Appetite 116 (2017) 284–290

Contents lists available at ScienceDirect

Appetite

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

“What time is my next meal?” delay-discounting individuals choose smaller portions under conditions of uncertainty

Annie R. Zimmerman*, Danielle Ferriday, Sarah R. Davies, Ashley A. Martin, Peter J. Rogers, Alice Mason, Jeffrey M. Brunstrom

Nutrition and Behaviour Unit, School of Experimental Psychology, University of Bristol, UK

ARTICLE INFO

Article history:
Received 28 September 2016
Received in revised form
10 April 2017
Accepted 9 May 2017
Available online 10 May 2017

Keywords:
Chaotic eating
Impulsivity
Delay discounting
Meal planning
Portion size

ABSTRACT

‘Dietary’ delay discounting is typically framed as a trade-off between immediate rewards and long-term health concerns. Our contention is that prospective thinking also occurs over shorter periods, and is engaged to select portion sizes based on the interval between meals (inter-meal interval; IMI). We sought to assess the extent to which the length of an IMI influences portion-size selection. We predicted that delay discounters would show ‘IMI insensitivity’ (relative lack of concern about hunger or fullness between meals). In particular, we were interested in participants' sensitivity to an uncertain IMI. We hypothesized that when meal times were uncertain, delay discounters would be less responsive and select smaller portion sizes. Participants ($N = 90$) selected portion sizes for lunch. In different trials, they were told to expect dinner at 5pm, 9pm, and either 5pm or 9pm (uncertain IMI). Individual differences in future-orientation were measured using a monetary delay-discounting task. Participants chose larger portions when the IMI was longer ($p < 0.001$). When the IMI was uncertain, delay-discounting participants chose smaller portions than the average portion chosen in the certain IMIs ($p < 0.05$). Furthermore, monetary discounting mediated a relationship between BMI and smaller portion selection in uncertainty ($p < 0.05$). This is the first study to report an association between delay discounting and IMI insensitivity. We reason that delay discounters selected smaller portions because they were less sensitive to the uncertain IMI, and overlooked concerns about potential future hunger. These findings are important because they illustrate that differences in discounting are expressed in short-term portion-size decisions and suggest that IMI insensitivity increases when meal timings are uncertain. Further research is needed to confirm whether these findings generalise to other populations.

1. Introduction

Impulsivity is a multidimensional construct that can be measured in various ways (Evenden, 1999; Whiteside & Lynam, 2016). Delay discounting is a facet of impulsivity, referring to the tendency to respond to the immediate rather than the long-term consequences of a decision (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). It is considered a behavioural-economic index of impulsive decision-making (MacKillop et al., 2011). A non-future oriented individual who discounts delayed rewards is often described as a ‘steep’ delay discounter. Steep temporal discounting has been related to an unhealthy diet, overeating, and obesity (Barlow, Reeves, McKee, Galea, & Stuckler, 2016; Kulendran et al., 2014; Manwaring, Green, Myerson, Strube, & Wilfley, 2011; Rollins, Dearing, & Epstein, 2010). Nevertheless, associations are often weak and unreliable (Appelhans et al., 2011; Eisenstein et al., 2015; Hendrickson, Rasmussen, & Lawyer, 2015; Leitch, Morgan, & Yeomans, 2013; Rasmussen, Lawyer, & Reilly, 2010; Stoeckel, Murdaugh, Cox, Cook, & Weller, 2013; Stojek, Fischer, Murphy, & MacKillop, 2014; Weller, Cook, Avsar, & Cox, 2008).

One explanation for these inconsistencies is that delay discounting can have multiple effects on food decisions. By contrast, the role of temporal discounting is often framed around a single proposition; that impulsive people overeat because they discount long-term health consequences (Zhang & Rashad, 2008). For example, associations between discounting and overconsumption are often attributed to a lack of concern for future weight gain (Barlow et al., 2016). This perspective stands at odds with research in both humans (Gregorios-Pippas, Tobler, & Schultz, 2009;

* Corresponding author.
E-mail address: annie.zimmerman@bristol.ac.uk (A.R. Zimmerman).

http://dx.doi.org/10.1016/j.appet.2017.05.019
0195-6663/

Mcclure, Ericson, Laibson, Loewenstein, & Cohen, 2008; Tanaka et al., 2004) and non-human animals (Mazur, 2001; Shelley, 1993), which shows that temporal discounting operates over much shorter delays of seconds and minutes. Recent studies have found that humans also discount the value of food and drink at intervals as short as 30 s (Hendrickson & Rasmussen, 2013; Lumley, Stevenson, Oaten, Mahmut, & Yeomans, 2016; Rasmussen et al., 2010). This indicates that people also discount short-term consequences of dietary decisions, rather than just long-term concerns about health or weight gain. In the present study we considered the prospect that dietary discounting occurs over an intermediate time frame (hours rather than years) and is evident in the selection of portion sizes from one meal to the next.

The majority of meals are planned in advance – people tend to select a portion to eat and then clean their plate (Fay et al., 2011; Wilkinson et al., 2012). Portion size is often governed by the 'expected satiety' of a food – a concern to select an amount that is sufficient to stave off hunger (the desire to eat) in the interval between meals (Brunstrom & Rogers, 2009; Brunstrom, Shakeshaft, & Scott-Samuel, 2008). Anticipated meals timings probably influence these decisions. However, no studies have systematically explored this phenomenon and it remains unclear how monetary delay discounting relates to meal planning in this context. To address these questions we explored the extent to which the length of an inter-meal interval (IMI) influences lunchtime portion-size selection.

One possibility is that meal planning might be less evident in steeper discounters. People plan their behaviours by evaluating the future consequences of a decision (da Matta, Gonçalves, & Bizarro, 2012). However, impulsive decision-makers may fail to consider all relevant information before making a choices (Verplanken & Sato, 2011). Given this logic, we anticipated that steep delay discounters would be less concerned with the relative consequences of a long or short IMI when making in-the-moment portion-size judgements. Therefore, we reasoned that steep discounters would show 'IMI insensitivity', (a relative lack of concern for potential hunger or fullness during the IMI) and have a smaller difference between portion sizes chosen at a short and long IMI.

In addition, we are interested in the effects of an uncertain IMI. Traditionally, a Westernised meal pattern comprises three primary meals; breakfast, lunch, and dinner. However, sometimes the IMI is uncertain. Recently, there has been an increase in 'chaotic eating' - snacking and eating meals at different times on different days (Samuelson, 2000; Warde & Yates, 2016). Irregular eating is associated with having a higher BMI (Sierra-Johnson et al., 2008) and is thought to be a contributing factor to high-energy intake and weight gain (Berg & Forslund, 2015; Murata, 2000). Unsurprisingly, various dimensions of impulsivity have been associated with chaotic eating behaviours, including opportunistic snacking and a preference for snack foods (Fay, White, Finlayson, & King, 2015; Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010).

One possibility is that irregular meal times encourage impulsive behaviours because they generate uncertainty. Uncertainty has been shown to increase delay discounting; individuals discount future rewards more steeply when the delayed event is perceived to be more risky or less certain (Baumann & Odum, 2012; Green & Myerson, 2010; Patak & Reynolds, 2007). It is important to mention that these studies manipulated the likelihood of an event occurring, rather than uncertainty around the exact timing of an event. We propose that uncertainty about the timing of an event may also increase discounting. When IMIs are certain, individuals can make predictions about future hunger or satiety. However, when event timings are variable, it is harder to plan for the future (Greville & Buehner, 2010). On this basis, uncertainty may increase discounting of information about future meal timings. To protect against the potential for hunger, individuals who are sensitive to the future might select larger portions when the IMI is uncertain. Conversely, steep discounters may be less responsive. Hence, we hypothesized that when meal timings were uncertain, steep delay discounters would select portion sizes that are smaller the average of those chosen when meal times were certain. We considered evidence for this hypothesis by systematically manipulating the certainty of an IMI.

In the present study we measured portion selection in response to information about the IMI. Participants chose lunch portions in three different conditions; two where the IMI was 'certain' (dinnertime at 5pm and 9pm), and one where the IMI was 'uncertain' (dinnertime at either 5pm or 9pm). To measure individual differences in future-oriented decision-making we used a standard monetary delay-discounting task. Our primary hypothesis was that information about future meal timings would influence portion selection at lunchtime. Specifically, we predicted that portion sizes would differ in each of the three conditions and that participants would select smaller portions with a certain short IMI, compared to a certain long IMI. Second, we proposed that steep money discounting would be associated with IMI insensitivity in both certain and uncertain conditions. When the IMI was certain, we hypothesized that steep discounters would show a smaller difference between portions chosen at 5pm and 9pm. When the IMI was uncertain, we expected steep discounters to select smaller portion sizes than the average of those chosen when meal times were certain. Finally, to explore how BMI relates to future-oriented decision-making, we assessed relationships between BMI, portion size, and monetary delay discounting.

2. Method

Participants: Participants ($N = 90$; 61 females, 29 males) had a mean age of 21.2y ($SD = 4.7$) and were healthy staff or undergraduate and postgraduate students at the University of Bristol, recruited through our laboratory volunteer database or as part of a course requirement. They received either £5 (Sterling) or course credits in remuneration for their assistance. The protocol was approved by the local Faculty of Science Human Research Ethics Committee. *A priori*, we thought it was crucial that participants were familiar with the foods we were including in the experiment. Therefore, we excluded fifteen participants who indicated eating either of the test foods either *'never'*, or *'less than once a year'*. A further five participants were excluded for selecting the minimum portion of chow mein (20 kcal) for lunch, in every condition. We suspect this reflects a technical error or otherwise a problem in understanding the requirements of the tasks. Six participants had missing data for the delay-discounting task due to a technical error. In these cases, values were entered as missing data. The final dataset comprised 70 participants (46 females, 24 males), with a mean age of 21.0 years ($SD = 4.2$), and a mean BMI = 21.68 kg/m^2 ($SD = 2.6$; range = 16.6–27.1). In total, 7 participants were underweight, 55 participants were lean and 8 were overweight.

Food images: Based on previous research (Brunstrom, Collingwood, & Rogers, 2010) we selected two different dishes that are commonly consumed as main meals in the UK: chicken chow mein and chicken tikka masala with rice. For each dish, we photographed a series of 50 images with portion sizes ranging from 20 kcal to 1000 kcal, in equal 20-kcal steps. The images were taken using a high-resolution digital camera under identical lighting conditions. The meals were photographed on the same white plate