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### Do distant foods decrease intake? The effect of food accessibility on consumption

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## Do distant foods decrease intake? The effect of food accessibility on consumption

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**Objective:** Two studies examined the hypothesis that making snacks less accessible contributes to the regulation of food intake. Study 1 examined whether decreasing the accessibility of snacks reduces probability and amount of snack intake. The aim of Study 2 was to replicate the results and explore the underlying mechanism in terms of perceived effort to obtain the snack and perceived salience of the snack.

**Methods:** In Study 1 ( $N=77$ ) and Study 2 ( $N=54$ ) distance to a bowl of snacks was randomly varied at 20, 70 or 140 cm in an experimental between-subjects design. Main outcome measures were the number of people who ate any snacks (probability of snack intake), the amount of snacks consumed and risk of compensatory behaviour as measured by food craving. In Study 2, self-report ratings of salience and effort were examined to explore potential underlying mechanisms.

**Results:** Study 1 showed lower probability and amount of intake in either of more distant conditions (70 and 140 cm) compared to the proximal condition (20 cm), with no unintended effects in terms of increased craving. Study 2 replicated the results of Study 1 and showed that distance affected perceived effort but not salience.

**Conclusions:** Making snacks less accessible by putting them further away is a potentially effective strategy to decrease snack intake, without risk of compensatory behaviour.

**Keywords:** obesogenic environment; food intake; food accessibility; distance

### Introduction

In the modern ‘toxic’ food environment, people are frequently confronted with tempting, unhealthy food that is easily accessible (Hill, Wyatt, Reed, & Peters, 2003). Together with other environmental factors, such as large portion sizes and the wide variety of ready-to-eat foods, the easy accessibility of food has been identified as promoting overeating and contributing to the high prevalence of overweight and obesity (Wansink, 2004). To maintain a healthy weight in the midst of plenty, people

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need to regulate their food intake, choosing whether or not to eat and how much to eat every time they are exposed to palatable but unhealthy foods (De Ridder & De Wit, 2006). To help people regulate their food intake, it has been proposed that changes to the 'toxic' food environment need to be made (Hill & Peters, 1998; Wadden, Brownell, & Foster, 2002). Environmental approaches have indeed shown promising results for diet change. For example, front-of-package nutrition labelling may help consumers to make healthier choices (Feunekes, Gortemaker, Willems, Lion, & Van den Kommer, 2008), and taxing unhealthy foods can reduce food intake (Epstein, Dearing, Roba, & Finkelstein, 2010).

### ***Food accessibility***

In a leading review of environmental interventions to reduce overweight, manipulating the accessibility of food was identified as a particularly promising strategy to reduce overeating and overweight (Faith, Fontaine, Baskin, & Allison, 2007). Faith et al. (2007) evaluated different dimensions of accessibility, such as access to means of transportation to travel to retailers (Dibsdall, Lambert, Bobbin, & Frewer, 2003), the extent of assortment of certain foods (Fiske & Cullen, 2004), the degree to which food is prepared or ready for consumption (Cullen et al., 2003), the free provision of food (Eriksen, Haraldsdottir, Pederson, & Flyger, 2003) and the spatial distance to food (Morland, Wing, & Roux, 2002), and concluded overall that increased accessibility of healthy foods may lead to increased acquisition and consumption of those healthy foods, because it makes it easier for individuals to make a healthy choice.

The studies reviewed by Faith et al. (2007) typically focused on increasing the accessibility of healthy food, based on the assumption that a healthy diet should include the consumption of fruits, vegetables and other healthy products. However, to avoid weight gain or to promote weight loss, decreasing the intake of unhealthy, energy-dense foods is also important (Hill, 2006). In this study, we therefore examine the impact of accessibility on the intake of unhealthy snacks. Specifically, we assess the effect of spatial distance on the probability and amount of intake of unhealthy snacks. Spatial distance is a straightforward aspect of accessibility and allows for a strict test of the effectiveness of accessibility manipulations. Importantly, there is already some evidence that increasing distance to unhealthy food can be effective in reducing intake. A study in young children, for example, showed that varying distance to a serving bowl (range: 28 cm to 11 m) affected the intake of both healthy and unhealthy snacks (Musher-Eizenman et al., 2010). As children in this study were required to eat at least some snacks, the effect of distance on the probability of any intake could, however, not be assessed. Two studies among adult employees assessed the effect of distance to a bowl of candies on amount of consumption over a 1 week period and showed that people ate less when a bowl of candies was placed at a larger distance (range: arms length – 2 m; Painter, Wansink, & Hieggelke, 2002; Wansink, Painter, & Lee, 2006). It has also been demonstrated that people eat less from their evening dinner when they leave the food in the kitchen instead of on the dinner table (Sobal & Wansink, 2007).

These studies provide an initial exploration of the effect of distance on the consumption of food and show, in particular, that increasing the distance to snacks decreases consumption. This study aims to build on these studies in three ways to better understand in what way distance affects consumption. First, compared to

earlier studies that used amount of consumption as an outcome variable, this study additionally examines whether increasing distance reduces the probability that people eat anything at all. Second, we assess probability and amount of intake at three varying distances. This design enables assessing whether the link between distance and intake is linear or depicts a threshold effect. This has important implications for implementation of food accessibility as a strategy to improve diet. If intake of unhealthy foods keeps decreasing as distance increases, an intervention using the largest possible distance would be superior in improving diet. However, if a threshold effect exists, a minor adjustment in presentation of unhealthy foods may have beneficial effects on intake. Assessing intake at three levels of distance also enables examining potential unintended effects of increasing distance to snacks, such as the risk of compensation in the amount of intake if snacks are placed at a relatively large distance. Third, we assess how people perceive and interpret distance to snacks in order to promote understanding why distance affects consumption. In particular, we are interested in whether the effect of distance relates to physical aspects (distant snacks require more effort to obtain), to psychological aspects (distant snacks are less salient), or both.

### *Physical and psychological components of distance*

A straightforward explanation of the effect of distance on snack intake may be that larger distances are associated with more effort to obtain the snacks. Instead of mindless consumption of snacks that are nearby (Wansink, 2004), snacks that are placed at a distance require effortful action from the individual. As an increase in required effort may decrease the motivation to obtain a snack (or any other rewarding object; Waugh & Gotlib, 2008), it seems that the more effort is required to obtain food, the lower the probability that individuals will make that effort. Indeed, a series of studies by Epstein and other researchers (Epstein & Leddy, 2006; Goldfield & Epstein, 2002; Salvy, Nitecki, & Epstein, 2009) have shown that when the behavioural costs of obtaining snacks increase, people choose these snacks less frequently. However, whereas perceived greater effort may help individuals in deciding not to take the snack, there is a risk of compensation if they eventually decide to have the snack. Individuals may be more inclined to reward themselves after exerting effort, believing they have deserved it (Kivetz & Zheng, 2006; Mick & Demoss, 1990). The risk of overeating as a reward for effort may, in particular, be present at larger distances when the effort to obtain snacks is higher. As our study design distinguishes between three distances to snacks, we are able to test the potential negative effects of larger distances in terms of compensatory eating.

Alternatively, distance may also affect snack intake because larger distances make snacks less salient in psychological terms. Psychological distance is the subjective experience that something is close to or far away from the self. Psychological distance increases when people are far away from an object or situation, including in time, socially, hypothetically or in space (Trope & Liberman, 2010). Psychological distance may make snacks less salient; because when the snack is placed further away, its properties are less vivid. Larger psychological distance from a tempting snack could therefore act as a 'cooling-down' strategy and decrease the probability that people succumb to temptation (Metcalf & Mischel, 1999). Whether people perceive distance in terms of effort, salience, or both, bears

important implications for the understanding of the mechanisms that underlie the effects of distance manipulations. If distance is perceived primarily in terms of effort, there is a risk of compensatory behaviours, whereas the perception of distance in terms of salience may 'cool down' the attractive properties of snacks.

### **Research overview**

The main aim of the reported research is to determine the effects of the accessibility of unhealthy snacks, in terms of their distance to the consumer, on the probability and amount of snack intake. We conducted two experimental studies in a controlled laboratory setting. In Study 1, we investigate whether decreasing accessibility by varying the distance to unhealthy snacks can be effective in reducing the probability and amount of snack intake. For an accessibility strategy to have any merit as a prevention method, individuals who eat less or nothing at all as a result of reduced snack accessibility should not compensate later. Therefore, we also examine the effect of distance on food craving after having been exposed to snacks (Franken & Muris, 2005; Herman & Polivy, 2004). We hypothesise that making unhealthy snacks less accessible by increasing the distance to snacks will decrease the probability and amount of intake and not affect food craving. In Study 2, a similar design as in Study 1 is employed. In addition, perceptions of effort and salience are assessed to examine processes that potentially explain the effects of distance. We hypothesise that a change in distance to snacks affects perceptions of both perceived effort and salience.

### **Study 1**

In Study 1, we examine whether manipulating the distance to a bowl of unhealthy snacks affects the probability and amount of intake. We predict that probability and amount of intake will decrease as distance increases. To assess potential compensatory effects, the effect of distance on the amount of intake of those who eat at least some snacks is assessed, as is craving after snack exposure.

### **Method**

#### *Participants and design*

Participants were recruited at the Utrecht University campus and invited to participate in an experiment in exchange for course credit or a monetary reward. Female students (age 17–38 years) of normal weight or mild overweight (body mass index [BMI] 18–30 kg m<sup>-2</sup>) were included in the study if they reported to have no food allergies or current eating pathology.

*Accessibility conditions.* Participants were randomly assigned to one of three conditions in which distance to a bowl of snacks was varied, measured from the armchair in which participants were seated. In the *proximal* condition, the bowl of snacks was easily accessible from where the participant sat, placed on a table at a distance of 20 cm from the right armrest of the participant's chair. In the *within-reach* condition, the participant had to reach over the table to be able to get the snacks,

which were placed at a distance of 70 cm from the armrest. In order to obtain the snack in the *distal* condition, the participant needed to get up and walk over to the snacks, which were placed on the table at a distance of 140 cm from the armrest. In all three conditions, the snacks were placed in plain sight.

Two participants (in the proximal condition) consumed extremely large portions of snacks ( $>3$  SD above the mean, which equals  $>55$  g) and were consequently excluded from the analyses. One participant indicated not to like the snacks used in this study at all and was also excluded from the analyses. This resulted in a sample of 77 participants: 23 participants in the proximal condition, 26 participants in the within-reach condition and 28 participants in the distal condition. Participants' mean age was 22.3 years ( $SD = 3.7$ ), and their mean BMI was  $22.4 \text{ kg m}^{-2}$  ( $SD = 3.0$ ).

### *Procedure*

Participants were invited to the laboratory to participate in a study of relaxation and personality. This cover story was used to create a situation in which unhealthy snacks could be presented to the participants unobtrusively. In the first part of the experiment, participants were seated in an armchair at a table with magazines and a bowl of snacks, and instructed to relax for 5 min. The experimenter informed the participants that during this period they could read and should feel free to eat from the snacks. In the second part of the experiment, the magazines and the bowl of snacks were removed and participants were presented with a laptop to fill out measures of age, time since last meal, food craving and liking of chocolate (assessed in this order). Subsequently, participants' weight and height were measured. Finally, participants were debriefed, reimbursed and thanked for their participation. A funneled debriefing procedure was used to probe for suspicion of the purpose of the study and the reason for the presence of snacks. None of the participants reported to have understood the true nature of the study.

### *Materials*

Since chocolate is a snack that is typically liked by most people (Weingarten & Elston, 1990), chocolate M&M's (without peanuts) were used in this study. The snacks were presented in a transparent bowl containing 1000 g of chocolate M&M's (equivalent to about 1000 M&M's). Four magazines on unrelated topics (e.g. home decorating) were presented, and it was verified that the magazines contained no food-related text or images.

### *Measurements*

#### *Control variables.*

**Time since last meal.** Participants were asked to indicate the time since their last meal prior to the experiment, to provide an indication of their hunger state [1].

**Liking of chocolate.** Participants indicated their liking of chocolate ('How tasty do you find chocolate?') on a 10-point scale, ranging from 0 (not at all) to 9 (very much). To mask the objective of this measurement, liking was also assessed for three other

unhealthy snacks (two savoury and one sweet) and for four healthy snacks (two savoury and two sweet).

*Dependent variables.*

**Snack intake.** To assess the probability and amount of intake, the bowl with M&M's was weighed before and after the alleged relaxation period, with the participant not present.

**Food craving.** Craving experienced after exposure to the unhealthy snacks was measured by the General Food Craving Questionnaire – State (Nijs, Franken, & Muris, 2007), which contains 15 items (e.g. 'I'm craving tasty food.') that are answered on a 5-point scale, ranging from 1 (totally disagree) to 5 (totally agree). A mean score for craving was computed (Cronbach's  $\alpha = 0.93$ ).

*Statistical analysis*

Possible covariates were assessed by looking at the correlations between the control variables and likelihood and amount of intake of snacks, and food craving. To ascertain whether distance (20, 70 and 140 cm) influences the likelihood of consuming any snacks, a logistic regression analysis was performed. To determine whether distance, as a three-level factor, affects the amount of snacks consumed, controlling for chocolate liking, a one-way analysis of covariance (ANCOVA) was performed on the full sample as well as on the subsample of participants who ate at least one M&M's. To determine whether distance (three-level factor) affects food craving, an analysis of variance (ANOVA) was performed. A *t*-test was conducted to compare craving in participants who ate any snacks and those who ate nothing.

**Results**

*Descriptives*

Table 1 presents the means and standard deviations (SDs) of and the correlations between the variables under study. Chocolate liking was significantly associated with amount of intake (but not likelihood of intake or food craving) and was therefore included as a covariate in the analyses of amount of intake.

Table 1. Means, SDs and correlations between the variables in Study 1 ( $N = 77$ ).

	Amount of snacks	Either or not eating	Food craving	Chocolate liking	BMI
Amount of snacks					
Either or not eating	0.95**				
Food craving	0.23*	0.25*			
Chocolate liking	0.25*	0.20	0.13		
BMI	-0.04	-0.10	-0.02	-0.07	
<i>M</i>	6.30		1.77	7.77	22.40
<i>SD</i>	10.07		0.69	1.48	2.96

Note: \* $p < 0.05$ ; \*\* $p < 0.01$ .

### Randomisation check

Separate ANOVAs showed no significant differences between the three distance conditions in BMI,  $F(2, 74) = 0.43$ ,  $p = 0.65$ , time since last meal,  $F(2, 64) = 1.80$ ,  $p = 0.17$  and liking of chocolate,  $F(2, 74) = 0.09$ ,  $p = 0.92$ , indicating that randomisation across conditions was successful.

### Tests of hypotheses

*Likelihood of consumption.* In the proximal condition (20 cm), 74% of the participants consumed any snacks, compared to 42% in the within-reach condition (70 cm), and 21% in the distal condition (140 cm). A logistic regression analysis showed that the effect of distance on likelihood of consumption was significant. In particular, compared to the proximal condition, participants in the within-reach condition were less likely to eat snacks ( $OR_{20 \rightarrow 70} = 0.26$ ,  $Wald = 4.77$ ,  $p = 0.03$ ), as were participants in the distal condition ( $OR_{20 \rightarrow 140} = 0.10$ ,  $Wald = 12.52$ ,  $p < 0.001$ ). There was no difference in likelihood of snack consumption between the within-reach and distal conditions ( $OR_{70 \rightarrow 140} = 0.37$ ,  $Wald = 2.65$ ,  $p = 0.10$ ).

*Amount of snacks consumed.* To assess the effect of distance on the amount of intake of snacks in the full sample, an ANCOVA was conducted with liking of chocolate as a covariate. Because the amount of intake was positively skewed, a reciprocal (inverse) transformation was performed. Distance significantly affected the amount of intake across all participants,  $F(2, 73) = 7.59$ ,  $p = 0.001$ . Chocolate liking was also significantly related to amount of snacks consumed,  $F(1, 73) = 4.23$ ,  $p = 0.04$ . *Post hoc* tests showed that participants in the within-reach condition (70 cm;  $M_{adj} = 3.77$ ,  $SD = 6.02$ ) consumed less than participants in the proximal condition (20 cm;  $M_{adj} = 10.30$ ,  $SD = 10.16$ ),  $p = 0.01$ . Likewise, participants in the distal condition (140 cm;  $M_{adj} = 5.36$ ,  $SD = 12.12$ ) consumed less than participants in the proximal condition,  $p < 0.001$ . No differences in amount of intake were found between the within-reach and distal conditions,  $p = 0.18$ .

There may be a risk of overeating when more effort is needed to obtain the food, as a reward for exerting the effort. Therefore, a further ANCOVA was performed to assess potential compensation of intake in the subsample of participants who ate any snacks. This subsample consisted of 17, 11 and 6 participants in the proximal (20 cm), the within-reach (70 cm) and the distal (140 cm) conditions, respectively. Results revealed that distance did not affect amount of intake when assessing the subsample of eaters only,  $F(3, 30) = 0.49$ ,  $p = 0.62$ , indicating an absence of compensatory eating in the two more distant conditions. Chocolate liking was included as a covariate and proved to be significantly related to amount of intake,  $F(1, 30) = 7.68$ ,  $p = 0.009$ .

*Craving.* Food craving after exposure to the snacks was assessed to determine whether individuals who ate less or nothing at all as a result of reduced snack accessibility were likely to compensate later. An ANOVA was performed on food craving, with distance as the independent variable. There was no effect of distance on craving,  $F(2, 74) = 1.61$ ,  $p = 0.21$ .

To ascertain that non-eaters do not crave food more after exposure to the bowl of snacks than those who have eaten any snacks, a *t*-test was performed with eating

status as the independent variable and craving as the dependent variable. Results indicate that non-eaters did not crave food more than eaters. Non-eaters in fact reported lower food craving ( $M = 1.62$ ,  $SD = 0.61$ ) than eaters ( $M = 1.97$ ,  $SD = 0.75$ ),  $t(75) = 2.24$ ,  $p = 0.03$ .

### ***Discussion***

Study 1 supported our hypothesis that making unhealthy snacks less accessible by increasing the distance to these snacks can be effective in decreasing the probability of any consumption of the snacks. Importantly, an increase in distance from 20 to 70 cm had a significant effect on the probability of intake, while an additional increase in distance from 70 to 140 cm did not reduce the probability or amount of intake any further. The effect of distance on intake thus already manifests itself at a relatively small change in distance. Furthermore, the lack of an additional benefit from placing snacks further away suggests a threshold rather than a linear effect of distance on snack intake. In addition, we found no evidence of compensatory eating in the two more distant conditions when looking at the subsample of participants who ate any snacks. Possible compensation after having been exposed to snacks placed at a larger distance was also not found in the results for food craving, and participants who ate nothing did not report a greater desire for food. In Study 2, we set out to replicate these findings and assess the potential role of subjective perceptions of distance to the snacks in terms of perceived effort and salience.

### **Study 2**

In Study 2, we sought to replicate the findings of Study 1 and explore the underlying mechanism by which distance may affect intake by assessing perceptions of distance in terms of perceived effort and salience. We expect both perceived effort and perceived salience to be affected by distance; when distance increases, perceived effort to obtain the snack will increase, while the perceived salience of the snack will decrease.

### ***Method***

#### *Participants and design*

Participants were recruited at the Utrecht University campus and invited to participate in the study in exchange for course credit or a monetary reward. Female students (age 17–29 years), with a BMI between 18 and 30 kg m<sup>-2</sup>, no relevant food allergies and no current eating pathology were included in the sample. The study design was similar to that of Study 1; participants were randomly assigned to one of the three accessibility conditions.

One participant indicated not to like chocolate and was consequently excluded from the analyses. As in Study 1, outliers on M&M's consumption (consuming 55 g or more) were excluded from the analyses ( $n = 3$ ; all in the within-reach condition). This resulted in a sample of 54 participants: 19, 17 and 18 participants in the proximal, the within-reach and the distal condition, respectively. Participants' mean age was 21.3 years ( $SD = 2.6$ ), and their mean BMI was 20.9 kg m<sup>-2</sup> ( $SD = 2.2$ ).

### *Procedure*

The procedure of Study 2 was identical to that of Study 1, except for items that were added to measure ratings of perceived effort and perceived salience.

*Perceived effort.* Perceived effort to obtain the snacks was assessed with five items (e.g. 'It required effort to be able to get the M&M's', 'The M&M's were effortlessly obtainable' [reverse coded]). Responses were given on a 5-point scale (1 = completely disagree, 5 = completely agree). Mean scores were computed for perceived effort (Cronbach's  $\alpha = 0.89$ ).

*Perceived salience.* Perceived salience of the snacks was equally assessed with four items (e.g. 'I hardly noticed the M&M's' [reverse coded]), with answers given on a 5 point scale (1 = completely disagree, 5 = completely agree). Mean scores were computed for perceived salience (Cronbach's  $\alpha = 0.83$ ).

The order in which variables were assessed in the questionnaire was as follows: age, perceived salience, perceived effort, food craving, liking of chocolate and time since last meal.

To verify our assumption that the perceived effort and salience items assessed two separate constructs, a principal component analysis with varimax rotation was performed. The eigenvalues ( $>1$ ) pointed to a two-factor solution. The five items assessing perceived effort loaded on the first factor (factor loading range: 0.81–0.84), while the four items assessing perceived salience loaded on the second factor (factor loading range: 0.80–0.82). The absence of a significant association between the perceived effort and salience scales ( $r = 0.02$ ,  $p = 0.88$ ) confirms our assumption that two separate constructs are measured.

As in Study 1, participants were debriefed, reimbursed and thanked for their participation. Again, funneled debriefing indicated that none of the participants understood the true nature of the study.

### *Statistical analysis*

Possible covariates were assessed by looking at the correlations between the control variables and likelihood and amount of intake of snacks and food craving. As in Study 1, a logistic regression analysis was conducted to assess the effect of distance (three levels: 20, 70 and 140 cm) on the likelihood of snack consumption. Two separate ANOVAs were performed to determine the effect of distance, as a three-level factor, on amount of consumption for the full sample and the subsample of participants who ate any snacks. We also examined effects of distance (three-level factor) on food craving by performing an ANOVA and conducted a *t*-test to assess differences in food craving between participants who did or did not eat any snacks. The effect of distance (three-level factor) on perceptions of effort and salience was determined by two separate ANOVAs.

## **Results**

### *Descriptives*

Table 2 gives the means, SDs of and the correlations between the variables under study. Likelihood and amount of intake of snacks, and food craving were not

Table 2. Means, SDs and correlations between the variables in Study 2 ( $N=54$ ).

	Amount of snacks	Either or not eating	Food craving	Chocolate liking	BMI	Perceived salience	Perceived effort
Amount of snacks							
Either or not eating	0.91**						
Food craving	0.04	0.08					
Chocolate liking	0.19	0.16	0.05				
BMI	0.22	0.24	-0.15	0.26			
Perceived salience	0.83**	0.77**	0.16	0.30*	0.26		
Perceived effort	-0.08	-0.12	-0.18	-0.17	-0.16	0.04	
<i>M</i>	10.72		2.07	8.24	20.89	3.12	2.73
<i>SD</i>	14.56		0.63	1.16	2.16	0.90	1.03

Note: \* $p < 0.05$ ; \*\* $p < 0.01$ .

significantly correlated with any of the control variables. Therefore, no covariates were included in the analyses. Perceived salience was significantly associated with liking of chocolate, suggesting that the snacks were more salient to participants who liked chocolate more.

#### *Randomisation check*

A series of ANOVAs showed no differences between the three distance conditions in BMI,  $F(2, 61) = 1.66$ ,  $p = 0.20$ , time since last meal,  $F(2, 51) = 0.56$ ,  $p = 0.58$ , and liking of chocolate,  $F(2, 51) = 1.24$ ,  $p = 0.30$ , indicating that randomisation across conditions was successful.

#### *Tests of hypotheses*

*Likelihood of consumption.* The results of Study 1 were replicated for likelihood of consumption of the snacks. In the proximal condition (20 cm), 79% of the participants consumed any snacks, compared to 35% in the within-reach condition (70 cm) and 44% in the distal condition (140 cm). The effect of distance was statistically significant. Compared to the proximal condition, participants in the within-reach condition were less likely to eat snacks ( $OR_{20 \rightarrow 70} = 0.15$ , Wald = 6.47,  $p = 0.011$ ), as were participants in the distal condition ( $OR_{20 \rightarrow 140} = 0.21$ , Wald = 4.41,  $p = 0.036$ ). There was no difference in likelihood of consumption of snacks between the within-reach and distal conditions ( $OR_{70 \rightarrow 140} = 1.47$ , Wald = 0.30,  $p = 0.58$ ).

*Amount of snacks consumed.* Since amount of intake was positively skewed, a reciprocal (inverse) transformation was performed. As in Study 1, distance significantly affected amount of intake in the full sample,  $F(2, 51) = 3.80$ ,  $p = 0.029$ . *Post hoc* tests indicated that participants in the within-reach condition (70 cm;  $M = 9.53$ ,  $SD = 16.50$ ) and participants in the distal condition (140 cm;  $M = 9.94$ ,  $SD = 16.09$ ) consumed less snacks than participants in the proximal condition (20 cm;  $M = 12.53$ ,  $SD = 11.49$ ),  $p = 0.013$  and  $p = 0.042$ , respectively.

No differences in amount of intake were found between the within-reach and distal conditions,  $p = 0.60$ .

The subsample of participants who ate any snacks consisted of 15, 6 and 8 participants in the proximal, the within-reach and the distal conditions, respectively. In line with the findings of Study 1, in this subsample, distance did not affect the amount of snack intake,  $F(2, 26) = 0.63$ ,  $p = 0.54$ , indicating that there is no compensatory eating as a result of exerting more effort.

*Food craving.* To check for differences in food craving after exposure to the bowl of snacks, an ANOVA was performed with distance to the snacks as the independent variable and craving as the dependent variable. There was no significant effect of distance on food craving,  $F(2, 51) = 0.047$ ,  $p = 0.63$ . To ascertain that non-eaters did not crave food more than eaters, a *t*-test was performed with eating status as the independent variable and craving as the dependent variable. Results indicated no differences in self-reported craving between non-eaters ( $M = 2.02$ ,  $SD = 0.72$ ) and eaters ( $M = 2.12$ ,  $SD = 0.54$ ),  $t(52) = 0.60$ ,  $p = 0.55$ .

*Perceived effort and perceived salience.* As hypothesised, distance significantly affected ratings of perceived effort,  $F(2, 51) = 21.99$ ,  $p < 0.001$ . *Post hoc* tests indicated that obtaining snacks was perceived to require more effort in the distal condition (140 cm;  $M = 3.51$ ,  $SD = 0.83$ ), compared to the within-reach condition (70 cm;  $M = 2.62$ ,  $SD = 0.87$ ),  $p < 0.001$ , and the proximal condition (20 cm;  $M = 1.84$ ,  $SD = 0.58$ ),  $p < 0.001$ . Obtaining snacks in the within-reach condition was also perceived to be more effortful than in the proximal condition,  $p = 0.004$ . Contrary to expectations, no significant effect of distance was found on ratings of perceived salience,  $F(2, 51) = 0.71$ ,  $p = 0.50$ . Mean subjective ratings of perceived salience were 3.0 ( $SD = 1.06$ ) in the distal condition, 3.0 ( $SD = 0.83$ ) in the within-reach condition, and 3.3 ( $SD = 0.79$ ) in the proximal condition.

## Discussion

Study 2 replicated the results of Study 1. Furthermore, the results show that distance to snacks affects perceived effort to obtain them; as snacks are placed further away, they are perceived as requiring more effort to obtain. Contrary to expectations, we did not find a significant effect of distance on ratings of perceived salience of the snacks; in all three conditions, the snacks were evaluated as moderately salient.

## General discussion

The aim of these studies was to assess whether distance to snacks affects the probability and amount of intake of unhealthy snacks. The results of two studies indicate that making snacks (M&M's) less accessible by increasing the distance to them can be effective in decreasing the likelihood of any intake as well as the amount of snacks that are eaten. The pattern of associations between distance and intake suggests a threshold model, as the probability and amount of intake decreased significantly when distance increased from 20 to 70 cm, while an additional increase in distance did not decrease the likelihood or amount of intake any further.

These findings suggest that, for easily accessible snacks, a small change in accessibility (50 cm) can already be effective in reducing intake. Furthermore, we found no effects of distance on the amount of intake when only comparing participants who had eaten any of the snacks, indicating the absence of a compensatory effect. Also, food craving proved to be unaffected by distance, suggesting that there is no elevated food craving as a result of making snacks less accessible, at least in the short term.

Several studies have shown that increasing the accessibility of healthy foods is an effective strategy to enhance the purchase and consumption of fruits, vegetables and other healthy products (Faith et al., 2007). The assumption that reducing the accessibility of unhealthy foods may decrease their intake has been tested less frequently. This study is among the first to show that decreasing the accessibility of unhealthy snacks may be an effective strategy in decreasing their intake.

### *Potential underlying mechanisms*

We hypothesised that both the physical aspect (in terms of perceived effort to obtain the snacks), as well as the psychological aspect of distance (in terms of perceived salience of snacks) would vary with actual spatial distance. As expected, we found that greater distance to snacks is associated with more perceived effort to obtain the snacks.

An individual may only be prepared to invest the effort needed to obtain a desired snack when the motivation to eat is high enough to warrant that effort (Waugh & Gotlib, 2008). Thus, an increase in the effort that is required to obtain a tempting food may differentiate between those who really want it and those who do not (Epstein, Truesdale, Wojcik, Paluch, & Raynor, 2003). Unfortunately, our design did not allow for an examination of the potential mediating role of perceived effort in the effect of distance on intake because perceived effort was assessed in the second phase of the experiment. Directly asking how participants perceived distance during exposure to the snacks would have been required to examine the potentially mediating role of effort but would probably also have compromised the manipulation, which is why it was assessed after the snack exposure. Future research should address the mediation issue by finding a way to assess the perception of distance without revealing the purpose of the study.

We found no effect of distance on the perceived salience of the snacks. This absence of an effect of distance on perceived salience was unexpected, as previous research has demonstrated that psychological distance to an object increases as spatial distance increases (Trope & Liberman, 2010). It may be that the range of distances examined in this study (20–140 cm) was too restricted to find any effects on perceived salience and that differences in perceived salience may only become apparent when larger differences in distance are examined. However, Trope and Liberman (2010) suggest that people are relatively more sensitive to changes in distance from the self at the proximal end of the continuum. An alternative explanation for the absence of an effect of distance on perceived salience may relate to the assessment of perceived salience in this study. The items that were used may not have captured the most relevant features of perceived salience. Future research could examine the role of perceived salience in

distance manipulations by employing other measures. Taken together, the results of this study do not allow for any definite conclusions on the underlying mechanism of distance effects on snack intake, although perceived effort appears to play a prominent role.

Our findings suggest that for easily accessible snacks, a small change in distance can be effective in decreasing the probability and amount of intake, implying that no major changes in accessibility are required to significantly reduce the intake of unhealthy snacks. The results further indicate that there are no compensatory effects on amount of intake or food craving for those exposed to snacks at relatively larger distances. These findings hold important implications for implementation of the accessibility strategy in health promotion interventions. In public environments, such as restaurants, company cafeterias or schools, increasing distance to unhealthy snacks is a relatively minor environmental change that can be easily implemented.

### ***Limitations and recommendations for future research***

This study has a number of limitations. First, our study included only healthy young women of normal weight or mild overweight. Future research should examine to what extent our findings can be replicated in overweight and/or male samples. In addition, our studies were conducted in a controlled environment, which has the advantage of controlling for potentially confounding factors. However, in a more typical food environment where there is a choice of many food products, it may be that the effect of distance to a specific food is overruled by the presence of other foods that are at closer proximity. Future research should examine whether the effects of distance hold under more complex conditions. Further, food craving was assessed to determine whether participants were likely to compensate food intake immediately after the experiment. Consequently, it is uncertain to what extent participants may have experienced a greater desire for food when taking into consideration a longer time frame.

### **Conclusions**

Our studies have shown that manipulating accessibility by changing distance to unhealthy snacks reduces the likelihood and amount of intake of these snacks. These studies provide an important contribution to the understanding of how the environment affects unhealthy food intake and suggests possible avenues for environmental interventions that reduce overeating and overweight. Future research addressing the limitations of this study will further add to this knowledge and help develop effective interventions to prevent overweight by decreasing consumption of unhealthy foods.

### **Note**

1. Due to an error in the digital questionnaire, data on *time since last meal* were missing for 10 participants.

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