

# Towards a Behavioral Vaccine: Exposure to Accessible Temptation when Self-Regulation is Endorsed Enhances Future Resistance to Similar Temptations in Children

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**Background:** Access to temptation is blamed for the rising prevalence of obesity in children. A popular way to counter this is to restrict physical access to temptation. As restrictions cannot be widely applied and may have adverse long-term effects, we examine whether accessible temptations in situations that endorse self-regulation train self-regulation. Specifically, we design a method that enhances children's self-regulatory skills in the long term. **Method:** In two studies, participants were exposed to temptation in phase one and their self-regulatory skills were measured in phase two. In Study 1, we endorsed self-regulation in the presence of accessible temptation for four consecutive days and measured consumption on the fifth day. In Study 2, we exposed children to temptation similarly and, in addition, manipulated temptation strength to show that being tempted is crucial for the skill to develop. Next, we measured saliva and preferences. **Results:** The findings suggest that exposure to temptation in a situation that supports self-regulation leads to better resistance to temptations in later contexts of accessible temptation in girls, but not boys. **Conclusions:** Our findings suggest that interventions aiming at strengthening children's self-regulatory skills through controlled exposure to temptation might be a productive long-term strategy to reduce consumption of unhealthy food.

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## INTRODUCTION

The wide availability and easy accessibility of unhealthy foods has been blamed for the current obesity epidemic (Faith, Fontaine, Baskin, & Allison, 2007; French, Story, Fulkerson, & Gerlach, 2003). The large variety and accessibility in big food portion sizes of energy-dense and highly palatable foods has often been linked to disproportionate consumption of these foods (Brownell & Horgen, 2004; Young & Nestle, 2002). To curb this excessive consumption in youths, interventions targeting the ease of access to tempting foods (e.g. candies or potato chips) at home or at school have received considerable attention over the past decade (Committee on School Health, 2004; Sothorn 2004; Hagger & Luszczynska, 2013). A common trend in these interventions is to build a temporary and protected environment where access to temptation is restricted. To illustrate, strategies aimed at restriction have ranged from substituting unhealthy foods with healthy options in vending machines to hinder temptation through pricing strategies (Edmonds, Baranowski, Baranowski, Cullen, & Myres, 2001; French et al., 2001).

Generally, this type of intervention is successful as long as the restriction holds, but an important potential weakness of this strategy is, however, that it may not have positive effects in situations where temptations are available but the restriction does not apply (French, Jeffery, Story, Hannan, & Snyder, 1997; Faith et al., 2007). Extending the restriction policy outside home and school is difficult to achieve because of practical and political reasons, and on top of that, restriction may render the “forbidden fruit” even more appealing (e.g. Fisher & Birch, 1999; Birch, Fisher, & Davison, 2003). Children who leave the restrictive home or school environment and enter a tempting environment that lacks these restrictions need to rely again on their own set of self-regulation skills. Unsupported self-regulation skills seem insufficient to resist food temptations. Adolescents who had easy access to unhealthy foods at home or in school had unhealthier eating patterns if they were not sufficiently equipped with self-regulation skills (De Vet et al., 2013). An approach that supports the development of children’s skills to resist highly accessible temptation may be more sustainable than one limiting exposure to temptation.

To explore the possibility of such an approach, we rely on previous findings illustrating the benefits of exposure to temptations to improve self-regulation skills. This emerging stream of research suggests that exposure may help rather than hinder successful resistance to temptation (e.g. Fischbach, Friedman, & Kruglanski, 2003; Geyskens, Dewitte, Pandelaere, & Warlop, 2008; Kroese, Evers, & de Ridder, 2009). Specifically, a so-called two-stage,

pre-exposure paradigm has been shown to bolster resistance to temptation. In this paradigm participants are either exposed or not to temptation in the first stage in a context that endorses self-regulation. In the second stage, participants are presented with a similar temptation without this endorsement (Geyskens et al., 2008). The typical finding is that after endorsed pre-exposure, subsequent free consumption is lower. Our research question is whether the pre-exposure paradigm can be used to increase children's self-regulating skills. To address this question, we adapted the delay-of-gratification task that presents children with a choice between a small immediate reward and a bigger delayed reward (e.g. Mischel & Ebbesen, 1970) in such a way that all children choose to delay gratification. This phase endorses self-regulation as children are motivated to decide not to consume the presented temptation but instead wait for the larger reward.

The main contribution of this paper is to test whether contexts that endorse self-regulation may affect preferences and consumption beyond the situation where the endorsement applies (Geyskens et al., 2008). In addition, we aim to replicate effects of pre-exposure that have been found in adults (Geyskens et al., 2008) and in pre-adolescent children (aged 8–11; Grubliauskiene, 2014). To assess improvements in self-regulating skills we turn to both behavioral (food consumption) and food preference (saliva and self-report) measures.

## THEORETICAL BACKGROUND

Physical access to a food temptation (e.g. brownie) while trying to resist the temptation puts individuals in a situation of behavioral conflict—the choice between indulging and resisting (Hoch & Loewenstein, 1991; Fischbach et al., 2003). Behavioral conflict can either be resolved unsuccessfully (e.g. eating the brownie) or successfully (e.g. not eating the brownie). Most research shows that the behavioral conflict induced by the presence or salience of a temptation triggers approach behavior to temptations (Seibt, Häfner, & Deutsch, 2007; Krieglmeier, Deutsch, De Houwer, & De Raedt, 2010; Zedelius, Veling, & Aarts, 2011) and leads to unsuccessful outcomes (e.g. Boon, Stroebe, Schut, & Jansen, 1998; Meltcafe & Mischel, 1999), especially if behavioral conflict is boosted (Mischel & Ebbesen, 1970; Mischel, Ebbesen, & Zeiss, 1972; Mischel & Baker, 1975). However, the focus of that research stream is on how behavioral conflict undermines self-regulation during exposure. This research overlooks the possibility that successfully resolving a conflict may have beneficial after-effects on self-regulation.

Several studies in various domains suggest that under specific conditions, behavioral conflict might generate processes that *reduce* rather than increase preferences for the temptation and hence boost resistance (Chen & Bargh,

1999; Veling, Holland, & Van Knippenberg, 2008; Custers & Aarts, 2011). This seemingly counterintuitive effect was first described in cognitive control theory in the context of cognitive tasks (Botvinick, Braver, Bargh, Carter, & Cohen, 2001). The reasoning behind cognitive control can, however, also be applied to a self-regulation context (Harmon-Jones, Schmeidel, Inzlicht, & Harmon-Jones, 2011; Dewitte, 2013). The assumption is that the behavioral conflict (resisting a temptation) recruits control processes enabling successful self-regulation in subsequent situations conditional on prior successful self-regulation (Geyskens et al., 2008; Dewitte, Bruyneel, & Geyskens, 2009). Importantly, other research has illustrated that such elicited enhancement of self-regulation may be sustainable (Verguts & Notebaert, 2009) when successful resolution of conflict is rewarded (Braem, Verguts, Roggeman, & Notebaert, 2012). These various lines of research suggest that exposure to temptation in situations that support successful self-regulation through rewards (e.g. in a task that implies that refraining from immediate consumption leads to reward) may have lasting effects on self-regulation success for similar temptations. We hypothesise that exposure to temptation in situations that endorse self-regulation reduces pre-adolescent children's subsequent consumption of and preference for similar temptations compared to those who were exposed to non-food temptation (H1).

Moreover, research has suggested that these improvements in self-regulation skills are dependent on the detection of behavioral conflict (Botvinick et al., 2001) and enhanced if behavioral conflict is boosted (Verguts & Notebaert, 2009; Kroese, Evers, & de Ridder, 2011). As such, the presentation of the temptation should be construed in such a manner that the behavioral conflict is still present in the pre-exposure phase. This implies that any type of self-regulation support in the pre-exposure phase that prevents the behavioral conflict from occurring may also suppress subsequent reinforcement of sustainable self-regulation (Fischbach & Trope, 2003; Verguts, Notebaert, Kunde, & Wühr, 2011). Our second hypothesis therefore states that exposure to temptation in situations that support self-regulation will not improve self-regulation if behavioral conflict is experimentally suppressed as compared to when behavioral conflict is enhanced (H2).

In the paradigm that we use, the situational restriction goal is task specific (participants decide on the spot to restrict consumption) and not individually variable. From this perspective, there is no reason to expect gender differences. However, research on gender differences in eating behavior has suggested that girls have a tendency to be more sensitive to food restriction instructions than boys (Thelen & Cormier, 1995; Fisher & Birch, 1999). Thus, it remains an open question whether the pre-exposure manipulation will affect both genders to a similar extent or mostly girls.

To test our predictions, we adapted the delay-of-gratification task. The delay-of-gratification holds that participants receive a larger reward when

they successfully resist a smaller reward during a fixed waiting period (for an overview, see Mischel & Ayduk, 2004). The classic measure of interest in this task is the assessment of children's ability to delay immediate consumption of temptation. However, our motivation is to implement a self-regulation supportive context where successful self-regulation in the face of temptation is constant across respondents and can be rewarded. We focus on how pre-exposure in the form of a self-regulation supportive context impacts consumption and preference *after* the delay time.

## STUDY 1

In Study 1, we used an adapted delay-of-gratification task, which we introduced to children as an earning game. This task required children to choose between having one tempting item (candy or marble, depending on condition) now, or wait and earn three later. By tripling the immediate reward and keeping the waiting time to decide limited, we standardised the pre-exposure phase ensuring that all experienced success and were exposed to temptation for 3 minutes, without reducing decision autonomy. We repeated the exposure on four consecutive days to boost the manipulation, based on the finding that repeated exposure to behavioral conflict enhances people's ability to deal with that conflict (Logan & Zbrodoff, 1979). On the fifth day, children were presented with another tempting candy and we measured self-regulation through consumption of candies (Schachter, Goldman, & Gordon, 1968). The delay between the exposure phase and the measurement phase was included as a first demonstration that the behavioral change is sustainable (Grubliauskiene, Verhoeven, & Dewitte, 2012). We expected that those who had been previously exposed to candy temptation would reduce their consumption of similar candy relative to those who had been exposed to marble temptations.

## Method

*Participants.* Sixty-three fourth and fifth grade children from one school were recruited ( $M_{age} = 9.5$ ,  $SD_{age} = 0.62$ ). Before analysis, those who consumed >3 standard deviations from the mean ( $N = 3$ ) were omitted. To assess the influence of successful self-regulation during pre-exposure, we omitted children who earned less than nine candies/marbles ( $N = 2$ ) to safeguard standardisation.<sup>1</sup> Of the remaining children, 31 did the delay task with candy ( $N_{girls} = 19$  and  $N_{boys} = 12$ ) and 27 with marbles ( $N_{girls} = 17$  and  $N_{boys} = 10$ ).

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<sup>1</sup> The inclusion of these two participants did not impact the statistical conclusions.

*Procedure.* Before the experiment started, teachers were briefed by the experiment leader and were instructed to follow the written procedure with standardised instructions and to remain neutral with respect to the delay decisions of the children.

Four classes were randomly assigned to the candy (experimental) or marble (control) condition (two classes in each condition). In the experimental condition the item of the earning game was a fruit candy (a popular branded candy in the participants' country) and in the control condition it was marbles (a popular toy in the participants' country). On the first day, Monday, after the mid-morning break, every class was introduced to the adapted delay-of-gratification task and children were told that they were playing an earning game with candies/marbles. They were told that they had the choice between receiving one candy/marble now or to wait and earn three candies/marbles later. They were further informed that they would have this choice four times, from the current day, Monday, until Thursday. On Friday, the earning game would end and they would receive their self-chosen earnings. Lastly, every day, after the adapted delay-of-gratification task, children's choice to delay or not was written on their individual paper "earning account". This allowed them to track their earnings on a daily basis. On the three subsequent days, children received similar instructions where they could choose between one candy/marble now and that they were free to eat/have it now, or wait and earn three candies/marbles on their earning account.

After this, teachers distributed the candies/marbles in a similar way in all classrooms. To cancel out small exposure differences related to the child's physical position in the class, we varied the distribution order systematically. After the distribution of candies/marbles, children were given 3 minutes to decide. Next, teachers retrieved the candies in the same order as they were distributed and circled the amount of candies/marbles, zero or three, earned. As such, children could earn between a minimum of zero and a maximum of 12 candies/marbles during the four days of the earning game that were handed out on the fifth day.

*Taste Test.* On the fifth day, children came to an experiment room one by one. Once seated, participants were informed that they were about to do a small, fun task. They were told that they were about to take part in a taste test where they could consume as much of the candy as they wanted. A bowl of attractive candies (different from the pre-exposure stage; red sweet gums from Haribo's®) was placed in front of the participants together with an evaluation form.

*Measures.* At the beginning of the intervention, before the adapted delay-of-gratification task started, children were asked to rate their general preference for candy on a 5-point scale. After the manipulation, a taste test

where consumption was unobtrusively measured served as the main dependent variable and a measure of self-regulation. To account for the possible side-effect of hunger on consumption, children were asked to indicate their hunger level on a 3-point visual scale before taking part in the taste test. During the taste test participants were asked to rate the candy on three dimensions on a 5-point scale. The first, “I like the taste of the candy”, was the secondary dependent variable. The other two, “The candy is pretty” and “The shape of the candies is nice”, were filler questions.

## Results and Discussion

In general, children indicated a high preference for candies ( $M = 4.65$ ,  $SD = 0.51$ ) and this preference was unaffected by the condition ( $F < 1$ ), gender ( $F < 1$ ) or the interaction between gender and condition ( $F(1, 57) = 1.91$ ,  $p = .17$ ).

For the remainder of the paper we add hunger and age as covariates in the analysis. Self-regulation of children aged between 8 and 11 years is still in full development (Williams, Ponesse, Schachar, Logan, & Tannock, 1999) and age may therefore matter. Hunger levels are closely associated with consumption (e.g. Wooley & Wooley, 1973).

*Tastiness of Candy.* We conducted an ANCOVA on “I like the taste of the candy”, a measure of self-stated preference for the candy, with pre-exposure (candy vs. control) and gender as independent variables and age and hunger as covariates. The analysis revealed no significant main effect for condition ( $F(1, 57) = 0.46$ ,  $p = .50$ ) or gender ( $F(1, 57) = .339$ ,  $p = .07$ ), nor a significant interaction effect ( $F(1, 57) = .08$ ,  $p = .77$ ). Further analysis revealed that the ratings were high overall, as 79 per cent of the participants answered the maximum on “I like the taste of the candy” and the remaining 21 per cent indicated 4 on the question “I like the taste of the candy” ( $M = 4.74$ ,  $SD = 0.43$ ). We therefore suggest that a ceiling effect might be accountable for the lack of significant results for this particular question.

*Quantity Consumed.* After a log transformation on the dependent variable quantity consumed, we conducted an ANCOVA with hunger and age as covariates, and pre-exposure (candy vs. control) and gender as between-subjects variables. The analysis revealed no main effect for pre-exposure ( $F(1, 57) = .48$ ,  $p = .49$ ), gender ( $F(1, 57) = 1.35$ ,  $p = .25$ ;  $M_{boys} = 20.97$ ,  $SD_{boys} = 15.03$  vs.  $M_{girls} = 13.49$ ,  $SD_{girls} = 11.60$ ) or age ( $F(1, 57) = 1.35$ ,  $p = .25$ ). The analysis further revealed a positive main effect of hunger ( $F(1, 57) = 5.62$ ,  $p = .05$ ,  $\eta_p^2 = .09$ ). There was a significant interaction between pre-exposure and gender ( $F(1, 57) = 4.97$ ,  $p < .05$ ,  $\eta_p^2 = .09$ ; see Figure 1, displayed in grams). Girls consumed less in the pre-exposure condition

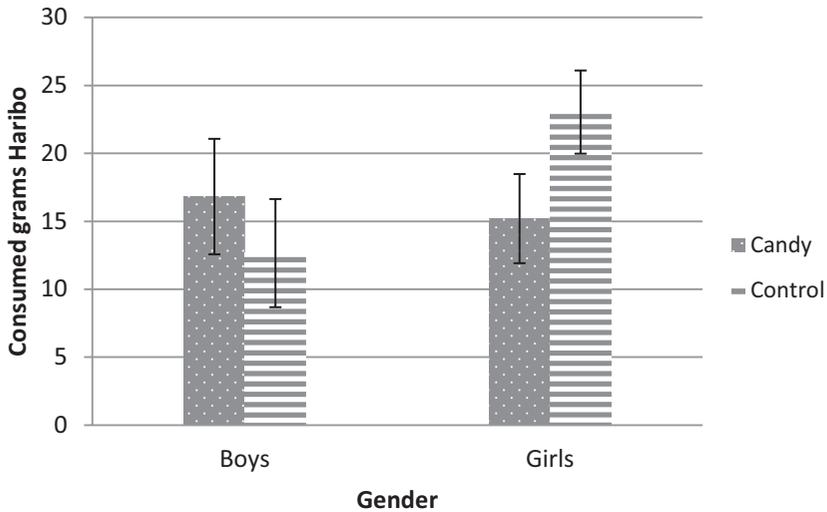


FIGURE 1. Quantity consumed (in grams) among conditions (Control vs. Candy) for girls and boys.

( $M = 15.19$ ,  $SD = 3.28$ ) relative to the control condition ( $M = 23.03$ ,  $SD = 3.06$ ,  $p < .05$ ). For boys, consumption did not differ between the candy ( $M = 16.81$ ,  $SD = 4.25$ ) and the control condition ( $M = 12.65$ ,  $SD = 3.98$ ,  $p = .35$ ). The absence of differences in consumption for boys cannot be accounted for by lower liking. Preference for candy, measured before the experiment, illustrated that both boys ( $M = 4.60$ ) and girls ( $M = 4.76$ ) liked them equally ( $F(1, 57) = .44$ ,  $p = .51$ ). Across gender, there was no difference between girls ( $M = 15.16$ ,  $SD = 3.25$ ) and boys ( $M = 16.66$ ,  $SD = 4.20$ ,  $p = .47$ ) in the candy condition. But, in the control condition, girls ( $M = 23.03$ ,  $SD = 3.04$ ) consumed more relative to boys ( $M = 12.82$ ,  $SD = 3.92$ ,  $p < 0.05$ ).

As hypothesised, boosting food-related behavioral conflict in a supportive self-regulating context enhanced self-regulation 24 hours after the last treatment. Specifically we illustrated that the repeated implementation of a self-regulation supportive context by rewarding postponement of consumption reduced consumption of similar candy in a subsequent exposure situation, in girls. In the first study we did not address the mechanism behind the behavioral effect. We focus on this in the second study to inspire further fine-tuning of this potential self-regulatory enhancing tool. First, we want to demonstrate the pivotal role of behavioral conflict in the pre-exposure effect by experimentally manipulating it. Second, we explore whether the increased behavioral resistance to temptation is reflected in preferences. Third, as the

results of Study 1 may in principle also be due to the increased consumption among girls in the control condition, we added a baseline measure in Study 2.

## STUDY 2

In Study 2 our goal is to provide evidence for the crucial role of behavioral conflict during pre-exposure in triggering behavioral change (Verguts & Notebaert, 2009). Here, our focus shifts from the delayed changes in self-regulation, as illustrated in Study 1, to the underlying process that might account for the changes in self-regulation. We shortened the delay time between initial exposure and the measurement phase as preferences are supposed to be relatively stable. As in the previous study, we created a self-regulation supportive context by rewarding the decision to postpone immediate consumption. During delay, we manipulated the intensity of the experienced behavioral conflict. We built on Mischel and Baker's (1975) ideation manipulation where children ideate about the tempting aspects (e.g. taste) or the non-tempting aspects (e.g. color) of temptation during the self-imposed delay. In the hot ideation condition, we invited children to ideate about the hot, tempting features of the candy, thereby boosting behavioral conflict. In the cool ideation condition, we decreased the behavioral conflict by letting children ideate about the non-tempting aspects of the temptation, relying on Mischel and Baker's (1975) finding that cool ideation prolongs children's ability to delay. We assume that cool ideation effectively suppresses the behavioral conflict because it reduces the attractiveness of the temptation. Importantly, this assumption implies that there is no need for self-regulation processes to be recruited in the presence of physical temptation, as the desired behavior is achieved through an alternative route. In the control<sup>2</sup> condition, we used a non-edible temptation, similar to the one used in Study 1, where we exposed children to attractive toys. We expected children in the hot condition to be less attracted to similar temptations upon subsequent exposure to them, relative to the control condition and the cool ideation condition. Lastly, to illustrate that the behavioral changes found in Study 1 may be reflected in a reduced preference for candy, we used an explicit self-report attractiveness

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<sup>2</sup> We initially used two versions of the control condition, sharing the feature that the temptation was not physically present during pre-exposure. In one version, the control condition showed a photograph of candies, and children chose between two candies now or eight later. In the other version, children were exposed to a non-food temptation, toys, of which they could get two now or eight later. At the outset of the project we felt that two control conditions may be more convincing, but the control conditions may be too different to combine. In the meantime other studies have shown that pictures of peers eating tempting food may also induce the pre-exposure effect (Grubliauskiene, 2014). Given this, we decided to select the toy control condition for this paper and drop the picture condition. In the Appendix we include the analyses with the two control conditions separately.

measure and an implicit attractiveness measure: saliva excretion on exposure to temptation. Salivary response is a preconsummatory, physiological and uncontrollable response to food palatability and is related to the motivation to acquire food (Peck, 1959; Wooley & Wooley, 1973).

## Method

*Participants.* One hundred and thirty-three children aged between 8 and 11 years old ( $M_{age} = 10.08$ ,  $SD_{age} = 0.96$ ) participated in the study. At the start of the experiment children were randomly distributed to one of the three conditions: hot and cool ideation and control. Fifty-two children were in the hot ideation condition ( $N_{boys} = 22$  and  $N_{girls} = 30$ ), 57 children in the cool ideation condition ( $N_{boys} = 24$  and  $N_{girls} = 33$ ) and 24 children in the control condition ( $N_{boys} = 10$  and  $N_{girls} = 14$ ). Those whose responses were three standard deviations from the mean on the variable “I think the chosen candy is very tasty” ( $N = 3$ ) and participants with incomplete responses ( $N = 3$ ) were omitted.

*Procedure.* Children came to the experiment room one by one, one every 15 minutes. There were no candies presented. Participants were randomly assigned to one of the three exposure conditions: hot ideation (hereafter called “hot”), cool ideation (hereafter called “cool”), and non-food temptation (hereafter called “control”). To ensure that the reward was maximally desirable, participants were asked to indicate their most preferred item out of two similar types of candies (M&M’s® and sweet gums by Haribo’s® in the experimental conditions). In the control condition, two bowls, one with marbles and one with stickers, were given. In all conditions, participants were invited to choose what they preferred. During this choice task, we conducted the first saliva test.

Next, we induced a self-regulating supportive context by telling all participants that they could either consume/have two candies/items now or eight candies/items after a 7-minute delay. The incentive (wait for eight candies) is higher and the delay time (7 minutes) lower than in the classical delay-of-gratification task to ensure that all children would decide to wait.

After the participants consented to delay (which all of them did), a timer was put on. Then, in the hot ideation condition, instructions were given to focus participants’ thoughts on the consummatory, tempting aspects of the reward (Mischel & Baker, 1975). The cool ideation instructions directed attention to the cool or abstract features of the temptation. In the control condition, no further instructions were given. In the hot and cool conditions, children waited with two candies in front of them. In the control condition, children waited with two non-food temptations in front of them.

After the delay, the experimenter returned and measured salivary flow again. Meanwhile, in the hot ideation and cool ideation conditions, the experimenter placed the bowl of their preferred candy in front of the participant. To ensure that children paid attention to the candy during the saliva measurement, the experimenter counted out loud the eight candies in a deliberately slow manner. In the control condition with products, the experimenter first gave them their deferred reward, either stickers or marbles. Next, two bowls, one with M&M's® and one with Haribo's®, were placed in front of them while the experimenter asked which they preferred. Then, as in the other conditions, the experimenter drew participants' attention to the candy by counting out eight candies in a deliberately slow manner during the saliva measure.

*Measures.* At the start of the experiment, children were asked to indicate their age and their hunger level on a 3-point visual scale, as in Study 1. Saliva was measured in two stages: during the first exposure to candy and after the delay. For this we used the Strongin-Hinsie Peck (SHP) method (Peck, 1959). After swallowing, three cotton dental rolls were placed under the tongue and between the cheek and lower gum on the left and right side of the participants' mouth. After 2 minutes, the cotton dental rolls were removed and weighed on a two digit point scale. At the end, participants indicated how much they wanted the candy on a 5-point scale: "I think the chosen candy is very tasty".

## Results and Discussion

*Saliva.* To account for heterogeneity in the sample and as we were interested in preference changes across the conditions with respect to the pre-exposure phase, we subtracted the first saliva measure from the second saliva measure. We further refer to this as saliva, where a higher score on saliva indicates a higher relative saliva secretion from time 1 to time 2. Next, we conducted an ANCOVA on saliva, with age and hunger as covariates, condition (hot, cool, and control) and gender as between-subjects variables.

There were no main effects for hunger ( $F(1, 132) = .25, p = .61$ ), age ( $F(1, 132) = 2.20, p = .14$ ), condition ( $F(2, 132) = .41, p = .67$ ), or gender ( $F(1, 132) = .19, p = .66$ ). However, a marginal interaction was found between condition and gender ( $F(2, 132) = 2.64, p = .07, \eta_p^2 = .04$ ; Figure 2). Further analysis showed that girls salivated marginally less in the hot condition, relative to the cool condition ( $p = .06, M_{hot} = -.11, SD_{hot} = .10$  vs.  $M_{cool} = .15, SD_{cool} = .09$ ) and significantly less compared to the control condition ( $p < .05, M_{hot} = -.11, SD_{hot} = .10$  vs.  $M_{control} = .24, SD_{control} = .15$ ). Between the cool and control conditions, no differences were found in girls for salivary response ( $p = .59, M_{cool} = .15, SD_{cool} = .09$  vs.  $M_{control} = .24,$

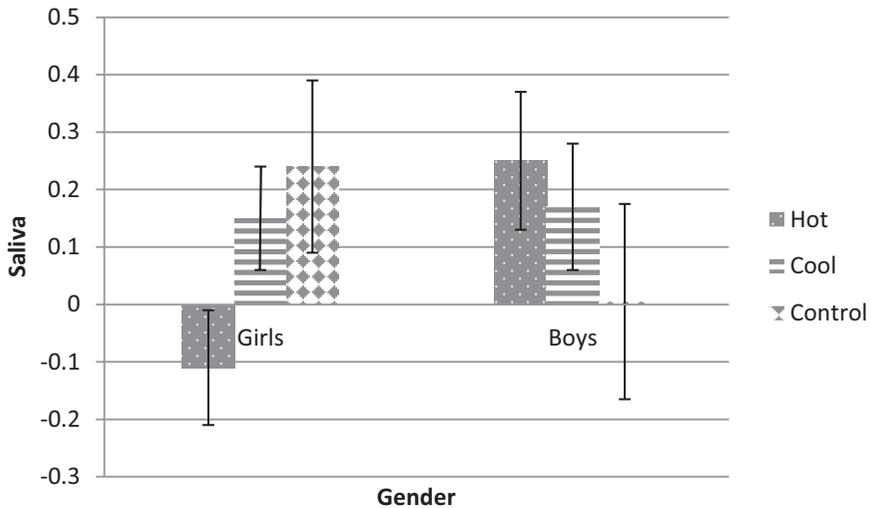


FIGURE 2. Saliva among conditions (Hot, Cool and Control) for girls and boys.

$SD_{control} = .15$ ). For boys, no salivary response differences were found between conditions. That is, boys' salivatory response between the hot and cool conditions ( $p = .65$ ,  $M_{hot} = .25$ ,  $SD_{hot} = .12$  vs.  $M_{cool} = .17$ ,  $SD_{cool} = .11$ ), or between the hot and control ( $p = .25$ ,  $M_{hot} = .25$ ,  $SD_{hot} = .12$  vs.  $M_{control} = .006$ ,  $SD_{control} = .17$ ), or between the cool and control conditions ( $M_{cool} = .17$ ,  $SD_{cool} = .11$  vs.  $M_{control} = .006$ ,  $SD_{control} = .17$ ) did not differ. Across gender, girls salivated significantly less in the hot condition relative to boys ( $p = .02$ ,  $M_{girls} = -.11$ ,  $SD_{girls} = .10$  vs.  $M_{boys} = .25$ ,  $SD_{boys} = .12$ ). In both the cool ( $p = .88$ ,  $M_{girls} = .15$ ,  $SD_{girls} = .09$  vs.  $M_{boys} = .17$ ,  $SD_{boys} = .11$ ) and control conditions ( $p = .29$ ,  $M_{girls} = .24$ ,  $SD_{girls} = .15$  vs.  $M_{boys} = .005$ ,  $SD_{boys} = .17$ ), no gender differences were found.

*Self-Report Measure.* To test whether the verbal measure "I think the candies are tasty" was influenced by the behavioral conflict manipulation, we performed an ANCOVA with condition (hot, cool, and control) and gender as independent variables and hunger and age as covariates. A similar pattern as in saliva was observed for the tastiness of the chosen candy. There were no main effects for hunger ( $F(1, 132) = .49$ ,  $p = .49$ ), age ( $F(1, 132) = 2.2$ ,  $p = .14$ ), condition ( $F(2, 132) = .67$ ,  $p = .51$ ), or gender ( $F(2, 132) = .002$ ,  $p = .97$ ) and a marginal interaction effect between condition and gender ( $F(2, 132) = 2.76$ ,  $p = .06$ ,  $\eta_p^2 = .04$ ; Figure 3). Further analysis showed that girls in the hot condition found the chosen candy less tasty than in the cool condition ( $p = .01$ ,  $M_{hot} = 3.91$ ,  $SD_{hot} = .15$  vs.  $M_{cool} = 4.47$ ,

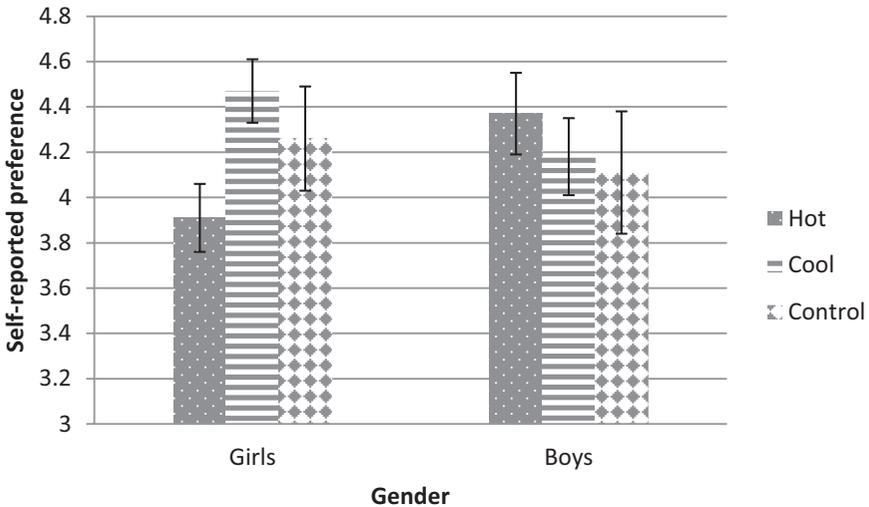


FIGURE 3. Self-reported preference between conditions (Hot, Cool and Control) for girls and boys.

$SD_{cool} = .14$ ). Girls did not evaluate the tastiness of the chosen candy differently between the hot and control conditions ( $p = .19$ ,  $M_{hot} = 3.91$ ,  $SD_{hot} = .15$  vs.  $M_{control} = 4.26$ ,  $SD_{control} = .23$ ), although the tendency was in the right direction, or between the cool and control conditions ( $p = .44$ ,  $M_{cool} = 4.47$ ,  $SD_{cool} = .14$  vs.  $M_{control} = 4.26$ ,  $SD_{control} = .23$ ). Similar to saliva we found no significant results for the tastiness of the candy for boys. Boys did not rate the tastiness of the chosen candy differently between the hot and cool conditions ( $p = .44$ ,  $M_{hot} = 4.37$ ,  $SD_{hot} = .18$  vs.  $M_{cool} = 4.18$ ,  $SD_{cool} = .17$ ), or between the hot and control conditions ( $p = .43$ ,  $M_{hot} = 4.37$ ,  $SD_{hot} = .18$  vs.  $M_{control} = 4.11$ ,  $SD_{control} = .27$ ), or between the cool and control conditions ( $p = .84$ ,  $M_{cool} = 4.18$ ,  $SD_{cool} = .17$  vs.  $M_{control} = 4.11$ ,  $SD_{control} = .27$ ). Viewed from another angle, and similar to the salivary response, girls in the hot condition found the candy less tasty relative to boys ( $p = .05$ ,  $M_{girls} = 3.91$ ,  $SD_{girls} = .15$  vs.  $M_{boys} = 4.37$ ,  $SD_{boys} = .18$ ). No gender differences were found for the cool ( $p = .21$ ,  $M_{girls} = 4.47$ ,  $SD_{girls} = .14$  vs.  $M_{boys} = 4.18$ ,  $SD_{boys} = .17$ ) and control conditions ( $p = .66$ ,  $M_{girls} = 4.26$ ,  $SD_{girls} = .23$  vs.  $M_{boys} = 4.11$ ,  $SD_{boys} = .27$ ).

In line with Study 1, we find that behavioral conflict during exposure to temptation is crucial for subsequent enhanced self-control. Behavioral conflict during exposure reduces the preference for the temptations, but again only for girls. When we suppress behavioral conflict during self-regulated exposure to temptation by instructing them to think of the temptation as

objects, girls' preference level does not change relative to the control condition, and is comparable to that of boys. For boys, there were no effects of the pre-exposure manipulation.

## GENERAL DISCUSSION

The aim of this paper was to explore whether behavioral conflict in the face of easily accessible temptation could train self-regulation and, hence, help children in the long term. In line with our reasoning, we show that exposure to temptations in a context that endorses self-regulation through reward reduces girls' but not boys' consumption over a time span. These findings are mirrored in preferences, as measured with verbal and physiological measures, where girls have lower preferences than boys. Moreover, we illustrate the pivotal role of behavioral conflict in building up self-regulation skills. When behavioral conflict is reduced, girls do not show the positive self-regulatory changes compared to those who experienced a stronger behavioral conflict. Overall, boys seemed to be insensitive to our manipulations.

### Implications and Future Research

Our findings are inconsistent with the widespread assumption in self-regulation literature and intervention programs that removing behavioral conflict helps individuals deal with temptations (e.g. Mischel & Baker, 1975). Field research shows that parents ban unhealthy foods (Hart, Bishop, & Truby, 2003) and the main focus of the literature has been to remove or reduce behavioral conflict by means of distraction (Mischel & Ebbesen, 1970), suppressing thoughts (Johnston, Bulik, & Anstiss, 1999), or forming implementation intentions (Loibl, Grinstein-Weiss, Zhan, & Bird, 2010). But the immediate success of reduced behavioral conflict (e.g. Mischel & Ebbesen, 1970) should not be mistaken for long-term success, which should be reflected in the establishment of better self-regulation over time.

Our results illustrate the benefit of high, instead of low, behavioral conflict in an exposure context that supports self-regulation. In this context, self-regulatory skills are, over time, enhanced in a manner that enables children to deal with settings of highly accessible temptation. The literature provides some indirect support that behavioral conflict may strengthen resistance to temptations (Dewitte, 2013) because the conflict signals a "threat" to the consumer's long-term goal (e.g. Brendl, Markman, & Messner, 2003; Vale, Pieters, & Zeelenberg, 2008; Mysreth & Fischbach, 2009). For instance, adult participants consume less of a temptation offered in large packages relative to a temptation offered in small packages, but only when they have the belief that large packages pose a threat for overconsumption (Vale et al., 2008).

Building on this, we illustrate that, if successful self-regulation is endorsed, behavioral conflict builds up self-regulatory skills and promotes future resistance to accessible temptation.

At this moment, it remains an open question as to why these findings cannot be generalised to boys. An attractive answer, given past research (Thelen & Cormier, 1995; Fisher & Birch, 1999), is that boys are less sensitive to the contextually induced food restriction goals and thus engage less in self-regulation during pre-exposure. However, we made boys choose to postpone immediate consumption, making them hold a local food restriction goal, independent of their sensitivity to externally induced food restriction goals or their initial disposition to hold food restriction goals. Alternatively, we cannot exclude that boys might generate cognitive strategies, self-management processes, or motivations (e.g. Bembenutty & Karabenick, 2004) that prevent the conflict in the pre-exposure phase, in the same way as we intended to achieve in the cool ideation condition. This self-selected conflict suppression would then prevent the reinforcement of self-regulatory skills over time (Mischel & Ayduk, 2004). We call for further research to include boys as well as girls to increase our insight into the set of possible reactions to exposure to temptation and into the role of restriction goals.

From a more practical view, our focus on children illustrates that well-crafted pre-exposure to temptation can be one of the potential tools against the obesity epidemic in the Western world. Developmental research has proposed that interventions aimed at children are often more effective (Kelder, Perry, Klepp, & Lytle, 1994) especially as childhood experiences with temptation leaves their traces up until adulthood (Puhl & Schwartz, 2003). Yet, we feel that future research might want to address two things based on our findings in Study 1. First, not all children were successful in postponing consumption and the dropouts might be of specific interest as they may represent a target group, such as overweight children or children with poor self-regulation skills. Second, the increased consumption of girls relative to boys in the control condition in the less controlled intervention study indicates that there might have been situational factors at play that affected boys and girls differently. Research could also focus on the underlying mechanisms that explain why successful self-regulation during behavioral conflict causes the pre-exposure effect. For instance, behavioral conflict during pre-exposure may train self-regulation because children form an attribution of themselves as successful in self-regulation, or because they reinforce the norm to consume smaller quantities. In addition, the role of autonomy may be further explored. In both our studies, we supported successful self-regulation without placing externally induced restriction goals. That is, children chose freely to postpone immediate consumption, and, consequently engaged in autonomous self-regulation. It can be argued that the more autonomy is given during behavioral conflict, the more difficult it

becomes for children to overcome indulgence. We countered this short-term side-effect by strongly supporting self-regulation in the face of behavioral conflict. Future research should try to find out how autonomy can be conveniently combined with supported self-regulation. Further developing the pre-exposure tool also requires more research on the reward. Interventions that promote self-regulation by increasing future access to temptation will probably raise some deontological issues irrespective of the possible advantages that it provides. A challenge for future research is to find alternative ways to reward self-regulation without eroding behavioral conflict during this phase. Lastly, children who delayed non-food temptations did not show any signs of increased temptation-related self-regulation. This raises the question of how specific self-regulation enhancement is after pre-exposure. The relevant dimension may be taste (e.g. sweet), food category (e.g. snacks), domain (e.g. food), or even broader. We call for future research to explore how specific this increase in self-regulation is and find ways to strengthen self-regulation in a broader context.

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## APPENDIX

### Study 1

Introduction to adapted delay of gratification: *“This week we are playing an earning game with marbles/candies. Four days in a row you will receive the choice between having one candy/marble now or not to eat/have it now, and earn three candies/marbles that you will receive at the end of the week. You will get one candy/marble today, Tuesday, Wednesday and Thursday. And every day you get to choose between eating/having it immediately, or earning more later. Every day that you choose to earn it, it will be added to your earning account. On Friday, you will receive your earnings. In order for you to track your earnings, we will keep a score on your earning account. Now, all of you will receive an earning account. Write down your first name and surname. After the game, I will circle the amount you have earned, zero or three. You should store this earning account in your desk. Leave this in your desk so you don’t lose it.”*

Instructions on days 1, 2, 3 and 4: *“I will give each one of you one candy/marble. All of you are free to choose. You can eat/have it now, or not. If you eat/have it now you will earn nothing on your earning account. If you leave the candy/marble untouched on your desk, then you have earned three candies/marbles on your account. If you want to have it now then you can take it. But if you want to earn three candies/marbles, you should leave the candy/marble on your desk. So you take it now or you leave it on the desk until I come to retrieve it. If you leave it on your desk, you will earn not one, but three.”*

Instructions taste test (day 5): *“Now, we would like you to participate in a taste test. Here, we have a bowl with candies and we would like your opinion on them. You can do this by filling in this questionnaire. You can have as much as you want. If you have filled in the questionnaire, let me know.”*

### Study 2

Delay-of-gratification instructions: *“I have to leave now but, if you want, you can have two of your favorite (product X) now. But if you wait until I return, you will get eight of (product X). I will be gone for seven minutes. Do you want to wait?”*

Hot ideation: *“While you wait, I want you to think about how it would be to eat the M&M’s/Haribo’s that you have decided to wait for. Imagine their taste, how it would be to hold them in your mouth, or how it would taste when you chew them. Think about how you love eating the M&M’s/Haribo’s and how much you want to eat them while waiting for me to return.”*

Cool ideation: “*While you wait, I want you to make a picture of a clown in your head using the colors of the M&M’s/Haribo’s. If you look at the M&M’s/Haribo’s, you see that they are round shaped and have bright colors fit for a clown. For instance, you can use red M&M’s/Haribo’s to form a nose. Picture a clown made of M&M’s/Haribo’s while waiting for me to return.*”

## Analysis with the Two Control Conditions Separately

An ANCOVA, with age and hunger as covariates and condition (hot, cool, control picture, control toy) and gender on saliva revealed no main effect for hunger ( $F(1, 132) = .11, p = .74$ ) or gender ( $F(1, 132) = .03, p = .86$ ), a marginal effect for condition ( $F(3, 132) = 2.53, p = .06$ ), and a significant positive effect for age ( $F(1, 132) = 4.06, p < .05$ ). A marginal interaction effect was found between condition and gender ( $F(3, 132) = 2.55, p = .06$ ; see Figure 1). Girls salivated less ( $p = .049$ ) in the hot condition relative to the cool condition. Girls did not differ for saliva ( $p = .79$ ) in the hot condition relative to the picture control condition. Girls salivated significantly less ( $p = .037$ ) in the hot condition than in the toy control condition. Between the cool and the picture control condition or the toy control condition, no differences in saliva ( $p_{pic} = .17, p_{toy} = .56$ ) were found for girls. There was also no significant difference between the two versions of the control condition for saliva ( $p = .10$ ).

An ANCOVA, with age and hunger as covariates and condition (hot, cool, control picture, control toy) and gender on self-reported liking for candy revealed no main effect for hunger ( $F(1, 132) = .48, p = .49$ ) or gender ( $F(1, 132) = .01, p = .91$ ), condition ( $F(3, 132) = 1.97, p = .12$ ), or age ( $F(1, 132) = .03, p = .86$ ). The interaction between condition and gender was marginal ( $F(3, 132) = 2.06, p = .10$ ; see Figure 2). Girls found the candy less tasty ( $p = .005$ ) in the hot condition relative to the picture control condition, but there were no differences in tastiness ( $p = .17$ ) in the hot condition relative to the toy control condition. Between the cool and the picture control condition or the toy control condition there was no difference in tastiness ( $p_{pic} = .57, p_{toy} = .43$ ) for girls. There was also no significant difference between the two versions of the control condition for tastiness ( $p = .25$ ).

Between gender, girls salivated less ( $p = .016$ ) and found the candy less tasty ( $p = .043$ ) relative to boys in the hot condition. For the other conditions, no gender differences were found for saliva ( $p_{cool} = .91, p_{picture} = .33, p_{toy} = .26$ ) or tastiness ( $p_{cool} = .18, p_{picture} = .83, p_{toy} = .64$ ). When looking at boys, no differences were found between the hot and cool conditions for saliva ( $p = .62$ ) or tastiness ( $p = .42$ ). Boys seem to salivate more in the hot condition relative to the control picture condition ( $p = .007$ ), but did not differ in their ratings of tastiness ( $p = .53$ ). No differences in saliva ( $p = .22$ ) or tastiness ( $p = .40$ ) were found between the hot condition and toy

control condition. Boys in the cool condition salivated significantly more than in the control picture condition ( $p = .02$ ), but tastiness did not differ between conditions ( $p = .18$ ). No differences were found between the cool and control toy conditions for boys for saliva ( $p = .40$ ) or tastiness ( $p = .84$ ). The two control conditions did not reveal any statistical difference for saliva ( $p = .10$ ) or tastiness ( $p = .25$ ).