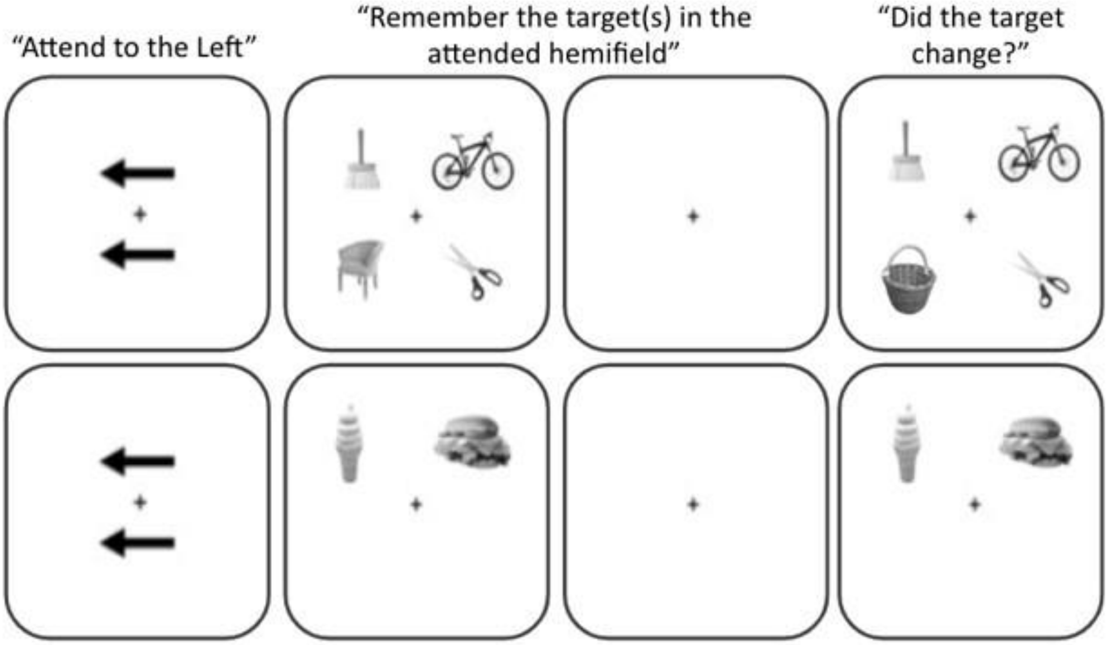
2.1.2. Stimuli and Apparatus

Stimuli consisted of images depicting either high-caloric foods (e.g., bowls of pasta, ice cream cones, pancakes, etc.) or non-food items (e.g., hammers, brushes, bicycles, etc.) selected from the FoodCast Research Image Database (Foroni et al., 2013) and the Food-Pics Extended image database (Blechert et al., 2014; Blechert et al., 2019). There were 18 images in each set (food v. non-food) which were grayscale for the task. On average, each image subtended 2.81° x 2.54° at a viewing distance of 48.5cm, although there were small differences in image size and dimensions across images (e.g., a plate of pancakes versus an ice cream cone). Images were presented at four fixed locations 4.63 degrees up and left, up and right, down and right, or down and left relative to a central fixation cross (a small + sign). On each trial, either one or two food or non-food images were presented bilaterally on each side of the screen. At the start of each trial, participants were cued to attend to a particular side of the screen by two black leftward or rightward facing arrows located above and below fixation. All stimuli were displayed on a computer monitor set against a white background.

2.1.3. Procedures

Participants completed four conditions (180 trials per condition) randomized across 15 blocks (48 trials per block). Each trial began with the appearance of a small fixation cross at the center of the screen for 500 ms, which participants were required to fixate throughout the trial. Directly following, an arrow cue appeared above and below fixation for 500 ms, directing the participant to attend to either the left or the right side of the screen (with equal probability) in preparation for a subsequent stimulus display. Following the arrow cue, the fixation cross remained on the screen for 200-400 ms. Next, a stimulus display composed of either two or four images was presented for 200 ms, with either one or two items appearing at the same location(s) on each side of the screen. The participant's task was to remember the image(s) appearing on the cued side of the screen (i.e., the side of the screen where the arrows were pointing at the beginning of the trial) and to ignore the image(s) on the uncued side.

Figure 1. Task Design and Sample Conditions for Experiment 1



Note: The top panel depicts a condition in which the participant was required to hold the two non-food targets on the left side of the screen in memory over a brief blank delay and to indicate whether one of them has changed to another item at test (rightmost panel). The bottom panel depicts a trial in which a single food target was to be remembered. The experiment included equal numbers of trials at each set size (one versus two items) and for each image type (food vs. non-food). See text for further details.

Images were selected at random from two categories: high calorie foods (e.g., pasta, doughnuts, ice cream, etc.) or neutral, non-food objects (e.g., tools, brushes, bikes, etc.). The stimulus display was followed by a brief, blank delay interval (900 ms), followed by either an identical array of images or an array in which one of the items on the cued side of the screen was changed to a different item from the same image category. Participants then used the computer keyboard to make a change/no-change response, indicating whether the images on the cued side of the screen were the same as those presented at the beginning of the trial, or if one of them had been changed. Thus, the experiment consists of a 2 x 2 design, with factors of Image Type (food, non-food) and Set-Size (one, two). This session was conducted in a single session that lasted about two hours.

2.1.4. Electrophysiological Recording

EEG was recorded from 64 scalp sites using active Ag/AgCl electrodes (BioSemi Active Two) positioned according to the standards of the modified international 10/20 system (American Electroencephalographic Society, 1994) and two additional electrodes positioned over the left and right mastoids. The common mode sense (CMS) electrode was located at site C1, with a driven right leg (DRL) electrode located at site C2. To monitor blinks and eye movements, the electrooculogram (EOG) was recorded from electrodes placed above and below each eye and ~1 cm to the left and right of the external canthi of each eye. EEG and EOG were recorded with a sampling rate of 512 Hz and a band-pass filter of .01-100 Hz.

Data was processed off-line using the EEGLab open-source Matlab-based toolbox (Delorme & Makeig, 2004) and custom written analysis scripts in Matlab (MathWorks, Inc., Natic, MA, USA). All signals were re-referenced offline to the algebraic average of the left and right mastoids, down sampled to 256 Hz. Next, the data was cleaned of large artifacts and an independent components analysis (ICA) approach was used to identify and remove blinks and eye movements from the continuous data. Following ICA, the data was epoched into 1200 msec long segments spanning the time interval 200 msec before to 1000 msec after first image display onset. To ensure artifact free epochs, we first combined EOG signals to derive bipolar vertical and horizontal channels. Additionally, to identify residual eye blinks that were not removed in the previous step and other artifacts (e.g., muscle movements), any trials containing an amplitude larger than 80 mV in the vertical bipolar EOG channel and 120 mV in any other channel within a moving window of 200 msec were excluded prior to analysis. Additionally, to remove trials contaminated by residual eye movements, a step function was used to detect amplitude changes larger than 25 mV in the horizontal bipolar EOG channel. Six participants were removed from further analysis due to the number of total trials rejected having exceeded 30% of total trials.

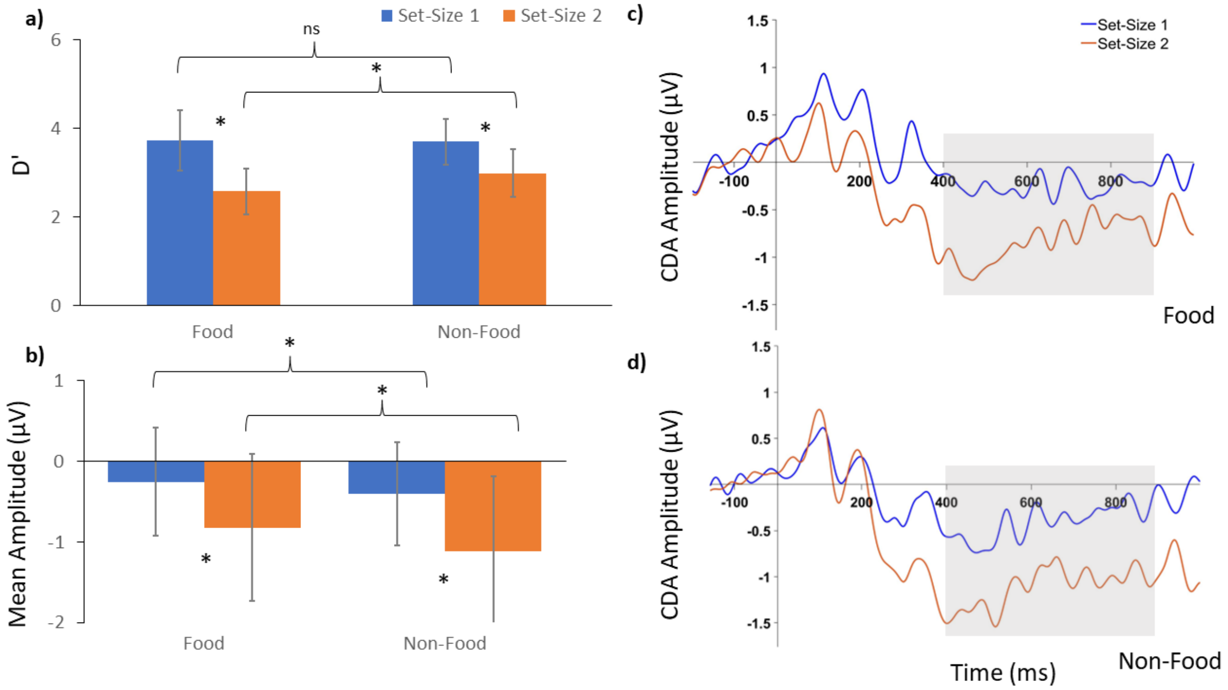
2.2. Results

2.2.1. Behavioral Analysis

To compare behavior across conditions, we computed the signal detection measure d' using the formula, d' = z(Hit Rate) – z(False Alarm Rate), where a Hit is responding “change” when a change actually occurred, a False Alarm is responding “change” when no change occurred, and ‘z’ refers to the z-score of each behavioral measure. We then conducted a two-way, repeated measures ANOVA with factors of Image Type (food, non-food) and Set-Size (one, two) and d' as the dependent measure. As expected, there was a significant main effect of Set-Size [F (1,20) =88.92, p<0.01], with lower d' when two versus one item had to be remembered. There was also a main effect of Image Type [F (1,20) = 4.68, p = 0.04]. Contrary to our expectations, performance was slightly better overall in the non-food versus food condition. Finally, there was also a significant interaction between Image Type and Set-Size [F (1,20) = 5.73, p = 0.03]. Although d' in the set-size one condition was somewhat higher for food than for non-food images, performance declined to a greater degree in the set-size two than set-size one condition for food versus non-food images.

These findings were confirmed by a series of paired samples t-tests, which revealed overall worse performance (lower d') in the set-size two versus set-size one conditions for both food [t (20) = 7.42, $p < 0.05$] and non-food items [t (20) = 6.14, $p < 0.05$]. By contrast, no significant difference was observed between food and non-food images in the set-size one condition [t (20) = 0.41, p = 0.41], but there was a significant difference between these conditions for set-size two [*t* (20) = -4.06, *p* = 0.0003]. Thus, performance was worse in the food versus non-food condition at set-size two, contrary to our prediction of enhanced storage for food-related information in WM.

Figure 2. Behavioral Performance and CDA Amplitudes Across Conditions for Experiment 1.



Note: a) Mean d' and b) Mean CDA amplitude at electrode PO3/PO4 as a function of Set-Size and Image Type across participants. c-d) CDA amplitude as a function of Set-Size at electrode P03/04 for the Food and Non-Food conditions.

2.2.2. CDA Analysis

To compare electrophysiological indices of storage in WM across conditions, we computed contralateral delay activity (CDA; Vogel & Machizawa, 2004; Stout et al., 2013). As discussed above, the CDA is a sustained negativity typically observed at lateral parietal and occipital sensors (e.g., PO3/PO4, PO7/PO8, P3/P4, O1/O2; see Roy & Faubert, 2023) over the hemisphere contralateral to the positions of the items to be remembered (i.e., over the hemisphere opposite to the side of the screen that the participant was cued to attend to at the beginning of the trial). The signal is obtained by deriving a contralateral-ipsilateral difference wave, which involves subtracting one or more contralateral channels to equivalent ipsilateral channel(s) to the attended side. For example, the CDA at electrode sites PO3/PO4 would consist of the difference between the average of all contralateral trials (i.e., attend left trials, at PO4, and attend right trials, at PO3) and all ipsilateral trials (i.e., attend left trials, at PO3, and attend right trials at PO4). The CDA typically onsets ~400 ms following the onset of the stimulus display and persists throughout the delay interval, terminating once the test display appears.

The CDA recorded at electrode PO3/PO4 for the food and non-food image conditions of the present study can be seen in Figure 2 panels b-d. A bar graph showing the mean amplitude of the CDA across conditions from 400-900 ms post-stimulus display at this same electrode set is depicted in Figure 2b. To compare CDA amplitude across conditions, we conducted a three-way repeated measures ANOVA with factors of Image Type (food, non-food), Set-Size (one, two), and Electrode Site (PO7/PO8, PO3/PO4, O1/O2), and mean CDA amplitude over the interval 400-900 ms post-memory display offset as the outcome variable. As noted above, six participants were excluded due to the number of rejected trials exceeding 30% of total trials. Thus, the sample size for these analyses was 15 rather than 21 (7 females). As can be seen, results confirmed the existence of a set-size dependent increase in the CDA for both image types: Set-Size, [F (1,14) = 12.02, $p < 0.01$]. There was also a significant main effect of Image Type, [F (1,14) = 7.66, $p = 0.02$], with a somewhat higher amplitude CDA for non-food versus food images overall. The Electrode Site main effect was also significant, [F (2,28) = 5.59, $p < 0.01$], suggesting that the amplitude of the CDA significantly differed across the three electrode pairs analyzed. The two and three-way interactions were not significant.

In keeping with these results, paired samples t-tests looking at mean CDA amplitude differences across conditions revealed statistically significant differences as a function of set-size at all three electrode sites for both image types (all *t*s > 2.10, all *p*s < 0.05). Specifically, the CDA amplitude at electrodes PO3/PO4 and PO7/PO8 were significantly larger during conditions with a set-size of two compared to conditions with a set-size of one. There was no significant set-size difference in CDA amplitude at electrode O1/O2 for food images ($p > 0.05$).

2.3. Discussion

The results of Experiment 1 support the hypothesis that the amplitude of the CDA will increase when one versus two food or non-food items are actively maintained in WM. Interestingly, and contrary, to Hypothesis 2 and previous results in this area (Rutters et al, 2015), both behavioral performance and the CDA were somewhat greater for non-food versus food images in this study. Why this was the case is not clear. Although we aimed to best match image sets in terms of size, overall complexity, and valence, there could continue to be small differences in image characteristics across the two sets of 18 images. These small differences should not impact our ability to assess WM filtering deficits for food vs. non-food items in Experiment 2.

3. EXPERIMENT 2

Experiment 2 used similar methods to assess the ability to keep task-irrelevant food- and non-food related information out of WM, and the relationship between this ability and the degree to which they engaged in binge eating behavior as measured by the Eating Disorders Diagnostic Survey for the DSM-V (EDDS-V). As in Experiment 1, the CDA was used to measure the amount of information that participants were holding actively in mind on each trial. In addition to the four conditions included in Experiment 1, filtering ability was assessed through the inclusion of three different conditions looking at WM for 1) one food target paired with one non-food target, 2) one non-food target paired with one food distractor, and, finally, 3) one non-food target with one non-food distractor. These three additional conditions made it possible to compare the CDA produced when two items needed to be remembered versus when one item needed to be remembered and one item (either food or non-food) needed to be ignored, as in Stout and colleagues (2013). Using this design, we aimed to test the following specific predictions:

Hypothesis 3: Food-related stimuli will be more difficult to filter out of WM than non-food stimuli. This will be evidenced by a larger CDA amplitude for the food distractor (one non-food target + one food distractor) versus the single non-food target condition. Conversely, we expected CDA amplitude for the non-food distractor (one non-food target + one non-food distractor) condition would not differ from the single non-food target condition.

Hypothesis 4: Individuals with high self-reported rates of binge eating will be less efficient at gating food-related information from WM. This will be evidenced by a negative relationship between self-reported binge eating rates and filtering efficiency scores derived from the food distractor condition (higher binge rates will predict lower filtering efficiency).

Conversely, we expected that binge eating rates will not be predictive of filtering efficiency scores for non-food distractors.

3.1. Methods

3.1.1. Participants

For Experiment 2, we recruited a total of sixty-six participants ranging between the ages of 18 and 35 (mean age of 23.5, 32 female) using the North Dakota State University Research Participant Listserv and the NDSU SONA system. Participant eligibility requirements were consistent with Experiment 1, with the additional requirement that participants have normal color vision. Specifically, all participants reported normal or corrected to normal visual acuity, they were able to provide written informed consent prior to participation, and they were excluded if they have a diagnosed mental illness or neurological condition known to involve impairments of attention and/or working memory (e.g., schizophrenia, attention-deficit hyperactivity disorder, Parkinson's disease, traumatic brain injury, etc.), which was also be self-reported. In addition, participants who reported engaging in food restriction were also excluded from participation. All participants were either monetarily compensated ($15 per hour) or received SONA credits (4 credits per hour) for participation. Assuming a one-tailed alpha of .05, a power analysis suggested that sample size of 55 participants would provide adequate power (.805) to detect a medium effect size (f^2=.15) for the planned analyses. An effect size of this magnitude is equivalent to what was observed in the study of Stout and colleagues (2013) looking at filtering efficiency in dispositionally anxious individuals. Given past findings in this area, we expect that results will reveal an increased tendency of individuals high in binge eating to unnecessarily store food-related information in WM.

3.1.2. Stimuli and Apparatus

The stimuli and apparatus were identical to Experiment 1, with the exception that each item appeared within a blue or red colored rectangular border, as depicted in Figure 3. Rectangular borders subtended 4.57° horizontal visual angle and 3.32° vertical visual angle and were centered at four fixed locations 4.63 degrees up and left, up and right, down and right, or down and left relative to a central fixation cross (a small + sign). Stimuli were presented at the center of each rectangular border (i.e., at the same positions they occupied in Experiment 1).

3.1.3. Self-Report Measures of Eating-Related Pathology

Prior to participation, participants recruited from the NDSU Research Participant listserv received an email inviting them to complete an online version of the Eating Disorders Diagnostic Survey for DSM-V (EDDS-V) administered in Qualtrics. The EDDS-V is a 23-item self-report questionnaire designed to measure anorexia nervosa, bulimia nervosa, and binge-eating disorder symptomatology aligned with the DSM-V diagnostic criteria. The scale is comprised of a combination of Likert ratings, dichotomous scores, behavioral frequency scores, and open-ended questions asking for weight and height. The first three questions assess attitudinal symptoms of anorexia and bulimia within the past 3 months. The next nine items measure the frequency of uncontrollable food consumption engaged in over the last three months. The following four items measure the frequency of compensatory behaviors (purging, laxative use, etc.). The next item measures the frequency of nighttime eating per month over the last three months. Lastly, individuals were asked to report how much their eating or body image impact their personal relationships as well as record their height, weight, highest weight at their current height, and sex. We engaged in targeted recruitment of participants based on their response to item 6 on the EDDS-V, which reads: *How many times per month on average over the past 3 months have you* *eaten an unusually large amount of food and experienced a loss of control?* Participants responded on a scale ranging from 0 to 12 or more times on average per month. Engaging in one or more binge episodes per week on average over the last three months is sufficient to meet criteria for BED. Confirming this “diagnosis,” however would require a more thorough psychological evaluation, which is beyond the scope of the current project.

Further participants were identified from the NDSU Department of Psychology SONA screening, specifically the EDDS-V screener using the same criteria as above, which was completed by all students enrolled in Intro to Psychology (Psych 111) each semester.

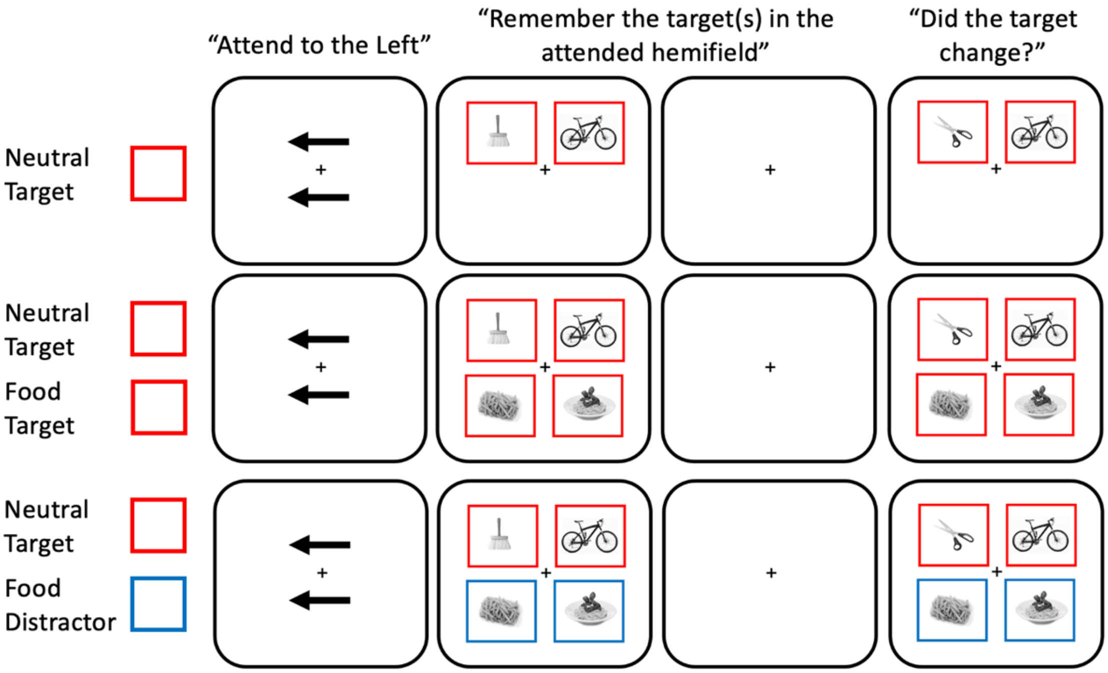
On their study visit, in addition to the EDDS-V, we had participants complete the Beck Depression Inventory (BDI) and the State-Trait Anxiety Inventory (STAI). The BDI is a widely used 21-item self-report questionnaire used to measure symptoms of depression and evaluate the need for additional suicide assessment (Beck et al., 1961). The STAI is a 40-item self-report questionnaire that will be used to measure the presence of dispositional (trait) and momentary (state) anxious states (Spielberger & Sydeman, 1994). Lastly, participants were asked to report their current hunger rating on a scale of 0 -10 and the time of their last meal.

The BDI and STAI, as well as BMI (derived from height and weight), hunger, and time of last meal will be included as covariates in our planned statistical analyses.

3.1.4. Procedure

Participants completed seven conditions (168 trials per condition) randomized across 21 blocks (56 trials per block). Individual trials proceeded in a manner identical to Experiment 1. Briefly, each trial began with the presentation of two arrow cues located above and below fixation cueing the participant to attend to and remember the item(s) appearing on that side of the screen. Next, a memory display appeared with either one or two food or non-food images positioned on each side of the screen. Each item was surrounded by either a blue or a red colored border, which cued the participant to either remember (e.g., if the border was red) or ignore (e.g., if the border was blue) that item. The color of the target and distractor borders was counterbalanced across participants. The memory display was followed by a short, blank delay interval and the appearance of a test display. The participant's memory was tested by having them indicate by button press whether one of the target images had changed to a new image or not.

Figure 3. Task Design and Sample Conditions for Experiment 2.



Note: In addition to the four conditions include in Experiment 1, Experiment 2 included both mixed food and non-food conditions as well as conditions that required one target item to be remembered (red border) and another distractor item to be ignored (blue border). Distractor images could be either foods or non-foods on different trials. See text for further details.

After their response, there was a brief inter-trial interval, followed by the next trial. Thus, this experiment consisted of seven total conditions, as follows: (1) one food target, (2) two food targets, (3) one non-food target, (4) two non-food targets, (5) one food target + one non-food target, (6) one non-food target + one non-food distractor, (7) one non-food target + one food distractor. To balance sensory inputs across visual hemifields, an equal number of items were also presented on the uncued side of the screen on each trial and each of these items were surrounded by a border that matched the corresponding border on the opposite (cued) side of the screen. However, these images were always to be ignored.

This session was conducted in a single ~ three-hour session. Participants were offered breaks at regular intervals (typically every 4-5 minutes), and their general comfort and well-being was monitored by a member of the research team. In total, they completed 1,760 trials.

3.1.5. Electrophysiological Recording

EEG recording, positioning, and processing were identical to Experiment 1.

3.1.6. Analysis Plan

As in Experiment 1, analyses focused on behavioral performance as measured by the signal detection measure, d', and the amplitude of the CDA as a measure of the number of items stored in WM on a given trial. To assess whether WM storage is enhanced for food- versus non-food stimuli we compared CDA amplitude as a function of image type (food vs. non-food) and set-size (one vs. two items) at three different sets of electrodes, as in Experiment 1. To assess filtering ability, we adopted the same approach as Stout and colleagues (2013), using the amplitude of the CDA across different conditions to derive a filtering efficiency score for each participant and distractor type (see also, Jost et al., 2011). Specifically, filtering efficiency for food-related distractors was calculated as the difference in CDA amplitude between trials in which two targets were presented (one non-food target and one food target) and physically identical trials in which a non-food target was paired with a food distractor. To derive a filtering efficiency score for non-food items, we computed the difference between CDA amplitude for trials in which two non-food targets were presented and trials in which one non-food target was paired with a non-food distractor. As noted above, a filtering efficiency score of zero indicates a complete failure of filtering (i.e., equivalent storage-related activity on trials where two targets were to be stored versus trials where one target was to be stored and one distractor to be ignored).

To assess whether filtering efficiency was lower for individuals who reported high levels of binge eating pathology, we performed a series of regressions looking at the relationship between filtering efficiency for food versus non-food distractors and binge eating pathology as measured by the EDDS. This was done separately for electrode pair of interest (P3/P4, PO7/PO8, O1/O2).

3.2. Results

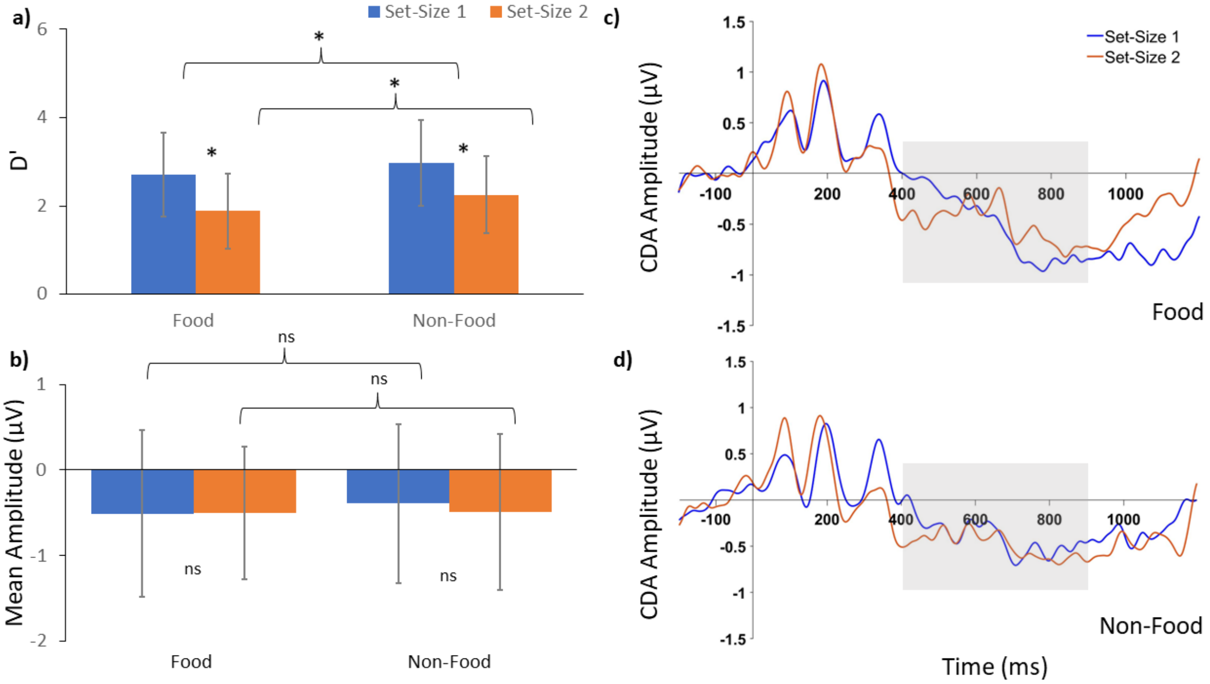
Of the sixty-six participants, nine had incomplete data due to technical issues, six were excluded due to the number of rejected trials exceeding 30% of their total trials, and three participants were removed as outliers having CDA amplitudes and d' scores for multiple conditions falling beyond three standard deviations from the mean. Therefore, for the CDA analysis, the final sample consisted of forty-eight participants (30 females). Data met assumptions for the completed analyses.

3.2.1. Behavioral Analysis

Calculation of signal detection measure d' was identical to Experiment 1. Experiment 2 replicated the primary findings from Experiment 1 for d'. Specifically, a two-way, repeated measures ANOVA found a significant main effect of Set-Size [F (1, 47) = 128.926, $p< 0.01$] and a significant main effect of Image Type [F (1,47) = 54.989, p =0.01]. However, in this larger sample, we did not find a significant interaction between Set-Size and Image Type [F (1,47) = 1.518, p = 0.224].

For both image types, a series of paired samples t-tests revealed that performance was worse overall when two versus one item needed to be remembered: food [t (47) = 10.0, p < 0.01]; non-food [t (47) = 8.97, p < 0.01]. Additionally, performance was worse for food versus non-food images for both set-sizes: SS1 [t (47) = -4.08, p < 0.01]; SS2 [t (47) = -6.10, p < 0.01]. These results indicate that, as observed in Experiment 1, performance was worse when two versus one item needed to be remembered and was worse overall for food stimuli.

Figure 4. Behavioral Performance and CDA Amplitudes Across Conditions for Experiment 2.



Note: a) Mean d' and b) Mean CDA amplitude at electrode PO3/PO4 as a function of Set-Size and Image Type across participants. c-d) CDA amplitude as a function of Set-Size at electrode P03/04 for the Food and Non-Food conditions.

3.2.2. Analysis of Image Type and Set Size Effects on the CDA

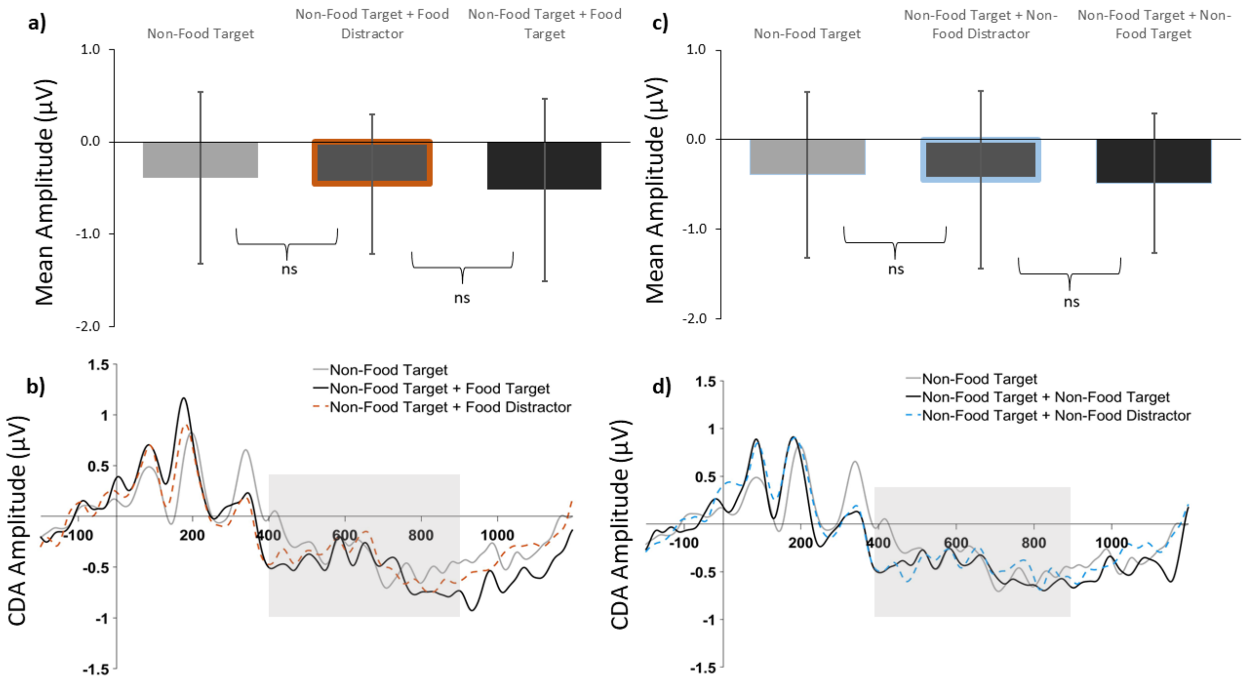
To determine whether CDA amplitude differed as a function of Set Size or Image Type at any of our chosen electrode sets, we conducted an identical three-way repeated measures ANOVA as in Experiment 1. As can be seen in Figure 3, results did not replicate the key findings from Experiment 1. Specifically, there were no significant main effects or interactions, with the exception of a significant two-way interaction between Image Type and Electrode Site [F (2,47) = 4.83, p = 0.01]. Visual inspection of the relevant data suggested that this was driven by a difference between food and non-food stimuli at electrode PO7/PO8. This was confirmed by a paired samples t-test [t (47) = -1.97, p = 0.05].

3.2.3. Analysis of Unnecessary Storage of Food and Non-food Items

To examine whether food distractors gained unnecessary access to WM, we conducted a series of t-tests comparing CDA amplitude between the food distractor condition (one non-food target + one food distractor) and the single non-food target condition and between the food distractor condition and the one non-food target + one food target condition. As can be seen in Figure 4, results revealed no significant differences between any of these conditions (all *p*s >0.05). Similarly, an identical analysis of unnecessary storage of non-food items also revealed no significant differences between conditions (all *p*s > .05).

These findings suggest that the CDA did not differ either as a function of set size or as a function of distractor presence for either image type. This likely reflects the lack of a significant Set Size effect between conditions.

Figure 5. CDA Amplitudes Across Distractor Conditions for Experiment 2.



Note: a-b) Mean CDA amplitude at electrode PO3/PO4 as a function of distractor conditions. c-d) CDA amplitude as a function of distractor conditions at electrode P03/04.

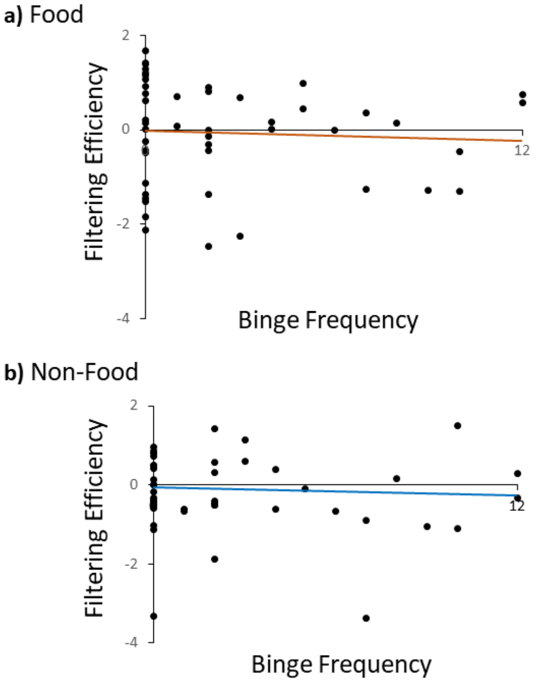
3.2.4. Analysis of Relationship Between Filtering Efficiency and Binge Eating

Although we failed to observe significant unnecessary storage of food distractors at the group level, we proceeded with our planned analysis of the relationship between food filtering efficiency and self-reported binge eating rates. Specifically, we ran a series of six (6) regressions to assess the relationship between binge eating frequency as measured by the EDDS-V and filtering efficiency scores for both food and non-food images at each electrode site. These analyses found no effect of binge eating frequency on filtering efficiency for either food or non-food images at any electrode site (all Rs < 0.02, all *p*s > 0.05).

3.2.5. Exploratory Analysis of the Relationship Between Filtering Efficiency and Other Variables of Interest

Although our specific hypothesis regarding the relationship between binge eating and food filtering efficiency was not born out, we elected to complete a series of exploratory regressions examining the relationship between filtering efficiency and other variables of interest, including BMI, self-reported hunger at the time of the EEG session, and time of last meal, which could conceivably impact the ability to filter out food-related distractors from WM. These analyses revealed a significant relationship between self-reported hunger and food filtering efficiency at electrode site PO3/PO4, [*F* (1,47) = 6.45, $p < 0.02$]. No other analyses were significant.

Figure 6. Scatter Plots Showing the Relationship Between Binge Eating Frequency and Filtering Efficiency



Note: (a) food and (b) non-food images. The relationship was not significant in either case (all Rs < .02)

3.3. Discussion

Analysis of behavioral performance for conditions 1-4 of Experiment 2 revealed an expected decline in performance when two versus one food or non-food item needed to be held in WM—that is, it was harder for participants to hold two things versus one thing actively in mind at the same time. However, this effect was not mirrored in the observed CDA amplitudes, contrary to our expectations based on the results from the corresponding conditions in Experiment 1. We also found no evidence to support our hypothesis that food distractors would be unnecessarily stored in WM. Specifically, the CDA did not differ between either of the two distractor conditions and the relevant one and two target conditions. Nonetheless, a series of regressions were conducted to examine whether, despite the lack of a set-size effect at the group level, there was evidence supporting the hypothesized relationship between binge eating rates and the unnecessary storage of food in WM. Perhaps not surprisingly, these analyses also revealed no significant effects of binge eating frequency on filtering efficiency for either food or non-food stimuli. However, a follow-up exploratory regression analysis did suggest that filtering of food distractors was predicted by self-reported hunger at the time of the session, but not by BMI or time since last meal. Although the significant effect of current hunger on filtering of food is potentially interesting, the results of Experiment 2 largely failed to support our initial hypotheses.

4. GENERAL DISCUSSION

Although Experiment 1 suggested the presence of a prominent CDA effect for food and non-food stimuli, Experiment 2 failed to replicate this effect. The lack of a set size effect in Experiment 2 severely hampered our ability to test the key hypotheses of interest. Future work on this topic could benefit by first confirming the presence of a significant set-size effect in a given group, and then conducting a follow-up study in the same group that includes the distractor conditions used in Experiment 2. Alternately, future research could focus on assessing this hypothesis using a design that does not depend on a significant set size effect. For example, Salahub and Emrich (2022) recently reported a study in which the CDA was used to measure the unnecessary storage of a single either threatening or neutral face distractor that was presented either on the visual midline of the display (i.e., at a position that would not be expected to produce a CDA) versus to the left or right of fixation (i.e. at a location that would produce a CDA). A similar approach could be adopted here.

Another approach that could be adopted to examine our hypotheses of interest (Hypothesis 3 and 4) would be to derive a behavioral, as opposed to electrophysiological, measure of filtering efficiency. A similar analysis could be conducted using the behavioral measures acquired in the present study and used to derive the signal detection measure d’. Specifically, WM capacity (k) can be estimated using the formula Set-Size x [Hit Rate - False Alarm Rate)/(1 - False Alarm Rate)], where Hit Rate and False Alarm rate are calculated identically to the calculation used for d' (Pashler, 1988). Further analyses can then be conducted to determine whether the presence of distractor items degrades the storage of task-relevant targets in WM (see, e.g., Stout et al., 2015). Plans to conduct these analyses are currently underway.

Finally, although it wouldn’t be prudent to make too much out of the findings of our exploratory analyses, the finding that self-reported level of hunger at the time of the session predicted food filtering efficiency was interesting and may be worth following up on. For example, it could be that food-related information is difficult to keep out of WM mainly when an individual is hungry, which would make sense. This finding suggests that it could also be interesting to assess filtering ability in conjunction with other eating related constructs, such as food cravings, which have been associated with an increased likelihood to binge eat in previous work (Schaefer et al., 2023).

5. CONCLUSIONS

Previous research has suggested that individuals with elevated eating-related pathology have a tendency to over-attend to disorder-relevant environmental cues, including food- and body-related information. It has been suggested that such biases may be promoted by the storage of food-related information in WM. In keeping with this possibility, research has shown that food images may be preferentially represented in WM and exert an outsized influence on attention compared to non-food information. Moreover, preliminary evidence has suggested that food-related items may be more likely to be involuntarily stored in WM and to interfere with ongoing behavior and cognition in eating disordered versus healthy participants. The goal of the present study was to assess the ability to store food versus non-food images in WM and to keep these stimuli out of WM when they are not relevant to the task. To do this, we adapted the methods of Stout and colleagues (2013; 2015), developed to study WM gating deficits for threat-related stimuli in dispositionally anxious individuals. Contrary to our expectations, results of the present study did not provide evidence of potential WM gating deficits as a function of binge eating. However, our ability to assess this hypothesis may be by the failure to find a significant set size effect for CDA amplitudes in this experiment. Future work would benefit by conducting the three additional conditions of Experiment 2 in the same group in which prominent set size effects were observed.

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