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No evidence of attentional bias to food words among non-clinical female restrained eaters

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Abstract

Past research has demonstrated mixed findings on attentional biases toward food and body words among non-clinical restrained eaters (Brooks, S., Prince, A., Stahl, D., Campbell, I. C., & Treasure, J. (2011). A systematic review and meta-analysis of cognitive bias to food stimuli in people with disordered eating behavior. *Clinical Psychology Review*, *31*(1), 37–151. doi:https://doi.org/10.1016/j.cpr.2010.09.006; Dobson, K. S., & Dozois, D. J. (2004). Attentional biases in eating disorders: A meta-analytic review of Stroop performance. *Clinical Psychology Review*, *23*(8), 1001−1022. doi:https://doi.org/10.1016/j.cpr.2003.09.004; Francis, J. A., Stewart, S. H., & Hounsell, S. (1997). Dietary restraint and the selective processing of forbidden and nonforbidden food words. *Cognitive Therapy and Research*, *21*(6), 633–646. doi:10.1023/A:1021804207132). Addressing previous methodological issues, this study examined college female restrained eaters' attentional bias to food words. We used 120 college females – 20 were classified as restrained eaters by the Restrained Eating subscale of Dutch Eating Behavior Questionnaire (Van Strien, T., Frijters, J. E., Bergers, G. P., & Defares, P. B. (1986). The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders*, *5*(2), 295–315. doi:https://doi.org/10.1002/1098-108X(198602)5:2<295::AID-EAT2260050209>3.0.CO;2-T). Using a computer-based program called MouseTracker for a Stroop test (Freeman, J. B., & Ambady, N. (2010). MouseTracker: Software for studying real-time mental processing using a computer mouse-tracking method. *Behavior Research Methods*, *42*(1), 226–241. doi:10.3758/BRM.42.1.226), attentional bias indicators of both process (i.e., what happens while attention is captured and directed; Area under the Curve and Maximum Deviation) and outcome (i.e., the end results of attention captured by certain stimuli; Reaction Time and Percentage of Errors) were measured to forbidden (i.e., unhealthy) and unforbidden (i.e., healthy) food words over animal words (i.e., used as control condition). Word stimuli were matched on frequency and syllables between conditions (Francis, J. A., Stewart, S. H., & Hounsell, S. (1997). Dietary restraint and the selective processing of forbidden and nonforbidden food words. *Cognitive Therapy and Research*, *21*(6), 633–646. doi:10.1023/A:1021804207132). No evidence of attentional bias to food words was found among non-clinical restrained eaters. Based on the results in the current study, non-clinical restrained eaters with no accompanying overeating may not show attentional bias to food words. Future studies could compare clinical and non-clinical restrained eaters with and without overeating symptoms on attentional bias to food versus body stimuli.

Keywords Attentional Bias · Emotional Stroop task · Food words · MouseTracker · Restrained eating

Introduction

Restrained eating to lose weight or maintain low weight is highly prevalent in non-clinical populations (Rand & Kuldau, 1990). Subthreshold restrained eating can be a precursor to eating disorders (e.g., Stice et al. 2011). Various negative consequences (e.g., depression, McCarthy, 1990) may arise from restrained eating, even at a subclinical level (Lee & Shafran, 2004).

Restrained eaters and those with eating disorders often share the fear of gaining weight, self-esteem contingent on body thinness, a continued sense of hunger, rebound binge eating/overeating (i.e., binge-purge type anorexia nervosa, bulimia nervosa; American Psychiatric Association, 2013), and cognitive

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preoccupation with body shape and food (e.g., Hollitt et al. 2010). Such cognitive preoccupation may occur early in the perceptual process. Restrained eaters and people with eating disorders may show perceptual sensitivity or attentional bias (Williamson, 1999) to relevant stimuli such as foods for the following reasons. First, foods are potential threats to their goal of restricting eating and thus need to be detected quickly to be avoided. Second, restrained eaters may feel hungry constantly but need to suppress thoughts about foods, which ironically renders thoughts for foods/foods-related schema more readily activated (Williams et al., 1999). This chronically activated food-related schema can lead restrained eaters' attention to be quickly captured by the food stimuli.

Research has shown that people with eating disorders demonstrate attentional bias to food and body stimuli (e.g., Dobson & Dozois, 2004), but findings with non-clinical restrained eaters have been mixed. Some have reported attentional bias to food words with a smaller effect size than in people with eating disorders (e.g., Brooks et al., 2011). Others have reported no such evidence (See Dobson & Dozois, 2004; Johansson et al. 2004). This study examined non-clinical restrained eaters' attentional biases toward food stimuli to clarify the mixed findings.

Present Study

Reasons for mixed findings include the operational definition of restrained eaters and the use of both food- and body-related stimuli. Many previous studies used the Restraint Scale (RS; Polivy et al. 1978) that appears to measure a tendency to overeat in addition to restraining eating, thus, it may actually measure a subclinical bulimic tendency. Other studies used the Restrained Eating subscale of the Dutch Eating Behaviors Questionnaire (DEBQ; van Strien et al., 1986), which measures intention and actual control/restriction of food due to weight concerns. Both RS-defined (e.g., Francis et al., 1997) and DEBQ-defined restrained eaters (e.g., Green & Rogers, 1993) showed longer reaction time to a mixed set of food and body words in a Stroop test. However, it is difficult to compare these results because different studies could be measuring different forms of restrained eating. It is also not clear whether attentional bias occurred to food words, body words, or both, and for which types of restrained eaters. Thus, the current study used the DEBQ restrained eating subscale that is closer to the definition of restrained eating (i.e., not necessarily accompanied by overeating) and only food words.

Another possible reason for mixed findings is potentially differential attentional biases to so called "forbidden foods – those that tend to be high-fat, calorie-dense and perceived as unhealthy (e.g. pie)" versus "non-forbidden foods – those perceived as healthy (e.g., broccoli)" (Francis et al., 1997). Urland and Ito (2005) found that foods viewed as unhealthy caused greater self-reported mixed feelings toward those foods. The only study (Francis et al., 1997) that examined the differences in attentional bias between forbidden and non-forbidden foods found no differences among non-clinical, RS-defined restrained eaters (i.e., accompanied by overeating). To address this issue, the current study compared forbidden and non-forbidden foods among DEBQ-defined restrained eaters.

Further, many previous studies did not match the number of letters and syllables, frequency, familiarity, or valence of words between conditions, which could systematically bias the results (e.g., Black et al. 1997). This study used the list of food and animal words (i.e., control) that had been matched on those dimensions in the English language from a previous study (Francis et al., 1997).

Finally, previous literature has focused mostly on the attentional bias outcomes (i.e., reaction time [RT; the amount of time to complete a problem] and percent correct [PC; the total percentage of questions answered correctly)], overlooking what happens while attention is captured and directed (i.e., the process; Francis et al., 1997). We used MouseTracker to examine both the processes and outcomes of attentional bias. MouseTracker captures dynamic mouse movements as participants choose between responses on the computer screen. Thus, in addition to RT and PC, MouseTracker provides process indicators of maximum deviation (MD; the distance between the idealized trajectory of the mouse movement for choosing the right answer [target stimuli] and the furthest point on the actual response trajectory, indicating overall attraction to the unselected response, Freeman & Ambady, 2010) and the area under the curve (AUC; the total area under a given trajectory and the idealized trajectory, indicating maximum attraction to it). For example, it is possible that restrained eaters show similar response choice reaction time (i.e., outcome) but may show some initial attraction to foods and then correct their response (i.e., process). In summary, this study tested the following hypothesis and exploratory question.

Hypothesis Among restrained eaters, RT (reaction time), PC (percent correct), MD (maximum deviation), and AUC (area under the curve) for food words in general (forbidden and non-forbidden words pooled together) will be higher than those for non-food words. However, among non-restrained eaters, RT, PC, MD, and AUC for food words will not differ from those for non-food words. The result would be demonstrated by a statistical interaction between eater group and word type.

Exploratory Question It is possible that forbidden food stimuli may be more threatening to restrained eaters and thus capture attention more. It is also possible that non-forbidden foods may be equally attention capturing because they are to be approached for weight control purposes. Therefore, we tested whether the RT, PC, MD, and AUC for forbidden versus non-forbidden food words would be different among restrained eaters versus non-restrained eaters.

Methods

Participants

Participants were 120 college females (age $M = 19.51$, $SD = 2.53$, mostly White [67.50%]) enrolled at a Midwestern university, participating voluntarily in the study for research credit. Following the 27% rule (Feldt, 1961, as cited by D'Agostino & Cureton, 1975), those who scored above 3.1 ($n = 48$) on the Restrained Eating subscale of DEBQ (van Strien et al., 1986) were considered restrained eaters, and those who scored below 1.9 ($n = 44$) were considered non-retrained eaters. With this sample size, a post hoc power analysis using G*Power (Faul et al. 2007) indicated power greater than .99 for a medium effect size for the two-way interaction between Eater Group and Word Type.

Stroop Task Materials

Each session was conducted on a standard Windows desktop computer using MouseTracker (Freeman & Ambady, 2010). In each trial, the mouse trajectories were sampled 60–75 times per second. The stimuli included 15 forbidden food words (e.g., pastry), 15 non-forbidden food words (e.g., celery), and 30 animal words that served as controls (e.g., camel). The word stimuli used, including food words and animal words, were taken from Francis et al. (1997) in an attempt to allow for better cross-study comparisons and because these words were matched based on word length and frequency. In that study, the authors chose these food words from studies that examined what foods restrained eaters tend to view as forbidden vs. non-forbidden. In this study, a modified version of the Food Evaluation (Francis et al., 1997) was used to examine how forbidden each food word was perceived by participants to make sure that the food words used in this study were perceived forbidden versus nonforbidden as intended. On this inventory, participants were asked to rate each food presented in the emotional Stroop task on a scale of 1 (dietarily permitted) to 9 (dietarily forbidden) based on the definition that forbidden meant "foods which you avoid in an effort to control body weight" (Francis et al., 1997). To ensure that participants viewed forbidden and nonforbidden words as distinctly different from one another, a paired sample t-test was conducted. The results revealed a significantly higher level of perceived forbiddenness for forbidden food words than unforbidden food words, $t(106) = -26.24$, $p < .001$. The list of the word stimuli along with the length and frequency data are presented in Appendix A in Table 4.

After completing 8 non-word practice trials (four XXXX, four OOOO) in one of four colors (red, yellow, blue, green), participants completed four main blocks of trials where each word was color-balanced by block. Each block contained 60 trials with word orders randomized for 240 total mouse trajectories per participant to be analyzed. In each trial, two colors were presented at each top corner the screen and a word was presented at the center. The task was to choose the color that the word was shown in by moving the mouse to the correct color as quickly and accurately as possible. The original Stroop task requires participants name the color that a word is written in regardless of the meaning of the word written (Williamson et al., 1999). An extension of the original Stroop task, the emotional Stroop task, uses emotionally relevant stimuli in place of color words (Williams et al. 1996). Research on attentional bias in psychopathologies using the emotional Stroop task generally concludes that people are frequently slower to name the color of a word if it was associated with their psychopathology (Williams, et al., 1996). Likewise, in our task, the time taken and errors and hesitance made in choosing the matching color of the food words compared to those with non-food words indicated attentional bias towards food words.

Restrained Eating Measure

The Restrained Eating subscale (10 items) of the DEBQ (van Strien et al., 1986) measured restrained eating on a 5-point scale (1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = very often). Higher scores reflect higher levels of restrained eating. The DEBQ has shown moderate factorial validity with factor loadings that are typically between .65 and .88 (van Strien et al., 1986). The Cronbach's alpha was reported to be .95 (van Strien et al., 1986) and was .92 in this study.

Results

Mean, standard deviations, and correlation coefficients among the outcome variables are presented in Table 1. Because outcome variables were either not correlated or very highly positively correlated, separate ANOVAs for each measure were conducted instead of a MANOVA with the four dependent variables considered together.

A 2 × 2 (Eater Group × Word Type) mixed-factor ANOVA was conducted combining forbidden and nonforbidden food words into a single food words condition on each dependent variable of RT, PC, MD, and AUC, with the between-subjects factor of Eater Group (restrained, non-restrained) and the within-subject factor of Word Type (animal words, food words), to test the hypothesis on the attentional bias towards food stimuli among restrained eaters. Then, another set of 2 × 3 (Eater Group × Word Type) mixed factor ANOVAs was conducted with forbidden and nonforbidden food word conditions separated, to explore whether restrained eaters show attentional bias to forbidden foods vs. nonforbidden foods differentially. We present only the significant effects of each analysis here, but statistics for all ANOVAs can be seen in Tables 2 and 3.

A 2 × 2 (Eater Group × Word Type) mixed factor ANOVA combining forbidden and nonforbidden food words into a single food words condition revealed no interaction effects

Table 1 Mean, standard deviations, and correlation coefficients among outcome variables

	Variables	M	SD	2	3	4	5	6	7	8	9	10	11	12
RT	1 Animal	1005.37	137.03	.97***	.98***	.00	.02	−.00	.06	.06	.06	−.17	.01	−.11
	2 Nonforbidden	1012.61	148.58		.95***	−.03	.03	−.02	.03	.07	.05	−.16	−.01	−.14
	3 Forbidden	1013.60	147.88			.04	.07	.06	.08	.10	.12	−.14	.04	−.11
MD	4 Animal	.40	.18				.93***	.93***	.77***	.70***	.75***	.21*	.35***	.25**
	5 Nonforbidden	.40	.17					.92***	.72***	.76***	.75***	.22*	.30**	.24*
	6 Forbidden	.41	.19						.69***	.66***	.78***	.28**	.30**	.18
AUC	7 Animal	.43	.52							.95***	.95***	.16	.32***	.34***
	8 Nonforbidden	.44	.50								.94***	.17	.25**	.32***
	9 Forbidden	.41	.54									.22*	.27**	.28**
PC	10 Animal	.40	.58										.26**	.14
	11 Nonforbidden	.24	.49											.18*
	12 Forbidden	.24	.49											–

* $p < .05$
** $p < .01$
*** $p < .001$

between Eater Group and Word type for any of the dependent variables (Table 2). Some main effects were found. The Eater Group main effect was significant, $F(1,90) = 6.80$, $p = .011$, $\eta^2 = .07$. Restrained eaters showed longer RTs across all the word conditions than non-restrained eaters. In addition, the Word Type main effect on PC was significant, $F(1,90) = 5.00$, $p = .028$, $\eta^2 = .05$. The percentage of correct answers was significantly higher in the Animal words condition compared to that in the Food words condition.

A 2 × 3 (Eater Group × Word Type) mixed factor ANOVA revealed similar results. No interaction effects between Eater Group and Word Type were significant for any of the dependent variables (Table 3). The Eater Group main effect on RT was again significant, $F\ (1,90) = 6.71$, $p = .011$, $\eta^2 = .07$. Restrained eaters showed longer RT across all the word conditions than non-restrained eaters. In addition, the Word Type main effect on PC was still significant, $F\ (2,89) = 3.92$, $p = .02$, $\eta^2 = .08$. A post-hoc analysis revealed that the percentage of correct answers was significantly higher in the Animal words condition compared to that in the Forbidden Food words condition, $t(91) = 2.80$, $p = .006$.

Discussion

This study aimed to clarify the meaning of previous mixed findings on non-clinical restrained eaters' attentional bias by (a) measuring restrained eating not accompanied by overeating, (b) focusing only on food words (vs. food and body words combined), (c) comparing attentional bias towards forbidden and nonforbidden foods words, (d) using previously established food and animal (i.e., control) words that were matched on frequency and length, and (e) employing MouseTracker to measure both process and outcome of attentional bias.

The hypothesis was that restrained eaters, compared to nonrestrained eaters, would show attentional bias to food words than to animal words that served as control, as indicated by slower RT (reaction time), larger MD (maximum deviation) and AUC (area under the curve), and lower PC (percent correct). It was also explored whether such attentional bias would be larger for forbidden (i.e., so-called unhealthy) foods than for nonforbidden (i.e., healthy) foods. The study hypothesis was not supported. The interaction effects between Eater Group and Word Type, whether food words were combined or not, were not significant. No attentional bias was observed in outcomes (i.e., RT, PC) or processes (i.e., AUC, MD) among restrained eaters, either for forbidden or nonforbidden food words. In short, our study found that, among non-clinical restrained eaters with no accompanying overeating, attention was not captured nor directed towards food-related words more strongly than towards animal words.

This finding appears to clarify some previous mixed findings. Some studies have suggested an attentional bias to food words among non-clinical restrained eaters (Cooper &

Table 2 Means, standard deviations, and 2 × 2 mixed ANOVA statistics for study variables with forbidden vs. non-fordbidden foods combined

Variables		Restrained eaters (n = 48)		Non-restrained Eaters (n = 44)		ANOVA			
		M	SD	M	SD	Effect	*F* ratio	*df*	η^2
RT	Animal	1039.02	147.14	956.81	151.73	Eater	6.80*	1,90	.07
	Foods	1045.36	153.27	963.03	163.58	Word	2.52	1,90	.03
						Eater x Word	.10	1,90	.00
MD	Animal	.40	.18	.40	.18	Eater	.06	1,90	.00
	Foods	.40	.18	.39	.19	Word	.50	1,90	.00
						Eater x Word	1.07	1,90	.01
AUC	Animal	1.04	.67	1.02	.56	Eater	.23	1,90	.00
	Foods	1.07	.27	.98	.35	Word	.15	1,90	.00
						Eater x Word	2.54	1,90	.03
PC	Animal	.46	.77	.55	.82	Eater	.59	1,90	.01
	Foods	.27	.44	.35	.58	Word	5.00*	1,90	.05
						Eater x Word	.00	1,90	.00

Animal Animal Words, *Foods* Food Words, *RT* Reaction Time, *MD* Maximum Deviation, *AUC* Area Under the Curve, *PC* Percent Correct

* $p < .05$

Fairburn, 1992; Francis et al., 1997), but these studies used RS to classify participants (i.e., restrained eating accompanied by overeating). Given that we did not find attentional bias to foods among DEBQ-defined retrained eaters (i.e., restrained eating not accompanied by overeating), it is possible that non-clinical restrained eaters have an attentional bias to foods only when they also exhibit the tendency to subsequently overeat (i.e., subthreshold bulimic tendency).

This lack of attentional bias towards foods was observed not only in the outcome measures of attentional bias that are more commonly used, but also in the process measures. In other words, restrained eaters did not demonstrate any different attentional process towards foods- versus animal-words. For example, there was no indication that their attentional was captured initially towards foods but quickly compensated (i.e., as indicated by larger MD or AUC) to complete the task. Also, although forbidden food words could be potentially more threatening in terms of weight gain potential, attentional bias was not observed even towards forbidden foods.

Then, it is reasonable to conclude that non-clinical restrained eaters with no accompanying overeating do not show attentional bias to food stimuli. Considering the previous studies, it also is

Table 3 Means, standard deviations, and 2 × 3 mixed ANOVA statistics for study variables with forbidden vs. non-fordbidden foods separate

	Variables	Restrained Eaters (n = 48)		Non-restrained Eaters (n = 44)		ANOVA			
		M	SD	M	SD	Effect	*F* ratio	*df*	η^2
RT	Animal	1039.02	147.14	956.81	151.73	Eater	6.71*	1,90	.07
	Nonforbidden	1045.38	156.02	955.80	163.21	Word	1.83	2,89	.04
	Forbidden	1045.35	153.86	966.25	166.90	Eater x Word	.68	2,89	.02
MD	Animal	.40	.18	.40	.18	Eater	.08	1,90	.00
	Nonforbidden	.40	.17	.38	.19	Word	2.44	2,89	.05
	Forbidden	.41	.20	.40	.20	Eater x Word	.53	2,89	.01
AUC	Animal	1.04	.67	1.02	.56	Eater	.32	1,90	.00
	Nonforbidden	1.04	.63	.96	.57	Word	1.46	2,89	.03
	Forbidden	1.10	.70	.99	.59	Eater x Word	1.38	2,89	.03
PC	Animal	.46	.77	.55	.82	Eater	.68	1,90	.01
	Nonforbidden	.35	.70	.41	.87	Word	3.92*	2,89	.08
	Forbidden	.19	.45	.30	.67	Eater x Word	.04	2,89	.00

Animal Animal Words, *Forbidden* Forbidden Food Words, *Unforbidden* Unforbidden Food Words, *RT* Reaction Time, *MD* Maximum Deviation, *AUC* Area Under the Curve, *PC* Percent Correct

* $p < .05$

reasonable to speculate that they may show attentional bias to body stimuli. A meta-analysis (Dobson & Dozois, 2004) found that participants with bulimia nervosa had attentional biases for a range of stimuli including body/weight and food, but that participants with anorexia nervosa only displayed biases to body/weight stimuli. Although these previous studies did not differentiate between restricting versus binge-purge type anorexia nervosa in their samples, it is possible that restrained eaters with no accompanying overeating/binge eating symptoms, either at clinical or non-clinical level, show attentional bias not to food- but to body-related stimuli because they may be more preoccupied with thinness than eating. On the other hand, restrained eaters with accompanying overeating/binge eating symptoms (i.e., clinical or non-clinical bulimic tendency) may show attentional bias to both food and body words due to their cognitive preoccupation with foods related to underregulated eating and their preoccupation with thinness, respectively. These speculations should be tested by comparing attentional bias to food versus body words among clinical and non-clinical restrained eaters with and without accompanying overeating/binge eating.

Another possibility is that attentional bias to foods may not be present for all restrained eaters but may be a potential moderator that can predict the future development of full-blown eating disorder among current non-clinical restrained eaters. In other words, a non-clinical restrained eater may be more likely to develop clinical level of disordered eating if and when she shows perceptual sensitivity to food-related stimuli. In fact, a longitudinal study demonstrated that dieters who later developed an eating disorder had more disturbed eating habits and attitudes than their peers (Fairburn et al., 2005), demonstrating distinctive characteristics of eating in secret, a fear of losing control over eating, and preoccupation with food/eating and shape/weight. The preoccupation with foods at the early perceptual process (i.e., attentional bias) may be another marker for developing eating disorders. This speculation is also supported by the previous findings on attentional bias to food words among the clinical sample with bulimia nervosa (Dobson & Dozois, 2004). The potential benefits of preventive efforts for reducing attentional bias to foods need to be tested in future studies.

Two unexpected main effects were found. Restrained eaters showed longer reaction times overall, and participants made more errors in forbidden food words condition compared to animal words condition. Possibly, a third variable associated with restrained eating tendency, such as perfectionism (e.g., McLaren et al. 2001) may have led restrained eaters to be more cautious and take more time in providing their responses in the Stroop task. However, it is not entirely clear why these main effects were observed, warranting future replication efforts.

Strengths and Limitations

This study has some limitations. First, many food items have an inherent color association (e.g., green broccoli), which may have confounded the Stroop process. Second, this study used animal words as control words. The word stimuli used were taken from Francis et al. (1997) to allow for better cross-study comparisons and because the words were matched based on word length and frequency. Nevertheless, it is important to acknowledge that the animal words, which served as the control words, may have contributed to differences across participants and may not be neutral compared to food words. Perhaps certain participants were vast animal lovers and thus had schema dedicated toward animals which would theoretically affect their responses to the "neutral" words. This effect was not strong enough to be picked up in any of the analyses. Nevertheless, it is important to consider the neutrality of these words. Future studies should use a stronger control group such as those with forbidden and non-forbidden items that were not food-related. Third, it is possible that 'forbidden' and 'non-forbidden' food may have differed on other dimensions than 'forbiddenness', which warrants consideration in future studies. Fourth, with MouseTracker, it was necessary to map two responses to each of the two buttons at the top left and right corners. It is possible that participants may have had difficulty choosing a response with each button connected to two responses. Further, this study did not control for the various configurations that could have been used for the response button mappings (e.g., "BLUE – GREEN" versus "BLUE – RED" or "GREEN – BLUE") and followed Markis's (2015) response button layout of "BLUE – GREEN" (left) and "RED – YELLOW" (right) for all trials. Notably, previous research which has utilized different button configurations did not report any differences (Yamamoto et al. 2016). Despite these limitations, however, this study clarified the meaning of the previous mixed findings on attentional bias among restrained eaters by addressing previous conceptual (i.e., who are restrained eaters) and methodological (i.e., food words only, word length matching) issues, thereby suggesting future research directions for attentional bias in the context of disordered eating.

Conclusion

This study demonstrated that non-clinical restrained eaters who do not engage in compensatory binge eating did not show attentional bias to food-related words, whether they are forbidden or non-forbidden food words. Future studies could examine whether they show attentional bias to body-related words, and if the current finding holds for clinical level of restrained eaters.

Compliance with Ethical Standards

Conflict of Interest All the authors declare that they have no conflicts of interest. The study was approved by Illinois State University IRB and conducted in accord with ethical principles.

Appendix

Table 4 Matched food and neutral words

Forbidden foods	Frequency	Word length	Control words	Frequency	Word length
Icing	1	5	Camel	1	5
Pastry	4	6	Ponies	6	6
Chips	3	5	Geese	3	5
Cake	13	4	Deer	13	4
Candies	2	7	Peacock	2	7
Pizza	3	5	Mules	3	5
Bacon	10	5	Mouse	10	5
Pie	14	3	Hen	22	3
Chocolate	9	9	Elephants	10	9
Sugar	34	5	Bears	1	5
Butter	27	6	Snakes	26	6
Cream	20	5	Sheep	23	5
Cookie	1	6	Coyote	1	6
Cereal	17	6	Insect	14	6
Puddings	1	8	Crocodile	1	9
Mean (*SD*)	10.60 (10.27)	5.67 (1.50)		9.07 (8.80)	5.73 (1.62)
Non forbidden foods	Frequency	Word length	Control words	Frequency	Word length
Celery	4	6	Falcon	4	6
Carrots	4	7	Dolphins	4	8
Asparagus	1	9	Anteater	1	8
Tomatoes	3	8	Cricket	3	7
Mushroom	2	8	Armadillo	2	9
Cantaloupe	1	10	Butterfly	2	9
Rice	33	4	Bird	31	4
Onions	4	6	Wolves	4	6
Salad	9	5	Seals	4	5
Broccoli	1	8	Squirrel	1	8
Peas	24	4	Cat	23	3
Egg	12	3	Hawk	14	4
Soup	16	4	Cows	16	4
Cherry	6	6	Chicks	1	6
Potato	15	6	Buffalo	16	7
Mean (*SD*)	9.00 (9.47)	6.27 (2.05)		8.40 (9.35)	6.27 (1.62)

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