Focus on the future: episodic future thinking reduces discount rate and snacking

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Focus on the future: Episodic future thinking reduces discount rate and snacking

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**Abstract**

Obesity seems related to a preference for immediate gratification. By changing this focus on short term benefits to a more future-oriented outlook, delay discounting (impulsive decision making) can be changed by a manipulation of episodic future thinking (EFT). EFT comprises a vivid mental simulation of general future experiences. EFT may also affect consumption of unhealthy foods, which can be seen as a choice for immediate gratification. Recent research shows that future orientation should be tailored to the behavior at outcome. We therefore hypothesize that the effectiveness of EFT on food intake could be enhanced by making the content food-related. We conducted a 2 (future vs past thinking) by 2 (food vs non-food related thoughts) between-subject design experiment in female undergraduates (N = 94), to compare the efficacy of EFT versus the recalling of episodic past events in reducing discount rate and caloric intake. Content of imagery was either unrestricted or food-related. Participants engaged in EFT or control episodic imagery while snacks were offered to freely consume, and next the Monetary Choice Questionnaire was completed as a measure of delay discounting, while again being engaged in EFT or control imagery. Both types of EFT reduced delay discounting, however, only food-related EFT lead to more restricted caloric consumption. Thus, we found evidence that EFT reduced discount rate during decision making. However, in order to restrict caloric intake, EFT should entail food-related imagery. As discount rate and caloric intake were not related in the current sample, the underlying mechanism remains to be discovered. Results however suggest that EFT is a promising technique to resist immediate gratification.

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**1. Introduction**

In the last decades, people became increasingly heavier and physically less fit, and the prevalence of obesity has increased worldwide (Finucane et al., 2011; Flegal, Carroll, Kit, & Ogden, 2012). When a person’s energy intake is greater than one’s energy consumption, weight gain will occur (Hill, Melanson, & Wyatt, 2000). Why is it so difficult for some to resist the temptation of palatable food? The taste of high sugar and high fat foods is highly enjoyable (Drewnowski & Greenwood, 1983) and eating high caloric foods is very rewarding at the time of consumption: the immediate contingencies are positive (Volkow, Wang, & Baler, 2011). When choosing what to eat, we have to weigh immediate pleasures vs. long-term health implications (e.g. healthy body weight and reduction of health risks) (Hall & Fong, 2007). When one is mainly focused on immediate pleasures, this could lead to palatable, though unhealthy, food choices. Studies on preferences for immediate reward frequently used a delay discounting task, in which individuals have to choose between a more valuable reward after a period of delay and a less valuable reward which is directly available (e.g., Bickel & Marsch, 2001). Dual-system models of decision-making (e.g. Bechara, 2005; Bickel et al., 2007) posit that delay discounting reflects the relative balance in activation between two competing neurobiological systems. The appetitive, impulsive system values immediate reinforcers, whereas the inhibitory, executive system is needed for the inhibition of the impulsive system to maximize long-term gains (Bickel et al., 2007). Someone who chooses relatively more often for the immediate smaller reward is thus considered to be more impulsive, whereas someone who is more willing to wait for a bigger reward, places more emphasis on benefits in the future (Bickel et al., 2007). Research has shown that obese individuals are more affected by...
this period of delay than subjects with a healthy weight, and a
higher discount rate (i.e., less willingness to wait for future bene-
fits) is related to a higher Body Mass Index (BMI) (Epstein et al.,
2014; Jarmolowicz et al., 2014; Weller, Cook Ill, Avsar, & Cox,
2008). A higher discount rate is also predictive of higher calorie
intake in obese women (Appelhans et al., 2012) and children who
are having more difficulty delaying reward, lost less weight during
a weight loss intervention (Best et al., 2012). Changing this concern
with immediate reward into a more future-oriented outlook could
therefore be useful in order to promote the choice of healthy foods
and thereby facilitate a healthy weight.

Episodic future thinking (EFT) is one strategy to shift one’s
preference from immediate gratification to delayed rewards (Peters
& Büchel, 2010). EFT refers to the possibility of humans to project
themselves forward in time and to pre-experience future events
(Büchel, 2010). EFT refers to the possibility of humans to project
and thereby control impulsive eating. It is important to note that
indeed be a useful technique to endorse long term consequences
in reducing caloric intake than general EFT.

2. Methods

2.1. Participants

Ninety-five female undergraduates of Maastricht University
between the ages of 18–30 were recruited using advertisements for
a study about the effects of deprivation on visualization. One
participant was considered an outlier on the dependent variable
(caloric intake > 3 SD) and therefore excluded from all analyses.
Therefore, our final sample consisted of 94 participants.

2.2. Procedure

Participants were asked to refrain from consuming anything
except for water for 2hr before participation. All appointments
were scheduled between 11am and 6pm. At arrival, participants
signed the informed consent, completed demographical data, rated
their current hunger, reported the time since their last meal and
completed some filler-questionnaires. Next a “break” was intro-
duced, in which snacks and water were provided to freely consume
while the manipulation, presented as a writing assignment (either
episodic future thinking or control; see description of manipulation
below) had to be completed. After fifteen minutes, the experi-
menter came back and removed the food. When the participant did
not finish yet, a maximum of 5 extra minutes to work on the
assignment was provided (15 participants; 16%), while the exper-
menter waited in the room. Everyone was finished after this extra
time. Next, a computerized questionnaire to assess discount rate
was completed. Subsequently, participants rated on a 7-point Likert
scale how much they thought about and how vividly they imagined
the events while completing the questionnaire. Next, the Consid-
eration of Future Consequences scale — food version and Restraint
Scale were completed. At the end of the study, participants' weight
and length were measured, and they were fully debriefed.
Completion took about 50 min, and participants received one
course credit or a voucher of €7.50 as a reward. The study was
approved by the ethical committee of the Faculty of Psychology and
Neuroscience of Maastricht University.

3. Materials and measures

3.1. Manipulations

Participants wrote about either events planned in the future
or events not related to food (Daniel et al., 2015, 2013b) found effects of
EFT on eating behavior even though the EFT manipulation was
unrelated to eating. Specifically, participants were encouraged to
imagine vivid positive future events, whereby the content of im-
agery was not restricted. It thus seems that the imagined future
events during EFT do not necessarily have to be related to the
delaying task or to eating episodes: Considering general future
events was enough to lead individuals into better eating-related
choices in the present.

However, there is reason to believe that future orientation
should be tailored to the behavior of interest. Someone can be more
future oriented in one aspect of his behavior, but not in another
(van Beek, Antonides, & Handgraaf, 2013). Earlier research has
shown that only a food-specific measure of time orientation was
related to healthy eating patterns (Dassen, Houben, & Jansen, 2015;
(Episodic Future Thinking: EFT) or about past events as control (Episodic Past Thinking: EPT). Participants either had to come up with unrestricted or food-related events, depending on the condition they were allocated to. Participants received the following instructions (instructions for the conditions who wrote about past events are shown between parentheses):

“We want to ask you to imagine events that realistically could happen or that you have already planned in the future (in a week, two weeks, a month, six months) [recall events that have taken place recently (one day ago, two days ago, a week ago, a month ago)]. This may for example be a getaway or something study-related; Think of something that applies to you. Experience this event already in mind [Re-experience this event in mind]. Consider as many details of this event as possible (what do [did] you do, where are [were] you, who are [were] with you, accompanying feelings). These images will be used in the next exercise. Describe the situation below.”

For the food-related EFT and EPT condition, it was added to the instruction that the events had to be food-related. As an example it was stated that this event could for instance be a dinner with friends or cooking an elaborate meal. Participants were also asked to consider how healthy the described food-related event is/was. Next, the participants rated every image on a 7-point Likert scale (1 = not at all; 7 = very much) on realism, details, vividness, positivity, difficulty to imagine, and how future-oriented the event was.

3.2. Caloric intake

Participants were provided with a bowl of chocolate chip cookies (±110 g; 497 kcal/100 g), a bowl of M&M’s (±200 g; 485 kcal/100 g), a bowl of syrup waffles (±160 g; 457 kcal/100 g) and a bottle of water. Participants were told that for study purposes it was no longer needed for them to be deprived of food, and since they had not eaten for at least two hours, some snacks and water were now provided to freely consume, while they were preparing at ease for the next assignment. They were told they could eat as much or as little as they wanted. Participants were not aware of the fact that the food was weighed before and afterwards and that caloric intake was calculated.

3.3. Monetary Choice Questionnaire

In order to assess the ability to delay gratification, participants completed a computerized version of the Monetary Choice Questionnaire (Kirby, Petry, & Bickel, 1999). This questionnaire consists of 27 questions, asking the respondent to choose either a smaller, immediate monetary reward or a larger, delayed monetary reward. An example of a question is “Would you prefer €14 today, or €25 in 19 days?” The timeframes of the future events approximated the time delays specified on the MCQ (7–186 days), based on time intervals specified by Lin and Epstein (2014). Participants received the following instructions regarding the EFT or control-EPT manipulation:

“This questionnaire consists of each a visualization task, where you have to imagine the events you just wrote about and subsequently a choice where you are asked to choose between an immediate reward and a higher reward you will only receive after a certain number of days. You will be asked which of the two rewards you prefer. The rewards include a certain amount of money. You will not really receive the amount of money you choose, but we want you to make your decisions as if you actually would receive the money. Please choose the option that you would prefer to receive, and not what you think we want you to choose. They are a total of 27 choices. You do not have to base your choice upon the imagined event; you have just have to vividly imagine that this event is really happening, and next you can choose your preferred reward.”

The geometric mean of the k-value (the degree of discounting) was calculated afterwards by use of an automated scoring spreadsheet made available online by Kaplan, Lemley, Reed, and Jarmolowicz (2014). See Kirby (2009) for more details about estimating the k-value. To normalize the distribution of scores, a natural-log transformation of k was used for all statistical analyses.

3.4. Restraint Scale

In order to discover the extent to which participants try to restrain or control their food intake, the Restraint Scale (RS: Herman & Polivy, 1980), which assesses weight concerns, weight fluctuations and self-reported attempts to diet, was used in this study. The RS is a self-report questionnaire consisting of 10-items, with possible scores ranging from 0 to 35. Higher scores are indicative of an increased intention to restrict food intake.

3.5. Consideration of Future Consequences scale — food version

In order to measure time perspective regarding eating behavior and health, participants completed the CFC-food (van Beek et al., 2013), an adapted version of the 14-item Consideration of Future Consequences Scale (CFC; Joireman, Shaffer, Balliet, & Strathman, 2012). The CFC-food consists of two subscales: CFC-immediate and CFC-future. An example of an item of the Immediate-subscale is “I only choose my food to satisfy immediate needs, figuring the future will take care of itself.” An example question for the Future-subscale is “I consider how my health might be in the future, and try to influence my health with my day to day eating behavior.” Participants indicated their agreement with the statements on a 7-point Likert scale, ranging from 1 = “totally disagree” to 7 = “totally agree.”

3.6. Body Mass Index

The height and weight of each participant was measured to calculate the Body Mass Index (BMI; kg/m²).

3.7. Hunger and taste rating

Participants were asked to indicate their current hunger at the beginning of the study. Participants were also asked to indicate how much they liked the offered snacks after removal of the bowls. Responses for hunger and taste rating were given on a 100 mm VAS-scale ranging from “not at all” to “very much”.

3.8. Analyses

Participants were randomly assigned to EFT (n = 23), food-related EFT (n = 24), EPT (n = 24) or food-related EPT (n = 23). First, group differences in the ratings of the images, restraint and BMI were explored. In case of group differences, these variables were included as a covariate on all subsequent analyses. As a manipulation check, we expected EFT images to be rated as more future-oriented than EPT images. Next, two two-way between subjects ANOVA were conducted with manipulation (EFT or EFT) and content (general or food-related images) as factors, and either
discount rate or caloric intake as dependent variable. For the analysis on caloric intake, current hunger and taste rating of the snacks were included as covariates.

4. Results

4.1. Manipulation check

Mean age of participants was 20.45 years (SD = 1.97, range 18–29) and mean BMI was 22.43 (SD = 2.75, range 17.74–31.78). The conditions did not differ on age, scores on the Restraint Scale or on calculated BMI (all p > 0.31; see Table 1). Hunger ratings were on average intermediate (M = 53.30, SD = 24.20) and did not differ between conditions (see Table 1). Taste ratings of the offered snacks were on average moderately high (M = 65.98, SD = 19.71). Participants who engaged in EPT (M = 70.10, SD = 17.66) rated the snacks as more palatable than those who engaged in EFT (M = 61.87, SD = 20.95), t(1, 90) = 4.20, p < .05, $\eta^2_p = 0.05$. For CFC-food, groups did not differ on the CFC-immediate subscale (all p > 0.67; see Table 1). For the future subscale, a significant difference for content occurred, F(1, 90) = 5.05, p < .05, $\eta^2_p = 0.05$, indicating that food-related groups had higher scores on the CFC-future subscale (M = 31.95, SD = 4.85) than general groups (M = 29.21, SD = 6.72).

All generated images were evaluated as reasonably realistic, detailed, vivid, easy to imagine and positive (see Table 2). No group differences on realism, details or difficulty of generating the images were found (all p > 0.24; see Table 2). Food-related images (M = 5.97, SD = 0.68) were on average evaluated as more positive than general images (M = 5.40, SD = 0.92), t(1, 90) = 11.25, p < .01, $\eta^2_p = .11$, and, although not statistically significant, as slightly more vivid (M = 5.54, SD = 0.61) than general images (M = 5.30 SD = 0.75), t(1, 90) = 2.86, p = 0.09, $\eta^2_p = 0.03$. Regarding the extent to which events were rated as future-oriented, a main effect of the future manipulation was found, F(1, 90) = 98.70, p < 0.001, $\eta^2_p = 0.52$, indicating that EFT groups (M = 5.23, SD = 1.04) thought more about the future than the EPT groups (M = 2.81, SD = 1.31). Thus, the EFT manipulation was successful in activating future images.

4.2. Discount rate

Groups did not differ on the vividness or amount of time spent on considering the events while they completed the MCQ (all p > 0.12). In Fig. 1, results of the two-way between subjects ANOVA for delay discounting are presented. The interaction effect between manipulation and content was not significant F(1, 90) = 0.01, p = 0.94, $\eta^2_p = .00$. There was a statistically significant main effect for the future manipulation, F(1, 90) = 5.66, p = 0.02, $\eta^2_p = .06$, which indicates that EFT (general: M = 5.63, SD = 1.33; food-related: M = −5.61, SD = 1.46) reduced discounting of the future relative to EPT (general: M = −5.03, SD = 1.03; food-related: M = −4.97, SD = 1.21). The main effect of content, F(1, 90) = 0.02, p = .89, $\eta^2_p = .00$, was not significant, which indicates that results were not different for general or food-related images.

4.3. Caloric intake

Participants on average consumed 208.63 calories (SD = 160.56, Range 0–616.76). Discount rate and caloric intake were not correlated (r = −0.03, p = 0.76). Within groups, discount rate and caloric intake were also not related (all p > 0.47). Results of the two-way between groups analysis of covariance with manipulation and content as factors, and hunger and taste ratings included as covariates are presented in Fig. 2.1 Content of imagery was either general or food-related. Hunger, F(1, 88) = 18.11, p < 0.001, $\eta^2_p = .17$ and taste F(1, 88) = 12.54, p < 0.01, $\eta^2_p = .13$, significantly predicted caloric intake. No main effect of manipulation, F(1, 88) = 2.58, p = .11, $\eta^2_p = 0.03$ or content, F(1, 88) = 0.09, p = .77, $\eta^2_p = 0.00$, occurred. The interaction between manipulation and content was significant, F(1, 88) = 5.01, p = .03, $\eta^2_p = .05$. Post hoc analyses performed separately for general versus food-related content revealed that food-specific EFT (EMM = 164.46, SE = 29.85) reduced caloric intake relative to food-related EPT (EMM = 273.79, SE = 30.95), F(1, 43) = 5.97, p = .02, $\eta^2_p = 0.12$. For general content, in contrast, caloric intake did not differ between EPT (EMM = 190.86, SE = 26.78) and EFT (EMM = 208.10, SE = 27.37), F(1, 43) = 0.20, p = .66, $\eta^2_p = 0.01$.

5. Discussion

The aim of the current study was to test whether discount rate and caloric intake could be altered by a manipulation of episodic future thinking, by shifting concern with immediate gratification to a more future-oriented outlook. As only food-specific measures of time orientation are related to healthy eating patterns, the current study explored whether the effects of EFT on food intake could be enhanced by making the content of imagery food-related. Delay discounting was indeed reduced by EFT. This effect was not determined by content: Both general and food-related EFT led to less discounting of the future compared to control groups who relived recent episodic past events. Further, in line with our hypothesis, results showed that only food-related EFT, but not general EFT, reduced food intake.

Thus, EFT during decision making resulted in less frequent choices of immediate reward, in accordance with earlier research (Benoit et al., 2011; Daniel et al., 2015, 2013a, 2013b; Lin & Epstein, 2014; Peters & Büchel, 2010). As unhealthy eaters are mainly present-minded for food and not in general (Dassen et al., 2015), only food-specific future thinking resulted in more restricted caloric intake, in line with our hypothesis. For the general manipulation, no group differences were found on caloric intake, which is surprising given earlier results (Daniel et al., 2015, 2013b). It was however suggested by Daniel et al. (2015) that participants in their study may have had food-specific images come to mind, by associating positive future images with food. Hence, their general manipulation could be more closely alike to our food-specific manipulation. Importantly, our sample of participants was different to the sample of Daniel et al. (2013b, 2015), where results were found for overweight/obese women and children high in dietary restraint. Our sample consisted of female students who were not necessarily motivated to restrict their caloric intake, which could make the possibility to restrict intake of snacks and show restraint seen as irrelevant. Earlier results show that the effect of episodic thinking is related to the vividness of the imagined events: the more vivid the imagery, the greater the reduction in discount rate (Peters & Büchel, 2010). Vividness of imagery was possibly not equal between conditions in this earlier studies (Daniel et al., 2015, 2013b). As all images were rated as equal in vividness, realism, difficulty and details, the current study provided a strong control by generating episodic past events.

As stated in the introduction: we hypothesized that by changing discount rate, caloric intake would also be altered by making less impulsive food choices. However, as no association was observed

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1 We also conducted all analyses with positivity and vividness included as a covariate (data not shown). However, as this did not change the pattern of outcomes, results are reported for the analyses without positivity and vividness included as a covariate.
between discount rate and caloric intake, it appears that this was not the mechanism underlying the effect of EPT on caloric intake. As choices where about money in the current discount task, this measure does not fully capture the real dilemma, choosing between palatable foods or future health outcomes. Though discount rate has been measured with food as a reinforcer before (Dassen et al., 2015; Odum & Rainaud, 2003; Rasmussen, Lawyer, & Reilly, 2010), these measures neither capture the dilemma, because by no discounting of the future in this delay discounting tasks, the future reward would be to receive even more of the (unhealthy) food. Future delay discounting tasks mirroring this dilemma more closely could possibly clarify this. Importantly, as the reinforcing value of food has been found to interact with delay discounting in predicting BMI (Appelhans et al., 2011; Epstein et al., 2014), including a measure of the reinforcing value of food in future studies would possibly contribute to a better understanding of the variation in food consumption. Reducing discount rate may only help to prevent or intervene on obesity in those who are high in food reinforcement. In addition, the snacks provided in the current study consisted of a sample of sweet snacks, yet savory snacks are often also energy dense (de Graaf, 2006). Though data was collected on how much the participants liked the snacks, no data were collected on snacking preferences. As a result, findings from the present study may not be representative for participants who prefer savory snacks over candy.

Results of Cheng, Shein, and Chiou (2012) showed that the effect of a future prime on discount rate and desirability of hedonic activities was mediated by time orientation. Time orientation was measured at a behavior-specific level in the current study. As no differences on the CFC-food subsciles occurred between the EFT and EFT groups, time orientation seems not to be the underlying mechanism which caused changes in caloric intake. However, as CFC is considered to be a stable individual difference (Stratham et al., 1994; Toepoel, 2010), this questionnaire was probably not sensitive to pick up small changes in future orientation as a state. Thus, based on current results, the possibility that the manipulation activated a temporary focus on future health outcomes cannot be excluded. Interestingly, in the current study, for the food-specific manipulation we used a global instruction (think of an event which is related to food), which was not restricted to consider healthy or unhealthy consequences. As unhealthy eaters do not consider future health consequences (Dassen et al., 2015), tailoring the content to goals of weight loss and health benefits could turn...
out even more beneficial (Daniel et al., 2015). However, images should be realistic, as fantasizing has been shown to be not effective in changing behavior (Oettingen, 2012).

Importantly, based on current results, we cannot be sure whether food-related EFT reduced caloric intake, food-related EFT increased caloric intake, or both. Future research should therefore include a neutral control. In order to use EFT as an intervention, we would also like to encourage future studies to look into more detail how long time effects last, as any long term effects remain to be investigated. An interesting next step would be to investigate whether training individuals to engage in EFT would help to delay gratification in daily life.

In conclusion, the current findings indicate that impulsive behaviors can be controlled by envisioning the future vividly. Specifically, generating future images reduces impulsive decision making, whereas only the generating of food-related images influences caloric intake. Thus, it is beneficial to make the content of EFT food-related in order to change eating behavior. The underlying mechanism stays to be discovered as changes in discount rate did not directly result in more restricted caloric intake. Future studies should further explore the mechanisms underlying EFT and examine the longevity of effects on behavior. Current results propose EFT as a promising technique to change concern with immediate gratification to a more future-oriented outlook.

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**References**


