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Cognitive Restructuring vs. Defusion: Impact on craving, healthy and unhealthy food intake

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ABSTRACT

Coping with food cravings is crucial for weight management. Individuals tend to use avoidance strategies to resist food cravings and prevent overeating, but such strategies may not result in the benefits sought. This study compared the effects of two cognitive techniques (Restructuring vs. Defusion) for dealing with food cravings in terms of their impact on healthy vs. unhealthy eating behavior (i.e., consumption of chocolate and/or carrots following the intervention). Sixty-five participants (M_{age} = 19.65 years) received either a 30-minute face-to-face instruction on cognitive restructuring (CR) or cognitive defusion (CD) along with 15 min of practice, or 45 min of obesity education and discussion (control). To examine craving and eating choices following the intervention, participants received bags of chocolate and carrots and were asked to carry these with them at all times over the next week, exchanging the bags every 2 days. Participants in the CD group ate fewer chocolates (M = 11.74) compared to CR (M = 17.06) and Control groups (M = 29.18) during the experimental week. The groups did not differ in number of carrot pieces eaten, though the CD group ate more carrots than chocolates. CD resulted in fewer self-reported cravings compared to CR and CO groups. At a final taste test, both CD and CR groups ate significantly fewer chocolates compared to the CO group. CD appears to be an effective technique in managing food craving and to present some advantages over CR.

Food cravings (FCs) are intense desires for specific or types of food (Hill, 2007; Kemps & Tiggemann, 2010) arising from physiological or psychological states (Moreno, Rodríguez, Fernandez, Tamez, & Cepeda-Benito, 2008). Cravings are multifaceted phenomena varying in underlying motivational origins (e.g., cognitive and affective vs. environmentally cue-induced; Moreno et al., 2008). FCs are common and are not by their nature problematic, pathological, or distressing (Fahrenkamp, Darling, Ruzicka, & Sato, 2019). They are reported by 58%–97% of a general population (Gendall, Joyce, & Sullivan, 1997), with prevalence reaching 98% in college women and 68% in men (Weingarten & Elston, 1991). Generally, FCs occur 2–4 times-per-week (Hill, 2007).

Despite their prevalence, FCs are often experienced as maladaptive or unwanted (Hill, 2007), partly due to the difficulty involved in resisting them (Weingarten & Elston, 1990). FCs reportedly lead to desired or similar food consumption in 80–85% of adults (Weingarten & Elston, 1991). And for most, desired food intake involves consumption of elevated sugar, fat and salt (Schumacher, Kemps, & Tiggemann, 2017). For example, chocolate is the most frequently craved food in Westernized cultures (Schumacher et al., 2017).

Struggling with FCs could become chronic. High craving levels are associated with problematic eating behaviors (Boswell & Kober, 2016), increased caloric intake (Chao, Grilo, White, & Sinha, 2014), increased BMI (White, Whisenhunt, Williamson, Greenway, & Netemeyer, 2002), and food addiction (Joyner, Gearhardt, & White, 2015). Difficult-to-resist food desires can undermine weight management, often preceding uncontrolled eating, binges, overeating, obesity (Baranowski, Cerin, & Baranowski, 2009; Forman et al., 2007; Lowe & Levine, 2005), and increasing risk for binge eating disorder or bulimia (Nijs, Franken, & Muris, 2007).

A common strategy used to resist FCs is food and caloric restraint. However, long-term restraint leads to increased binges, high caloric intake, and eating-related problems (Herman & Polivy, 1988). Strategies used to suppress strong FCs tend to be cognitive (e.g., thought

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suppression, distraction) and they warrant closer examination.

Cognitive-Behavioral Therapy (CBT; e.g., CBT Weight Management, Fairburn, Wilson, & Schleimer, 1993) is widely utilized and effective for eating problems (NICE, 2004). A major CBT component is cognitive restructuring (CR), where unhelpful thoughts (e.g., "I need a chocolate") that lead to unwanted behavior (e.g., overeating) are identified and replaced with more adaptive thought patterns (Hofmann & Asmundson, 2008). Despite CBT's effectiveness, there is limited empirical support of its success in dealing with FCs (Juarascio, Forman, & Herbert, 2010). Further, CR, in particular, may be an inappropriate technique for addressing cravings.

The effectiveness of CR alone (without the full CBT package) for craving or negative thoughts has not been directly examined (Juarascio et al., 2010). It is thus unclear what components account for CBTs' effectiveness. Boutelle and Bouton (2015) suggest an important role for inhibitory learning and emphasize extinction as a central component in managing FCs. For example, cue exposure reduces maladaptive responses to FCs without including CR (Jansen, Schyns, Bongers, & van den Akker, 2016; Van den Akker, Schyns, & Jansen, 2016). Longmore and Worrell (2007) review, concludes that cognitive interventions (i.e., CR) do not provide added benefit to behavioral ones. Indeed, CR is criticized for overemphasizing "control" at the risk of teaching suppression and experiential avoidance (Eifert & Forsyth, 2005; Karekla, 2004).

An alternative cognitive strategy is Cognitive Defusion (CD), developed as part of Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 2011). CD involves observing inner events like cognitions without them controlling behavior (Gillanders, Sinclair, MacLean, & Jardine, 2015; Karekla, Karademas, & Gloster, 2018). For example, using a phrase like "I am having the thought that…. I need chocolate," may foster relating to the thought as an experience rather than a fact (Harris, 2009). This introduces "distance" that allows for behavior to come under the control of important aspects of context (e.g., eating or not eating chocolate in accordance with factors independent of craving); therefore, the targeted mechanism of action is a change in the thoughts' functions rather than their contents (as in CR).

Forman et al. (2007) compared CD to CR in response to chocolate cravings and found CD (vs. CR) to lower chocolate consumption. CD was most effective among participants most susceptible to cravings (i.e., those who reported high levels of food sensitivity). However, they did not directly compare CR to CD, as additional treatment components were included in their interventions. Other studies investigating CD for FCs found that CD led to significantly fewer chocolates eaten compared to cognitive suppression (Hooper, Sandoz, Ashton, Clarke, & McHugh, 2012), distraction (Hulbert-Williams et al., 2019), and mindful acceptance or relaxation (Jenkins & Tapper, 2014). Only one study directly compared CR to CD for decreasing craving-consistent eating behaviors and found CD participants resisted consuming chocolates 3 times more than CR participants (Moffitt, Brinkworth, Noakes, & Mohr, 2012).

While there is growing support for CD's effectiveness in decreasing unhealthy eating, its role in promoting healthy eating behaviors remains unclear. CD is proposed to make available cognitive resources needed for more adaptive responses (Moffitt et al., 2012). As cravings seem to be, at least partly, conditioned responses to antecedent hunger (Gibson & Desmond, 1999; Gilhooly et al., 2007; Steel, Kemps, & Tiggemann, 2006), eating healthy snacks would be an adaptive response. In this way, CD could not only reduce probability of eating the craved "unhealthy" food, but also increase eating alternative healthier foods (e.g., fruits and vegetables).

This investigation extends Moffitt et al.'s (2012) study and examines the potential effect of CD vs. CR on craving, chocolate consumption, and healthy food intake during a weeklong experimental period and follow-up taste-test. CD was hypothesized to be more effective than CR and control groups in decreasing cravings and chocolate consumption and increasing alternative healthy food choices.

1. Methods

1.1. Participants

A-priori power analysis (G*Power software; Faul, Erdfelder, Lang, & Buchner, 2007) suggested a minimum N-of-48 for detecting a medium effect size $f^2 = .20$. Calls were sent via psychology professors providing course credit for participation. Sixty-five University of Cyprus undergraduates ($M_{age} = 19.65$ years, Range: 18 to 25 years) were randomly assigned based on a list of random numbers (random.org) to one of three groups: CD ($N = 24$), CR ($N = 24$) or Control (CO; $N = 17$). Fifty-eight were female and seven males (CD = 1, CR = 4, CO = 2). Most were single (90.80%); either lived with their parents (76.90%), friends or alone (13.90%); Greek-Cypriots (87.69%) or Greeks (12.3%). None were on a diet to lose weight or undergoing treatment for eating related problems (exclusion criterion).

1.2. Measures

For any measure not validated in Greek, standard forward and backward translation procedures were employed.

Demographic information included dieting and eating behaviors history and current or previous weight loss attempts.

Control questions (developed by the authors) examined average typical chocolate and separately vegetable (carrot & cucumber) intake and assessed on a Likert-type scale how much participants: (a) like chocolate (especially specific types included in the study), carrots, and cucumbers (1 = not at all to 10 = very much), (b) have self-control over chocolate intake (1 = no restraint to 9 = complete restraint), and (c) force themselves to eat vegetables such as carrots or cucumbers (1 = no force to 9 = greatly force myself).

Power of Food Scale (PFS; Lowe et al., 2009) assesses (21-items) psychological influence of the food environment. The authors report good psychometrics: high internal consistency and temporal stability (4-month test-retest, $r = .77$), convergent validity (moderate correlations with Three-factor Eating and the Dutch Eating Behavior Questionnaires), and Cronbach's $\alpha = .91$. This study's Cronbach's alpha = .85.

Food Craving Questionnaire-State (FCQ-S; Cepeda-Benito, Gleaves, Williams, & Erath, 2000) assesses state-dependent cravings to consume chocolates (15-items) rated on a scale (1 = strongly disagree to 5 = strongly agree). It demonstrates excellent internal consistency ($\alpha = .88$–.94; Cepeda-Benito et al., 2000), construct validity with scale stability across time (Vander Wal, Johnston, & Dhurandhar, 2007), and convergent validity (significant correlations with chocolate consumption frequency and Attitudes to Chocolate Questionnaire; Meule & Hormes, 2015). This study's' Cronbach's alpha = .92.

Food Cravings Questionnaire-Trait (FCQ-T) assesses (39 items) typical chocolate craving patterns with grouped into 9 subscales and rated according to how true each described pattern is of them (1 = never-6 = always). The FCQ-T demonstrates excellent internal consistency ($\alpha = .94$), 3-week test-retest stability of .88 (Vander Wal et al., 2007), and convergent validity with medium to high bivariate correlations with measures of similar constructs (Cepeda-Benito, Fernandez, & Moreno, 2003). Cronbach's alpha = .93 for this sample.

Self-Efficacy (adapted from Moffitt et al., 2012) is assessed via one-question (scale: 1 = not-at-all to 5 = very confident): "How confident are you in your ability to manage your eating behaviors?" This scale was previously used in similar studies and single-item measures of domain-specific self-efficacy have demonstrated convergent, discriminative, and predictive validity and utility (Hoeppner, Kelly, Urbanoski, & Slaymaker, 2011).

Daily diary of cravings and eating report. Created for this study,

participants completed a daily (during the 7-day experimental week) electronic self-report diary assessing how many times per day they (i) experienced cravings for chocolate (0 times, 1–2, 3–5, or 6-or-more times), (ii) ate chocolate (0 to 6 portions), and (iii) ate other substitute food or sweets (0 to 6 portions).

1.3. Procedure

Following ethics approval (Cyprus National Bioethics Committee) undergraduate psychology participants consented and completed study questionnaires. Study purpose was described as comparing different strategies for resisting craved foods (nothing was mentioned about eating a healthy alternative). Participants were randomly assigned either to 30-min instruction plus 15 min of practice in CR or CD, or to Control (45-min obesity psychoeducation and discussion about responses to chocolate and cravings). Group intervention sessions were led by three doctoral clinical psychology trainees, one for each condition (each with training and allegiance thereto).

1. The **Cognitive restructuring** intervention (adapted from Beck, 1976; Ellis, 2003; Moffitt et al., 2012), began with defining CR and explaining strategies (e.g., automatic-unhelpful thoughts identification, over-evaluation of negative consequences, unreasonable thought challenge, and replacement with realistic alternatives). Then, participants applied a CR strategy to a personal food related thought using a thought-record sheet. The core message was to resist the temptation of doing what thoughts demand by actively challenging, disputing, and replacing them with more helpful thoughts so as to act differently (i.e., not give into the craving).
2. The **Cognitive defusion** intervention (adapted from Forman et al., 2007; Hayes et al., 2011; Lillis, Hayes, Bunting, & Masuda, 2009; Moffit et al., 2012) began with defining CD and explaining strategies (e.g., look at the thoughts and not from the thoughts, observe your thoughts and don't get "hooked" by them, create space and let the thoughts come and go of their own accord, and separate thoughts from actions). A defusion strategy was practiced ("Leaves on a Steam," Hayes et al., 2011) to a personal food related thought and a practice-sheet provided. The core message was to resist acting on what the thoughts demand by distancing ourselves from these thoughts, observing, creating space for them to exist, and instead choosing an adaptive response to the situation.
3. **Experimental week**. Participants were provided with bags of 30 chocolates (i.e., small, round chocolates called "Galaxy Minstrels," popular in Europe similar to, and slightly larger in size than M&Ms) and 30 carrot pieces (cut in the same size and shape as the chocolates). They carried these for 1 week and ate as they pleased. Participants in the CD and CR groups were encouraged to use techniques instructed to deal with chocolate cravings whereas control participants were given no specific instructions. They returned to the lab every 2 days to exchange bags with new ones. Uneaten chocolates and carrots were counted after participants departed. Each day, participants were asked via email reminders to complete their electronic diary.

At week's end, participants returned to the lab for a taste test. Thirty pieces of "Twix" chocolates (different type and shape) and 30 pieces of cucumber (different type of vegetable, cut in the same size as the chocolates) were placed in two bowls on a table in the experiment room. Participants were told the purpose was to describe taste differences following the experiment, and they could eat as many chocolate and cucumber pieces they wanted in order to describe their taste. Participants were left alone for 5 min for this task. Then, they wrote on a piece of blank paper how the two types of food tasted and completed post-test questionnaires. Number of consumed chocolates and cucumbers was recorded after participants' departure.

1.4. Data analysis

Primary analyses were executed in five steps using SPSS 22.0. To ensure missing data were not systematic, a Little's MCAR test was run for all data (except the diary data). This was non-significant, suggesting that missing data pattern was independent of data values. No imputation was required. For the daily diary data, R was used to examine data missing at random via descriptive analysis and multilevel logistic regression models. The craving and eating report presented with high and uniform response probabilities suggesting their values may be further examined for primary research purposes.

First, a MANOVA, to ensure no pre-intervention differences between groups (CR vs. CD vs. Control) on eating-behaviors history and answers to control questions was run. Second, two separate MANOVAs examined hypothesized group differences on eating behaviors during the experimental week: (1) mean amount of chocolate and carrots consumed from bags (two dependent variables), and (2) mean daily self-reported amount of chocolate, carrots, or other sweets consumed (three dependent variables). Next, a univariate ANOVA examined group effects on average daily reported craving. Fourth, repeated-measures ANOVAs were conducted with group (between-subjects variable) and time (repeated-measures variable: pre vs. post) on power of food, state and trait cravings, and self-efficacy. Finally, an ANOVA examined taste-test group differences on chocolate and cucumber consumption.

2. Results

All participants completed the study. All logged into the electronic diary daily and 98.22% completed the craving question. For the rest of the diary questions completion rate was on average 95.05% (range: 90.48–99.16%).

2.1. Pre-intervention group differences

Groups did not differ before the intervention on: likeability of chocolate (high likeability reported), weekly chocolate consumption (2–3 times/week), self-control over eating chocolate (medium self-control), likeability of vegetables (medium likeability), frequency of carrot consumption (once a week to a few times-per-month) and having to force themselves to eat them (low force), how likely they are to eat a chocolate when a craving thought appears, or degree of self-control over eating (medium likelihood for both; see Table 1). Only time-since-last meal was statistically significant ($F(2,62) = 3.90$, $p = .03$, $\eta^2 = .11$) with both CD and CR groups reporting greater amount of time in hours since they ate compared to controls (see Table 1).

2.2. Effect of intervention on eating behavior and cravings

2.2.1. Eating during the experimental week (Table 2)

The first overall MANOVA was significant, $F(4,122) = 11.69$, $p < .001$, $\eta^2 = .28$. Groups significantly differed on mean amount of chocolate consumed during the experimental week. CD group ate significantly fewer chocolates compared to CO and CR. The CR group ate significantly fewer chocolates than control. No significant differences were observed between groups on carrot consumption. Only the CD group ate more carrots than chocolates, $F(1,23) = 258.14$, $p < .001$.

The second overall MANOVA was significant, $F(6,120) = 21.17$, $p < .001$, $\eta^2 = .51$, with groups differing on all dependent variables (see Table 2). In all cases, the CD group reported eating significantly fewer chocolates, carrots, and sweets than control, but not CR. The CR group also ate less than controls. Fig. 1 shows daily reported consumption separately for chocolates, other sweets and carrots for each group.

2.2.2. Cravings during the experimental week

A univariate ANOVA showed significant between-group differences,

Table 1
Means and standard deviations of pre-intervention ratings on control questions of typical chocolate and vegetable consumption parameters as a function of group.

	Cognitive Defusion		Cognitive Restructuring		Control Group	
	Mean	SD	Mean	SD	Mean	SD
Like chocolate (1 − 10)	8.88	1.36	9.21	1.02	8.82	1.24
Frequency of chocolate consumption	1.46	.88	.88	.85	1.00	.71
Self-control over eating chocolate (1–10)	4.25	.54	4.46	.54	5.00	.64
Like vegetables (e.g., carrots & cucumbers)	6.08	.45	6.08	.45	7.41	.54
Frequency of carrot consumption	2.38	1.17	2.88	.74	2.71	.85
Force self to eat vegetables	3.04	.52	3.58	.52	3.12	.62
Have craving thought and ability to not eat favorite food	3.08	.22	2.92	.22	3.06	.27
Ability to change thought and not eat favorite food	2.80	.24	2.89	.24	3.71	.29
Likelihood to eat chocolate when have a craving thought	3.25	.23	3.33	.23	3.47	.27
Control over eating	3.25	.21	3.17	.21	3.35	.25
Time since last meal (hours)	2.21[a]	1.77	2.38[b]	1.64	1.06[a,b]	1.14
Time since last chocolate consumption (hours)	8.13	2.29	6.42	3.03	7.41	2.69

Note[1]: Frequency of consumption: 0 = daily, 1 = 2–3 times per week, 2 = 1 time per week, 3 = a few times per month, 4 = never.
Note[2]: No statistically significant differences were found between groups, except for Time since last meal, where $F(2,62) = 3.90$, $p = .03$, $\eta^2 = .11$. [a]Significantly different from each other ($p < .05$). [b]Significantly different from each other ($p < .05$).

$F(2,62) = 4.08$, $p < .05$, $\eta^2 = .12$; CD group experienced fewer average number of cravings ($M = .24$, $SD = .05$) compared to both CR ($M = .29$, $SD = .07$) and CO ($M = .28$, $SD = .06$) groups. There were no significant differences between CR and CO.

2.2.3. Intervention effects on power of food, craving and self-efficacy (see Table 3)

Repeated measures ANOVAs showed no significant Group × Time interaction on the Power-of-Food scale. However, there was a significant main effect for Time ($F(2,58) = 4.43$, $p < .05$) with an overall decrease from pre ($M = 2.87$, $SE = .08$) to post ($M = 2.74$, $SE = .07$) and a main effect for Group, $F(2,58) = 5.24$, $p = .008$, $\eta^2 = .15$. Given the interest of comparing the two active interventions between them and to the control condition, single-degree-of-freedom interaction contrasts showed a significant decrease in CD compared to CR ($M_{Difference} = .35$, $SE = .16$, $p = .032$) and to CO ($M_{Difference} = .53$, $SE = .17$, $p = .003$), but no differences between CR and CO.

No significant Group × Time interactions were found for Cravings-State and Trait (FCQ). There was, however, a significant main-effect on state cravings for Time ($F(1,58) = 17.73$, $p < .001$, $\eta^2 = .23$) with decreases from pre to post assessment. There were also significant main effects on trait cravings for Time ($F(1,62) = 12.37$, $p = .001$, $\eta^2 = .17$) and Group ($F(2,62) = 3.74$, $p < .05$, $\eta^2 = .11$). Single-degree-of-freedom interaction contrasts showed decrease in trait cravings for CD and CR from pre to post intervention, whereas the craving for the CO group did not change. The only significant difference between groups was between the CD and CO groups at post-assessment.

No significant Group × Time interaction was found for self-efficacy. There was a significant main effect for Time ($F(1,62) = 7.00$, $p = .01$, $\eta^2 = .10$), with self-efficacy increasing from pre to post-assessment for all groups.

2.2.4. Eating during the taste-test

Between-group differences were significant, $F(2,59) = 26.55$, $p < .001$. CD ($M = 1.13$; $SD = .97$) and CR ($M = 1.09$, $SD = 1.48$) both ate fewer chocolate pieces than CO ($M = 4.00$, $SD = 1.73$), but did not differ in taste-test consumption. No significant differences were observed for the cucumber taste-test, $F(2,59) = .60$, $p > .05$.

Given that the present sample was mainly comprised of females, all analyses were rerun twice: (1) with gender as a covariate, and (2) analyzing only female data. Result patterns did not differ from those above, so males were retained to preserve power.

3. Discussion

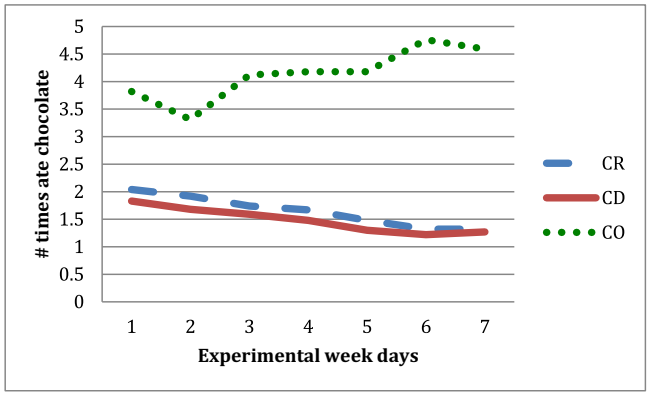
This study compared the effectiveness of two cognitive techniques, CR vs. CD, in dealing with FCs. Consistent with Moffitt et al. (2012), Forman et al. (2007), and Schumacher, Kemps, and Tiggemann (2018), the CD consumed fewer chocolates than both the CR and CO groups during the experimental week (objectively and subjectively assessed), and fewer chocolates than controls during a taste test. Recently, Schumacher et al. (2018) found CD was successful in decreasing the likelihood of craving-related consumption in a general sample of women recruited online. Also, in two experiments, CD significantly lowered thought intrusiveness, imagery vividness and craving-intensity when compared to guided-imagery and mind-wandering control (Schumacher et al., 2017). These studies combined with the present one, provide additional support for CD as an effective strategy in changing eating behavior in the presence of cravings. Intervention effects were also evident in the consumption of other sweets during the

Table 2
Means and standard deviations of electronic diary ratings of chocolate and carrot consumption as a function of group.

	Cognitive defusion		Cognitive restructuring		Control				
	M	SD	M	SD	M	SD	F(df)	p	η_p^2
Total # chocolate pieces eaten from bags[1]	35.21[a]	23.39	51.17[a]	3.38	87.53[a]	5.64	25.06	< .001	.45
Average # chocolate pieces eaten from bags[1]	11.74[a]	7.80	17.06[a]	10.13	29.18[a]	1.88			
Total # carrot pieces eaten from bags	70.83	24.30	61.63	25.87	74.76	25.61	1.52	.23	.05
Average # carrot pieces eaten from bags	23.61	8.10	20.54	8.62	24.92	8.54			
Average # of times reported cravings	1.70[a]	.32	1.94	.60	2.00[a]	.40	2.64 (2,62)	.08	.08
Average # of times reported eating chocolates	1.39[a]	.43	1.54[b]	.63	4.11[a,b]	1.06	86.95 (2,62)	< .001	.74
Average # of times reported eating carrots	2.31[a]	1.15	1.74[b]	.86	3.83[a,b]	1.37	17.99 (2,62)	< .001	.37
Average r# of times reported eating other sweets	1.32[a]	.48	1.26[b]	.56	2.93[a,b]	1.34	25.64 (2,62)	< .001	.45

Note[1]: One serving of "Galaxy Minstrel" chocolates = 10 pieces (120 calories).
Note[2]: [a]Significantly differ from each other ($p < .05$), [b]Significantly differ from each other ($p < .05$).

a



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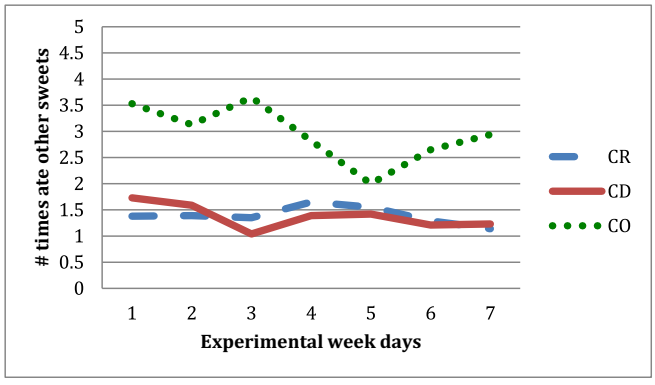

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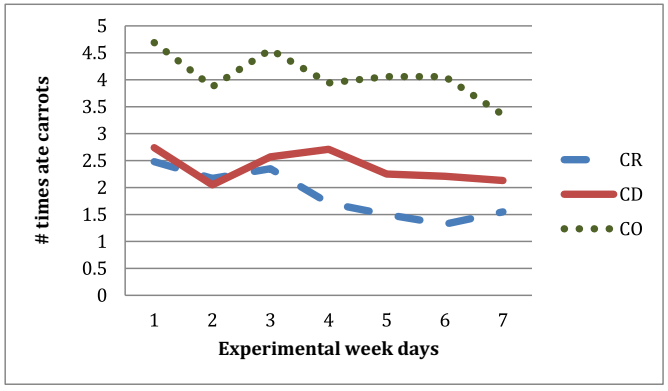

Fig. 1. Daily reported consumption separately for chocolates, other sweets and carrots eaten for each group.

experimental week, as the CD and CR groups ate fewer sweets than controls, despite no instructions to limit sweet or chocolate intake. Differences between the approaches appear consistent with the theoretical framework and goals.

Another purpose of this study that extended previous explorations was to examine if responding to food cravings with CD would increase healthy eating (e.g., consuming vegetables). Groups did not differ in the number of carrots eaten during the experimental week or cucumbers eaten during the taste-test. The CD group did, however, eat proportionately more carrots than chocolates during the experimental week compared to the other groups. Therefore, decreasing unhealthy eating in the presence of cravings does not automatically lead to an increase in consumption of healthy food alternatives. Craving interventions with this goal will likely need to specifically train individuals to assess the function of the craving (e.g., hunger- vs. emotion-cued) and to make healthy choices (food-related or otherwise), depending on the craving's function. For example, CD could be enhanced with additional intervention components based on ACT (e.g., valued-based actions), and with new cue-exposure interventions (e.g., Boutelle & Bouton, 2015,Boutelle et al., 2015; Schyns, Roefs, Mulkens, & Jansen, 2016).

Though a reduction in cravings is not an explicit purpose of CD, this group experienced fewer daily cravings and less preoccupation with food than the CR or CO groups, echoing findings by Schumacher et al. (2017, 2018). This suggests that when a person actively attempts to reduce cravings (e.g., via suppression, avoidance, restructuring), cravings paradoxically increase (Barnes & Dunn, 2010). However, when a person focuses on behaving differently in the presence of cravings, cravings decrease (Hooper et al., 2012).

Similar to findings by Moffitt et al. (2012), however, this same differential effect on craving was not observed pre-and post- intervention scores of trait and state scales of the FCQ. Instead, despite differences in daily reports of craving between groups, participants across all groups reported reduced cravings following the intervention. This converges with other studies that demonstrate divergent results between daily diary retrospectives, self-assessments of acute psychological states, and general retrospective self-assessments (e.g., Tomiyama, Mann, & Comer, 2009), and supports continued use of multi-method assessment when studying self-reported cravings. In the future, ecological momentary assessment could be incorporated which would involve repeated measures over the course of the day and as the cravings occur. This would also allow for examination of relevant contextual variables (e.g., mood, hunger, or situation).

The self-efficacy of individuals to deal with FCs without eating craved sweets also increased significantly in all groups from pre to post-intervention. It may be that increased self-efficacy is a general mechanism of change, such that successful craving interventions tend to work, in part, by increasing self-efficacy. Future studies might focus explicitly on exploring both general and specific mechanisms of change in interventions designed to address problematic craving. For example, one mechanism-of-change specific to CD may be acceptance of internal states (e.g., cravings) or as a result of a break-down in the automaticity of eating (Jenkins & Tapper, 2014). Additionally, findings from the emotion suppression literature (e.g., Wenzlaff & Wegner, 2000) suggest that different cognitive techniques may demand different levels of cognitive resources and CD may demand fewer resources than CR. Establishing mechanisms of change and potential moderators of craving intervention effectiveness could help determine the conditions under which CR might be preferable to CD, and vice versa.

A limitation of the study could be that cravings were assessed via self-report in this and previous studies, which only yield valid data to the extent that participants are both able and willing to describe their behavior or experiences accurately. Although the current study attempted to eliminate some of the error associated with retrospective accounts by taking daily reports, proxy measures of craving could be adapted from the drug craving literature (e.g., see Rosenberg, 2009) and should be explored for adaptation to FCs assessment.

Another limitation was the brief nature of the intervention (45 min) and the lack of evaluation of participant skill with the cognitive strategy trained. Future studies might allow for more practice with feedback and evaluate skill-level in the strategy taught. Such research would also allow for evaluations of what minimum “doses” produce intervention effects and maintenance of behavioral changes. Future studies should examine these parameters along with others affecting weight gain and obesity (e.g., physical activity) and commonly targeted in eating interventions.

There were also limitations associated with sampling of

Table 3
Intervention effects on power of food, craving and self-efficacy.

	Cognitive defusion				Cognitive restructuring				Control						
	Pre		Post		Pre		Post		Pre		Post				
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	F(df)	p	η_p^2
Power of food total	2.58	.69	2.45	.56	2.92	.57	2.80	.58	3.11	.50	2.98	.49	.01 (2,58)	> .05	.00
Food Craving Questionnaire-State	38.27	13.49	36.22	11.15	42.45	7.11	36.72	9.72	43.35	10.46	33.88	9.94	2.37 (2,58)	> .05	.08
Food Craving Questionnaire-Trait	96.92[b]	29.71	81.21[a,b]	32.67	116.42[c]	33.29	98.04[c]	41.17	113.76	23.39	106.18[a]	21.38	.61 (2,62)	> .05	.02
Self-efficacy	4.25	2.52	4.92	2.95	4.46	2.86	5.13	2.42	5.00	2.52	6.12	2.20	.21(2,62)	> .05	.01

Note1: [a]Significantly differ from each other ($p < .05$), [b]Significantly differ from each other ($p < .05$). [c]Significantly differ from each other ($p < .05$)

participants. Though this study did not specifically target females, more females than males participated. Although findings were the same with gender included as a covariate, and when exclusively data from females were analyzed, future studies may focus explicitly on examining gender differences in cravings, chocolate consumption, and impact of different cognitive techniques.

Finally, a different therapist ran each intervention type to ensure theoretical allegiance and proper training in the interventions used. However, there may have been confounding therapist effects. Future iterations of this study might use recorded instructions in the interventions (e.g., Schumacher et al., 2018).

Overall, this study supports CD for better responding to FCs. Participants instructed in CD ate fewer chocolates (both during the experimental week and in follow-up taste-test), experienced fewer chocolate cravings, and reported a greater decrease in food thoughts preoccupation than participants in CR or CO groups. Interventions aiming to help non-clinical populations manage their unwanted cravings and control eating behavior (especially sweets) would benefit from the inclusion of CD techniques.

Author statement

All authors would like to declare no conflict of interest. All authors were personally and actively involved in conducting this research and writing the manuscript for publication.

All ethical considerations were taken into account when conducting this research. The research received bioethics approval from the National Bioethics Committee of Cyprus.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eatbeh.2020.101385.

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