Appetite 101 (2016) 31–36

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

The parallel impact of episodic memory and episodic future thinking on food intake

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ARTICLE INFO

Article history:
Received 19 November 2015
Received in revised form
11 February 2016
Accepted 22 February 2016
Available online 23 February 2016

Keywords:
Episodic memory
Episodic future thinking
Food intake

ABSTRACT

This research examined the effects of both episodic memory and episodic future thinking (EFT) on snack food intake. In Study 1, female participants ($n = 158$) were asked to recall their lunch from earlier in the day, to think about the dinner they planned to have later in the day, or to think about a non-food activity before taking part in a cookie taste test. Participants who recalled their lunch or who thought about their dinner ate less than did participants who thought about non-food activities. These effects were not explained by group differences in the hedonic value of the food. Study 2 examined whether the suppression effect observed in Study 1 was driven by a general health consciousness. Female participants ($n = 74$) were asked to think about their past or future exercise (or a non-exercise activity), but thinking about exercise had no impact on participants' cookie consumption. Overall, both thinking about past food intake and imagining future food intake had the same suppression effect on participants' current food intake, but further research is needed to determine the underlying mechanism.

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1. Introduction

Many people believe that we eat because we are hungry and stop eating because we are full (e.g., Hetherington, 1996; Mook & Votaw, 1992; Vartanian, Herman, & Wansink, 2008), but research indicates that cognitive factors play an important role in regulating people's eating behavior. In particular, memory for what one has recently consumed appears to influence subsequent food intake. In an early demonstration of the connection between memory and food intake, Rozin, Dow, Moscovitch, and Rajaram (1998) showed that patients with anterograde amnesia would consume multiple lunches offered at 10–20 min intervals. Subsequent research has demonstrated that memory also plays a role in the food intake of neurologically-intact individuals. For example, Higgs (2002) had participants recall what they had eaten for lunch earlier that day, or recall what they had eaten for lunch the previous day, prior to taking part in a snack-food taste test. That study found that recalling previous food intake resulted in decreased food intake, but only for those who recalled their lunch from earlier the same day. Furthermore, Higgs and Donohue (2011) found that asking participants to mindfully engage with their lunch by focusing on the sensory properties of the food led to enhanced memory for what was eaten, and also resulted in greater suppression of food intake at a subsequent snack.

Although there have been several demonstrations that recalling recent food intake can suppress subsequent food intake, less is known about the mechanisms underlying this effect. One possibility is that recalling previous food intake affects how hungry or full people feel (Brunstrom et al., 2012). Specifically, reminding participants that they have recently eaten might lead them to feel less hungry (or more full) and thus suppress intake. Higgs (2002), however, found no effect of recall instruction on participants' ratings of hunger, fullness, or general desire to eat. An alternative possibility (and one that we explored in the current research) is that recalling prior eating occasions changes the perceived hedonic value of the to-be-eaten food. Specifically, when thinking about what they have recently eaten, people might derive less pleasure from the food in front of them at the present moment and therefore eat less of it.

1.1. Episodic future thinking

Recent work has shown that recalling prior events engages similar neural mechanisms that are involved in thinking about the

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http://dx.doi.org/10.1016/j.appet.2016.02.149
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future (Schacter, Addis, & Buckner, 2007; Szpunar, Watson, & McDermott, 2007). Episodic Future Thinking (EFT) is the ability to mentally simulate hypothetical future scenarios, and may draw on prior experiences that then allow one to imagine the future (Szpunar, 2010). In the context of eating behavior, this could be particularly relevant because people may recall prior eating episodes when planning future eating behavior. Thus, the link between episodic memory and episodic future thinking may indicate an important parallel between how recalling the past and imagining the future could influence (and potentially reduce) food intake, suggesting a common mechanism that relies on cognitive factors related to memory and planning. One recent study (Daniel, Stanton, & Epstein, 2013) examined the impact of imagining future events on delay-discounting and food intake among individuals with obesity, and found that EFT led to decreased ad libitum food intake. However, the EFT used in that study was not related to food and thus it unknown whether thinking about one's future food intake has a parallel effect to thinking about one's past food intake.

1.2. The present research

The aim of the present research was to extend previous work by examining the role of *both* episodic memory and episodic future thinking on participants' food intake. In Study 1, participants first took part in a memory task in which they were asked to recall a recent meal, to think about a future meal, or to think about a non-food activity. We then examined the impact of the memory task on food intake by measuring the amount that participants ate during a cookie taste test. We also tested the possibility that any observed effects of the memory task on food intake would be accounted for by differences in the perceived hedonic value of the food. To do so, we assessed both cravings for the specific food prior to eating and liking of the food during the taste test. Study 2 examined whether the effects of episodic memory and future thinking on food intake extend to thinking about recent or future exercise. Together, these studies aimed to provide initial evidence that recalling the past and imagining the future can have a parallel impact on food consumption, illustrating the role of reconstructive memory and future planning when eating.

2. Study 1

Building on previous research examining the role of memory in food intake, Study 1 sought to determine whether EFT has the same inhibitory effects on participants' food intake as does recalling past food intake. Participants in the food recall group wrote about what they ate for lunch that day and participants in the EFT group wrote about what they were planning to have for dinner later that day. There were also three comparison groups: a non-food episodic memory group (who wrote about how they got to the experiment room), a non-food EFT group (who wrote about how they were going to get home at the end of the day), and a control group (who completed a descriptive writing task). All participants then took part in a cookie taste test. We predicted that both recall of past food intake and thinking about future food intake would lead to lower food intake compared to the three comparison groups. We also predicted that any group differences in food intake would be accounted for by differences in craving for and liking of the test food.

2.1. Method

2.1.1. Participants

Participants were 158 female unrestrained eaters who were recruited from an introductory psychology course at a large Australian university, or who were recruited from the community. Students received course credit for their participation, and community participants received AUD $10. Previous research on memory effects on food intake has found large effects (Higgs, 2002). A power analysis determined that, with alpha set at .05 and power set at .80, 80 participants were required to detect a large effect. However, because the episodic future thinking component of this study was novel, we took a more conservative estimate of the effect size and doubled the number of participants recruited for the study. Participants' mean age was 19.48 years ($SD = 2.27$). No other demographic information was recorded. This study was approved by the university's ethics committee.

2.1.2. Materials

2.1.2.1. Dietary restraint. Participants were prescreened using the Restraint Scale (Herman & Polivy, 1980). Only those participants who scored below 15 on this scale were eligible to participate in the study.

2.1.2.2. Memory manipulations. The memory manipulations were based on the procedures used in previous studies on memory and food intake (e.g., Higgs, 2002), as well as research on EFT (e.g., Schacter et al., 2007; Szpunar, 2010; Szpunar et al., 2007). Participants in the food-recall condition were asked to write about the lunch they had eaten that day. The specific instructions were as follows: “Remember what you ate for lunch today. Think about what you ate, where you ate, who you ate with, and anything related to the meal you ate earlier today. Please write down anything that comes to mind. Do not worry about spelling or grammar. You will have 5 min to complete this task.” Similar instructions were used in the food-EFT condition, but participants were instead asked to think about their plans for their dinner that night: “Think about what you plan to eat for dinner later today. Think about what you will be eating, where you will be eating, who you will be eating with, and anything related to the meal you plan to eat later today.” For the non-food-recall and non-food-EFT groups, participants were asked to write about how they got to the experimental room that day and how they planned to get home at the end of the day, respectively. Finally, participants in the non-memory control group were shown an abstract figure and were asked to describe the figure in as much detail as possible.

2.1.2.3. Taste test. The cookies used in the taste test were Arnott's Premier Chocolate Chip Cookies (Arnott's Australia). Each cookie weighed approximately 15 g, was 6.5 cm in diameter, and contained approximately 315 kJ (75 kcal). Each participant was presented with a bowl filled with 21 cookies to ensure that they could eat as much as they wanted without feeling self-conscious about their intake. Bowls of cookies were weighed before and after the experimental session to determine the amount that participants consumed (in grams). Participants were asked to taste and rate the cookies on a variety of factors (how salty, sweet, crunchy, bitter, and chewy). Only three items were of interest in the present study: “How much do you like this cookie”, “How good tasting is this cookie”, and “How satisfying is this cookie”. These items were rated on a 10-cm visual analogue scale anchored by *Not at all* and *Very much* and were combined to form an overall index of liking of the cookies (Cronbach's $\alpha = .90$).

2.1.2.4. Craving for cookies. After being shown the bowl of cookies, but prior to tasting any of them, participants were asked to rate the strength of their desire to eat the cookies and the strength of their craving for the cookies (1 = *Not at all*, 9 = *Extremely strong*). These two items were highly correlated ($r = .79$, $p < .001$) and were combined into an overall index of craving for cookies.

2.1.2.5. Vividness of imagery. Previous research suggests that the vividness of the imagery can impact the strength of the memory effect on subsequent food intake (Higgs & Donohue, 2011; see also Baddeley & Andrade, 2000), and we therefore included two measures to address this possibility. First, we included the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973) as a measure of individual differences in the ability to "see" mental images to determine whether those who have more vivid mental imagery would be more strongly impacted by the manipulation. The VVIQ contains 16 items asking participants to imagine a variety of scenes or objects (e.g., a rising sun). The vividness of each scene is then rated on a 5-point scale (1 = *Perfectly clear and as vivid as normal vision*, 5 = *No image at all, only "knowing" that you are thinking about of the object*). Scores are summed to create an overall VVIQ score (Cronbach's $\alpha = .85$). Second, participants also rated the vividness of their mental image of the scenario they imagined when they were completing the writing task. This item was rated using a visual analogue scale anchored by *Not at all vivid* and *Extremely vivid*. This measure was included to account for the possibility that the effects might be strongest for those participants who had more vivid recall of the situation they were asked to describe.

2.1.2.6. Baseline hunger. At the beginning of the experiment, participants rated how hungry they were using a visual analogue scale anchored by *Not at all hungry* and *Extremely hungry*. Baseline hunger was examined as a potential covariate in the analyses.

2.1.3. Procedure

Participants signed up for a study on "visual imagery and taste perception." In order to maximize the likelihood that participants had eaten lunch but not dinner prior to the experimental session, all participants were tested between 2 pm and 5 pm. Upon arrival, participants provided informed consent. Participants reported their current hunger level, completed the VVIQ, and were then randomly assigned to complete one of the five writing tasks. After completing the writing task, participants rated the vividness of their imagery during that task and were then moved to a separate table to complete the taste test. Participants were shown the bowl of cookies that they would be tasting and were ask to reported their cravings for the cookies. They were then given 10 min to taste the cookies and complete the taste rating form. After completing the taste test, participants were asked to indicate when they had lunch that day and when they planned to have dinner later that day. Finally, participants were verbally debriefed using a funnel debriefing procedure (Bargh & Chartrand, 2000); no participants guessed the hypothesis.

2.1.4. Statistical analyses

Preliminary analysis indicated that baseline hunger did not differ by condition ($F = 0.77$, $p = .55$; Table 1) and was also not correlated with food intake ($r = .06$, $p = .48$). Therefore, hunger was not included as a covariate in the analyses. A one-way ANOVA was used to test the effect of memory condition on participants' food intake. Next, we examined whether VVIQ scores moderated the effect of the memory condition on participants' intake by conducting a two-way ANOVA with condition and VVIQ scores (dichotomized based on a median split) as the independent variables and with food intake as the dependent variable. We also conducted a one-way ANOVA to test whether task vividness ratings varied as a function of condition, and a correlational analysis to determine whether (for the experimental conditions) task vividness was correlated with food intake. For the proposed mechanisms, we first conducted one-way ANOVAs to determine whether cravings for and liking of the cookies varied by condition. We then examined whether craving and liking ratings were correlated with overall food intake. Finally, we examined the impact of including those factors as covariates in the primary food-intake analyses.

Table 1
Effect sizes (Cohen's *d*) for all pairwise comparisons in Study 1.

	Food EFT	Non-food recall	Non-food EFT	Control
Food recall	0.17	−1.07	−0.79	−1.23
Food EFT	–	−1.35	−1.08	−1.58
Non-food recall		–	0.29	−0.16
Non-food EFT			–	−0.52

2.2. Results

2.2.1. Effect of condition on food intake

The one-way ANOVA revealed that mean cookie consumption varied by condition, $F(4, 153) = 13.41$, $p < .001$, $\eta^2_p = .26$ (see Fig. 1). Follow-up planned comparisons indicated that participants in both the food-recall and the food-EFT conditions ate significantly less than did participants in any of the other conditions ($ps \leq .002$; $d = -0.79$ to -1.58), but that there was no significant difference between the food-recall and food-EFT conditions ($p = .54$, $d = 0.17$; see Table 1 for effect sizes for each pairwise comparison).

2.2.2. Vividness of imagery

Examining the VVIQ as a potential moderator of the effect of condition on food intake revealed no significant main effect of VVIQ, $F(1, 148) = 1.42$, $p = .24$, $\eta^2_p = .01$, and no significant condition × VVIQ interaction, $F(4, 148) = 0.21$, $p = .93$, $\eta^2_p = .01$.

Ratings of task vividness did vary by condition, $F(4, 153) = 2.38$, $p = .05$, $\eta^2_p = .06$ (Table 2). Planned comparisons indicated that the control task was rated as significantly less vivid than was any of the experimental conditions ($ps < .05$), but there were no significant differences among the experimental conditions ($ps > .45$). Furthermore, ratings of task vividness in the food-related conditions were not significantly correlated with participants' food intake (food recall: $r = -.17$, $p = .37$; food EFT: $r = .21$, $p = .25$).

2.2.3. Potential mechanisms

There were no differences between conditions in craving for the cookies, $F(4, 153) = 1.22$, $p = .30$, $\eta^2_p = .03$, or in liking of the cookies, $F(4, 153) = 0.81$, $p = .52$, $\eta^2_p = .02$ (Table 1). Furthermore, although both craving ($r = .34$, $p < .001$) and liking ($r = .32$, $p < .001$) were significantly correlated with the amount consumed, entering

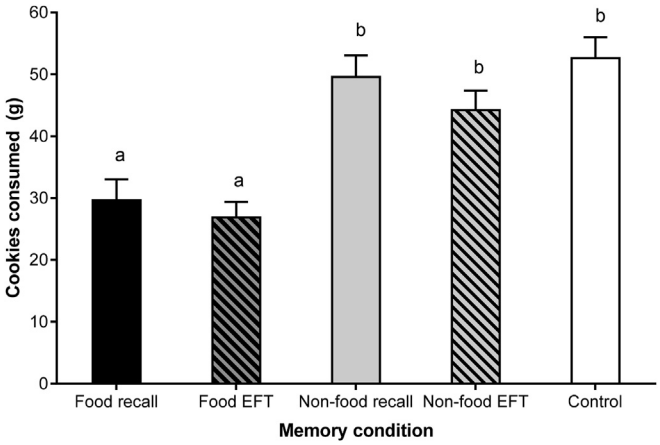

Fig. 1. Mean cookie consumption by memory condition in Study 1. Bars with different superscripts are significantly different at $p < .05$. Error bars represent standard error of the mean.

Table 2
Mean (SD) for each of the potential covariates included in Study 1.

	Food recall ($n = 31$)	Food EFT ($n = 32$)	Non-food recall ($n = 32$)	Non-food EFT ($n = 32$)	Control ($n = 31$)
Hunger	2.52 (2.15)	2.49 (2.36)	1.78 (1.84)	2.18 (2.02)	2.69 (2.53)
Task vividness	6.80 (1.66)	6.82 (1.98)	7.17 (1.85)	6.78 (1.68)	5.75 (2.42)
Craving	6.16 (1.49)	5.11 (2.17)	5.72 (2.17)	5.58 (1.86)	5.90 (2.20)
Liking	7.68 (1.47)	7.16 (2.11)	7.63 (2.19)	7.95 (1.65)	7.82 (1.96)

those two factors as covariates did not change the pattern of results for the intake analysis.

2.3. Discussion

Participants who were asked to recall their previous meal or to imagine their next meal ate fewer cookies than did participants who were asked to recall or imagine a non-food event and participants in the control group. These findings extend the work of Higgs (Higgs, 2002; Higgs & Donohue, 2011) by demonstrating that thinking about a future meal has the same suppression effect as thinking about a past meal. Furthermore, these effects emerged independent of any individual differences in visual imagery ability and any differences in how vivid participants' imagery was during the writing task. Thus, the findings of Study 1 suggest that thinking about recent past food intake or recent prospective food intake result in reduced consumption of a snack food compared to thinking about non-food-related past or future events. The fact that the magnitude of the suppression effect was very similar for the food-recall and food-EFT conditions further suggests that they may operate via a common pathway in influencing people's food intake.

We also tested one possible mechanism underlying the observed suppression effect by examining whether craving for or liking of the food could account for the decreased food intake in the food-recall and food-EFT conditions. Neither craving for nor liking of the cookies varied by condition, and including those factors as covariates in the analysis did not change the pattern of results. Thus, changes to the hedonic value of the food as a function of memory condition does not appear to be a viable explanation for the observed suppression of food intake.

An alternative possible explanation is that recalling one's past food intake or imagining one's future food intake both prime a general health consciousness that leads participants to eat less of an unhealthy snack (cookies were the test food in Study 1). This speculation is also consistent with the results of Higgs and Donohue's (2011) study, which found that focusing on the food one is eating during a lunch session (which enhances memory for the food eaten) reduced later consumption of chocolate biscuits but not digestive biscuits. In order to determine whether priming of a general health consciousness could be responsible for the effects of food memory on intake, Study 2 tested whether the same effects emerge when thinking about a recent past or future exercise session. We reason that thinking about exercise might activate a similar health consciousness as thinking about a meal, and thus might result in decreased consumption of cookies relative to a control group. This hypothesis is consistent with research showing that participants who watched exercise commercials before having lunch consumed less food than did control participants (Van Kleef, Shimizu, & Wansink, 2011).

3. Study 2

Participants in this study were asked to recall the last time they exercised, or to imagine the next time they planned on exercising, before taking part in a taste test. If priming of health consciousness is indeed involved in the suppressed eating that follows thinking about one's food intake, then similar effects might be expected when thinking about one's exercise. That is, we would predict that participants asked to think about their previous or future exercise would eat less than would participants in the control group.

3.1. Method

3.1.1. Participants

Participants were 74 women who reported that they exercised regularly (defined as moderate intensity exercise 2–3 times per week over the past two months, at minimum). We selected this minimum threshold to increase the likelihood that participants would have a recent past or planned future exercise episode that they could describe in the writing task. Participants were recruited through online notice boards as well as flyers posted in local gyms and on the university campus. A power analysis determined that, with alpha set at .05 and power set at .80, 66 participants were required to detect a large effect (as found in Higgs, 2002; and Study 1 of the present paper). Participants received AUD $10 for taking part in the study. Participants' mean age was 22.57 years ($SD = 3.65$), and their mean Body Mass Index (BMI; kg/m^2) was 22.02 ($SD = 3.53$). This study was approved by the university's ethics committee.

3.1.2. Materials and procedure

The procedure in Study 2 was the same as in Study 1 with the following exceptions: (1) Sessions were run between 11 am and 5 pm; (2) rather than writing about their food intake, participants were asked to write about the last time they exercised or the next time they planned to exercise (other than the focus on exercise, the instructions for the writing task were identical to those used in Study 1); and (3) the non-food recall and non-food EFT groups were omitted because they did not differ from the control group in Study 1.

3.2. Results and discussion

In contrast to Study 1, mean cookie consumption did not vary by condition, $F(2, 71) = 0.52$, $p = .60$, $\eta^2_p = .01$ (see Fig. 2). Because Higgs (2002) found suppression effects for recall of the same day's lunch but not the previous day's lunch, we re-ran the main analysis limiting our sample to those participants whose past exercise/future exercise was within one day of the experimental session. The pattern of results did not change, $F(2, 59) = 0.44$, $p = .65$, $\eta^2_p = .02$.

As in Study 1, baseline hunger did not differ between conditions ($F = 0.13$, $p = .88$; Table 2) and was also not significantly correlated with food intake ($r = .20$, $p = .09$). Therefore, hunger was not included as a covariate. There were no differences between conditions in cravings, $F(2, 71) = 1.60$, $p = .21$, $\eta^2_p = .04$, or in liking, $F(2, 71) = 0.46$, $p = .63$, $\eta^2_p = .01$ (Table 3). Furthermore, although both craving ($r = .38$, $p = .001$) and liking ($r = .24$, $p = .04$) were significantly correlated with the amount consumed, entering those

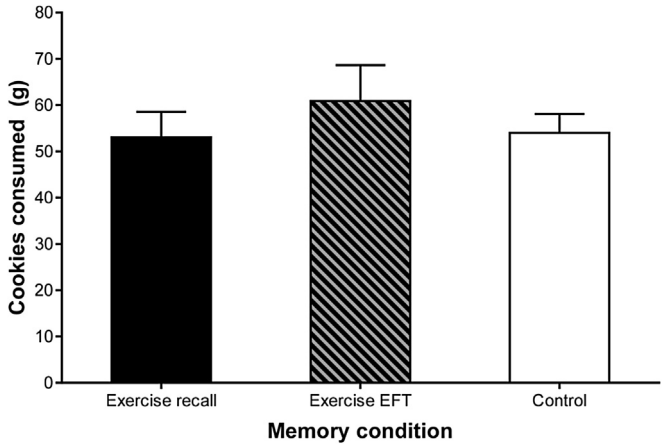

Fig. 2. Mean cookie consumption by memory condition in Study 2. Error bars represent standard error of the mean.

two factors as covariates did not change the pattern of results for the intake analysis. Overall, then, thinking about exercise did not have the same suppression effect on snack food intake that was observed when participants thought about their food intake.

4. General discussion

The aim of this research was to extend current knowledge regarding the cognitive factors (in particular, episodic memory) affecting food intake. Consistent with previous studies (e.g., Higgs, 2002), Study 1 found that thinking about what one had for lunch earlier that day resulted in decreased food intake compared to thinking about a set of abstract shapes (the control group) or thinking about how one got to the room for the experiment. This latter finding suggests that it is not simply a general past-orientation that leads to reduced food intake, but rather that it is specific to thinking about what one has eaten. Overall, the effect of memory of a recently eaten meal on food intake appears to be quite robust.

In addition to extending previous research, the present study makes a novel contribution by examining the effect of thinking about one's future food intake on current food intake. We found that participants who were asked to think about what they planned to have for dinner that night also reduced their food intake relative to the control group (and relative to participants who were asked to think about how they were going to get home at the end of the day). Furthermore, the magnitude of the decrease in food intake was the same whether participants were asked to think about their past or their future food intake. This finding illustrates the parallel role of memory and future thinking on food consumption, and may suggest a common pathway based on reconstructing the past and imagining the future (cf. Schacter et al., 2007; Szpunar, 2010). Other research has also demonstrated that repeatedly imagining eating a specific food subsequently led to reduced consumption of that food (Morewedge, Eun Huh, & Vosgerau, 2010). It would be interesting for future research to explore whether the suppression effects observed for episodic memory, EFT, and imagined consumption operate via similar or different processes.

Table 3
Mean (SD) for each of the potential covariates included in Study 2.

	Exercise recall ($n = 24$)	Exercise EFT ($n = 24$)	Control ($n = 26$)
Hunger	4.98 (2.11)	5.27 (1.96)	5.19 (2.02)
Task vividness	7.44 (1.55)	7.90 (1.87)	6.54 (2.04)
Craving	6.13 (1.93)	6.92 (1.24)	6.56 (1.37)
Liking	7.09 (2.25)	7.32 (1.62)	7.58 (1.47)

In the present research, we also examined potential mechanisms of the suppression effect of memory on food intake. First, Study 1 tested whether the hedonic value of the test food was affected by the memory task. If recalling one's recent meal or thinking about one's next meal decreases the perceived desirability of the current food, then participants might report less craving for or pleasure from the cookies. Study 1 found no differences among conditions in terms of either cravings for or liking of the food, and controlling for those factors did not alter the pattern of results. Thus, the hedonic value of the cookies does not appear to explain the effects of the memory task on participants' food intake. It is possible, however, that there are other more implicit measures of liking/wanting/craving (Epstein, Leddy, Temple, & Faith, 2007; Finlayson, King, & Blundell, 2008) that might be more sensitive to the effects of memory of one's recent food intake in these contexts. Future research could explore this possibility.

Second, we examined whether a general health consciousness might be responsible for the suppression effects observed in Study 1. We reasoned that, if thinking about one's recent food intake primes a general health consciousness that in turn reduces food intake, then the same effect might be observed when thinking about one's recent exercise. Study 2 found no effect of thinking about one's past or future exercise on food intake. Thus, this study does not support the health-consciousness explanation. It is possible that these null results emerged because the exercise prime has multiple contrasting effects. For example, thinking about recent exercise might prime health consciousness resulting in reduced food intake, consistent with the findings of Van Kleef et al. (2011). However, thinking about recent exercise might also give one permission to eat more because they might focus on recently burned calories (or calories that will be burned in the future), resulting in increased food intake (cf. Werle, Wansink, & Payne, 2011). These contrasting effects could be observed between participants, or even within participants, resulting in an overall null effect. Nonetheless, at present, there is no evidence that health-consciousness can explain the findings of Study 1 that thinking about past or future food intake decreases how much one eats.

An alternative potential mechanism, and one that should be considered in future research, is that the memory task influences how much people think is an appropriate amount to eat. Research indicates that a range of eating cues (e.g., social influences, portion size) affect food intake by providing a norm of how much is appropriate to eat (Herman, Polivy, Pliner, & Vartanian, 2015; Kerameas, Vartanian, Herman, & Polivy, 2015; Vartanian, Sokol, Herman, & Polivy, 2013). For example, Vartanian et al. (2013) found that eating with a companion who eats a large amount leads people to perceive that it is appropriate to eat more (and to actually eat more) compared to eating with a companion who eats very little. Similarly, Kerameas et al. (2015) found that the size of the portion of food, as well as how the food is presented, influenced perceptions of how much was an appropriate amount to eat, which in turn influenced how much participants ate. In the current context, it may be that thinking about one's recent food intake (but not one's recent exercise) affects how much is perceived as an appropriate to eat at a subsequent eating occasion. However, this proposed mechanism will need be tested in future research.

4.1. Limitations and future directions

The results of the present studies need to be considered in the

context of some limitations. First, the test food was an unhealthy snack food (cookies) and it is possible that both the suppression effect itself and the specific mechanisms underlying this effect would be different for other types of foods (cf. Higgs & Donohue, 2011). Furthermore, the effect of the meal recall or future imagining task might depend on the nature of the meal being recalled or imagined. In our study, participants were simply asked to recall their actual lunch or what they planned to have for dinner, which may have been a fairly typical meal for them. In contrast, Tomarken and Kirschenbaum (1984) found that participants who were specifically asked to imagine consuming a high-calorie dinner later in the day consumed more food at a post-lunch snack than did those who were asked to imagine consuming a low-calorie dinner. Thus, future research is needed to test the parameters and limits of the effect of recall on food intake.

Second, as in previous studies (e.g., Higgs, 2002; Higgs & Donohue, 2011), our sample was limited to young women who (at least for Study 1) were unrestrained eaters. Robinson, Hardman, Halford, and Jones (2015) suggested that different subgroups (e.g., male vs. female participants; restrained vs. unrestrained eaters) may respond differently to eating tasks conducted under laboratory conditions, particularly if they are aware that their food intake is being observed, although few studies have directly examined whether these differences emerge. It may be that the effects of episodic memory and EFT on food intake were exaggerated in the present research because of the specific characteristics of our participants. Future research should therefore test whether the effects we observed would generalize to more diverse samples. Another factor that could be considered in future research is individual differences in disinhibition (a tendency to overeat in response to external cues). There is some evidence that disinhibition moderates the effects of recall on food intake. For example, Higgs, Williamson, and Attwood (2008) found memory effects on food intake only among those low in disinhibition. It might be that disinhibition similarly moderates the effect of EFT on food intake. In addition, the current findings may have important implications regarding populations that have memory impairments, or attentional deficits (such as older adults or young children with ADHD), that prevent them spontaneously recalling prior episodic details about past eating, or engaging in episodic future thought regarding upcoming opportunities to eat. Thus, research could examine how enhancing recall or future thought could benefit these special populations.

4.2. Conclusions

Remembering one's previous food intake has been consistently shown to suppress intake of snack foods, and we further showed that thinking about one's future food intake has an equivalent suppression effect. The reduction in intake observed in Study 1 was more than a 100-kcal decrease in energy consumed. Hill and colleagues (e.g., Hill, Wyatt, Reed, & Peters, 2003) have argued that a decrease in daily energy intake on the order of 50–100 kcal could be enough to offset the rise in obesity. Thus, future research could examine the utility of recalling the past or planning the future as a strategy to reduce overeating in people's everyday lives (including social and cultural events that typically lead to overeating). Although the effects of thinking about one's food intake are quite robust, what is less clear is *why* these effects emerged. In the present study, changes in hedonic value or in general health consciousness do not appear to explain the effects of recall on food intake.Thus, future research is needed to identify the specific mechanisms that can account for the effects of both past recall and future imagining on food intake. In summary, we found important similarities in terms of how episodic remembering and episodic future thinking impact food intake, suggesting a role for imagining past and future events on eating behavior.

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