Playing with Food: The Effects of Food Pre-Exposure on Consumption in Young Children

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Abstract

Recent research has shown that pre-exposure to food can lead to reduced subsequent consumption in older children and adults when they focus on a task with a non-eating goal during exposure. One assumption is that the reduced consumption is a consequence of self-regulation that helps to concentrate on the task. Because self-regulatory mechanisms are still under development in young children, we studied the effects of food pre-exposure in young children under the age of six ($N = 81$). Children played a memory game with real sweets (food pre-exposure) or similar non-food stimuli (non-food pre-exposure) and we measured their subsequent food consumption. In contrast to the findings with older children in other studies, we found that pre-exposure led to an increase (not a decrease) in subsequent consumption. This effect was stronger among children with a higher BMI. Food exposure paradigms might not lead to the desired reduction in food intake in young children, whose BMI is positively associated with food reactivity. Thus, food exposure must continue to be considered a strong risk factor for obesity in young children.

Keywords: self-regulation, food consumption, food exposure, food pre-exposure, children, BMI

Introduction

Given the far-reaching consequences of being overweight for children's psychological well-being and health (Strauss & Polack, 2003), it is important to study how and when can children effectively self-regulate and strengthen their resistance to tempting food. The prevalence of overweight and obesity has increased dramatically in recent years (Ng et al., 2014), and can affect children even at a young age (Currie et al., 2009). In a recent review of data for several European countries, the prevalence of overweight and obesity in four- to six-year-old boys, for example, was found to range between nine and 27 percent (Elmadfa, 2009). One factor that researchers regard as a potential driver of these alarming rates is the ubiquitous exposure to tempting foods such as sweets (Wansink, 2004; Wansink, Painter, & Lee, 2006; Fisher & Kral, 2008). However, the effects of food exposure on consumption are more complex than one might expect.

At first glance, a consistent finding appears to be that exposure to food cues increases one's motivation to eat the corresponding food. For example, researchers found that preceding exposure to food or food-related cues led to the selection of larger portion sizes of the same food (Ferriday & Brunstrom, 2008) and increased consumption (Fedoroff, Polivy, & Herman, 2003, Folkvord, Anschütz, Buijzen, & Valkenburg, 2013), even when individuals were satiated (Cornell, Rodin, & Weingarten, 1989). Recently, however, researchers have reported that exposure to food cues does not necessarily lead to an increase in subsequent consumption - the increase in consumption failed to appear, or a decrease in consumption occurred, in situations when consumers were cued with real food in a task in which eating was not the goal (Grubliauskiene & Dewitte, 2014; Geyskens, Dewitte, Pandelaere, & Warlop, 2008), when they evaluated a large number of food pictures (Larson, Redden, & Elder, 2014), or when they imagined eating the food repetitively (e.g., 30 times; Missbach, Florack, Weissmann, & König, 2014; Morewedge, Huh, & Vosgerau, 2010).

While there are first indications that under specific circumstances exposure to food cues can lead to a reduction in food consumption among adults, research with children applying exposure paradigms that might lead to resistance to food temptations is rare. One notable exception is a study by Grubliauskiene and Dewitte (2014), who asked children between seven and 12 years old to construct words from letter shaped candies in the food pre-exposure condition. Importantly, the objective was to use the candies to form words, not to consume them. Compared to a control condition, pre-exposure to one food (candies) did not lead to an increase in consumption of other sweets, similar but not identical to the exposed food, among girls, and even led to a decrease in consumption among boys. De Boer, de Ridder, de Vet, Grubliauskiene, and Dewitte (2015) used a similar task to build a self-control training with children aged between eight and 11 years old. After the training, they found that, compared to a control group, girls consumed less from attractive candies that were different from those used for the training.

The findings by Grubliauskiene and Dewitte (2014) and de Boer et al. (2015) are promising, but the studies differed in important respects from other studies on the effects of pre-exposure to food cues, and thus raise three important questions. First, other studies concentrating on sensory stimulation by food exposure typically use the same kind of food during both the exposure and consumption phases (Petrovich, 2013), and not a different kind of food, as in the above mentioned studies. Hence, the effect of pre-exposure to food with a non-eating goal in mind on consumption of the cued (exposed-to) food remains unknown.

Second, the studies by Grubliauskiene and Dewitte (2014) and de Boer at al. (2015) did not take into account the children's body mass index (BMI). Because BMI seems to be related to the strength of cueing effects of food on consumption, (Ferriday & Brunstrom, 2011; Jansen, et al., 2003; Tetley, Brunstrom, & Griffiths, 2009), regarding it as a potential moderator might provide better insight into the effects of food pre-exposure on children's consumption, which appear mixed at present.

Third, the aforementioned studies were conducted with children older than six. It is uncertain whether exposure to food would lead to cueing (increasing consumption) or blocking (decreasing consumption) effects in younger children, who have weaker self-regulatory competences (Best & Miller, 2010).

Bearing these three points in mind, the objective of the present study was to further examine the pre-exposure effects of food. Specifically, we studied pre-exposure effects in young children between three and six years of age and measured the consumption of both cued and non-cued food. We also examined the children's body mass index (BMI) as an important moderator of the effect of food pre-exposure on consumption.

The main contribution of the present study is to further differentiate the consumption-cueing and -blocking effects of pre-exposure to food and to find out whether pre-exposure to food prioritizing a non-eating goal can lead to reduced subsequent food intake even among young children. This would be an indication that a basic self-regulatory mechanism is already operating at this early age.

Theoretical Background

A basic assumption in research on the regulation of food intake is that, leaving aside deprivation-induced appetite, food cues give rise to a motivational state to consume food (Fedoroff, Polivy, & Herman, 1997; Kemps, Tiggemann, & Hollitt, 2014; Weingarten, 1985). Indeed, when humans taste, smell, or look at palatable food before actually eating it, the body elicits a great variety of physiological responses in preparation of consumption that are small in magnitude, but observable (Mattes, 1997). For example, the perception of food can elevate salivary flow (Nederkoorn, Smulders, & Jansen, 2000; Pangborn, Witherly, & Jones, 1979) and heart rate (Andersen et al., 1992; Nederkoorn, et al., 2000). Furthermore, studies with both humans and animals indicate that cues associated with food promote appetite for the cued food and are learned via conditioning (Fedoroff et al., 1997; Petrovich, 2013).

Considering that these basic mechanisms are activated when food is perceived, it seems rather surprising that exposure to food cues might strengthen resistance to food. However, humans do not only focus on eating when they are exposed to food, but often have other goals or tasks to pursue that modify their focus during food exposure. Indeed, a basic distinction between different exposure paradigms is that participants apply different foci to the food. For example, a typical study in which consumers ate more after food pre-exposure is a study by Fedoroff et al. (2003) in which participants strongly focused on the food it self: Participants in the relevant conditions were exposed to the smell of pizza or chocolate chip cookies from an oven for 10 minutes while they wrote down their thoughts about that food. By contrast, studies finding that food pre-exposure can reduce subsequent food intake often require participants to pursue a task during the pre-exposure in which a focus on eating and the sensory aspects of the food is not adequate (Duh, Grubliauskiene, & Dewitte, 2016; Geyskens et al., 2008; Grubliauskiene & Dewitte, 2014). For example, in Grubliauskiene and Dewitte's (2014) study, the children in the food-exposure condition had to physically construct words from the provided letter shaped candies. It is reasonable to assume that a strong focus on non-eating aspects of food reduces the desire to consume the food and spills over to a subsequent situation in which the food can be consumed and leads to a reduced consumption in this situation (Geyskens et al., 2008).

To perform a non-eating task when exposed to food requires self-control abilities to resolve the conflict between the desire to eat and the fulfillment of the non-eating task. However, the self-control abilities of young children under the age of seven are still under development (Best & Miller, 2010) and they have much greater difficulty resolving conflicts in simple tasks than older children (Rueda, Posner, & Rothbart, 2005). If such control abilities are not operating during pre-exposure to the food, pre-exposure to food will be less likely to lead to decreased subsequent consumption. Because knowledge about self-regulation effects in food consumption in young children is scarce, it is important to study the effects of pre-exposure to food prioritizing a non-eating task on subsequent consumption with participants under the age of seven.

To study the pre-exposure effects of food properly, it is further crucial to examine these effects on the cued food as well as on an alternative non-cued food. Examining only the effects of pre-exposure on non-cued food (e.g., Grubliauskiene & Dewitte, 2014) comes with the disadvantage that possible effects on cued food are not observed, thus underestimating potential undesired effects.

It is further important to investigate the role of children's BMI and determine whether children with a higher BMI are less likely to show reduced consumption after food pre-exposure compared to children with a lower BMI. Jansen et al. (2003), for instance, found that overweight children failed to regulate their food intake after they were exposed to an intense smell of food like normal weight children did. Ferriday and Brunstrom (2011) reported that exposure to food in participants with a higher BMI led to greater salivation and a greater desire to consume both cued and non-cued food. Jansen et al. (2012) further found that a higher BMI among children is related to children's food approach behaviors such as food responsiveness, possibly explained by genetic influences on weight and on susceptibility to eating in the presence of foods. Since reactivity to food cues has been discussed as a risk factor for obesity (Tetley et al., 2009), and above-mentioned evidence suggests a link between BMI, representing an indirect measure of obesity (body fat levels), and regulation of food intake, we expected that the children's BMI would moderate the response to food pre-exposure.

The Study

To test the hypothesis that pre-exposure to food in a non-eating task leads to reduced subsequent consumption of both the cued food and another non-cued food and whether this effect is weaker for children with a higher BMI, we conducted a study with kindergarten children, who took part in two experimental sessions in their kindergarten. We manipulated food pre-exposure with a memory game with sweets in one condition, and with similar, but non-food stimuli in the other condition. We measured the consumption of the food used in the memory game (cued food) and another kind of food (non-cued food) after the game. The order of the experimental sessions, representing the two conditions, was counter-balanced, as in similar studies (e.g., Jansen et al., 2003). We also controlled for possible effects of gender.

Materials and method

Participants. We recruited 90 children between three and six years of age from two public kindergartens located in a medium size city in a Western European country. Following the principle of consent in studies involving children, we first thoroughly informed the children's parents about the study in a letter that also included a consent form. If parents agreed to let their child participate, we collected their signed consent forms. Children's participation was completely voluntary. Out of the 90 children who agreed to participate in the experiment, we subsequently excluded nine children from the data analysis due to incomplete participation, i.e.

taking part in only one out of the two experimental sessions. The final sample consisted of 81 normally developing children (one with special needs), 38 boys and 43 girls, with an average age of five years and one month (SD_{age} = 10.13 months). The children's body mass index (BMI) was 14.95 on average (SD_{BMI} = 1.52). We conducted the study between 10:30 am and 12:30 pm on regular school days over two weeks at the end of February and beginning of March 2017.

Design and procedure. To examine the effect of food pre-exposure on consumption of the cued food and another non-cued food, the children took part in a first experimental session followed by a second experimental session seven days later. Approximately one week before the first experimental session, the experimenter measured children's height and weight and asked the children to indicate how much they liked the two sweet snacks used in the experiment (Tutti Frutti, Prince biscuits). The children indicated their liking by choosing the most appropriate smiley face, ranging from a very happy face (5 = *like very much*) to a frowning face (1 = *do not like at all*).

We employed a 2 (Pre-exposure: food vs. non-food) x 2 (Order: food pre-exposure – non-food pre-exposure vs. non-food pre-exposure – food pre-exposure) mixed design for the experimental sessions. In one experimental session, the children played a game in which they were exposed to one sweet snack (Tutti Frutti). In the other experimental session, the children played a game with non-food stimuli (tokens). We randomized the order of the sessions. The experimenter conducted the experimental sessions with small groups consisting of up to six children.

At the beginning of the experimental sessions, the experimenter picked up the children from their kindergarten groups and took them to a separate room where the experiment took place. After the experimenter told the children that they would be playing a "fun game", the children indicated their current hunger level by choosing between a picture of a hungry person and a picture of a satiated person. Then, the experimenter explained the memory game, which was used to manipulate food exposure. When food was part of the memory game, the experimenter emphasized to the children that the food was for playing the game, not eating. The experimenter mostly observed the game, but would also join in depending on the amount of players in order to keep the proceedings constant in each group. Upon finishing the memory game, the experimenter provided each child with a glass of water to drink during consumption, as well as two separate bowls of sweet snacks: one containing 95g of Tutti Frutti sweet snack (cued food) and the other containing 95g of Prince biscuits (non-cued food). The experimenter instructed the children to eat as much as they wished. After five minutes, the experimenter asked the children to take a last treat and finish eating. Then, the children again indicated how much they liked the sweet snacks on a 5-point Likert scale by choosing the most appropriate smiley face, ranging from a very happy face (5 = *like very much*) to a frowning face (1 = *do not like at all*).

Manipulation of food pre-exposure (memory game). We used a memory game to manipulate food pre-exposure between the experimental and control conditions (Figure 1). The memory game was inspired by the “pexeso” game popular among kids, and had similar rules. During the game, the experimenter presented 40 neutral colored cardboard cups turned upside down to hide their content on a laminated board. Different numbers of Tutti Frutti snacks (vs. tokens) were placed under each cup such that there were always two cups on the board with the same number of snacks (vs. tokens) underneath, forming a pair. The experimenter asked the children to first choose and turn over one cup, count the number of snacks (vs. tokens), and then choose and turn over another cup and compare the numbers. If a child found a pair with matching numbers, she or he could take the content, but was not allowed to consume the snacks. That child then continued to play the game until she or he did not find a pair and it was the next child's turn. The memory game lasted about 10 minutes.

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Food consumption measure. After the children had finished eating, the experimenter weighed the bowls and calculated the amount of food eaten by subtracting the weighed amount from the original 95 grams.

Results

One week before the first experimental session, the children reported very high liking of the sweets that they later consumed in the experimental sessions (Tutti Frutti: $M = 4.28$, $SD = 1.20$; Prince Biscuits: $M = 4.47$, $SD = 1.14$). Similar to previous studies with well-liked snacks (de Boer et al., 2015), liking of the sweets remained stable throughout the experiment and was not affected by the experimental conditions, $F(1, 80) = 1.31$, $p = .26$, $\eta_p^2 = .02$.

Consumption. We hypothesized that pre-exposure to food would inhibit consumption of the cued and non-cued foods compared to non-food pre-exposure. To test this hypothesis, we conducted a 2 (Pre-exposure: non-food vs. food) by 2 (Food type: cued vs. non-cued) repeated measures analysis of variances with consumption in grams as the dependent variable. The analysis yielded a significant pre-exposure x food type interaction, $F(1, 80) = 7.45$, $p = .008$, $\eta_p^2 = .09$, which qualified the main effects of the exposure condition, $F(1, 80) = 7.17$, $p = .009$, $\eta_p^2 = .08$, and food type, $F(1, 80) = 43.43$, $p = .000$, $\eta_p^2 = .35$ (Figure 2). We further analyzed the nature of the interaction by computing paired *t* tests separately for the cued and the non-cued food. Children ate more of the non-cued food in the food pre-exposure condition (M = 25.16, SD = 16.75) than in the non-food pre-exposure condition (M = 21.20, SD = 13.58), $t(80) = 3.19$, p = .002, $d_z = 0.35$. Importantly, this difference in consumption was not present for the cued food ($M_{food\ exposure} = 9.60$, $SD_{food\ exposure} = 9.14$; $M_{non\ food\ exposure} = 9.86$, $SD_{non\ food\ exposure} = 9.00$), $t(80)$ = 0.33, p = .74, $d_z = 0.04$. Hence, the results that do not take BMI into account show neither an increase nor a decrease in consumption of the cued food as a function of food pre-exposure, but increased consumption of the non-cued food after food pre-exposure compared to non-food pre-exposure.

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To examine whether the reported effects depend on the children's BMI, we conducted a mixed-design analysis of variance with BMI as a continuous between-subject factor and food type (cued vs. non-cued) as a within-subject factor. The dependent variable was the difference between consumption after food pre-exposure and consumption after non-food pre-exposure. Specifically, we subtracted consumption in the non-food pre-exposure condition from consumption in the food pre-exposure condition. Negative values indicated a decrease in consumption after food pre-exposure, whereas positive values indicated an increase in consumption after food pre-exposure. We decided to use difference scores as the dependent variable because this procedure reduces the complexity of the analysis. Note that recent research in this area has applied difference scores in the same way (Chen, Veling, Dijksterhuis, & Holland, 2016; Serfas, Florack, Büttner, & Voegeding, 2017). We expected a main effect of BMI on the difference between the conditions. The analyses confirmed our expectation (Figure 3),

$F(1, 79) = 3.69$, $p = .05$, $\eta_p^2 = .06$. To further illustrate the effect of BMI, we conducted a spotlight analysis for thin (10^{th} percentile, Kromeyer-Hauschild et al., 2001) and overweight children (90^{th} percentile, Kromeyer-Hauschild et al., 2001). We calculated the BMI-percentiles based on the present sample. The 10^{th} percentile (thin) in the present sample corresponds to a BMI of 13.37 and the 90^{th} percentile (overweight) corresponds to a BMI of 16.84. Note that we did not factorize the BMI, but compared the difference in consumption at specific values, i.e. the 10^{th} and 90^{th} percentile, of the continuous between-subject factor BMI in a general linear model analysis. To do so, we shifted the mean of the original BMI data by subtracting 13.37, respectively 16.84 from it. We then conducted our analysis on the mean-shifted data. After the food pre-exposure compared to non-food pre-exposure, thin children ate significantly less of the cued food, $B = -2.60$, $SE = 1.08$, $t(80) = -2.42$, $p = .02$, $\eta_p^2 = .07$, and more of the non-cued food, $B = 3.57$, $SE = 1.81$, $t(80) = 1.98$, $p = .05$, $\eta_p^2 = .05$. In contrast, overweight children ate significantly more of both the cued food, $B = 2.56$, $SE = 1.20$, $t(80) = 2.14$, $p = .04$, $\eta_p^2 = .05$, and even more of the non-cued food, $B = 4.43$, $SE = 2.01$, $t(80) = 2.21$, $p = .03$, $\eta_p^2 = .06$. The effect of food type, $F(1, 79) = 2.20$, $p = .14$, $\eta_p^2 = .03$, and the BMI x food type interaction, $F(1, 79) = 1.47$, $p = .23$, $\eta_p^2 = .02$, were not significant.

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In addition, we attempted to verify that age, sex, order of conditions, and the specific kindergarten children attended did not influence the effect on consumption. Therefore, we included each control variable separately in the prior analysis. Specifically, we conducted mixed-design analyses of variance with each control variable, as well as BMI, as between-subject factors and food type (cued vs. not cued) as a within-subject factor. The difference in consumption between the conditions was again the dependent variable. None of the control variables changed the prior pattern of results and none of the main effects or interactions including a control variable were significant, Fs(1, 77) < 2.59, $p > .11$, $\eta_p^2 < .03$.

Discussion

Extant research has shown that exposure to food cues prepares individuals for the consumption of food and increases food consumption (Petrovich, 2013). But interestingly, recent research has also suggested that food exposure can lead to reduced food intake in situations in which eating is not the prioritized goal during exposure (Duh et al., 2016; Grubliauskiene & Dewitte, 2014; Geyskens et al., 2008). Indeed, de Boer et al. (2015) even suggested that exposure to tempting food might serve as a "behavioral vaccine" to strengthen resistance to similar food. However, focusing on a task while being distracted by palatable food requires self-control abilities, which might be not fully developed already in children at a younger age (Best & Miller, 2010). Therefore, we conducted a study to get more insight into possible resistance effects in young children.

The results of our study with kindergarten children between the ages of three and six show that the objective to further study the effects of food pre-exposure in young children was justified, and that resistance effects do not naturally occur at this age. Overall, and when the BMI was not taken into account, we found an increase in consumption after food pre-exposure, which was mainly driven by consumption of the non-cued food. Hence, at the very least, it is premature to regard exposure to food as a general "behavior vaccine" to train children's resistance to tempting food at this age.

The results of the present study support the notion that exposing children to food, especially when they are overweight, can trigger consumption. The finding that the consumption of non-cued food of thin and overweight children increased after food pre-exposure is particularly interesting, because previous studies with older children found a higher resistance to non-cued food (de Boer et al., 2015; Grubliauskiene & Dewitte, 2014). However, researchers have observed effects of pre-exposure to food-related cues on the consumption of cued and non-cued food before (Ferriday & Brunstrom, 2008). Particular relevant in the context of our study are the findings of Folkvord et al. (2013). The authors used an ad game to manipulate the exposure to candy brands that resembled the task applied in the present research importantly, because the main goal during the execution of the task was not an eating goal. In line with the present findings, Folkvord et al. (2013) found that exposure to popular candy brands in ad games led to a simultaneous increase in consumption of the advertised as well as non-advertised candies. However, despite the similarity between the game that was played by children in the current study and the ad game used in the study by Folkvord et al. (2013) and a game used in a similar study by Folkvord, Anschütz, Nederkoorn, Westerik, and Buijzen (2014), there are also important differences between these studies and the present study. First, the children in the studies be Folkvord and colleagues were between 7 and 10 years old, while the ages of the children in our study were between 3 and 6 years. Second, in the studies by Folkvord and colleagues the children were not exposed to real food. It is very likely that ad games do not lead to a strong conflict between eating goals and the goal to complete the task as it was the case in our study. This might be also the reason why the results of the studies with ad games are different from the results with real food exposure with children at the same age (Grubliauskiene & Dewitte, 2014).

At present, it is not clear whether the effects of ad games and direct exposure to food in a non-eating task elicit the same processes to the same strength. A basic mechanism which supports individuals to execute a task and pursue a goal is to suppress competing goals (Brendl, Markman, & Messner, 2003; Serfas et al., 2017). This mechanism might be particular strong when individuals are exposed to tempting food cues and might block the stimulating effects of food cues (Geysken et al., 2008). It is plausible to assume that such effects are less distinguished in ad games when the food is not present.

A first hint that self-regulatory processes are involved in the effects of exposure to food in a task with a non-eating goal is reflected in the moderating effects of the BMI. While both groups of children ate more of the non-cued food after food pre-exposure, thin children ate less of the cued food after pre-exposure than after non-food exposure. By contrast, overweight children ate more of the cued food after pre-exposure to this food. Previous research has pointed already to a possible link between higher BMI and less successful regulation of food intake (Jansen et al., 2003; Tetley et al., 2009) as well as higher reward sensitivity, lower inhibitory control (Nederkoorn, Braet, Eijs, Tanghe, & Jansen, 2006), and slower habituation (Temple, Giacomelli, Roemmich, & Epstein, 2007). Hence, the present results are in line with other research on the consumption-eliciting effects of food cues and further support the proposition that reactivity to food cues could be a risk factor for overweight (Tetley et al., 2009).

Though the observation of differences in food exposure effects between children differing in the BMI suggests that self-regulatory processes are involved in the response to food exposure in young children, the question remains what the concrete self-regulatory mechanisms are that underlie these differential effects and whether it is the focus on the non-eating task that impedes the activation of eating goals and desire to eat in children. Finally, it has to be stressed that the

BMI is influenced by multiple factors and it does not represent an ideal measure of successful self-regulation on its own. The BMI is an important measure in obesity research and it has been shown that it is related to self-regulation over long period of time (Schlam, Wilson, Shoda, Mischel, & Ayduk, 2013). However, it is important to directly measure self-regulatory abilities, as well. For example, Francis and Susman (2009) measured self-regulatory capacities with a waiting game at the age of three and with a delay of gratification task at the age of five. They found that self-regulatory failures at these ages were correlated with rapid increases in children's BMI. Similarly, research could test whether such measures of self-regulatory failures are related to the reactivity to food cues in children.

In conclusion, the present study shows that food exposure paradigms that might reduce food consumption in older children or adults might not lead to reduced food consumption in younger children. The findings further provide evidence that reactivity to food cues is already higher among children with a higher BMI at this age. The found increase in consumption indicates the effect to be of rather small scale. Nevertheless, the estimation of the increasing weight gain rate within the population suggests that merely taking a few bites more or less of each food constitutes the difference between weight gain, weight maintenance or weight loss (Hill, Wyatt, Reed, & Peters, 2003). Indeed, it is important to obtain greater insight into the link between reactivity to food cues and individual differences in executive control abilities in young children. Future research might focus on whether deactivation of the eating goal (Geyskens et al., 2008) or devaluation of the food stimuli (Veling, Holland, & van Knippenberg, 2008) helps young children improve task performance in the prioritized task, and finally might spent more effort on possible interventions to overcome undesired effects of food exposure (Folkvord, Veling, & Hoeken, 2016).

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Supplementary material

Figure 1. Memory game used as manipulation of food exposure.

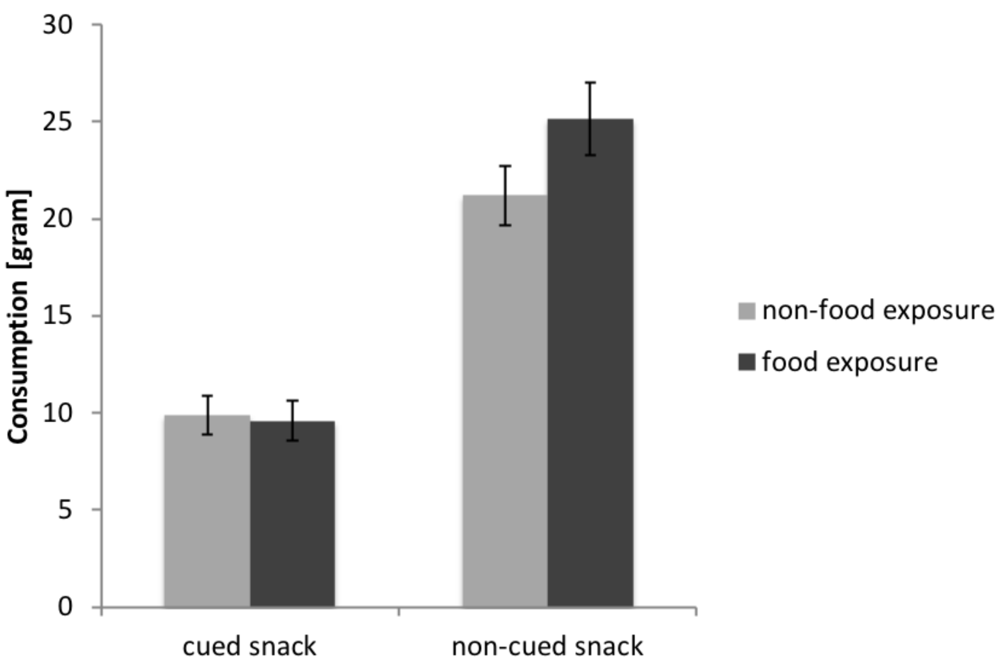

Figure 2. Consumption in grams of (non-)cued food after (non-)food pre-exposure.

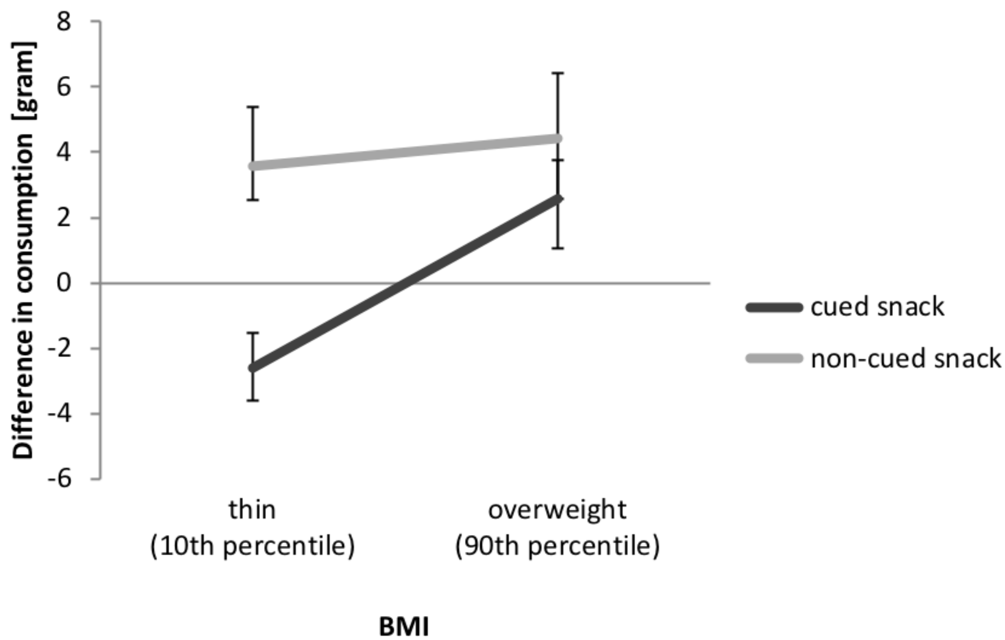

Figure 3. Effect of BMI on the difference in consumption after food pre-exposure of the cued versus non-cued food. Difference in consumption was obtained by subtracting the consumed amount in the non-food pre-exposure condition from the amount in the food pre-exposure condition. Negative values indicated a decrease in consumption after food pre-exposure, whereas positive values indicated an increase in consumption after food pre-exposure.