Temptation and Self-regulation

Can controlled exposure to temptation be used to improve self-control?

MSc Thesis

MSc Applied Communication Science – Specialization Health and Society
Prof. dr. Emely de Vet (supervisor)
Angeliek Verdonschot 910923871130
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Abstract

**Background**: a high intake of unhealthy food is one of the causes for the rise in childhood obesity. Self-regulation skills are needed to resist the temptation of palatable food. However, there is a lack of knowledge about how self-control in the field of food temptation can be improved.

**Objective**: to investigate the effect of controlled exposure to food temptations on subsequent delay of gratification among children.

**Methods**: fifty-nine children (4-6 years old) participated in the exposed group (n=30) or control group (n=29). The research included an individual experimental design with two phases; (1) controlled exposure phase and (2) testing phase.

**Procedure**: all children were asked to fill in a colouring with candy (experimental group) or toys (control group). After that, they had to choose the candy they like best out of three. The researcher explained they could eat one candy immediately, or if they waited till the researcher was back he/she would get another candy extra. The researcher observed the children by a hidden live camera. After 10 minutes the researcher came back and gave another candy in case the child did not snack, or no candy if the one candy was already eaten.

**Results**: no significant effect of the intervention on the subsequent delay of gratification was found between both conditions. However, two outcomes were significant. Firstly, the older the children were, the less strategies they applied to avoid the temptation. Secondly, the more the children (only the ones in the below-liking-group) liked the candy, the less strategies to avoid the temptation they applied.

**Conclusion**: when pre-exposing children to candy, subsequent self-control in terms of delay of gratification will not increase. Strategies may help with resisting temptation. For further research it is recommended to recruit younger participants spread over more schools with a different environment.

**Keywords**: childhood obesity, self-regulation, food temptation, eating behaviour, healthy lifestyle.
Preface

Here it is, my final thesis project. In the beginning of my academic education, the master thesis was something I was dreading to do. I heard several frightening stories from people that I knew about their struggles with writing their thesis. However, last April I started this project after my trip to South America. To be honest, I was not afraid at all to start! Over the years, I developed myself academically and personally that helped increase my confidence in writing – and made me even more enthusiastic! And right now, I am proud to present it to you: my master thesis.

Nutrition behaviour has always had my interest. This was confirmed when I wrote my bachelor thesis about the relationship between perceived self-efficacy and healthy eating. During my everyday life, I like to think about how you can make people aware of their food choices and convince them of the importance of a healthy lifestyle. This thesis made me realize that a healthy lifestyle is not only focusing on promoting healthy food choices, but also learning resisting temptation of unhealthy foods. Therefore, this thesis contributed to finish my master Health & Society with a content and good feeling.

Without all the help and support from all the people around me, I would not have been able to write this thesis. First of all, I would like to thank Prof. dr. Emely de Vet. Thank you for supervising me. Our productive meetings and your obvious passion for your work, made me more enthusiasm than expected about this topic and even science in general. Also, a major thanks to the school De Kring in Rijen that participated in my research, including teachers and children who helped me with the experiment of my research. Lastly, I would like to thank my friends and family for your support and faith in me.
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1. Introduction

1.1 Problem definition

Nowadays childhood obesity is a growing worldwide problem (Martire et al., 2013). Obesity has more than doubled since 1980 and in 2013 a total of 42 million children under the age of five were overweight or obese (World Health Organisation, 2014). Body Mass Index (BMI) describes the index of weight-for-height that is commonly used to indicate the person has a healthy weight or not and is defined as ‘a person’s weight in kilograms divided by the square of his height in meters (kg/m²)’ (World Health Organisation, 2014). The term overweight is used when a person has a BMI greater than or equal to 25 and people with a BMI greater than or equal to 30 are obese (World Health Organisation, 2014). Today’s public health is threatened by obesity because it increases the risk of certain health problems, such as hypertension, diabetes type 2 and heart failure (Landsberg et al., 2013). Obesity also has a damaging social effect of being a ‘bigger’ person.

From 1980 to 2008, the prevalence of overweight in Dutch children increased two to three fold and the prevalence of obesity was four to six fold higher (Figure 1) (Schönbeck et al., 2011; Van Dommelen et al., 2014). Today’s children have more food choices and temptation than previous generations, and in many cases parents often give in to what their child want (Popper and Kroll, 2005). These circumstances can make it difficult for the child to choose since this ‘power’ can be confusing and conflicting. This may increase their intake of foods and subsequently the increase in childhood obesity (Popper and Kroll, 2005). Other studies found that the availability of fast food and the environment can influence the intake of calorie-dense food as well (Faith et al., 2007; Cobb et al., 2015). An obesogenic environment, where unhealthy foods high in fat and sugar are readily available and easily accessible, increases the chance of becoming obese (Egger & Swinburn, 1997). Recently, multiple environmental practices are used to influence the unhealthy eating behaviour to challenge overweight and obesity. Some examples are increasing physical activity, healthy school meals or snacks and creating awareness of the child’s direct environment (Hesketh et al., 2005; O’Dea & Wilson 2006; Gentile et al., 2009). When the environment is unable to protect against temptation, people will be exposed to temptation and may fall prey to eating unhealthy food (Faith et al., 2007).

![Figure 1 | Prevalence of overweight and obesity in the Netherlands in 1980, 1997 and 2009](image-url)
To curb this overconsumption of unhealthy food, interventions are needed. Past studies showed that treating obesity among adults is less successful than endeavouring to tackle childhood obesity (Fiese et al., 2013). Another study that encouraged tackling childhood obesity found that BMI increase between the ages of two to six years contributes to adult overweight (De Kroon et al., 2010). Also, obese adults who were already overweight before the age of eight years, are found to be heavier in adulthood, compared to those who became overweight in adolescence or adulthood (Freedman et al., 2001). These studies indicate the utmost importance of early prevention of childhood obesity.

Self-regulation is needed to resist the temptation of unhealthy and energy-dense food. Self-regulation refers to the ability to control ones impulses with a short-term rewarding value in order to achieve long-term goals. The presence of self-regulation can be helpful to overcome unhealthy food temptation. Therefore, it is likely that self-regulation skills are needed to overcome childhood obesity (De Vet et al., 2013). An important aspect of self-regulation is the delay of gratification, which is defined as ‘the ability to resist the temptation for an immediate reward and wait for a later reward’. The delay of gratification experiment, also known as the ‘Marshmallow experiment’, was introduced by Mischel and Ebbesen (1970) and tested the theory of cognitive control among young children. A follow up study of this experiment showed that self-control is a prediction factor for BMI later in life. According to Mischel and Ebbesen (1970), it is important to strengthen the delay of gratification, in order to resist temptation such as palatable foods.

One study tested the effect of pre-exposure to temptation on children’s (n=149) consumption behaviours (Grubliauskiene & Dewitte, 2014). This was done by conducting an experiment with two phases: an exposure to temptation manipulation phase and a bogus taste test of similar temptation. One outcome was that exposure to calorie-dense, low-nutrient foods did influence resistance to temptation in boys, but not in girls (Grubliauskiene & Dewitte, 2014). This may be caused by the fact that self-regulation strategies might have matured better in girls than boys. Another reason may be that girls were more distracted than boys by the specific task that the goal conflict was reduced (Grubliauskiene & Dewitte, 2014). However, Another study showed that pre-exposure to food stimulates the reduction of food intake when the participants will be tempted again is also effective in developing countries such as South Africa (Inseng Duh et al., 2015). The participants (n=103) were exposed to a tempting unhealthy food (candy) in such a setting that eating the food was discouraged by a task goal. The main outcome was that the experimental group (that was pre-exposed with candy) consumed significantly fewer grams of candies, compared to the control group (that was not pre-exposed with candy).

Even though studies are performed concerning both self-regulation and the environmental impact, there is still knowledge missing on how self-control can be improved. At this point, literature does not show whether resisted temptation can boost the self-control of the individual in the following occurrence of temptation in terms of delay of gratification. To fill in this gap, this study examines how self-control can be improved in combination with controlled exposure to temptation and delay of gratification.
1.2 Research questions
The general research question and specific research questions of current research are:

General research question:
- ‘Can controlled exposure to temptation be used to improve self-control?’

Specific research questions:
- ‘Does controlled exposure to food temptation contribute to subsequent eating-related self-control?’
- ‘What strategies can be used during food temptation to maintain subsequent eating-related self-control?’

1.3 Objective
The objective is to investigate the effect of temptation on subsequent self-control among 4-6 year olds.

1.4 Hypothesis
Based on found literature (e.g. Grubliauskiene & Dewitte, 2014; Inseng Duh et al., 2015), it is expected that children with temptation in the exposure phase will wait longer on the gratification in the testing phase, compared to the control group, which was not tempted during the exposure phase.
2. Theoretical framework

This second chapter includes the literature necessary to understand the hypotheses and content of this thesis. Paragraph 2.1 is used to explain the concept of self-control, its main theories and the meaning of the cognitive development of children. In paragraph 2.2, temptation and palatable foods are discussed. The main reasons why self-control may reduce or increase are described in 2.3. Paragraph 2.4 explains the concept of delay of gratification. The last paragraph (2.5) includes the conceptual framework with the hypotheses of current research.

2.1 Self-control

Self-control has been defined as ‘the exertion of control over the self by the self’ (Muraven & Baumeister, 2000). Baumeister and Heatherton (1996) pointed out that a lack of self-control leads to impulsive behaviour, which subsequently can lead to unhealthy eating. The concept of self-control plays an important role in many domains in our life, from being productive at work to maintaining a healthy diet to resisting getting irritated at your spouse after a long and tiring day (Milyavskaya et al., 2015). Many of today’s societal difficulties are attributed to poor self-control, such as eating too much palatable food, drugs, smoking or violence. These problems would disappear, or at least weaken if only people were better at controlling their impulses (Milyavskaya et al., 2015). Self-regulation consists of balancing the self-control efforts against the presence and strength of impulses and temptations that can distract one’s goal pursuits and must be overcome with efforts (Milyavskaya et al., 2015). According to Baumeister (2002) self-control is influenced by the amount of attractiveness and desirability of behaviour. The terms ‘self-control’ and ‘self-regulation’ are written in this report interchangeably since both refer to the self’s capacity to alter its own states and responses (Baumeister, 2002).

Previous studies found that more intelligent children are rated as more self-controlled by parents and other informants (Moffitt et al., 2011; Olson et al., 2005). Based on previous research, there are two reasons why intelligence might facilitate self-control in children and improve their performance in the delay of gratification task. First, in the face of temptation, more intelligent children may use more self-regulatory strategies compared to less intelligent children, which helps them to overcome difficulties in self-control (Rodriguez et al., 1989). The second reason is that more intelligent children may have less problems with keeping abstract goals in mind thus helping them pursue goals (Fujita & Carnevale, 2012; Shamosh et al., 2008).

The target behaviour of self-control is determined by the reflexive system. Attractive behaviour causes impulses that can influence the behaviour, e.g. the attractiveness of a candy may cause an impulse of wanting to eat it, what may lead to eating it (De Boer et al., 2011). Next to the reflexive system, there is also the reflective system what determines explicit or implicit self-set goals. Desirable behaviour is the sort behaviour which is in line with these self-set goals, e.g. doing sports three times a week (De Boer et al., 2011).

According to De Boer et al (2011) there are two types of self-control; stop control and start control. Stop control has been defined as ‘self-control aimed at short-term attractive but long-term undesirable behaviour in order not to perform this behaviour’. Start control has been defined as ‘self-control aimed at short-term unattractive but long-term desirable behaviour in order to perform this behaviour’ (De Boer et al., 2011). If attractive behaviour is undesirable (e.g. eating a candy), stop control is needed to avoid
On the one hand, if desirable behaviour is unattractive as determined by the reflexive system (e.g. low motivation to do sports three times a week), start control is needed to perform this unattractive desirable behaviour. To clarify, the immediate attractiveness of behaviour is determined by the reflexive, or 'hot' system and the long-term desirability is determined by the reflective 'cool' system, which is explained in the next paragraph about the hot/cool theory.

Hot/cool theory
Metcalfe and Mischel (1999) introduced the hot/cool theory, which entails two different views on self-control. This theory posits that food temptations activate a 'hot', impulsive system. On the other side there is a 'cool', rational system, which represents long-term health goals. The different characteristics between these two systems can be seen in Table 1.

Table 1 | Characteristics of the Hot – and Cool system, interpreted from the paper by Metcalfe and Mischel (1999)

<table>
<thead>
<tr>
<th>Hot system</th>
<th>Cool system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional</td>
<td>Cognitive</td>
</tr>
<tr>
<td>“Go”</td>
<td>“Know”</td>
</tr>
<tr>
<td>Simple</td>
<td>Complex</td>
</tr>
<tr>
<td>Reflexive</td>
<td>Reflective</td>
</tr>
<tr>
<td>Fast</td>
<td>Slow</td>
</tr>
<tr>
<td>Develops early</td>
<td>Develops late</td>
</tr>
<tr>
<td>Accentuated by stress</td>
<td>Attenuated by stress</td>
</tr>
<tr>
<td>Stimulus control</td>
<td>Self-control</td>
</tr>
</tbody>
</table>

On the one hand, a cool, cognitive system stimulates self-regulation and on the other hand, a hot, emotions and impulses based system undermining efforts at self-regulation (Metcalfe & Mischel, 1999). Naturally, behaviour follows stimuli that creates automatic reactions, but can be neutralized by self-regulation strategies to control behaviour (Metcalfe & Mischel, 1999). Will-power is needed to inhibit such impulsive responses and can be triggered by the cool system. In other words, mental 'cool' networks suppress the behaviour, which would otherwise be influenced by impulses (hot) (Dewitte, 2013). To overcome deviating to the hot system and to activate the cool system, self-regulatory competences, such as metacognitive knowledge and attention skills are needed (Dewitte, 2013).

Counteractive self-control theory
Trope and Fishbach (2000) developed the counteractive-control theory. This theory explains self-control processes that occur during exposure to temptation (Coelho et al., 2008). After exposure to temptation, an approach tendency towards indulgence and activation of a goal are triggered. Thus, exposure to a temptation activates a counteractive goal, which encourage self-regulation (Dewitte, 2013).

The idea behind this counteractive activation is that a conflict can occur between immediate short-term goals and lasting long-term goals. As reaction to this conflict, people might exercise counteractive control to overcome influence of short-term effect and secure long-term outcomes (Trope and Fishbach, 2000). A high amount of self-control influences the effect of short-term outcomes in determining one's actions. In other words, the higher the short-term threat, the more self-control is needed.

Trope and Fishbach (2000) pointed out with this theory that exposure to temptation can bolster the value of a long-term goal and can support behaviour in order to achieve the long-term goal. Results of this study demonstrate the influence from exposure to food-related cues to eating behaviour. It was
found that exposure to a basket of chocolates and a gourmet food magazine led to more intentions to avoid high energy and unhealthy foods and made it more likely to choose a healthy food, compared to respondents who were not exposed to a food cue.

Considering the counteractive self-control theory, a few assumptions should be taken into account. First, the power of the counteractive control depends on the valued long-term outcomes. For example, a person who does not have weight loss as a long-term goal is probably less likely to bolster the value of overcoming unhealthy food temptation. Second, when the short-term effects are extremely high, a person is unlikely to apply as much self-control effort as actually is needed. The counteractive control increases if the valence of short-term outcomes increases as well, up to a point where people are not capable to apply the required amount of counteractive self-control.

To summarize, even though this theory assumes that the more temptation a person is subjected to the more counteractive self-control is needed, this assumption has its limits. Only when the effects of short-term goals are moderate, self-control efforts can influence certain activities to overcome the temptation. Finally, exercising counteractive control in advance of performing a certain activity can help people to choose the right behaviour (Trope and Fishbach, 2000).

**Cognitive development**

Research with children as target group must take into account the range of cognitive ability of the children (Guinard, 2000). Children are not born with all the skills of an adult since many cognitive and affective abilities will be developed during the first few years of life (Mau et al., 2014). Previous studies found that, in many areas, children have different mental resources and processes at their disposal, compared to adults (John, 2008). John (2008) structured the cognitive development of children into three different phases: the perceptual stage (3-7 years old), the analytical stage (7-11 years old), and the reflective stage (11-16 years old) (Mau et al., 2014).

The development of food preferences starts in children in the perceptual stage (from 3-7 years old) (Guinard, 2000; John, 2008). In this phase, children have a short attention span and are explicitly bound to the observable aspects of their environment and observe situations in one dimension by using the concept of centration (John, 2008). They also have limited processor skills, which suggests the process is not yet fully developed (Popper and Kroll, 2005). A recent study showed that fulfilling hedonic needs and taste are the most important factors in children by making their food choice (Nguyen et al., 2015). This study from Nguyen et al. (2015) also indicated that children from the age of four do understand the concept of healthy and unhealthy foods and know how to categorize them.

**2.2 Temptation**

In this research the concept of self-control has the main focus, which is related with temptation since self-control is only challenged when the person is tempted by something. According to the dictionary temptation is defined as ‘something that causes a strong urge or desire to have or do something and especially something that is bad, wrong, or unwise’. But in science, the interpretation of temptation has several aspects. One study indicated that the experience of temptation can be seen as an ‘impulsive process’ due to temptations which are activated by stimuli present in our environment, such as when you walk by a pie shop, or by internal triggers as feeling hungry, or by strong motivational and hedonic impulses, as feelings of desire (Milyavskaya et al., 2015). Hughes (2002) pointed out that tempting
objects are mostly forbidden, attractive and hold a moral component. A person who is tempted knows that giving in to the temptation is somewhat wrong (Papies et al., 2008).

Unhealthy foods
Unhealthy foods are seen as palatable foods that are high in fat and sugar (Wilsher et al., 2016). These foods can lead to dependence of that specific food group since the reminder of the pleasure of eating tasty. Tasty, high-calorie food is easily available and experienced as highly rewarding (Erlanson-Albertsson, 2005; Papies et al., 2014). According to an evolutionary perspective, human beings have reliable preferences for unhealthy, energy-rich foods and an aversion to bitter (Hall, 2016; Popper & Kroll, 2005). This is explained in a study that stated that palatable foods are easily transferred into energy (Nesse & Berridge, 1997). Children in the age group between four and six years old have a striking preference for fast food and sweets, which are soft, sweet and/or savoury and on the other hand a distinct dislike for bitter and sour tastes (Zeinstra et al., 2007; Popper & Kroll, 2005; Birch, 1999).

2.3 What may reduce or increase self-control
According to Baumeister (2002) effective self-control depends on at least three major ingredients, namely (1) the standards, (2) a monitoring process and (3) the operational capacity to alter one’s behaviour. Self-control can be undermined if any of these fails. Ego depletion is a common theory which claims that repeated exertion of self-regulation is related to self-control failure. However, there are other studies that suggest other interpretations and weaken the ego depletion theory.

Standards, monitoring and capacity to change
Standards includes goals, ideals, norms and other guidelines that specify the desired response. If one is not willing to change, for example reaching an ideal weight, there is no need for self-regulation behaviour (Baumeister, 2002). It is shown that children’s behaviour is less consistent if their mother and father give different rules or prescriptions (Maphet and Miller, 1982). This can cause a conflict among goals and can undermine self-control as well. Another important aspect is the emotional situation of the person (Baumeister, 2002). Generally, people want to feel good, and when someone is upset, the goal of feeling better in any way (e.g. eating unhealthy food) becomes increasingly central to their actions. In other words, emotional distress contributes to breakdowns in self-control (Baumeister et al., 1994). Tice et al. (2001) studied in an experiment people’s resistance to eating unhealthy snack foods. Participants were put into a sad mood and were asked to eat some snack foods and fill in a questionnaire, which was ostensibly as part of a marketing study. The focus was mainly on how much they would eat. One outcome was that sad people ate more than the other participants. However, in a variation of the experiment, half the participants were told that eating would not improve their mood or emotional state. These participants did not eat more than the other participants, which means that eating more snack food when depressed is done only when one thinks it will help in feeling better (Tice et al., 2001).

The second crucial ingredient of self-control is the process of monitoring, which is about keeping track of the relevant behaviour (Baumeister, 2002). Self-control breaks down when people lose track of their behaviour. A study found that when a dieter has broken her diet, she stops keeping track of her food, what may lead to eating binges (Polivy et al., 1986). Alternatively, successful dieters keep careful track of the foods they eat and the amount of calories these contain.
Baumeister (2002) pointed out that the capacity to alter the self contains the third essential ingredient of self-control. This element is about the capacity of being able to make the self-perform the necessary actions and contains three main types of theories (Baumeister et al., 1994); (1) willpower or strength, (2) cognitive processes and (3) self-control as a skill. Each theory has its own prediction as to what will happen if people have to perform different kinds of acts of self-control in a row. The willpower or strength model states that the person will have lost energy on the first act, so the second act of self-control would be less effective compared to the first act. The second theory on cognitive processes suggests the opposite; the first act of self-control would ‘load the software’ which will improve subsequent acts of self-control because the person is already in the mode of self-regulation (Baumeister, 2002). Self-control as a skill, the third theory, predicts little effect of previous acts of self-control on subsequent self-control trials, since skill remains essentially the same over consecutive acts, although in the long term it will show gradual improvement (Baumeister, 2002).

**Ego depletion**

Another theory which is related to self-control is ego depletion, which can also be described as self-regulatory strength model, which claims that the self’s crucial resources have been depleted after consecutive acts of self-control (Baumeister, 2002; Muravan et al., 1999). A commonly used example for this model is the muscle metaphor. This metaphor claims that self-control cannot be exercised unlimited, just like a muscle, because at one point the self-regulatory skills will be exhausted (Muravan et al., 1999; de Vries, 2013). It will lose its flexibility and wears out. After this exhaustion, depleted people have more tendency to respond to the impulses they have and give in to temptation, compared to normal mood people. In the field of temptation of unhealthy food, the self-regulatory strength model indicates that if someone will be tempted long enough by unhealthy food, eventually the person can no longer resist the temptation and will consume the unhealthy food.

One important remark about this theory is that the environment should be able to provide protection against the temptation, otherwise the person will be exposed and tempted and falls prey to eating unhealthy food (Faith et al., 2007). Another interesting point is that if a temptation is resisted successfully, this may boost the self-control in the subsequent occurrence of temptation, which may increase the chance of another successful resisting of temptation. This issue is in contrast with the theory of ego depletion and weakens the statements of this theory. Also, previous research (Johnson and Birch, 1994) resulted in the outcome that controlling child-feeding strategies were associated with a decrease in the ability of children to self-regulate energy intake. Next to that, another study pointed out that restricted access to unhealthy foods can increase the focus of a child’s attention on these foods and may consequently promote their overconsumption (Fisher and Birch, 1999). Recent studies indicated that being pre-exposed to temptation does not necessarily lead to self-control depletion (Boer et al., 2015; Grubliauskiene & Dewitte, 2015). It was significantly found that girls aged between 8-11 had a lower liking of candy after previous exposure to temptation and boys aged between 7-12 ate less candy when being pre-exposed to temptation, compared to other participants in the control group without the pre-exposure (Boer et al., 2015; Grubliauskiene & Dewitte, 2015).

**2.4 Delay of gratification**

In the late 1960s Walter Mischel developed the delay of gratification task among 4-year olds, also known as the ‘Marshmallow Task’. This task quantifies self-control as the ability to wait for a preferred treat (in this task two marshmallows later), while forgoing a less preferred reward (one marshmallow at that
moment). Delay time was assessed as a measure of self-regulation. The self-regulation of the children was low when the focus was on the hot, consummator quality of food. Conversely, when focussing on cool, non-consummator aspects, children were able to delay longer. This study showed that the hot emotional system undermines self-regulation when participants are tempted with food. Another outcome was that when children were distracted from the hot stimulus, either external as internal, they were forwarded to the cool system (Dewitte, 2013; Metcalfe & Mischel, 1999; Mischel et al., 1989).

Other subsequent studies found that the delay of gratification predicts an array of positive academic, social, and health outcomes later in life (Ayduk et al., 2000; Mischel et al., 1988; Shoda et al., 1990). Next to that, reward-related impulses are found to be the most obvious potential confound in the delay of gratification task (Duckworth et al., 2013). To exemplify, if an individual resists temptation (e.g., not eating a cookie), it is not clear whether the person is exerting self-control over her or his impulses (e.g., to achieve a target weight) or, alternatively, is not very tempted in the first place (e.g., did not even want that cookie). This means that it can vary per person why he or she can wait longer during a self-control exercise.

Table 2 gives an overview of delay of gratification studies with the differences in age category, sort of gratification, maximum time during task and used materials. These studies are used as a basis by setting up the testing phase of current experimental research.

Table 2 | Overview of articles which includes delay of gratification task

<table>
<thead>
<tr>
<th>Article reference</th>
<th>Age category and amount of participants</th>
<th>Sort of gratification</th>
<th>Maximum time during task</th>
<th>Used materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duckworth, A. L., Tsukayama, E., &amp; Kirby, T. A. (2013). Is it really self-control? Examining the predictive power of the delay of gratification task. <em>Personality and Social Psychology Bulletin</em>, 0146167213482589.</td>
<td>Fifth-grade (N=56) mean age was 10.28 years old.</td>
<td>A variety of snacks (e.g., cookies, chocolate candies, pretzels, grapes, chips). A small amount and a large amount.</td>
<td>30 minutes</td>
<td>Camera &amp; bell</td>
</tr>
<tr>
<td>Seeyave, D. M., Coleman, S., Appugliese, D., Corwyn, R. F., Bradley, R. H., Davidson, N. S., ... &amp; Lumeng, J. C. (2009). Ability to delay gratification at age 4 years and risk of overweight at age 11 years. <em>Archives of pediatrics &amp; adolescent medicine</em>, 163(4), 303-308.</td>
<td>4 years old (N=966)</td>
<td>A variety of snacks (e.g. candy, animal crackers, or pretzels). A small and large quantity.</td>
<td>7 minutes</td>
<td>Camera &amp; bell</td>
</tr>
</tbody>
</table>


| Mischel, W., Shoda, Y., & Rodriguez, M. I. (1989). Delay of gratification in children. *Science, 244*(4907), 933-938. | 4 years old | A variety of snacks, small toys or tokens, which differ in value. (e.g. one marshmallow versus two, two small cookies versus five pretzels) | 15 minutes | Laboratory settings & recorder |
| Mischel, W., Shoda, Y., & Peake, P. K. (1988). The nature of adolescent competencies predicted by preschool delay of gratification. *Journal of personality and social psychology, 54*(4), 687. | Mean age was 4 years and 5 months. (N=95) | Variety of preferred snacks (e.g. one marshmallow versus two marshmallows) | 15 minutes | Bell |
| Mischel, W., Ebbesen, E. B., & Raskoff Zeiss, A. (1972). Cognitive and attentional mechanisms in delay of gratification. *Journal of personality and social psychology, 21*(2), 204. | Mean age was 4 years and 6 months. (N=50) | A marshmallow and a pretzel (the unchosen one when the child rings the bell, the chosen one when he does not ring the bell) | 15 minutes | Bell & a barrier behind which the researcher was. |
| Mischel, W., & Ebbesen, E. B. (1970). Attention in delay of gratification. *Journal of Personality and Social Psychology, 16*(2), 329. | Mean age was 4 years and 6 months. (N=32) | A pretzel and a marshmallow (a pretzel to practice the task and the marshmallow as a long term goal during delay of gratification task) | 15 minutes | A barrier with a small hole for the researcher to look through to observe the participant |

2.5 Conceptual framework and hypotheses

The elements that are discussed in this study are shown in a conceptual framework (Figure 2). Hypotheses are formed based on the main theories in the field of self-control and delay of gratification. H1 represents the main hypotheses and H2 – H5 consists of the sub hypotheses of this research. An overview of the hypotheses is given in Table 3.

H1 is based on previous studies that found that pre-exposure to food temptation stimulates the reduction of food intake during subsequent temptation to unhealthy food (Inseng Duh et al., 2015; Grubliauskiene & Dewitte, 2014). This statement is supported by the counteractive self-control theory that explains that exposure to a temptation activates a counteractive goal, which encourage self-regulation and likely followed by a healthy food choice (Dewitte, 2013; Trope and Fishbach, 2000; Coelho et al., 2008). H2 and H3 are based on the hot/cool theory. This theory explains that food temptations activate a ‘hot’, impulsive system, and a ‘cool’ rational system. According to the literature, it is expected that increased hunger and liking of snacking are variables that may increase the ‘hot’ impulsive system and therefore decrease self-control (De Boer et al., 2011).

H4 and H5 are based on the cognitive development of children. It is assumed the older the children, the more self-control they have since they are developing cognitive skills, such as self-regulation skills.
during their life (Mau et al., 2014). Next to that, previous studies found that self-regulation skills are needed to overcome unhealthy food temptation (De Vet et al., 2013; Dewitte, 2013), which lead to the expectation the higher the self-control, the more delay of gratification.

Table 3 | Hypotheses

| H1 | When pre-exposing children to temptation, this will increase their subsequent delay of gratification |
| H2 | When children are more hungry and like the temptation more, this will decrease their subsequent delay of gratification |
| H3 | When children are less hungry and like the temptation less, this will increase their subsequent delay of gratification |
| H4 | When children have more self-control and are older, this will increase their subsequent delay of gratification |
| H5 | When children have less self-control and are younger, this will decrease their subsequent delay of gratification |

Figure 2 | Conceptual framework
3. Methods

This chapter explains the methodology of current research such as how the experiment is conducted in detail. Information about the participants, design, procedure and the measurements is described. At the end of this chapter the data management and data analysis are explained.

3.1 Participants

Convenience sampling was used as the sampling method of the experiment. One school that agreed to participate took part in the research. The sample of participants without exclusion consisted of 74 children. A total of 15 children were excluded since their parents objected participation. After this reform, no other children were excluded, which leads to a sample of 59 children. The participants consisted of children from second and third grade (in Dutch: groep twee en drie), aged between four and six years old. Both boys and girls were included.

3.2 Design

Current research has an experimental design with two phases, an exposure phase and a testing phase. The exposure phase comprised two conditions, namely exposure to candy for the experimental group, and no exposure for the control (i.e. beads instead of candy). The children in the experimental group were exposed in a context that discouraged its consumption where they did not eat the candies as consuming would hinder the purpose of the task which required all the candy. The control group used beads (Figure 6) for performing their task. Because candy is a common temptation to children and previous studies succeeded as well to temp children with candy, it is chosen to experiment with candies (Duckworth et al., 2013; Seeyave et al., 2009 and Mischel & Ebbesen, 1970). The second phase (testing phase) contained a testing phase whereby all children (both experimental and control groups) could choose to receive one piece of candy at that moment, or they had to wait 10 minutes to receive two pieces of candy, which is based on the ‘Marshmallow Task’ from Mischel et al. (1989). The waiting time (10 minutes) was shorter compared to previous studies (15 minutes) (Mischel et al., 1989; Mischel et al., 1972), because the children had to complete the previous task (10 minutes) which also required them to concentrate. Table 4 gives an overview of the experimental setup.

Table 4 | Experimental setup

<table>
<thead>
<tr>
<th>Experimental setup</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Before start of experiment</td>
<td>1. Hunger assessment (N=59 / all children)</td>
</tr>
<tr>
<td></td>
<td>2. Liking question about snacking (N=59 / all)</td>
</tr>
<tr>
<td></td>
<td>3. Liking question about:</td>
</tr>
<tr>
<td></td>
<td>- Puffed rice (N=30 / exposed group)</td>
</tr>
<tr>
<td></td>
<td>- Playing with beads (N=29 / control group)</td>
</tr>
<tr>
<td>Exposure phase</td>
<td>Conditions:</td>
</tr>
<tr>
<td></td>
<td>1. Colouring in with candy (N=30 / exposed group)</td>
</tr>
<tr>
<td></td>
<td>2. Colouring in with beads (N=29 / control group)</td>
</tr>
<tr>
<td>Testing phase</td>
<td>For all children:</td>
</tr>
<tr>
<td></td>
<td>- Choose which candy like best</td>
</tr>
<tr>
<td></td>
<td>- Each child receives one candy with instructions for receiving an extra candy</td>
</tr>
</tbody>
</table>
Pilot

A pre-test of the task of the exposure phase was done at a day care in Ede among children from fifth and sixth grade (in Dutch: groep 5 en 6) to optimize the experimental setup. The 14 children liked the task and all finished the task in the given time (five minutes). More than half of the group admitted to finding it difficult not snacking some candies during the task. Five of all the 14 children snacked some candies. All children understood the instructions of the task. Figure 8 gives an overview of some pictures of this pilot. Only one adaption was done which involved the pieces of candy given to complete the colouring. Instead of the initial total of 56 pieces of candy (seven candies per part of the colouring), which were for some children too many for filling in the colouring, it was chosen to give the children 32 candy (four candies per part of the colouring) to fill in the colouring. In this way the colouring could be completed without left-overs, meaning that the children could not think that after completing the colouring, the left-overs could be eaten. The age category of these children (8-10 years old) did not correspond with the age category of current research (4-6 years old). Therefore it was not checked whether the level of difficulty of the task was appropriate for children in the age category of 4-6 years old.

3.3 Procedure

The consent of Social Sciences Ethical Committee (SSEC) was acquired before the onset of experiments (Appendix 1). The children in each class were assigned to the experimental- and control group by using a randomization program (Randomizer.org). The preparation for this study started in April and the school was invited at the beginning of July. When a school was willing to participate, all the required information was provided by email (Appendix 2). In the beginning of September, the parents of the children were informed about the background, aim and content of the research by means of a letter (Appendix 6). This letter provided all information regarding the experiment, their children and their possibility to withdraw. The parents were informed of the ingredients of the candy used in the study and were asked to inform the researcher before a mentioned date if their child had certain allergies which were in conflict with the experimental setup. The six-day-long experiment took place daily from 8.40 till 14.30. Each individual experiment lasted around 30 minutes. One researcher performed all the experiments. Every day around a total of 10 individuals participated in the research. Each child was picked up from their class by the researcher. The children sat in an individual room. They were introduced to the study by the researcher and were asked to take a seat in front of a table.

Exposure phase

As a start of the experiment, the children were asked how hungry they were by filling in a template (Appendix 3 and Figure 3). Once the children answered the question about their fullness the researcher asked how much they liked snacking candy in general using a five-point scale with smiley faces derived from the scale by Guinard (2000) (Figure 4). The experimental group, was asked how much they liked puffed rice and the control group how much they liked it to play with spread beads (Figure 4). Outcomes of this latter question of the control were not included in the results since this was only a question to have a similar duration and amount of questions compared to the exposed group.
### Figure 3 | Appetite scale – Teddy’s tummy

<table>
<thead>
<tr>
<th></th>
<th>Heel vies</th>
<th>Vies</th>
<th>Niet vies en niet lekker</th>
<th>Lekker</th>
<th>Heel lekker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoeveel trek heb je nu?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Heel vies</th>
<th>Vies</th>
<th>Niet vies en niet lekker</th>
<th>Lekker</th>
<th>Heel lekker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vind je snoepen lekker of vies?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Heel vies</th>
<th>Vies</th>
<th>Niet vies en niet lekker</th>
<th>Lekker</th>
<th>Heel lekker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vind je manna’s lekker of vies?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Heel stom</th>
<th>Stom</th>
<th>Niet stom en niet leuk</th>
<th>Leuk</th>
<th>Heel leuk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vind je spelen met strijkkralen leuk?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Subsequently, the children in the experimental group (N=30) were asked to fill in a colouring of a flower (Figure 5) with candies (Figure 6) in exactly the same way as the example that they also saw in front of them (Figure 9). The researcher informed the children explicitly to use all the candy to fill in the colouring in the same way as the example. In this way it was subtly pointed out that it was not good to snack any of the candies. The researcher however did not explicitly restrict them from eating the candies. The researcher said the following:

[“Here you see a nice colouring of a flower which is already filled in with puffed rice candies, as you can see. And you also have in front of you an empty colouring, which is exactly the same flower. I want you to fill in the empty colouring with the candies you have in front of you. But be sure to use all the rice candy because you need them all! So keep your attention and don’t miss any candy!”]

The second condition was almost the same as the first condition, with the only difference being that the children (the control group) did not fill in the colouring of a flower with candies but with ironing beads (Figure 6). The example of colouring of the control group was filled in with ironing beads. The researcher said exactly the same as to the tempted group, but instead of the word candy, ironing beads was used. The amount of ironing beads was not counted because it was not expected the ironing beads were consumed.
Figure 5 | Flower colouring

Figure 6 | Puffed rice (exposed group) and ironing beads (control group) for filling in the colouring

Figure 7 | Three sorts of candy

Figure 8 | Pictures of pilot at day care in Ede
Testing phase

The testing phase was the same for all the children. It started directly after the exposure phase with the individuals. To start off with, the children were asked to choose their favourite candy out of three different types of candy (in Dutch: 'Apekoppen, Haribo Chamallows ruitspek en Haribo Kers-cola fruitgum') (Figure 7). This was chosen in order to maximize the temptation by using a treat the children really like. The researcher told the children that they could choose between two options: either at that moment they could eat one candy they liked, or they had to wait and will get two pieces of their favourite candy. The researcher said the following:

["If you wait without eating the candy and without getting out of your seat until I come back by myself, then you can have the other candy as well. If you don’t wait and you eat the candy before I come back, you can only have one candy"]

The two questions ‘what do you have to do to receive another candy?’ and ‘what will happen if you already eaten the candy before I come back?’ were asked to determine whether the child understood the concept. Subsequently, the researcher left the room and the child was left alone with the one piece of candy. The researcher observed the children by a hidden live camera with FaceTime (video data was not recorded). The focus of this observation was on the performance of strategies to resist the temptation. A format (Appendix 4) was used to indicate and notice the behaviour as precisely as possible, which was based on the TESQ-E questionnaire, which was developed to assess self-regulation (De Vet et al., 2014).

After 10 minutes (tracked by the use of a stopwatch), or sooner if the child ate the candy, the researcher came back and checked whether the respondent was able to resist the temptation. If the participant succeeded, the researcher gave one more piece as a bonus. The children that did not succeed in resisting the temptation and who ate a part or the whole candy, did not get the other candy. Pictures of both the exposure phase and the testing phase are presented in Figure 9.

Figure 9 | Pictures of the exposure phase (left) and the testing phase (right)
3.4 Measures

For current research, a number of different parameters were measured to obtain results.

Self-control

Self-control of the children was based on six questions rated by the teachers (Appendix 5). This questionnaire is based on literature of De Boer et al. (2011) regarding the concept of stop and start control. Only aspects of assessing stop control were included because current experiment was only focused on that aspect of self-control (De Boer et al., 2011). The questionnaire included six questions (e.g. ‘is good at resisting temptation’ and ‘says inappropriate things’) on a 5-point-like-scale from 1 ‘Not at all’ to 5 ‘Very much’. The results of this questionnaire were used as control variable that was analysed to determine if there was variation between the children in the amount of self-control. The score of the six questions was summed up and was interpret as the higher the score, the higher the self-control of the child. These six items were combined into one broader variable because the Cronbach’s alpha was 0.95, which was higher than 0.6/0.7 and indicates good reliability. Therefore, the analysis could include not six, but only one variable for the amount of self-control according to the teachers, what made the analysis simpler.

Appetite

Before the experiment started, the children were asked how hungry they were by filling in a template (Appendix 3 and Figure 3). Three pictures of a teddy’s tummy (in Dutch: Beertje z’n Buik) were shown: full, half full and not full. The scale is interpreted from the paper by Bennett and Blissett (2014). The researcher indicated the feeling before dinner will be ‘empty’ (showing the teddy with the empty tummy) and after dinner it will be ‘full’ (showing the teddy with the full tummy). This is according to Bell and Tepper (2006) an approach which made it easier for the children to understand the question. Thereafter, the researcher asked the children to indicate their feeling of fullness at that moment using the 3-point scale. This measurement was used as a check to assess whether there was variation between the children.

Delay of gratification

The delay of gratification had four concepts. The first concept was time to approach to the candy. The time it took before the child did approach to the candy (eating, touching, smelling or licking) was recorded by the researcher. The second concept was succeeding the task or not, to check whether the children ate candy, or were able to resist the temptation. The third concept was strategies that were applied when children were tempted (failure). The strategies that were applied (touching, smelling or licking) were tracked by the researcher. The fourth concept was strategies that were applied when children avoided the temptation (success). The strategies that were applied (such as looking away, leaving chair, playing with or hiding hands) were also tracked by the researcher during the testing phase.

Consumption

During the exposed phase it was checked if the exposed children snacked some candy during the experiment. This to control if the instructions for the assignment were understood. This measurement can be seen as a manipulation check.

Self-regulation strategies

During the testing experiment, the children were observed by the researcher through a live camera. FaceTime was used to perform this live observation. A format (Appendix 4) was used to indicate and
notice the behaviour as precisely as possible, which was based on the TESQ-E questionnaire, which was developed to assess self-regulation (De Vet et al., 2014).

3.5 Data management
Two types of data were collected, namely data from: (1) teacher questionnaire and (2) field experiments. Data was transcribed into software SPSS. During the field experiments, photographs and field notes were made. The results from the field experiment were transcribed into a Microsoft Word document. Data is available upon request for other interested researchers as well.

3.6 Data analysis
To study whether pre-exposure to candy enhances delay of gratification one-way ANCOVA testing was executed in IBM SPSS Statistics 23 using the statistical significance level of $P<0.05$ (De Boer et al., 2014; Grubliauskiene & Dewitte, 2015 and Geyskens et al., 2008). It is chosen to conduct ANCOVA due this test is mostly executed in study with an experimental design (Field, 2013). The outcome variables are checked on normal distribution. All outcome variables were normal distributed, except one, namely 'Time to approach'. This outcome variable is therefore transformed to a new variable, namely 'Time to approach LN'. After this transformation, the outcome variable was also normal distributed.

The control variables, dependent and independent variables were determined based on the measures in the experiment (Figure 10). Control variables included ‘Age’, ‘Gender’, ‘Liking of snacking’, ‘Liking of puffed rice’ (experimental) and ‘Appetite’. Exposure to temptation, in the exposure phase exposed to puffed rice, is determined as the independent variable. The focus of current research is on delay of gratification, which includes therefore the main dependent variable of the data analysis. A longer delay of gratification represented a higher score for self-regulation behaviour. This main dependent variable is split in four more specific variables to perform a more extensive analysis. These four dependent variables are 1) ‘Time to approach (in minutes)’, 2) ‘Eating the candy’, 3) ‘Temptation approach’ (‘Touching’, ‘Smelling’ and ‘Licking’) and 4) ‘Avoidance approach’ (‘Looking away’, ‘Leaving chair’, ‘Playing with or hiding hands’, ‘Talking to themselves’ and ‘Playing with something else’). The dependent variables where compared between the exposed and control group. A contrast with the control conditions as a reference category was conducted in the cases a significant level was measured. This was done to test the significance level for both conditions individually.

Manipulation check
A manipulation check was performed in the exposed group to assess whether the children understood the instructions. After the task to fill in the colouring with puffed rice, the amount of puffed rice was counted to determine if the children did snack.

Randomisation check
An independent t-test is done to check whether the variances are equal, comparing both conditions (experimental and control). For the variables ‘Gender’ and ‘Delay of gratification – eating’, chi square testing was used for an association between the two conditions, since both variables are nominal data. For the other variables an independent T-test is done.
Correlations
Nearly all correlations between the control variables and outcome variables are measured by Spearman since most of the correlations included categorical variables. Only the continuous correlations are measured by Pearson (‘Age’, ‘Self-control’, ‘Time to approach’ and ‘Time till went from chair’) (Field, 2013).

ANCOVA and Logistic Regression
To test the main effect and between group effect(s), AN(C)OVA is done for the three continuous variables (‘Time to approach’, ‘Avoidance approach’ and ‘Temptation approach’), and a Logistic Regression is done for the dichotomous variable (‘Delay of gratification – eating’). Only the control variables that showed significant effect are used as covariates in the analysis.

Moderator analysis
A moderator analysis is used to determine whether the relationship between the independent and dependent variables depends on another variable. The variable ‘Liking of snacking’ was significantly different in both conditions. Therefore, the dependent variables are tested with a moderator analysis with the variable ‘Liking of snacking’ and ‘Condition’ as possible moderators. A simple slope analysis to test the effect of condition for above-liking and below-liking is tested for the effects that were (almost) significant. Therefore, two more specific variables are computed, namely ‘zaboveliking’ that stands for the part of the participants that liked snacking and ‘zbelowliking’ stands for the other half that did not like snacking that much.
4. Results

This chapter gives an overview of the results of the experiment defined in the methodology. First the descriptive information is described for both the control variables and the outcome variables. The main outcomes are illustrated in tables and the main results are described.

4.1 Descriptive information

Table 5 gives an overview of the descriptives of the control variables and the outcome variables. The average age of all children was 5.37 (SD=0.667) and 40.7% were boys. The randomisation check indicated that there were no differences in age, gender, appetite, self-control, time to approach, delay of gratification, temptation approach and avoidance approach, but a difference existed in liking of snacking (Table 5). At the start of the experiment, children in the experimental group liked snacking significantly better than children in the control group. Therefore, correction is attributed for the remainder of the research by using the variable ‘Liking of snacking’ as a covariate for subsequent tests in the result section.

Manipulation check

All children understood and completed the task as intended since no puffed rice was missing after the task, indicating that children were not eating during the pre-exposure phase.

Table 5 | Descriptives

<table>
<thead>
<tr>
<th></th>
<th>Control condition</th>
<th>Experimental condition</th>
<th>Test</th>
<th>Value</th>
<th>Df</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong> (4-6 years)</td>
<td>Mean 5.41</td>
<td>Mean 5.33</td>
<td>F=2.152</td>
<td>P=0.148</td>
<td>57</td>
</tr>
<tr>
<td><strong>Gender</strong> b</td>
<td>44.8%</td>
<td>36.7%</td>
<td>X²=0.407</td>
<td>P=0.524</td>
<td>1</td>
</tr>
<tr>
<td><strong>Liking of snacking</strong></td>
<td>1.59</td>
<td>1.77</td>
<td>F=4.846</td>
<td>P=0.032*</td>
<td>51.496</td>
</tr>
<tr>
<td><strong>Appetite</strong></td>
<td>0.83</td>
<td>0.87</td>
<td>F=2.361</td>
<td>P=0.130</td>
<td>57</td>
</tr>
<tr>
<td><strong>Self-control</strong></td>
<td>0.38</td>
<td>0.25</td>
<td>F=0.005</td>
<td>P=0.946</td>
<td>57</td>
</tr>
<tr>
<td><strong>Time to approach (in minutes)</strong></td>
<td>3.22</td>
<td>2.90</td>
<td>F=3.173</td>
<td>P=0.083</td>
<td>39</td>
</tr>
<tr>
<td><strong>Delay of gratification (eating)</strong></td>
<td>13.8%</td>
<td>3.3%</td>
<td>X²=2.080*</td>
<td>P=0.195</td>
<td>1</td>
</tr>
<tr>
<td><strong>Temptation approach</strong></td>
<td>1.08</td>
<td>1.24</td>
<td>F=0.000</td>
<td>P=0.985</td>
<td>53</td>
</tr>
<tr>
<td><strong>Avoidance approach</strong></td>
<td>1.85</td>
<td>2.24</td>
<td>F=1.875</td>
<td>P=0.177</td>
<td>53</td>
</tr>
</tbody>
</table>

*Levene’s Test for Equality of Variances is significant at the 0.05 level
**This variable is a sum score of the variables ‘Touching’, ‘Smelling’ and ‘Licking’
***This variable is a sum score of the variables ‘Looking away’, ‘Leaving chair’, ‘Playing with or hiding hands’, ‘Talking to themselves’ and ‘Playing with something else’
\* Two cells (50%) have expected count less than five, therefore the p-value is based on the Fisher’s Exact Test
\*\* Percentage of boys
Correlations

The control variable ‘Age’ was significant correlated with the outcome variable ‘Avoidance approach’ (P=-0.323). All the other control variables were not significant correlated with any of the outcome variables. Thus, in further calculations with the outcome variable ‘Avoidance approach’, next to the variable ‘Liking of snacking’, ‘Age’ is used as a covariate. Of the other three outcome variables only ‘Liking of snacking’ is used as covariate.

Figure 13 gives an overview for both conditions of the amount of liking of snacking. This shows that there is no obvious difference between the control group and the experimental group. To check whether the children in the experimental group liked the puffed rice, an overview is presented (Figure 14). This overview shows that the children in the experimental group had a similar opinion about the puffed rice (N=30, Mean=1.50, SD=0.900), compared to the results of liking of snacking of all children (N= 59, Mean=1.68, SD=0.600). Next to that, the control variable ‘Appetite’ was also overall similar in both conditions (Figure 15).

![Figure 13](image1.png) Level of liking of snacking according to both conditions

![Figure 14](image2.png) Level of liking of puffed rice in experimental group

![Figure 15](image3.png) Level of appetite according to both conditions
4.2 Observation

Table 7 gives an overview of the results of the observation during the testing phase of the experiment. The main remark about this table is that for all variables, except for the variable ‘Delay of gratification - eating’, the experimental group has higher values, compared to the control group. The differences between the control and experimental group are not significant for most observations, with the exception of the variable ‘Leaving chair’, which is significant (P=0.042). The difference in value between both conditions for this latter variable is remarkably large, compared to the other variables. In the control group 34.6 percent left their chair, while in the experimental group 62.1 percent did left their chair.

Table 7 | Results from observation

<table>
<thead>
<tr>
<th></th>
<th>Control condition</th>
<th>Experimental condition</th>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Eating (delay of gratification) (N=59)</td>
<td>4</td>
<td>13.8%</td>
<td>1</td>
<td>3.3%</td>
</tr>
<tr>
<td>Touching (N=56)</td>
<td>19</td>
<td>70.4%</td>
<td>21</td>
<td>72.4%</td>
</tr>
<tr>
<td>Licking (N=55)</td>
<td>3</td>
<td>11.5%</td>
<td>7</td>
<td>24.1%</td>
</tr>
<tr>
<td>Smelling (N=55)</td>
<td>7</td>
<td>26.9%</td>
<td>8</td>
<td>27.6%</td>
</tr>
<tr>
<td>Looking away (N=55)</td>
<td>21</td>
<td>80.8%</td>
<td>25</td>
<td>86.2%</td>
</tr>
<tr>
<td>Talking to themselves (N=55)</td>
<td>8</td>
<td>30.8%</td>
<td>13</td>
<td>44.8%</td>
</tr>
<tr>
<td>Playing with something else (N=55)</td>
<td>9</td>
<td>34.6%</td>
<td>12</td>
<td>41.4%</td>
</tr>
<tr>
<td>Playing with or hiding hands (N=55)</td>
<td>10</td>
<td>38.5%</td>
<td>13</td>
<td>44.8%</td>
</tr>
<tr>
<td>Leaving chair (N=55)</td>
<td>9</td>
<td>34.6%</td>
<td>18</td>
<td>62.1%</td>
</tr>
</tbody>
</table>

*Levene’s Test for Equality of Variances is significant at the 0.05 level
**More than 20% have expected count less than 5, therefore the Fisher’s Exact Test is written in the Value column, instead of the P=value of Chi-square

4.3 Main results

The difference between both groups for the outcome variable ‘Temptation approach’ was not significant (F=0.000, P=0.985). For the outcome variable ‘Avoidance approach’, the difference between both conditions was also not significant (F=1.875, P=0.177). Table 6 illustrates the percentages for the different levels of the variables ‘Temptation approach’ and ‘Avoidance approach’ and Figure 11 and Figure 12 give an overview of the frequencies for the variables from which those two variables have been formed.

Next to that, the difference between both conditions for the outcome variable ‘Time to approach (in minutes)’ was also not significant (F=3.173, P=0.083). One remark that should be taken into account is that the results for this outcome are not based on all children. In the control group only 18 children approached (eat, touch, lick or smell) the candy (Missing=11) and in the experimental group 23 children approached the candy (Missing=7). For the ‘Delay of gratification – eating’ 13.8 percent (N=4) of the control group and 3.3 percent (N=1) of the experimental group did eat the candy and the difference was not significant (X²=2.080, P=0.195). Because this amount of children was that low (N=5), no valid comparison or interpretations can be made since both conditions had way more children who did not eat the candy (N=54), compared who did eat the candy (N=5).
Table 6 | Outcome variables based on levels

<table>
<thead>
<tr>
<th></th>
<th>Control condition</th>
<th>Experimental condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td><strong>Temptation Approach</strong> (N=55)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valid</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Avoidance Approach</strong> (N=55)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valid</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

*This variable is a sum score of the variables ‘Touching’, ‘Smelling’ and ‘Licking’

**This variable is a sum score of the variables ‘Looking away’, ‘Leaving chair’, ‘Playing with or hiding hands’, ‘Talking to themselves’ and ‘Playing with something else’

Figure 11 | Frequency of touching, smelling and licking the candy - variable ‘Temptation approach’

Figure 12 | Frequency of looking away, leaving chair, playing with or hiding hands, talking to themselves and playing with something else – variable ‘Avoidance approach’
Based on the Logistic Regression, the effect of the control variable ‘Liking of snacking’ on the outcome variable ‘Delay of gratification – eating’ was not significant (SE=0.981, P=0.518). Also the effect of the condition was not significant (SE=1.159, P=0.160). According to the ANCOVA test the variable ‘Liking of snacking’ is not a significant covariate for the variable ‘Time to approach’ (F=0.208, P=0.651) (Table 9). Also the condition did not show significant effect (F=0.021, P=0.886). The outcome of the ANCOVA with ‘Liking of snacking’ as covariate and ‘Temptation approach’ as outcome variable was not significant (F=2,813, P=0.100). Next to that, the effect of the condition was also not significant (F=0.112, P=0.739). Table 8 and Table 9 give an overview of the results of the main analysis. According to the ANCOVA test the control variable ‘Age’, was a significant covariate for ‘Avoidance approach’ as outcome variable (F=4,380, P=0.041). This indicates that age has effect on the avoidance strategies that the children conducted. The correlation with the variables ‘Age’ and ‘Avoidance approach’ was negative (-0.323). This indicates that the older the children were, the less avoidance strategies they applied during the testing phase of the experiment. The effect of the control variable ‘Liking of snacking’ was not significant (F=0.085, P=0.771). Also the effect of the condition was not significant (F=1.496, P=0.227).

The results of the moderator analysis with the new variable ‘LikingXCondition’ as covariation and ‘Avoidance approach’ as dependent variable was almost significant (F=3.889, P=0.054). The moderator analysis with variable ‘LikingXCondition’ was for the other three outcome variables not significant (see Table 10). The results of the Regressions with the more specific variables ‘zaboveliking’ and ‘zbelowliking’ indicate that intervention had a significant effect (P=0.022) on the avoidance strategies, but only on children who were in the ‘below-liking’ group. The intervention did not have effect on children who were in the ‘above-liking’ group and liked snacking, since it was not significant (P=0.671). All other outcomes with the moderations included were not significant. This indicates that the effect of the pre-exposure of temptation was not different for children that like snacking a lot, or do not like snacking.

Table 8 | Results logistic regression for outcome variable ‘Delay of gratification – eating’

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>St. error</th>
<th>Value</th>
<th>Df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>-1.628</td>
<td>1.159</td>
<td>0.160</td>
<td>1</td>
</tr>
<tr>
<td>Liking of snacking</td>
<td>0.634</td>
<td>0.981</td>
<td>0.518</td>
<td>1</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.898</td>
<td>1.812</td>
<td>0.110</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 9 | Results ANCOVA

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Covariate</th>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to approach (in minutes)</td>
<td>Liking of snacking</td>
<td>F=0.208</td>
<td>P=0.651</td>
</tr>
<tr>
<td></td>
<td>Condition</td>
<td>F=0.021</td>
<td>P=0.886</td>
</tr>
<tr>
<td>Temptation approach</td>
<td>Liking of snacking</td>
<td>F=2.813</td>
<td>P=0.100</td>
</tr>
<tr>
<td></td>
<td>Condition</td>
<td>F=0.112</td>
<td>P=0.739</td>
</tr>
<tr>
<td>Avoidance approach</td>
<td>Age</td>
<td>F=4.380</td>
<td>P=0.041*</td>
</tr>
<tr>
<td></td>
<td>Liking of snacking</td>
<td>F=0.085</td>
<td>P=0.771</td>
</tr>
<tr>
<td></td>
<td>Condition</td>
<td>F=1.496</td>
<td>P=0.227</td>
</tr>
</tbody>
</table>

*Levene’s Test for Equality of Variances is significant at the 0.05 level

Table 10 | Results moderator analysis

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Covariate</th>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to approach (in minutes)</td>
<td>Liking of snacking X Condition</td>
<td>F=0.182</td>
<td>P=0.672</td>
</tr>
<tr>
<td>Temptation approach</td>
<td>Liking of snacking X Condition</td>
<td>F=2.435</td>
<td>P=0.125</td>
</tr>
<tr>
<td>Avoidance approach</td>
<td>Liking of snacking X Condition</td>
<td>F=3.889</td>
<td>P=0.054</td>
</tr>
<tr>
<td>Delay of gratification (eating)</td>
<td>B</td>
<td>St. error</td>
<td>Value</td>
</tr>
<tr>
<td></td>
<td>10.275</td>
<td>8678,998</td>
<td>0.999</td>
</tr>
</tbody>
</table>
5. Discussion & Conclusion

The aim of the current study was to research whether the self-control, in terms of delay of gratification, of children aged 4 to 6 can be enhanced by pre-exposure to food temptation. Self-regulation skills are needed to successfully resist temptation (De Vet et al., 2013). When a person develops more self-control to overcome temptation during childhood, the chances of that person becoming an adult with a healthier lifestyle increase (Freedman et al., 2001). Figure 16 gives an overview of the adjusted conceptual framework and Table 10 of the hypotheses, based on the results of the experiment.

5.1 Hypotheses based on results

The main hypothesis (H1) is rejected since children who were pre-exposed to food temptations did not use more adaptive self-regulation strategies or less maladaptive self-regulation strategies than children who were not pre-exposed to food temptation. Further, no differences existed between the two groups in their ability to delay gratification. These findings suggest that exposure to tempting foods is not beneficial to self-regulation, but exposure to tempting foods in a rather controlled way doesn’t hamper it either.

According to the outcomes of the experiment the second and third hypothesis (H2 and H3) are partly rejected. The variable ‘Appetite’ did not show any significant effect. However, the control variable ‘Liking of snacking’ was significantly different in both groups. Further tests showed that the less the children liked snacking, the more they applied strategies to avoid the temptation (‘Avoidance approach’). However, this was only significant for the group that did not like snacking that much (below liking of snacking group) compared to the other group that liked snacking a lot and which was not significant. Therefore H2 and H3 are partly rejected.

Based on the results, the variable ‘Age’ is found to have a significant effect on the outcome variable ‘Avoidance approach’. From this outcome, it can be derived that the older the children, the less avoidance strategies they applied to resist temptation. This result is the opposite of the formulated hypotheses (H4 and H5). Therefore, the positive and negative effect of age of H4 and H5 should be reversed (Figure 16). According to this result, the age category of 4-6 years old may be interpreted as a well-fitting target population for this sort of research, whether there is a significant difference between the results of the younger children (around 4 years old), compared to the older children (around 6 years old). The variable of self-control did not have any significant effect, which caused a rejection of H4 and H5 (Figure 16).
5.2 Answering the research questions

The main research question ‘Can controlled exposure to temptation be used to improve self-control?’ is difficult to answer based on the results, since there were only five children that failed the task and ate their candy during the testing phase. One interesting remark; during the experiment almost all children applied strategies that might have helped them with overcoming the temptation, since almost all children (N=54) succeeded in completing the task. Therefore it can be concluded that controlled exposure may improve self-control since it triggers the children to apply strategies to resist the temptation. Table 11 gives an overview of the research questions and the answers.

### Table 10 | Hypotheses based on results

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Description</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>When pre-exposing children to temptation, this will increase their subsequent delay of gratification</td>
<td>Rejected</td>
</tr>
<tr>
<td>H2</td>
<td>When children are more hungry and like the temptation more, this will decrease their subsequent delay of gratification</td>
<td>Partly rejected</td>
</tr>
<tr>
<td>H3</td>
<td>When children are less hungry and like the temptation less, this will increase their subsequent delay of gratification</td>
<td>Partly rejected</td>
</tr>
<tr>
<td>H4</td>
<td>When children have more self-control and are older, this will increase their subsequent delay of gratification</td>
<td>Rejected</td>
</tr>
<tr>
<td>H5</td>
<td>When children have less self-control and are younger, this will decrease their subsequent delay of gratification</td>
<td>Rejected</td>
</tr>
</tbody>
</table>
The answer for the first specific research question ‘Does controlled exposure to food temptation contribute to subsequent eating-related self-control?’ can be answered with yes, because there were two significant differences between both conditions. The variables ‘Age’ and ‘Liking of snacking’ resulted in having some contributions to the avoidance strategies for temptation. That showed a contribution to the controlled exposure to food temptation. The other variables ‘Gender’, ‘Self-control’ and ‘Appetite’ did not show any different effects for both conditions.

The answer to the second specific research question ‘What strategies can be used during food temptation to maintain subsequent eating-related self-control?’ can also be answered since most children applied strategies and did overcome the temptation. The five main strategies that were applied are 1) Looking away (N=46), 2) Leaving chair (N=27), 3) Playing with or hiding hands (N=23), 4) Talking to themselves (N=21) and 5) Playing with something else (N=21). It can be concluded that especially these five strategies may help the children to maintain subsequent eating-related self-control because almost all children succeeded in completing the task, which indicates a high eating-related self-control.

Table 11 | Research questions and answers

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Can controlled exposure to temptation be used to improve self-control?</td>
<td>Yes, in a way that controlled exposure triggers the person to apply strategies that help to resist the temptation.</td>
</tr>
<tr>
<td>1a. Does controlled exposure to food temptation contribute to subsequent eating-related self-control?</td>
<td>For the variables age and liking of snacking yes, but not for the variables gender, self-control according to teachers and appetite.</td>
</tr>
<tr>
<td>1b. What strategies can be used during food temptation to maintain subsequent eating-related self-control?</td>
<td>The five most applied strategies that were used to overcome temptation were 1) Looking away, 2) Leaving chair, 3) Playing with or hiding hands, 4) Talking to themselves and 5) Playing with something else.</td>
</tr>
</tbody>
</table>

Explanation for unexpected findings

The results of current research are not in line with previous studies that found that pre-exposure to food temptation leads to a reduction of food intake during a subsequent temptation (Grubliauskiene & Dewitte, 2014; Inseng Duh et al., 2015). One explanation for this difference could be that the children of current research already had experience (e.g. at home or at school) with tasks relating to temptation and self-regulation skills, and had therefore no troubles with succeeding the tasks during the experiment. To check this potential effect, it is recommended to perform the same experiment at at least one other school. Also, it may be the case that the children of the current research had already developed sufficient skills to overcome the temptation or the task could be too easy for the age category, which can explain that almost all children succeeded the task. To confirm this interpretation, it is suggested to conduct the same experiment with children in a younger age category (e.g. 3-5 years old). Also, it is suggested to execute a pilot that include participants of same age category as the main study in order to check whether the task is of appropriate level of difficulty. Other aspects that might have influenced the results are described in the next paragraph ‘Limitations and recommendations for further research’.
5.3 Limitations and recommendations for further research

The research had several limitations. First, young children may have limited linguistic skills, which can affect their ability to understand symbols or pictures (Popper and Kroll, 2005). The questions about the level of appetite and the level of liking of snacking could therefore have been misunderstood or misinterpreted by the children, which may have influenced the outcomes of the research. However, the researcher did check after every question at least once whether the question was understood to guarantee correct answers.

The children might have been distracted during the experiment due to a window in the door that made it possible to look into the hallway. Most of the time there were other children in the hallway (e.g. playing or reading books). This could have distracted the children and therefore could also have influenced their behaviour. According to previous research, distracted children, either external as internal, are forwarded to the cool system that help them resisting temptation (Dewitte, 2013). A suggestion for further research could be to perform experiments in a room without any windows that can potentially distract children. Another limitation could be the fact that all children were rotating several times a day, which led to a high amount of interaction between the children. Some children talked with each other about the experiment. This interaction between the children might have increased the amount of children who knew a lot about the content of the experiment, even if they still had to participate. This may have influenced the behaviour of some children. Nevertheless, this latter limitation is not expected to have a significant impact, since the experiment is an individual experiment where the children were alone in the room and the children did not know the underlying meaning of the research.

The sample size was nearly beyond the limit of more than 30 participants per condition (Field, 2013), which lead to a low representativeness of the population (Field, 2013). Therefore, for further research it is recommended to examine a larger sample. Another limitation is that in the analysis only the frequencies of behaviour are included, so no time frame of each action is taken into account. This may lead to wrong interpretation of the outcomes, since for example an action of two minutes is according to the analysis interpreted the same as an action of two seconds.

All children were recruited from one primary school only. According to the director of the school, the children of his school are generally of higher social economic status (SES) compared to the average children in the Netherlands. This may decrease the generalizability of the outcomes and can explain why almost all children succeeded the task since previous research found that more intelligent children have more self-control (Rodriguez et al., 1989; Fujita & Carnevale, 2012; Shamosh et al., 2008). Further research should therefore include children with a generalizable background to guarantee results that can be compared to average children in the Netherlands. Nevertheless, it is expected that the results of current research can be compared with the average child due to the fact it was an individual experiment and even children with a high SES may have a low eating-related self-control.

The experiment was in the second week of the beginning of the new schoolyear (September), and the teachers received the questionnaire already on the first school day. However, the teachers did not know all children very well because half of the group was ‘new’ for the teachers since that September. This made it difficult for the teachers to fill in the questionnaire about self-control of these new children. Therefore, the teachers got one week extra (total two weeks instead of one) to get to know the children a bit more. Based on those two weeks the teachers filled in the questionnaire. This lack of knowledge
about the new children might have influenced the results of the questionnaire. Therefore, for further research, it is recommended to ask input from teachers, only when they have had the children in class for at least two months and with the comment ‘the longer, the better’.

The impact of parents is not included in current research due to the lack of time and the high complexity of involving parents in research. However, it might be interesting to test the effect since parents do influence the actual behaviour of their child(ren) (Minello & Blossfeld, 2016). Previous research found that children’s behaviour is less consistent if their parents give different rules or prescriptions (Maphet and Miller, 1982). The norms and values that are learned at home might contribute to processes such as the development of self-regulation skills. Therefore, for further research it is recommended to include the impact of parents on the children (such as rules or habits for snacking behaviour at home) as well, for example by using questionnaires or a more interactive experimental design, such as a workshop with parents and children included.

5.4 Strengths

Next to the limitations, also some strengths of the research should be mentioned. One strength is that the experiment is conducted by only one researcher. This researcher treated all children the same, which led to a similar influence of the researcher on all children, which improves the comparability of the results. When two or more researchers conduct the experiment, the children can interpret the explanation during the experiment differently since one researcher may be, for example, stricter than the other. The results of this research are not influenced by this bias since the research is performed by just one researcher.

The setup of the experiment for both conditions (experimental and control) was the same. All children had the same amount of questions and the task was also almost the same. The only aspect that was different was filling the colouring with puffed rice or with string beads. The experimental group got a question about how much they liked puffed rice and the control group got the question about how much they liked playing with string beads. This latter question was not included in the analysis, but kept the amount of questions and time for both groups the equal, which increases the comparability between both conditions.

The research included a manipulation to check if the task was understood by the children. Results showed that all children understood the task. Also, the children were asked which sort of candy, out of three sorts, they preferred. This element increased the chance that they had to resist temptation to a candy they really liked, which was not guaranteed in the Marshmallow Task (Mischel and Ebbesen, 1970). Another strength is that all outcome variables are controlled for most factors that may influence the results. The outcomes are corrected for age, gender, the amount of self-control, appetite, liking of snacking and liking of puffed rice (for the experimental group). This increases the validity of the results of this study.

5.5 Conclusion

When pre-exposing children in the age category from 4-6 years old to puffed rice, subsequent eating-related self-control in terms of delay of gratification will not increase. The subsequent eating-related self-control does not change after pre-exposure in a context that the intake of food was discouraged by completing a task with candy. However, some interesting findings should be mentioned. First, the older the children were, the fewer strategies they applied to avoid the temptation. This was the opposite of
one of the hypotheses. Second, the more the children (who belong to the below-liking of snacking group) liked snacking, the fewer strategies they applied to avoid the temptation.

An interesting remark is that almost all children applied strategies to resist the temptation and only five (out of 59) ate their candy during the testing phase. This led to the suggestion that the strategies that were applied may help with succeeding the task and may be seen as a tool to help with overcoming temptation. The five most applied strategies were 1) Looking away, 2) Leaving chair, 3) Playing with or hiding hands, 4) Talking to themselves and 5) Playing with something else. Other reasons why almost no child failed may be that the children had already sufficient experiences with food temptation (e.g. at school or at home), or the task was too easy for their age. Or the children might have developed already enough skills to overcome the temptation. Therefore, for further research it is recommended to recruit participants of younger age (e.g. 3-5 years old), spread over more schools with a different environment and with different backgrounds to guarantee that they still have to develop some skills. Table 12 gives an overview of the main findings of current research.

To conclude, the relation between pre-exposure of food temptation and subsequent self-control in terms of delay of gratification is complex. For further research, it is recommended to examine a larger sample, spread over more schools with different environment and background, in a room without any window, with a younger age category (e.g. 3-5 years old) and with a task that has an appropriate level of difficulty. Deeper insight is needed on the effect of the various factors on eating-related self-control. This study can be seen as one step further in the field of food temptation and eating-related self-control, but to confirm any statements, more steps should be taken.

Table 12 | Main findings

<table>
<thead>
<tr>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-exposure of food temptation does not increase nor decrease subsequent eating-related self-control in terms of delay of gratification.</td>
</tr>
<tr>
<td>Pre-exposure does have effect on the avoidance strategies for children who belong to the group that does not like snacking that much in a way that the less they like snacking, the more strategies to avoid food temptation are applied.</td>
</tr>
<tr>
<td>The older the child (in the range of 4-6), the less strategies are applied to avoid food temptation.</td>
</tr>
<tr>
<td>Translating pre-exposure of food temptation in a practical intervention with self-control in terms of delay of gratification is complex. Deeper insight is needed in the factors that may have influence on eating-related self-control.</td>
</tr>
</tbody>
</table>
Literature


Appendix 1. Social Sciences Ethical Committee consent application

How can controlled exposure to temptation be used to improve self-control?

Project team
Dr. Emely de Vet (supervisor)
Angeliek Verdonschot (researcher)

Funding
Wageningen University and Research Centre

Period
April 2016 – November 2016 (experiment July 2016)

Background: childhood obesity is a growing worldwide problem. A high amount of unhealthy food intake is one of the causes for this rise in childhood obesity. The availability of fast food and the environment is related to the intake of calorie-dense foods. When the environment is unable to add protection against temptation, people will be exposed to temptation and will fall prey to eating unhealthy food. Self-regulation is needed to resist the temptation of energy-dense, unhealthy and cheap food. Self-regulation refers to the ability to control one’s impulses with a short-term rewarding value in order to achieve long-term goals. Self-regulation skills may therefore be needed. Even though many studies are performed about self-control and environmental impact, there is knowledge missing about how self-control can be improved. Past studies suggest that pre-exposure to food temptations may contribute to the ability to resist tempting foods in a subsequent eating-related task (Inseng Duh et al., 2015). This study will build on that work aiming to investigate how self-control can be improved through controlled exposure to temptations. With controlled exposure, we mean that food temptations are visible, salient and tangible but are not supposed to be eaten from.

Research questions: the general research question for this research will be ‘How can controlled exposure to temptation be used to improve self-control?’. The general research question will be answered by the following two specific research questions: (1) ‘Does controlled exposure to food temptation contribute to subsequent eating-related self-control?’ and (2) ‘What strategies can be used during food temptation to maintain subsequent eating-related self-control?’

Objective: to investigate the effect of controlled exposure to food temptations on subsequent delay of gratification among 5-7 year olds.

Hypothesis: it is expected that participants who are exposed to food temptations are better able to wait for a delayed gratification compared to the control group, which will not be tempted with foods during the exposure phase.
Design: this study will have a pre- and post-test experimental design with two groups. The experimental group will have two phases; (1) controlled exposure phase and (2) testing phase. The participants (N=60) will consist of children (boys and girls) from second and third grade, aged between four and six years old. A Randomization program will be used to distribute the participants in the exposed (N=30) or non-exposed (control) group (N=30) at an individual level.

Procedure: as a start the researcher will ask the participants to indicate their feeling of fullness. After that both groups (exposed and non-exposed) will be asked to fill in a flower colouring with candy (puffed rice) (experimental group) or toys (beads) (control group). The children in both groups will get the right amount of candies/beads to identically copy the flower colouring example. This subtly communicates the message that children are not allowed to eat the candy, because then it would be no longer possible to complete the task. Nevertheless, the candy will be count before and after the experiment to check if participants did eat from the candy. After they have completed the flower colouring task, participants will be asked to choose the candy they like best out of three (in Dutch: “Apekoppen, Haribo Chamallows ruitspek en Haribo Kers-cola fruitgum”). Doing so allows to include a reward in the delay of gratification task in part 2 of the experiment, that is really perceived as a reward by the children. Next, the researcher will explain that they can eat one candy immediately or if they wait till the researcher will be back he/she gets another candy extra. The researcher will observe the participants by a hidden live camera with FaceTime or Skype (video data will not be recorded). After 15 minutes (or sooner if the child ate the candy) the researcher will come back and will give another candy if the participant did not snack, or no candy if the one candy was already eaten.

Measures: Self-control: the teachers will fill in a questionnaire with 6 items about the self-control of each participant (appendix 4) (based on de Boer et al., 2011). The results of this questionnaire will be used as control variable to check whether participants in the experimental and control condition are equal in amount of self-control prior to the experiment. Hunger: the children will be asked to indicate how hungry they are by pointing out a teddy’s tummy that is depicted with full, half full and almost empty stomach (appendix 2) (Bennett and Blissett, 2014). Delay of gratification will be expressed in two variables. 1) Dichotomous: able or unable to resist the candy for the delayed period, 2) continuous: the amount of time (in minutes) participants delayed gratification. Self-regulation strategies: during the testing experiment the participants will be observed by the researcher through a live camera by FaceTime or Skype. Strategies in order to resist temptation will be noticed with use of a format (appendix 3) (Walter et al., 1989; De Vet et al., 2014). Consumption during exposure: For participants in the experimental group, the candy will be count before and after the experiment to check if participants did eat from the candy. This to control if the instructions for the assignment were understood. This measurement can be seen as a manipulation check. Age: the age of each participant will be asked in the questionnaire of the experimental phase (appendix 2).

Data management: Data arrived from questionnaires will be entered into software SPSS. During the field experiments, and field notes will be made. The other results from the field experiment will be transcribed into a Microsoft Word document.

Data analysis: The variables will be categorised in dependent or independent variables and categorical or continuous. Then appropriate tests, such as Chi Square, t-test, ANOVA, LDA, QDA and Regression, will be applied with SPSS.
Application Form Review Social Sciences Ethics Committee
Date: 7 June 2016

<table>
<thead>
<tr>
<th>Names applicants</th>
<th>Angeliek Verdonschot (student) Emely de Vet (supervisor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title of the research project</td>
<td>How can controlled exposure to temptation be used to improve self-control?</td>
</tr>
<tr>
<td>Location</td>
<td>Wageningen</td>
</tr>
<tr>
<td>Funding sources</td>
<td>Wageningen University</td>
</tr>
<tr>
<td>Period</td>
<td>April 2016 – November 2016 (experiment July 2016)</td>
</tr>
</tbody>
</table>

**Part I: Research process**

1. Is your research project in the field of medical research, or does it involve the use of medical instruments on human participants?
   - No

2. Describe how you will recruit participants and the inclusion and exclusion criteria
   Dr. Emely de Vet will contact the primary school from her own children, which is located in Gilze. Two reasons why it is expected they will participate are; (1) they may be more helpful because of the relation with Dr. de Vet and (2) they may not get often the question to participate research – compared to schools in and around Wageningen – and may be therefore more willing to participate. Inclusion criteria are children in the age category of 5-7 years. Exclusion criteria are children who can not participate due to any kind of allergy related with the used products in the experiment and children who are not allowed by their parents to participate. If the school is willing to participate, the teachers and parents of the children will receive a letter with the aim and process of the research.

3. Will you request written or oral consent from your participants? If yes, add the consent form or explain the procedure for oral consent. If no, please explain
   - Yes. See appendix.

4. Are participants fully informed about the aims of the research?
   The children not, but the parents and the teachers will be informed about the aim of the research. This because otherwise it can influence the behaviour of the participants, which can influence the outcomes of the study.

5. Do vulnerable groups participate in your research (e.g. children, elderly, disabled or mentally handicapped persons)?
   - Children will participate in age category 5-7 years.

**Part II: Data management**

6. Will you collect data on confidential or sensitive issues? If yes, explain how you guarantee the confidentiality of these data.
   - No

7. Does your project involve adaptations of the regular data management protocol of your chair group? If yes, please explain.
   - No

**Part III: Risks**

8. Do participants run physical (health), emotional, social, political or any other risk by participating in this research? If yes, please explain what you will do to minimize or counterbalance these risks.
   - No
9. Does your research take place in unsafe areas (e.g. conflict or war zone, or in an area with high risks of natural disasters)? If yes, is there protocol for the protection of the involved researchers and participants? Explain how you manage the safety of people involved.

No
Ethical Clearance

To whom it may concern

The following project proposal has been reviewed by the Social Sciences Ethics Committee (SEC):

Applicants: Angeliek Verdonschot, Prof Dr Emely de Vet
Title: How can controlled exposure to temptation be used to improve self-control?
Location: Wageningen
Funding sources: Wageningen University
Period: April 2016 – November 2016

The Committee has concluded that the proposal deals with ethical issues in a satisfactory way and that it complies with the Netherlands Code of Conduct for Scientific Practice.

With kind regards,

Prof. Dr Marcel Verweij
Chair Social Sciences Ethics Committee
Appendix 2. Information letter for teachers

**Brief voor leraren**

Beste meneer/mevrouw,

Overgewicht is momenteel een van de belangrijkste gezondheidsproblemen in Nederland, zowel onder volwassenen als onder de jeugd. Er is steeds meer en vaker ongezond (vet- en suikerrijk) voedsel beschikbaar, op veel meer plaatsen en in grotere hoeveelheden, waardoor we vaak ongemerkt teveel en het verkeerde eten. Het vergt dan ook veel zelfbeheersing om steeds het hoofd te moeten bieden aan al die verleidingen. Vooral voor kinderen, wiens vermogens tot zelfbeheersing nog volop in ontwikkeling is, is weerstand bieden aan voedselverleiding een uitdaging. Tegelijkertijd geldt voor gezond eten ook "jong geleerd, oud gedaan" en is het aanleren van gezonde eetgewoonten juist op jonge leeftijd belangrijk. Wageningen Universiteit onderzoekt daarom nieuwe manieren om kinderen te leren omgaan met (voedsel)verleidingen.

De komende week (datum) wordt er bij uw leerlingen een nieuwe manier onderzocht om zelfbeheersing te verbeteren. We onderzoeken of het oefenen met zelfbeheersing door kinderen onder gecontroleerde omstandigheden bloot te stellen aan snoep kan bijdragen aan een betere zelfbeheersing op een later moment. De ene helft van de kinderen gaat een kleurplaat na knutselen met snoepjes. De andere helft zal dezelfde kleurplaat na knutselen met strijkkralen. Doordat de kinderen alle snoepjes nodig hebben om het werkje te kunnen voltooien, oefenen de kinderen met het weerstand bieden aan de verleiding.

In het tweede deel van het onderzoek, doen we de beroemde ‘Marshmallow test’. Kinderen kiezen een snoepje en hen wordt verteld dat ze op dat moment één snoepje mogen eten, of wanneer ze 10 minuten wachten een tweede zelfde snoepje krijgen. De kinderen worden dan alleen gelaten met dat ene uitgekozen snoepje en na 10 minuten of eerder als het snoepje is opgegeten komt de onderzoeker terug. De onderzoeker belooft de kinderen die het snoepje niet op hebben gegeten met een twee snoepje en wanneer er is gegeten van het ene snoepje krijgen ze niets extra’s. Op deze manier wordt hun zelfbeheersing getest en de groep kinderen die heeft geknutseld met snoep wordt vergeleken met de groep kinderen die de kleurplaat heeft na geknutseld met strijkkralen.

U hoeft voor dit individuele onderzoek niets te doen. Een onderzoek zal ongeveer 20 minuten duren. We werken met twee onderzoekers en proberen 12 kinderen per ochtend (9.00 – 12.00) te onderzoeken. De kinderen zullen door een van de twee onderzoekers uit uw klas worden gehaald en naderhand worden teruggebracht.

We hebben enkele vragen voor u samengesteld om meer informatie over de kinderen te krijgen. Deze 6 vragen kunt u vinden op het andere formulier dat u heeft ontvangen van ons. We zouden u willen vragen om dit formulier per kind zorgvuldig te beantwoorden. We zouden het erg op prijs stellen als u ons hiermee helpt. Aan het eind van elke dag met onderzoeken komen we de ingevulde formulieren bij u ophalen.

We hopen dat we u niet tot last zijn en willen u alvast hartelijk danken voor uw medewerking!

Mocht u vragen hebben, neem dan gerust contact op.

Met vriendelijke groet,

Angeliek Verdonschot

Email: angeliek.verdonschot@wur.nl
Telefoon: 0624190162
Appendix 3. Questionnaire – Exposure phase

1. Naam: ……………………
2. Leeftijd: …………………
3. Jongen/meisje (doorhalen wat van toepassing is)
4. Hoeveel trek heb je nu? (zie template)

<table>
<thead>
<tr>
<th>Hoeveel trek heb je nu?</th>
<th>Geen trek</th>
<th>Een beetje trek</th>
<th>Heel veel trek</th>
</tr>
</thead>
</table>

Scale interpreted from the paper by Bennett and Blissett (2014)

<table>
<thead>
<tr>
<th>Vind je snoepen lekker of vies?</th>
<th>Heel vies</th>
<th>Vies</th>
<th>Niet vies en niet lekker</th>
<th>Lekker</th>
<th>Heel lekker</th>
</tr>
</thead>
</table>

For experimental group:

<table>
<thead>
<tr>
<th>Vind je manna's lekker of vies?</th>
<th>Heel vies</th>
<th>Vies</th>
<th>Niet vies en niet lekker</th>
<th>Lekker</th>
<th>Heel lekker</th>
</tr>
</thead>
</table>
For control group:

<table>
<thead>
<tr>
<th>Heel stom</th>
<th>Stom</th>
<th>Niet stom en niet leuk</th>
<th>Leuk</th>
<th>Heel leuk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vind je spelen met strijkkralen leuk?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix 4. Observation format – Testing phase

Naam: ........................................... Leeftijd: ...... Jongen/Meisje
Experimenal/Control ................. Aantal gesnoept tijdens exposure phase:.................................

<table>
<thead>
<tr>
<th>Gedrag/strategie</th>
<th>Op welk(e) tijdstip(pen)</th>
<th>Overige opmerkingen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Verleid worden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opeten</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aanraken</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proeven</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likken</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ruiken</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Vermijden van verleiding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zo min mogelijk ernaar kijken</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Controleren van verleiding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uit het zicht leggen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Afleiding zoeken</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tegen zichzelf praten</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met iets anders spelen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anders namelijk...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Format interpreted from the paper by Mischel et al. (1989) and De Vet et al. (2014).
**Appendix 5. Questionnaire for teachers**

**Vragenlijst voor leraren – over kinderen**

**Naam kind:** ………………………………………

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hij/zij kan verleidingen goed weerstaan</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Hij/zij vindt het moeilijk om met slechte gewoontes te stoppen</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Hij/zij zegt ongepaste dingen</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Hij/zij doet wel eens dingen die slecht voor hem/haar zijn als ze leuk zijn</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Plezierjjes weerhouden hem/haar soms van het (huis)werk af te krijgen</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Soms kan hij/zij zichzelf er niet van weerhouden iets te doen, zelfs als hij/zij weet dat het verkeerd is</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

De volgende uitspraken gaan over hoe u tegen uw leerling aankijkt. Het is de bedoeling dat u aangeeft in hoeverre de uitspraken op het desbetreffende kind van toepassing zijn. Omcirkel het antwoord van uw keuze.

Dit waren de vragen. Mocht u nog vragen hebben dan kunt u gerust mailen of bellen. Hartelijk dank voor uw medewerking!

Met vriendelijke groet,

Angeliek Verdonschot.

Email:angeliek.verdonschot@wur.nl

Telefoon: 06-24190162
Appendix 6. Information letter for parents

Toestemming onderzoek onder leerlingen van groep 2 en 3

Achtergrond

Wat houdt het onderzoek in voor uw kind?
Het onderzoek wordt op school afgenomen op zes ochtenden tussen maandag 12 september t/m dinsdag 20 september. De kinderen worden één voor één uit de klas gehaald voor zo’n 20 minuten.

Elk kind wordt gevraagd om een kleurplaat van een bloem na te maken. De ene helft van de kinderen doet dit werkje met snoepjes, de andere helft met kraaltjes. Op basis van toeval wordt bepaald waarmee uw kind de kleurplaat maakt.

Na het werkje mogen kinderen uit drie soorten één snoepje aanwijzen wat ze lekker vinden. Het kind krijgt één snoepje, maar wordt verteld dat het er twee krijgt als het 10 minuten kan wachten met eten. Uw kind wordt dan alleen gelaten met het snoepje. Tijdens de wachtijd wordt uw kind via een live camera verbinding via FaceTime door de onderzoeker geobserveerd. Na 10 minuten of eerder als het kind het snoepje op heeft, komt de onderzoeker terug. De onderzoeker belooft uw kind met een tweede snoepje wanneer er niet is gegeten, of niets extra’s wanneer er is gegeten van het ene snoepje.

Allergie, dieet en overige informatie
De eetwaren in het onderzoek zijn niet door ons bewerkt, maar worden aangeboden zoals ze ook in de supermarkt verkrijgbaar zijn. Bij deze brief vindt u een overzicht van de producten die worden gebruikt voor dit onderzoek. Heeft uw kind een allergie of een speciaal dieet waardoor hij of zij bepaalde producten niet mag eten, meld dit dan door ons te mailen of bellen. Wij horen ook graag andere bijzonderheden zijn die relevant zijn voor het onderzoek.
Vrijwillige medewerking en anonimiteit
Deelname aan dit onderzoek is op vrijwillige basis. Uw kind mag op elk moment stoppen met deelname. Indien u besluit om niet deel te nemen aan het onderzoek, dan heeft dit geen gevolgen voor u of uw kind(eren). De gegevens van dit onderzoek zullen volledig anoniem blijven en worden alleen voor dit onderzoek gebruikt. Gegevens worden niet aan derden verstrekt. Door het gebruik van een live camera, wordt uw kind geobserveerd. Om de privacy van uw kind te waarborgen, worden er geen beelden opgenomen.

Deelname aan het onderzoek
Alle kinderen doen mee aan het onderzoek, tenzij u bezwaar maakt tegen deelname. Als u, om welke reden dan ook, niet wilt dat uw kind meedoet, laat dit dan voor 12 september 2016 weten door een e-mail aan de onderzoeker Angeliek Verdonschot te sturen. Graag hierbij de volledige naam van uw kind en de naam van de klas vermelden om misverstanden te voorkomen.

Vragen?
Heeft u vragen of opmerkingen betreft dit onderzoek, dan kunt u hiervoor terecht bij de onderzoeker Angeliek Verdonschot of de onderzoeksleider Emely de Vet.

Wij danken u vast heel hartelijk voor uw medewerking aan het onderzoek.

Met vriendelijke groet,

Angeliac Verdonschot
E-mail: angeliek.verdonschot@wur.nl
Telefoon: 06-24190162

Prof. dr. Emely de Vet
E-mail: emely.devet@wur.nl
Telefoon:0317-486146
Bijlage: Overzicht van producten die gebruikt worden tijdens het onderzoek

= Strijkkralen van plastic. Dit zal niet worden geconsumeerd.

= Gepofte rijst (Manna). Ingrediënten: suiker, rijst (12%), glucosestroop, water, concentraten (saffloer, spirulina), kleurstoffen: E100, E120.

= Apekoppen. Ingrediënten drop&gums: Glucosestroop, suiker, gemodificeerd zetmeel, glucosefructosestroop, zoet-hout (3%), melasse, plantaardige proteïne, verdikkingsmiddel (johannesbroodpitmeel, xanthan), salmiakzout, voedingszuur (citroenzuur), natuurlijk aroma, natuurlijke aromastof, keukenzout, fruit- en plantenconcentraties (passievrucht, mango, sinaasappel, gardenia), glansmiddel bijenwas wit en geel). Kan sporen van melk bevatten.

= Haribo Kers-cola fruitgum. Ingrediënten: glucosestroop; suiker; zetmeel; voedingszuur: citroenzuur; karamelstroop; vlierbesextract; glansmiddelen: bijenwas wit en geel, carnaubawax; aroma; vruchten- en plantenconcentraties: vlierbes, zwarte bes, sinaasappel, aronia, druif, citroen; fruitsuiker uit johannesbrood; invertsuikerstroop.

= Haribo Chamallows ruitspek. Ingrediënten: suiker; glucosestroop; dextrose; water; bevochtigingsmiddel: sorbitol; gelatine; natuurlijke aroma; kleurstoffen: curcumine, karmijn.