Eating less from bigger packs: Preventing the pack size effect with diet primes

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Abstract

An increase in the package size of food has been shown to lead to an increase in energy intake from this food, the so-called pack size effect. Previous research has shown that providing diet-concerned individuals with a reminder, or prime, of their dieting goal can help them control their consumption. Here, we investigated if providing such a prime is also effective for reducing the magnitude of the pack size effect. We conducted two experiments in which the cover of a dieting magazine (Experiment 1) and diet-related commercials (Experiment 2) served as diet goal primes. Both experiments had a 2 (pack size: small vs. large) x 2 (prime: diet vs. control) x 2 (dietary restraint: high vs. low) between participants design. We measured expected consumption of four snack foods in Experiment 1 (N = 477), and actual consumption of M&M's in Experiment 2 (N = 224). Results showed that the diet prime reduced the pack size effect for both restrained and unrestrained eaters in Experiment 1 and for restrained eaters only in Experiment 2. Although effect sizes were small, these findings suggest that a diet prime motivates restrained eaters to limit their consumption, and as a result the pack size has less influence on the amount consumed. We discuss limitations of this research as well as potential avenues for further research and theoretical and practical implications.

Keywords

pack size effect, portion size effect, goal priming, dietary restraint, consumption quantity decisions, dieting goal

Highlights

- We tested if a diet prime reduces the pack size effect among restrained eaters.
- When the dieting goal is active, restrained eaters manage to control consumption.
- We measured expected consumption and actual consumption of tempting snacks.
- The diet prime reduced the pack size effect for restrained eaters.

Introduction

An increase in the portion or pack size has been shown to lead to an increase in energy intake (Diliberti, Bordi, Conklin, Roe, & Rolls, 2004; Fisher & Kral, 2008; Levitsky & Youn, 2004; Rolls, Morris, & Roe, 2002; Rolls, Roe, Kral, Meengs, & Wall, 2004; Rolls, Roe, & Meengs, 2007; Stroebele, Ogden, & Hill, 2009; Wansink, 1996) and to weight gain (French et al., 2014). The phenomenon that people eat more when more food is available, is often referred to as the portion or pack size effect[1]. Portion and pack sizes have increased considerably in the past years (Nielsen & Popkin, 2003) and this increase has been identified as one of the main causes of the rise in overweight and obesity (Chandon, 2013; Hill & Peters, 1998; Rozin, Kabnick, Pete, Fischler, & Shields, 2003; Young & Nestlé, 2002). It thus seems important to develop ways of diminishing the portion and pack size effect.

So far, studies aimed at reducing the magnitude of the portion and pack size effect either had no or only limited success. Different types of mindfulness exercises did not reduce the portion size effect (Cavanagh, Vartanian, Herman, & Polivy, 2014; Marchiori & Papies, 2014), telling participants that portion sizes had been randomly determined did not affect their impact (Marchiori, Papies, & Klein, 2014), and placing a serving size recommendation on the pack somewhat reduced the pack size effect but did not completely remove it either (Spanos, Kenda, & Vartanian, 2015; Versluis, Papies, & Marchiori, 2015). Hence, in the current study, we investigated another method to reduce the magnitude of the pack size effect. More specifically, we tested if exposure to a diet goal prime can help individuals with a dieting goal to keep their consumption under control and as a result, diminish the pack size effect.

Pursuit of goals has been recognized as an important driver of consumer behaviour in general (Kopetz, Kruglanski, Arens, Etkin, & Johnson, 2012; Osselaer & Janiszewski, 2012) and eating behaviour in particular (Stroebe, van Koningsbruggen, Papies, & Aarts, 2013). For many people, eating behaviour is influenced by the goal to stay slim or even lose weight

(Andreyeva, Long, Henderson, & Grode, 2010; Bish, et al., 2005). One group that has received particular research attention are restrained eaters, or chronic dieters, who chronically try to restrict their food intake in order to control their body weight. While these dieters often overeat when exposed to attractive food cues (Fedoroff, Polivy, & Herman, 1997, 2003; Harris, Bargh, & Bronwell, 2009) they do manage to control their consumption when exposed to reminders of their dieting goal (Anschutz, Van Strien, & Engels, 2008; Papies & Hamstra, 2010; Buckland, Finlayson, Edge, & Hetherington, 2014; Papies, Potjes, Keesman, Schwinghammer & van Koningsbruggen, 2014; Papies & Veling, 2013; see Papies, 2016, for an overview). Papies and Hamstra (2010), for example, showed that the number of meat snacks consumed by restrained eaters was significantly lower when they were exposed to a poster with health and diet words than when they were not exposed to such a poster. Similarly, Buckland et al. (2014) showed that dieters reduced their intake of a tempting snack when exposed to diet-congruent images instead of control images. These findings are consistent with goal priming research more generally which has shown that priming a goal by external cues can trigger goal-directed behaviour, if the primed goal is indeed regarded as desirable (Aarts, Custers, & Veltkamp, 2008; Custers & Aarts, 2005; Papies, 2016).

While this work suggests that a diet prime can reduce consumption of restrained eaters, we do not yet know whether it can also reduce the pack size effect. A prominent explanation for the pack size effect is that the portion or pack size communicates a consumption norm that people use as a guidance for how much is appropriate to eat (Rolls, Morris, & Roe, 2002; Wansink, 2010; Wansink & van Ittersum, 2007; Wansink & Chandon, 2014). More specifically, Herman, Roth & Polivy (2003) and Herman and Polivy (2005, 2014) argue that portion and pack sizes act as upper limits for intake and define how much can be maximally eaten without being perceived as an excessive eater. As a result, bigger packs thus allow greater consumption. Here, we suggest that if restrained eaters are reminded

of their dieting goal, for example through a diet prime, they will be motivated to restrict their intake in order to pursue the dieting goal, instead of relying on the pack size as a reference point for how much to eat. Since pursuing the dieting goal will decrease intake especially from large packs, while having less impact on the already reduced intake from smaller packs, this will weaken the pack size effect. We thus hypothesized that for restrained eaters, a diet prime would reduce consumption from large packs and hence diminish the magnitude of the pack size effect. Since for unrestrained eaters, dieting is not a relevant goal, they should, in contrast, not be affected by the diet prime.

To test these predictions, we conducted one online experiment and one laboratory experiment. In the online experiment, we measured expected consumption and tested if exposure to a diet prime (the cover of a dieting magazine) would lower the pack size effect for restrained but not unrestrained eaters. We chose an online method for our initial study as previous work has shown that the portion and pack size effect is also present when measuring expected consumption instead of actual consumption (Robinson, Te Raa, & Hardman, 2015; Versluis et al., 2015). In the laboratory experiment, we measured actual consumption of candies and again tested if exposure to a diet prime (dieting commercials) would affect the pack size effect for restrained eaters.

Experiment 1

In this experiment, we investigated the effect of a diet prime on the expected consumption of four tempting snacks. Participants took part in two ostensibly unrelated studies. In the first study, they were asked to evaluate a magazine cover on a number of characteristics. As in Van Koningsbruggen, Stroebe, and Aarts (2011), half of the participants were presented with the cover of a dieting magazine, while the other half saw the cover of a travel magazine. In the second study, participants indicated how much they expected to eat from four snacks, which were presented in either large or small packs.

Methods

Design

The experiment had a 2 (pack size: large vs. small) X 2 (prime: dieting goal vs. control) X 2 (dietary restraint: high vs. low) between participants design. Participants were randomly assigned to the one of the four experimental conditions, and dietary restraint was assessed as a continuous individual difference variable.

Participants

The sample consisted of members of the general Dutch population between 18 and 55 years old. Participation was restricted to consumers without a food allergy and who were not on a diet that would prohibit them from eating the snack foods in the study. As participants had to estimate their consumption, we expected that the variance in the data would be relatively high, and that effect sizes would thus be relatively low. Hence, we recruited a large sample size to obtain sufficient power. We aimed to recruit around 500 participants, for a power of 0.99 with an effect size of 0.2, and a power of 0.61 with an effect size of 0.1 (Cohen, 1988; Zhang & Yuan, 2015). A total of 556 participants began participating in the study, and 510 completed it. Of these, 19 participants were excluded from analysis because of poor data quality (completing the survey in less than 5 minutes, while the mean completion time was 15 minutes (*SD* = 11); giving the same answer to at least 21 of the 22 *agree*/*disagree* and *true*/*false* statements). Another 2 participants were excluded because they correctly guessed the purpose of the study as investigating the impact of the magazine cover on expected consumption. Finally, 12 participants misunderstood the expected consumption question and were therefore excluded [2]. This led to a final sample of 477 participants, of which 244 were women. The mean age was 40 years (SD = 11).

Procedure

Participants were recruited by panel agency GMI, who also provided them with a small monetary compensation for participation. The questionnaire was administered in Dutch. Participants were informed that they would be participating in two separate studies of a Dutch University. After introductory questions about food allergies and age, participants were presented with either the cover of the dieting magazine ‘Get in shape’ or the cover of the travel magazine ‘Time for travel’. After participants answered the questions about the magazine cover, they were directed to the second study. Here, they were presented with snack eating scenarios to assess expected consumption of the four snack foods. For chocolate, participants were presented with a picture of a chocolate bar in its actual size and with the following scenario: ‘Imagine that it is afternoon and you feel like eating something tasty. You decide to unwrap the chocolate bar shown below. The total weight of the bar is 180 (75) gram. How many pieces of chocolate do you think you will eat?’. Participants then typed the number of chocolate pieces in an input box to indicate their expected consumption. To clarify what we meant by a piece of chocolate, we displayed a picture of one chocolate piece next to the input box. The scenario for M&M’s, chips and cocktail nuts was similar, only in this case, consumption was asked in ‘hands’ instead of ‘pieces’. The screen showed a picture of a hand holding a small amount of the snack, and we asked participants how many of these hands they expected to eat. Table 1 gives an overview of the snack foods and pack sizes used in the study. Please refer to the online supplementary material for screenshots of the consumption scenarios. The order in which the four foods were presented was randomized. Finally, participants completed a number of additional questionnaires and were debriefed.

Table 1: Pack size and measurement of expected consumption of the four snack foods in Experiment 1

	Size small pack	Size large pack	Measurement unit for expected consumption (DV)
Milk chocolate	75gr	180gr	Pieces
Peanut M&M's	165gr	400gr	Hands
Chips with paprika flavour	120gr	300gr	Hands
Cocktail nuts (peanuts in a crispy coating)	120gr	300gr	Hands

Materials

The health magazine 'Get in shape' featured a photo of the silhouette of a woman jumping into the arms of a man. Both models had a healthy weight. The headlines on the cover referred to weight loss, diets, discipline, and fitness. The travel magazine was a 'city special' which showed images of London and featured headlines related to city trips. The design and colour palette of both magazines was similar (see online supplementary material).

For the consumption scenario of the chocolate, we showed a picture of either a 180 gram (30 pieces) or a 75 gram (14 pieces) plain milk chocolate bar of the Dutch brand Verkade. For the cocktail nuts, the large pack was represented by a 300 gram bag of the Dutch brand Duyvis. At the time of the research, the cocktail nuts were not commercially available in a small pack size, hence the image of the large pack was manipulated in Jasc Paint Shop Pro (Version 7, Jasc Software, Inc.) to look like a 120 gram pack. For M&M's, we used the Dutch 'Maxi' bag to represent a large pack (400 gr), and a portion bag available in the US to represent a smaller pack (165 gr). The small and large bag of chips were represented by an image of respectively a 120 gram bag and a 300 gram bag of paprika-flavoured chips of the brand Lays. All packs were shown at their actual size, except for the bags of chips which were shown at approximately 65% to make them fit on the screen. All packs were visibly held by a hand which served as a size reference to judge the actual size of the pack. In case nutrition information was visible on the front of the pack, this was removed.

Other measures

The measures that are included in the subsequent analyses are listed here. For all other measures please refer to the online supplementary material. All scales are 7-point scales, unless stated otherwise. For two randomly selected snacks we asked participants to explain how they had determined their expected consumption (open-ended question). Next, participants indicated their size impression (*very small* to *very big*, *don't remember*) of each pack of snack food shown in the expected consumption questions. We then asked how difficult or easy it was for the participants to indicate their expected consumption. To measure participants' general portion size preferences, we asked them to evaluate a 30 gram portion of each snack food (*way too little* to *way too much*). Participants then filled in the dietary restraint subscale of the Three Factor Eating questionnaire (Stunkard & Messick, 1985; $\alpha = 0.86$). Next, participants indicated if they were currently trying to lose weight (yes, a bit, no) and completed the perceived self-regulatory success scale (Fishbach, Friedman & Kruglanski, 2003; $\alpha = 0.84$). This was followed by statements regarding the tendency to eat the whole pack: 'If I open a package with sweets or salty snacks, I usually eat the whole package, regardless of its size', 'It is easy for me to close a package from which I am eating, so I can save some for later, and 'I almost never eat the whole contents of a package', $\alpha = 0.79$. We then asked some questions about each of the snack foods in the study, including consumption frequency (eat at least once a week; eat at least once a month; eat at least once a year; ate it in the past, but not in the past year; I never eat it) and liking. We assessed current hunger by two questions ('How hungry are you at this moment?'; 'How much could you eat right now?'; $\alpha = 0.87$). Next, participants provided their gender, weight and height. Finally, participants wrote down what they thought the purpose of each of the two studies was, before they were debriefed and could write down general comments.

Data analysis

Statistical methods

We used two-way analysis of variance (ANOVA) and chi-square tests to determine if there were differences between experimental conditions with regard to participant characteristics. To test our hypothesis concerning the effect of diet prime and pack size on expected consumption of restrained eaters, we used a general linear model (GLM) to conduct regression analyses in which pack size and prime were included as factors and dietary restraint as a continuous variable, as well as all interaction terms. To further examine the nature of the interactions with the continuous restraint variable, we used a simple slopes analysis as described by Aiken and West (1991), to compare the effects of pack size and diet prime at a high score on dietary restraint (1 SD above the mean) and a low score on dietary restraint (1 SD below the mean). Furthermore, as we made a specific a-priori prediction regarding the effect of the diet prime on restrained eaters who were provided with a large pack of snack food, we tested this effect directly using the relevant contrast, rather than relying merely on the three-way interaction omnibus test (see Hanock & Klockars, 1996). We tested this contrast within the GLM, and using simple slopes analysis, we compared expected consumption from a large pack in the diet prime and control conditions at a dietary restraint score that lay 1 SD above the mean. Finally, to examine potential effects of other variables such as BMI and self-regulatory success, we included them in the GLM, and in case of a significant moderating influence, we used simple slopes analyses to further examine their effect on pack size or prime.

All analysis were carried out with SPSS (release 20.0.0, 2011). An α-level of 0.05 was used for all statistical tests. As a measure of effect size we reported partial eta squared and used the following rules of thumb for interpretation of the effect size: small is 0.01, medium is

0.06 and large is 0.14 (Cohen, 1988). We did not include effect sizes for effects that were not or only marginally significant, as these effects sizes were consistently very small.

Data transformation

Although data of participants who indicated extreme expected consumption amounts were excluded as described above, there were still participants who indicated that they would consume more than the contents of the whole pack. The answers to the open-ended questions suggested that many of these participants assumed that the amount they filled in corresponded to eating the whole pack. It is thus likely that most of these answers were simply wrong estimations of how much is in the pack. We therefore replaced these answers by the contents of the whole pack, which resulted in replacements for respectively 10 and 34 participants in the large and small pack condition. In addition, however, we provide the results without replacements or when excluding these participants, which leads to similar conclusions as our main analyses.

Results

Randomization check

There were no significant differences between the four conditions with regard to gender, BMI, dietary restraint, current dieting behaviour, hunger, liking of the snacks, consumption frequency of the snacks, general portion size preferences and tendency to eat the whole pack (all *p*s > 0.10).

As can been seen in Table 2, participants in the control condition had a somewhat higher score on the perceived self-regulatory success scale than those in the diet prime condition, $F(1, 473) = 5.01$, $p = 0.03$, $\eta_p^2 = 0.01$. Since including this variable as a covariate did not change any of the results reported below, we report results without self-regulatory success as a covariate.

Table 2: Participants' characteristics across conditions. Standard deviations are provided in parentheses.

	Control condition		Diet prime condition	
	Small pack	Large pack	Small pack	Large pack
% Female	56% (N = 66)	51% (N = 65)	49% (N = 53)	49% (N = 60)
% Currently dieting	57% (N = 67)	50% (N = 64)	52% (N = 57)	57% (N = 69)
BMI (kg/m^2)	25.37 (5.21)	25.11 (5.48)	25.83 (4.65)	26.12 (5.15)
Dietary restraint	7.81 (4.78)	7.94 (4.96)	7.23 (4.46)	7.15 (5.23)
Self-regulatory success	4.12 (1.49)	4.24 (1.49)	3.87 (1.46)	3.87 (1.51)
Hunger	3.11 (1.47)	3.12 (1.49)	3.29 (1.56)	2.86 (1.48)

Effect of pack size, prime, and dietary restraint

We transformed expected consumption from pieces / hands to grams and averaged consumption across the four snack foods. Average expected consumption was 52.7 grams (*SD* = 43.6). Men expected to consume around 9 grams more than women, $t(475) = 2.29$, $p = 0.02$. Sixteen participants reported that they would not eat anything from any of the snacks. We did not exclude these participants, however, as not expecting to eat anything could be the result of our diet prime.

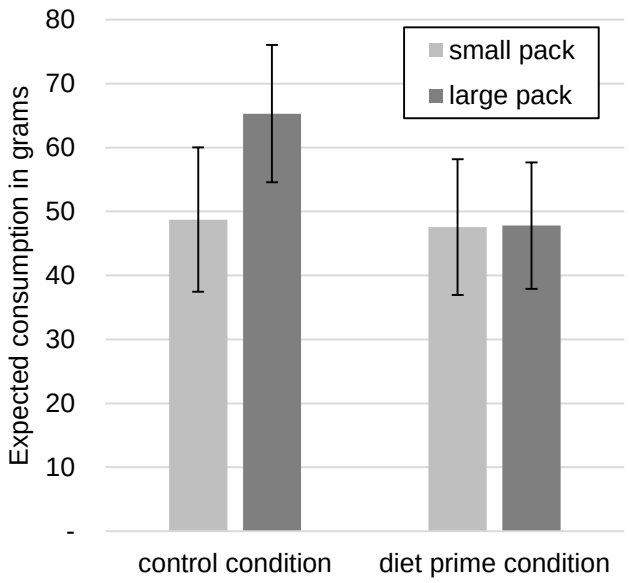
Our main regression analysis conducted in the general linear model (GLM) showed that both prime and pack size had a main effect on expected consumption, $F(1, 469) = 5.78$, $p = 0.02$, $\eta_p^2 = 0.01$, and $F(1, 469) = 4.68$, $p = 0.03$, $\eta_p^2 = 0.01$, respectively. The interaction of prime and pack size was also significant, $F(1, 469) = 4.42$, $p = 0.04$, $\eta_p^2 = 0.01$, and can be seen in Figure 1. To examine this interaction further, we analysed the simple main effects of pack size in the control and diet prime conditions separately. This showed that the pack size effect was significant in the control condition, $F(1, 469) = 9.40$, $p < 0.01$, $\eta_p^2 = 0.02$, but not in

the diet prime condition, $F(1, 469) < 0.01$, $p = 0.97$. Thus, the diet prime reduced the pack size effect.

In addition, dietary restraint had a main effect on expected consumption, $F(1, 469) = 20.35$, $p < 0.01$, $\eta_p^2 = 0.04$, such that participants with higher restraint scores expected to eat less of the snacks. However, contrary to our prediction, restraint did not moderate the effect of pack size, prime or their interaction, all *p*s > 0.14.

Finally, we directly contrasted consumption in the diet prime condition with consumption in the control condition separately for restrained eaters and for unrestrained eaters who were presented with a large pack. A simple slopes analysis revealed that expected consumption of restrained eaters (1 SD above the mean) in the large pack condition, was significantly lower in the diet prime condition than in the control condition, $F(1, 469) = 4.25$, $p = 0.04$, $\eta_p^2 = 0.01$. The diet prime was equally effective, however, for unrestrained eaters in the large pack condition, $F(1, 469) = 7.04$, $p = 0.01$, $\eta_p^2 = 0.01$.

Fig. 1: Average expected consumption in the control and diet prime conditions when presented with a large or a small pack of snack foods. Since the diet prime reduced expected consumption in the large pack condition similarly for restrained and unrestrained eaters, means are collapsed across these groups.



Assessing the influence of "whole pack eaters"

As indicated previously, some participants reported that they would eat an amount equal to or greater than the contents of the whole pack. In the preceding analysis we replaced these answers by the maximum amount in the pack. To assess the impact of this transformation, we conducted two additional analyses: using the untransformed data, and excluding these participants from analysis.

The GLM with the untransformed data showed a main effect of prime, $F(1, 469) = 5.56$, $p = 0.02$, $\eta_p^2 = 0.01$, no main effect of pack size, $F(1, 469) = 1.01$, $p = 0.32$, and an interaction of prime and pack size, $F(1, 469) = 4.09$, $p = 0.04$, $\eta_p^2 = 0.01$. Again, the pack size effect was significant in the control condition, $F(1, 469) = 4.74$, $p = 0.03$, $\eta_p^2 = 0.01$, but not in the diet prime condition, $F(1, 469) = 0.50$, $p = 0.48$.

Repeating the analysis without the 44 participants for which replacements were made, showed a main effect of pack size, $F(1, 425) = 8.23$, $p < 0.01$, $\eta_p^2 = 0.02$, no main effect of prime, $F(1, 425) = 1.06$, $p = 0.30$, and a marginally significant interaction, $F(1, 425) = 2.71$, $p = 0.10$, $\eta_p^2 = 0.01$. Again, the pack size effect was significant in the control condition, $F(1,$

425) = 10.16, $p < 0.01$, $\eta_p^2 = 0.02$, but not in the diet prime condition, $F(1, 425) = 0.73$, $p = 0.39$.

In sum, using either the untransformed data or removing "extreme" responses did not lead to different conclusions than our main analysis. In all three analyses, the diet prime reduced the pack size effect.

Additional analyses

Additional regression analyses showed that hunger, liking of the snack foods, BMI and gender did not moderate the effect of either pack size or prime on expected consumption, all *p*s > 0.09. Perceived self-regulatory success showed a significant interaction with pack size, $F(1, 466) = 4.83$, $p = 0.03$, $\eta_p^2 = 0.01$, such that the pack size effect was only significant at low perceived self-regulatory success, $F(1, 466) = 9.85$, $p < 0.01$, $\eta_p^2 = 0.02$, and not at high success, $F(1, 466) < 0.01$, $p = 0.99$.

Discussion

This experiment confirmed that a diet prime can diminish the pack size effect. This suggests that a diet prime motivates consumers to keep their consumption under control, and as a result they rely less on the pack size to determine the appropriate consumption amount. Contrary to our hypothesis, however, the effect of the diet prime was not moderated by dietary restraint. A possible explanation is that the diet prime not only activated a health goal, but also communicated the social norm of keeping consumption under control. To prevent coming across as excessive eaters, both restrained and unrestrained eaters might have limited their consumption after having been exposed to the magazine cover displaying social reminders of a healthy lifestyle (Herman, Roth & Polivy, 2003; Herman & Polivy, 2014).

Although this experiment provided some initial support for diet primes as effective ways to reduce the pack size effect, there are also some important limitations. First, we only measured expected consumption, such that participants made a single decision about how

much they would eat in a hypothetical situation. In addition, no actual food was present, and participants did not have to monitor their consumption while actually eating and enjoying the food. Both of these factors might have made it relatively easy for participants to regulate their expected consumption. To determine if diet primes also reduce the pack size effect when participants actually eat from a tempting snack, Experiment 2 was designed to replicate the design of Experiment 1, while including actual snack consumption as our dependent variable. This also allowed us to examine whether the effect of a diet prime would be moderated by participants' restrained status when in an actual eating situation, as we initially hypothesized. Finally, although the findings of Experiment 1 were promising, effect sizes were rather small. This might be due to the large variance in hypothetical consumption amounts that participants provided, and might also be different in an actual eating situation.

Experiment 2

In Experiment 2, we investigated the effect of pack size and diet prime on consumption of M&M's in a laboratory setting. Participants could freely eat from either a large or small bag of M&M's while watching movie clips and commercials. Exposure to the diet prime was manipulated via these commercials, which were either about diet-related products or about products unrelated to dieting or food.

Methods

Design

The design was the same as in Experiment 1.

Participants

Dutch university students between 18 and 26 years participated for course credit or a small monetary compensation. We expected that the variance in the data would be less than in Experiment 1, as we now measured actual consumption instead of expected consumption. Based on an expected effect size of 0.2, we aimed to recruit at least 200 participants to obtain

0.80 power (Cohen, 1988; Zhang & Yuan, 2015). When signing up for the study, participants were informed that they would be asked to watch and evaluate movie clips. The provision of a snack was not mentioned in the study description. We excluded participants with food-related allergies or diseases from analyses (N = 15). We furthermore excluded participants who guessed that our study purpose was to assess the effect of the movie clips / commercials on the amount of M&M's consumed (N = 19). The final sample consisted of 224 participants (92 women). Their mean age was 21 years (*SD* = 1.6). The experiment was approved by the ERIM Internal Review Board of Erasmus University.

Procedure

Upon arrival in the lab, participants were brought to individual cubicles by the experimenter and received an instruction sheet. Participants were informed that they were about to watch a number of different movie clips and that some snacks would be available which they could eat freely while watching. An open package of M&M's, water and a napkin were present on the desk in each cubicle. All other materials and questions were presented on the computer. The participants first answered a question about the instructions to make sure participants had read them. After completing some mood ratings, which also unobtrusively included questions assessing current hunger and satiety, participants started with the first of three blocks of clips. Each block consisted of two commercials and a movie clip. After each block, participants were asked to recall both the movie and the products advertised in the commercials. They also rated the movie clip on different aspects. When participants finished the rating of the third movie clip, they were instructed to call the experimenter, who removed the pack of M&M's and started the second part of the questionnaire, which contained eating and diet-related questions. Debriefing information was provided via an e-mail which was sent the day after the last day of the experiment. Before and after each session, the M&M packages were weighed to determine how much each participant had consumed.

Materials

The diet commercials were chosen to prime a dieting goal without inducing negative body-related affect in restrained eaters. The diet commercials were about Dannon Light & Fit yoghurt, Weight Watchers, Nike Basketball, and Special K breakfast cereals. The message of each commercial was focussed on resisting tempting foods, starting with dieting, setting and reaching your goals, and a weight loss plan. The non-diet-related commercials were for Ikea garden furniture, Intel, Philips Ambilight, Jeep Renegade, Amazon Kindle, and FedEx. In these commercials and in the movie clips, no references were made to dieting, food, or exercise. In the diet prime condition, blocks 1 and 3 showed one 30 second commercial about a diet-related product and one 30 second commercial unrelated to dieting, so that participants would be less likely to guess the purpose of the study. In block 2, we showed a dieting commercial of 30 seconds and a motivational exercise commercial of 90 seconds. The exercise commercial was included to appeal to males, as commercials for dieting products are almost exclusively aimed at females. To make the viewing experience realistic, we chose the length of the commercials such that the commercial block would not last longer than the movie clip. In the diet prime condition, participants were thus exposed to four diet-related commercials which took up 2 minutes and 30 seconds of the total viewing time of 16 minutes.

Participants received peanut M&M's in either a 'Maxi' 400 gram bag or a 200 gram bag. The opening of the bag was cut to about 6 cm, large enough for the M&M's to pour out easily, but small enough to prevent participants from reaching into the bag with their hand. Water was provided in a 0.5L jug.

Other measures

The measures that were included in the subsequent analyses are listed here. For all other measures please refer to the online supplementary material. Before watching the clips, feelings of hunger and fullness were assessed together with a number of other feelings,

including happy, sad, relaxed, irritated, enthusiastic and thirsty. These questions were framed as 'to what extent do you feel…' (1 = *not at all* to 7 = *very much*), and they were repeated at the end of the experiment, before the demographic questions. Just before the researcher removed the bag of M&M's, participants were asked what they thought the purpose of the first part of the study was. Liking, consumption frequency of M&M's, and general portion size preference were assessed with the same questions as in Experiment 1. The measures for dietary restraint (α = 0.88), current dieting behaviour, perceived self-regulatory success (α = 0.67), and tendency to eat the whole pack (α = 0.79) were also the same as in Experiment 1. Finally, participants indicated their gender, height and weight.

Data analysis

The same analysis procedures were used as in Experiment 1.

Results

Randomization check

There were no significant differences between the four experimental conditions with regard to perceived self-regulatory success, dietary restraint, gender, BMI, current dieting behaviour, hunger, fulness, liking of the M&M's, consumption frequency of the M&M's, and general portion size preference (all *ps* > 0.05, see Table 3).

Table 3. Participants' characteristics across conditions. Standard deviations are provided in parentheses.

	Control condition		Diet prime condition	
	Small pack	Large pack	Small pack	Large pack
% Female	48% (N = 32)	43% (N = 24)	34% (N = 16)	36% (N = 20)
% Currently dieting	33% (N = 22)	13% (N = 7)	28% (N = 13)	27% (N = 15)
BMI (kg/m^2)	22.24 (2.28)	21.65 (2.2)	21.86 (2.14)	22.76 (2.8)

Dietary restraint	8.14 (5.33)	6.89 (4.26)	7.43 (4.80)	7.04 (5.26)
Self-regulatory success	4.27 (1.30)	4.40 (1.23)	4.47 (1.14)	4.45 (1.19)
Hunger (before eating)	3.55 (1.75)	3.79 (1.57)	3.77 (1.58)	3.71 (1.85)
Fullness (before eating)	3.79 (1.41)	3.43 (1.29)	3.55 (1.28)	3.60 (1.44)

Effect of pack size, prime, and dietary restraint

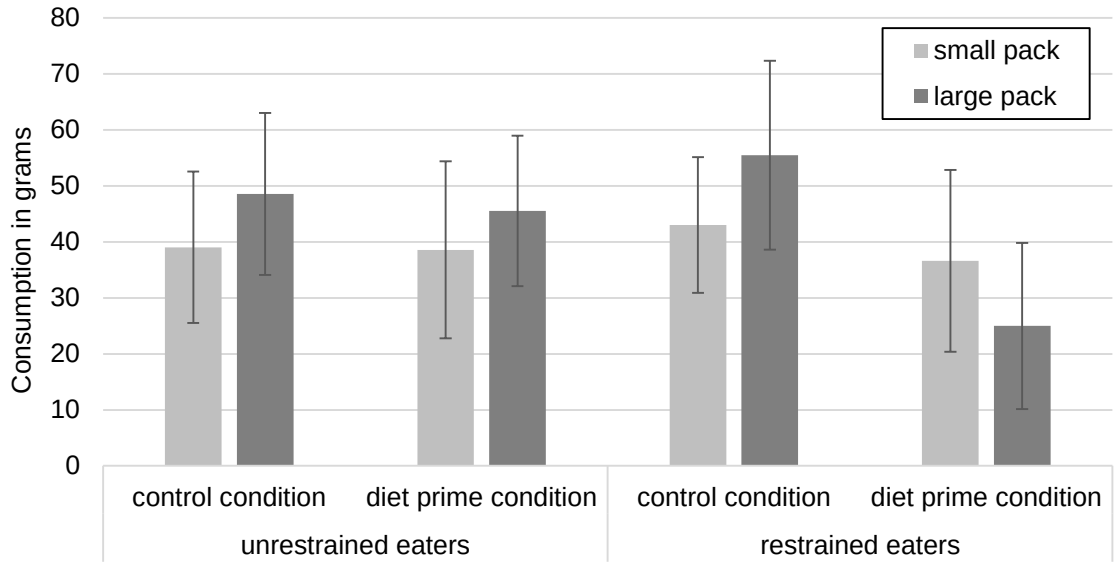
Average consumption was M = 41.9 (SD = 39.0) grams of M&M's which translates into 214 kcal. Men and women consumed similar amounts, $t(222) = 1.53$, $p = 0.13$. Fifty-nine participants refrained from eating any M&M's.[3] We did not exclude these participants from analyses as the study instructions did not require participants to eat something. Furthermore, not eating could also be the result of our diet prime.[4]

Results showed that, contrary to our hypothesis, there was no main effect of pack size, $F(1, 216) = 0.69$, $p = 0.41$. The main effect of prime, however was marginally significant, $F(1, 216) = 3.72$, $p = 0.06$, $\eta_p^2 = 0.02$, such that participants who were exposed to diet commercials (M = 36.9, SD = 33.3) consumed somewhat less than control participants (M = 46.0, SD = 42.9). Again in contrast to Experiment 1, the interaction of prime and pack size was not significant, $F(1, 216) = 1.62$, $p = 0.20$. Restraint did not significantly moderate the effect of pack size, prime or their interaction, all ps > 0.12, and also did not have a main effect on consumption, $F(1, 216) = 0.30$, $p = 0.59$.

Based on our a-priori prediction, we then directly contrasted consumption in the diet prime condition with consumption in the control condition separately for restrained eaters and for unrestrained eaters who were provided with a large pack. As predicted, the consumption of restrained eaters (1 SD above the mean) in the large pack condition, was significantly lower in the diet prime condition (M = 24.98, SE = 7.54) than in the control condition (M = 55.47, SE = 8.56), $F(1, 216) = 7.15$, $p < 0.01$, $\eta_p^2 = 0.03$. On average, restrained eaters thus ate about 156 calories (30.5 grams) less of M&M's in a large pack when reminded of their dieting

goal. Also as predicted, unrestrained eaters (1 SD below the mean) eating from large packs were not affected by the prime, $F(1, 216) = 0.09$, $p = 0.76$. Similarly, restrained and unrestrained eaters eating from small packs were not affected by the diet prime, all *p*s > 0.50. In other words, restrained eaters significantly reduced their consumption from large packs when primed with a dieting goal and therefore displayed a smaller pack size effect, as we had hypothesized, while unrestrained eaters were not influenced by the prime. These findings are displayed in Figure 2.

Fig. 2: Snack consumption of restrained eaters (1 *SD* above the mean, see Aiken & West, 1991) and unrestrained eaters (1 *SD* below the mean) in the control and diet prime conditions when eating from a large or a small pack of M&M's.



Potential effects of time of day

In line with Boland, Connell and Vallen (2013), we explored the effect of time of day of the experiment (9 am to 12 pm vs. 12 pm to 5 pm) as an additional factor. Time of day had a main effect on consumption, $F(1, 213) = 15.16$, $p < 0.01$, $\eta_p^2 = 0.07$. It did not interact with prime, $F(1, 213) = 0.04$, $p = 0.84$, but interacted with pack size, $F(1, 213) = 4.98$, $p = 0.03$, η_p^2

= 0.02. Simple main effects showed that there was no pack size effect in the morning, $F(1, 213) = 2.03$, $p = 0.16$, $\eta_p^2 = 0.01$, with consumption from the small and large pack respectively being $M = 34.03$ ($SE = 5.62$), and $M = 22.08$ ($SE = 6.22$), while there was a marginally significant pack size effect in the afternoon, $F(1, 213) = 3.28$, $p = 0.07$, $\eta_p^2 = 0.02$, with consumption from the small and large pack respectively being $M = 42.75$ ($SE = 4.62$), and $M = 54.20$ ($SE = 4.33$). We therefore ran an additional analysis testing our main hypothesis only among afternoon participants, which showed that prime and pack size both had a marginally significant main effect, $F(1, 135) = 2.77$, $p < 0.10$, $\eta_p^2 = 0.02$, and $F(1, 135) = 3.12$, $p = 0.08$, $\eta_p^2 = 0.02$, respectively. The interaction of prime and dietary restraint reached marginal significance, $F(1, 135) = 3.32$, $p = 0.07$, $\eta_p^2 = 0.02$, and so did the three-way interaction of dietary restraint, prime and pack size, $F(1, 135) = 2.72$, $p = 0.10$, $\eta_p^2 = 0.02$, such that restrained eaters presented with a large pack ate significantly less in the diet prime condition than in the control condition, $F(1, 135) = 8.82$, $p < 0.01$, $\eta_p^2 = 0.06$. Again, unrestrained eaters and restrained eaters presented with a small pack were not affected by the prime, all *p*s > 0.72.

Additional analyses

Additional regression analyses showed that perceived self-regulatory success in dieting, hunger, fullness, BMI, liking of the M&M's, consumption frequency of the M&M's, and gender did not moderate the effect of the pack size and diet prime, all *p*s > 0.05.

Discussion

This experiment was designed to replicate Experiment 1 in an actual consumption setting. Although the conventional omnibus test only revealed a marginally significant main effect of the diet prime, with consumption being lower in the diet prime condition than in the control condition, specific contrasts revealed the expected effects of the diet prime on restrained eaters. As hypothesized, the diet prime reduced restrained eaters' consumption from large packs, and as a result diminished the pack size effect. Also in line with our

expectations, but contrary to Experiment 2, the diet prime was not effective for unrestrained eaters. We should note that many participants did not eat any M&M's, and while this could be the result of their dieting goal, it led to a high number of zero's in the data, so that these findings should be interpreted with caution. While this is a drawback of the procedure used, we did not want to focus participants' attention on the fact that we were interested in their eating behaviour by requiring them to eat some of the tempting snack, in order to reduce demand and observer effects.

General Discussion

We conducted two experiments that tested whether exposure to a diet prime influences consumption quantity decisions of restrained eaters and diminishes the pack size effect. As hypothesized, the diet prime reduced restrained eaters' expected and actual consumption from large packs. In line with other goal priming studies in the domain of eating behaviour, these findings suggest that activating the goal of dieting can help dieters control their intake even in the presence of large quantities of tempting snacks. Thus, goal primes may offer a promising strategy to curb the pack-size effect among diet-concerned individuals.

Two unexpected findings warrant further discussion. In Experiment 1, unrestrained eaters unexpectedly reported to eat less when they had been primed with the dieting goal. It is possible that in addition to a reminder of one's goal of dieting, the prime we used also communicated the social norm of moderating one's consumption, and thus affected unrestrained eaters, but only when self-reports of expected consumption were assessed.

Furthermore, Experiment 2 did not show a significant pack size effect, which is in contrast with numerous previous studies showing this effect for both meals and for snacks (see Zlatevska et al., 2014; Marchiori et al., 2016, for meta-analyses). Possibly, this difference is due to our experimental procedure, which differed in important ways from many other studies. First of all, participants did not eat directly from an open container but had to pour the

M&M's from the bag. This action required participants to take their eyes off the screen and focus on the M&M's, which might have made eating less automatic and more deliberative (Cheema & Soman, 2008; Geier, Wansink & Rozin, 2012; Painter, Wansink, & Hieggelke, 2002), and thus decreased the pack size effect. We also found that time of day moderated the pack size effect, with the effect being stronger in the afternoon than in the morning. Possibly, self-regulation is more difficult later in the day (Hofmann, Vohs, & Baumeister, 2012), and a chocolate snack seems more desirable in the afternoon (see Papies, 2013), which makes it more difficult to resist the temptations of a large pack of M&M's (Boland et al., 2013). Thus, the fact that Experiment 2 was conducted in both morning and afternoon sessions could explain why the overall pack size effect was relatively weak.

Limitations and future research

Effect sizes in our experiments were small, making replication of these results important. We conducted our experiments in settings that encouraged natural eating decisions, which allowed for considerable variance in consumption data due to factors such as hunger, time of day, and liking of the foods[5]. This may have made it relatively hard to detect the effects of pack size and prime. At the same time, these are the conditions under which intervention tools to curb the portion size effect will have to be effective outside the laboratory. We should note that even though the statistical effect sizes of the primes were relatively small, the predicted effect of the diet prime on restrained eaters eating from a large pack did lead to a reduction in intake by about 156 calories on average, which is a strong and meaningful effect on eating behaviour. In addition, even small changes in intake can lead to weight loss (see for example Kaipainen, Payne, & Wansink, 2012), for example if repeated goal priming supports the formation of healthy habits (Papies, 2016). It is therefore informative that systematic effects of diet primes were still found, as predicted, among those who value the goal of dieting.

Future research could use a within-participants design to more accurately assess on an individual level how interventions such as exposure to a diet prime impact the pack size effect. However, preventing demand effects in such a set-up will be challenging as it will be much easier for participants to guess the purpose of the study. To reduce variance in consumption data in a between-participants design, it should be considered to require that participants refrain from eating for a specific period before the study or to possibly provide participants with a fixed meal a few hours before the experiment (Blundell et al., 2010).

The difference in outcome between Experiment 1 and Experiment 2 suggests that the two experimental methods measure different aspects of consumption. In Experiment 1 participants reported what they would do in their natural, at-home situation, while in Experiment 2 participants had the hedonic experience of actually eating the food. Ideally, future research would combine these two methods by measuring actual consumption in a more naturalistic eating environment.

The results of the current experiments are in contrast to some studies that did not find an effect of a diet prime on consumption (Peláez-Fernández & Extremera, 2011) or even found that a diet prime increased instead of decreased consumption among restrained eaters (Seddon & Berry, 1996; Strauss, Doyle, & Kreipe, 1994; Warren, Strauss, Taska, & Sullivan, 2005). What these studies have in common is that they all exposed participants to images of thin, beautiful women, rather than other, direct reminders of dieting. Such images can lead to negative body-related affect in restrained eaters (Groesz, Levine, & Murnen, 2002), which can trigger overeating. Furthermore, length and frequency of exposure and the degree to which attention is drawn to the diet primes, could also impact their effectiveness. In Peláez-Fernández & Extremera (2012), for example, participants were not asked to read or look at the magazine that was used as the diet prime, whereas in the current studies, the primes were explicitly integrated into the experimental procedures. Future research could focus on

identifying how different types of diet primes and the ways of exposing participants to them impact eating (see Papies, 2016).

The scale used to identify restrained eaters could also influence whether effects of primes on restrained eaters' consumption are found. In studies where pictures of attractive models were used as diet primes, consumption among restrained eaters increased in response to the diet primes when restraint was measured using the Revised Restrained Scale (RS; Herman & Polivy, 1980; Warren et al., 1994, Seddon & Berry, 1996; Strauss et al., 1994), but decreased when restraint was measured using the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Frijters, Bergers, & Defares, 1986; Anschutz et al., 2011). It has been argued that the RS tends to mainly measure behaviours and consequences related to unsuccessful dieting (Stice, Ozer, & Kees, 1997), while other scales such as the DEBQ and the Three Factor Eating questionnaire (Stunkard & Messick, 1985) measure successful dieting behaviour (Laessle, Tuschl, Kotthaus, & Pirke, 1989; Lowe, 1993). Diet primes with images of thin models might induce less negative affect in successful dieters than in unsuccessful dieters, and hence reduce consumption when dietary restraint is measured using the DEBQ or TFEQ, but increase consumption when the RS is used to measure restraint. More research is needed to determine how different ways of measuring dietary restraint can influence study results.

Conclusion

The present research presents initial evidence that diet primes can reduce the pack size effect for restrained eaters. The diet prime is likely to activate the dieting goal (Papies, 2012) and in this way, it will motivate restrained eaters, who value this goal, to keep their consumption under control. These findings suggest that the pack size effect is not an inevitable consequence of the current eating environment which can only be prevented by structurally changing this environment (Cohen & Farley, 2008; Wansink, 2010). Instead, we

show that if consumers are sufficiently motivated to limit their consumption and are reminded of this motivation at the right time, the pack size effect can be weakened.

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Footnotes

[1]Note that, contrary to some other authors, we define the pack size effect as the difference in amount consumed when a person is provided with a large amount of food in a large pack or with a small amount of food in a small pack.

[2]Two of these participants indicated in the open-ended answers that they indicated consumption in units (instead of the requested 'hands') and another 10 provided extremely high expected consumption amounts (> 80 hands).

[3]The relatively large percentage of participants who refrained from eating anything led to a skewness in the data. However, inspection of the residuals did not reveal any major problems, and we continued our analysis with the GLM.

[4]Comparison of the percentage of participants who ate nothing across the conditions revealed that this percentage was indeed much higher in the diet prime – restrained eaters – large pack condition (52%) than in any of the other conditions (24%), $x^2(1, N=224) = 8.10$, $p < 0.01$. Not eating thus might have been a strategy that restrained eaters used to keep consumption from large packs under control.

[5]In Experiment 2, both hunger and liking had a substantial effect on the amount consumed, $F(1, 213) = 31.59$, $p < 0.01$, $\eta_p^2 = 0.13$, and $F(1, 213) = 28.28$, $p < 0.01$, $\eta_p^2 = 0.12$, respectively.

Online supplement A

Additional measures included in Experiment 1

Measure	Scale
Do you follow any of the following diets?	*cow-milk free* / *lactose free* / *diet for allergy nuts and peanuts* / *diet for diabetics* / protein restricted / fat or cholesterol restricted / *colour agent free* / energy or protein rich diet / I follow none of the above specified diets* * Participants that followed diets displayed in italics were not allowed to continue with the questionnaire.
What is your age?	Open-ended question
First impression of the magazine cover.	1 = *unattractive* to 5 = *attractive* 1 = *does not appeal to me* to 5 = *appeals to me* 1 = *does not attract attention* to 5 = *attracts attention* 1 = *busy* to 5 = *calm* 1 = *does not fit the content* to 5 = *fits the content*
Ranking of the 5 topics on the cover.	Most appealing topic gets a 1, least appealing topic gets a 5.
Evaluation of the colour scheme of the cover	1 = *does not attract attention* to 5 = *attracts attention* 1 = *busy* to 5 = *calm* 1 = *does not fit the content* to 5 = *fits the content*
Extent of (dis)agreement with a number of statements about the cover, such as: 'The topics on the cover are appealing' and 'I would pick up this magazine and leaf through it'	1 = *strongly disagree* to 7 = *strongly agree*
What price would you find reasonable for the magazine?	Open-ended question
Would you buy the magazine for that price?	I would definitely buy it; I might buy it; I would probably not buy it; I would definitely not buy it; I don't know
Selection of statements about snacking, including: 'When I take a snack, I determine upfront how much I will eat' and 'When I take a snack, I keep eating till I am no longer hungry'	1 = *strongly disagree* to 7 = *strongly agree*
Frequency of snacking in the afternoon	0-7 days a week
Currently pregnant or breastfeeding?	Yes/no
Currently using medicines that influence appetite?	Yes/no
Now or in the past diagnosed with an eating disorder?	Yes/no/no answer
Highest completed education	Lager onderwijs (LO) / Lager beroepsonderwijs (LBO) of Voorbereidend Middelbaar Beroepsonderwijs (VMBO) / MAVO / HAVO or VWO / MBO / HBO / Universitair / Other
Living situation	Living alone / Living with parents or family / Living with friends or students / Married or living with partner
Children below 18 living in the household	Yes/no
My expected consumption of the snacks was lower because I saw the health magazine.	1 = *strongly disagree* to 7 = *strongly agree*

Online supplement B

Covers of the magazines – Experiment 1

Figure B1: Cover of the dieting magazine (diet prime condition)

Translation

From XXL to M! Sanne and Tim did it.

Discipline. Get it and hold on to it!

The newest fitness trends.

Tested: Losing weight. No diet, no muscle pain.

Win: A personal trainer worth €10.000!

Figure B2: Cover of the travel magazine (control condition)

Translation

Local in London. Unique, undiscovered places.

Amsterdam. Looking for Rembrandt.

Undiscovered cities: Krakow, Bern, Antwerp, Lille, Trier

Romantic Vienna

Win. Luxury weekend in Paris.

Online supplement C

Screenshots of the expected consumption questions – Experiment 1

Figure C.1. Expected consumption question - chocolate large

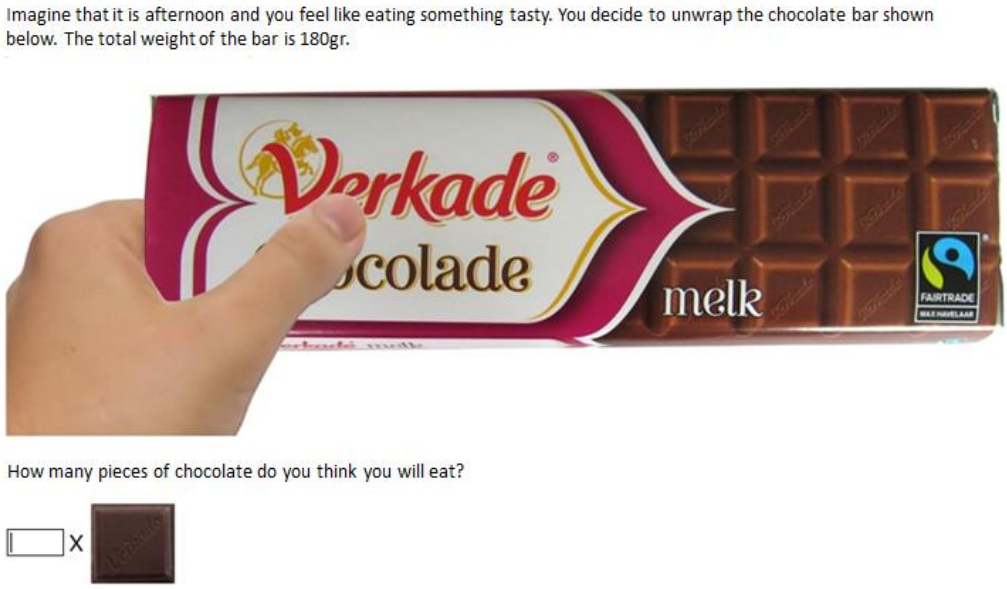

Figure C.2. Expected consumption question - M&M's with peanuts large

Figure C.3. Expected consumption question – Chips large

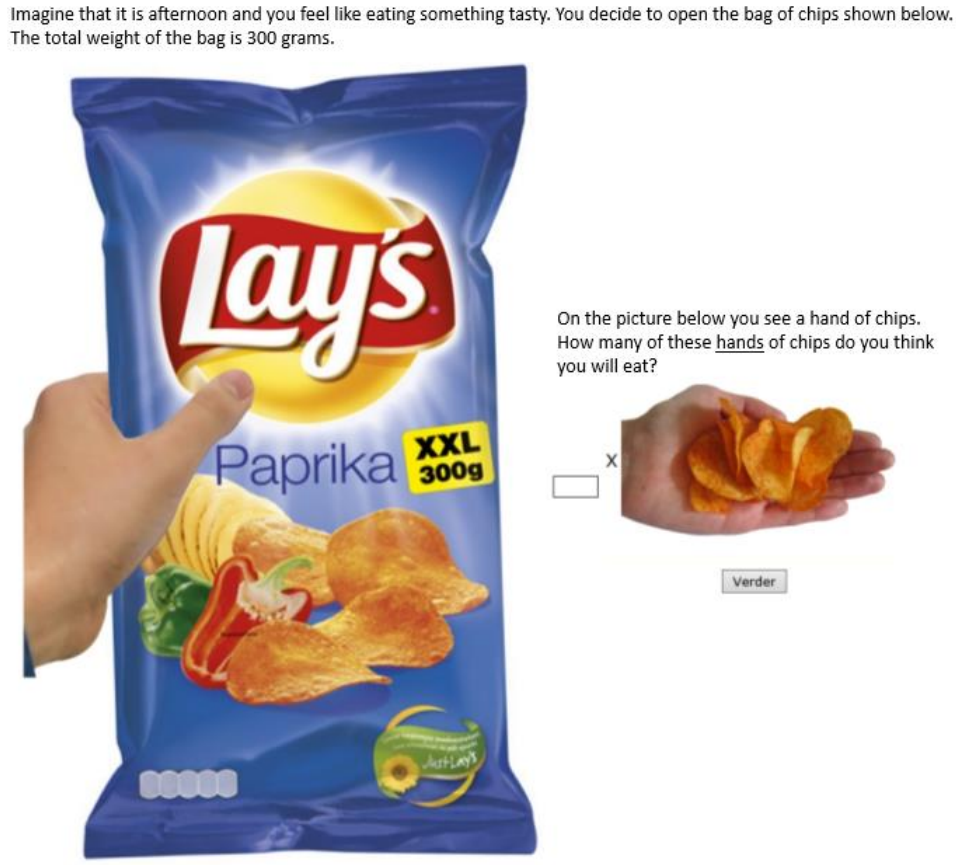

Figure C.3. Expected consumption question – Nuts large

Online supplement D

Additional measures included in Experiment 2

Measure	Scale
The trailer from <insert name movie>… / The short movie… - Made me sad - Made me laugh - Was exciting - Captured my attention - Trailers only: Gives a good overview of the content of the movie - Trailers only: I would like to see this movie - Short movie only: Was enjoyable	1 = *strongly disagree* to 7 = *strongly agree*
During the 15 minutes in which you watched the movie clips and ate M&M's, to what extent was your attention focused on the movie clips?	1 = *not at all focused on the movie clips* to 7 = *very much focused on the movie clips*
During the 15 minutes in which you watched the trailers and ate M&M's, to what extent was your attention focused on eating the M&M's?	1 = *not at all focused on eating the M&M's* to 7 = *very much focused on eating the M&M's*
How often do you eat a snack while watching tv?	1 = *never* to 7 = *always*
On how many days in the week do you take a snack?	Morning: *0 – 7* days Afternoon: *0 – 7* days Evening: *0 – 7* days
Selection of statements about snacking behaviour, including: 'When I take a snack, I determine upfront how much I will eat' and 'When I take a snack, I keep eating till I am no longer hungry'	1 = *strongly disagree* to 7 = *strongly agree*
Selection of statements from the appearance subscale of the State Self Esteem scale (Heatherton & Polivy, 1991), such as 'I feel satisfied with the way my body looks right now.'	1 = *strongly disagree* to 7 = *strongly agree*
Currently using medicines that influence appetite?	Yes/no
Do you follow any of the below diets?	*cow-milk free* / *lactose free* / *diet for allergy nuts and peanuts* / *diet for diabetics* / protein restricted / fat or cholesterol restricted / *colour agent free* / energy or protein rich diet / I follow none of the above specified diets* *Participants that followed diets displayed in italics were excluded from analyses.
Now or in the past diagnosed with an eating disorder?	Yes/no/no answer
I ate less from the M&M's because I saw commercials about dieting and sports.	1 = *strongly disagree* to 7 = *strongly agree*