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Exploration of explicit and implicit methods for better understanding of preadolescents' attitudes and preferences towards sweet food

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Abstract

The prevalence of obesity has almost tripled since 1975 and is no longer a problem to be addressed for high income countries only. Children are representing one of the most rapid growing obesity groups, a matter closely connected to an increased consumption of unhealthy food, sugary foods especially. The human attitudes and preferences are the main driving forces behind our every decision, and manifest either implicitly or explicitly. Understanding drivers of food choices in children, and how to extract useful information from implicit and explicit approaches is essential for supporting relevant measures to prevent the obesity epidemic.

The objective of this master thesis was to investigate children's sugar preference and attitudes towards sweet food through implicit and explicit methodologies. While explicit methods are conducted with intent and awareness, implicit methods operate on an unconscious level; therefore, the methods provide complementary information. Participants were 124 children, aging from 9 to 11 (preadolescents). They completed four explicit tests and one implicit test. A questionnaire informing about their sugar preference, general health interest, food behavior, and cognitive and affective attitudes were answered as part of the explicit testing. The children also performed a blind preference test of two chocolate milks (with and without added sugar), as well as a real choice task where they could choose and take home a chocolate milk of their choice (with and without added sugar). For the implicit measurement, an approach-avoidance test was performed, using joysticks to push or pull for different image stimuli, which mimic the human movement, thus the potential unconscious attraction to the stimuli. From a food picture database, 18 food items were chosen and compared with 18 non-food items, based on the image properties. All the food items could be eaten as snacks and represented a normal portion size. They were selected based on their calorie content and perceived sweetness (low-medium-high). The experimenter's assumptions of perceived sweetness of the stimuli were re-categorized based on participants' sweetness ratings.

Participants with and without an approach bias to sweet food were compared regarding chocolate milk preference, choice and explicit attitudes. The participant group with an approach bias for

the sweet food stimuli preferred the sugar containing chocolate milk significantly more often than the group without approach bias to sweet food. This effect was not found for the real choice task. Social desirability could be a reason as well as the fact that other than the blind test, the sugar free chocolate drink contained artificial sweetener. Significant differences were also observed in participants' reward behavior and general health interest while there was no effect in regards to "craving for sweet food", and affective and cognitive attitudes.

This study suggests the approach avoidance task as a suitable and simple implicit test to find out about children's approach behavior to food. The results add to our knowledge about children's food preferences and attitudes towards sweet and non-sweet food, and the discrepancy and complementarity between implicit and explicit methods to assess consumers attitudes.

Sammendrag

Forekomsten av overvekt har nesten tredoblet seg siden 1975, og er ikke lenger et problem utelukkende i det vi kan omtale som høyinntektsland. Barn representerer en av de raskest voksende fedmegruppene, et faktum som er nært knyttet til økt inntak av usunn mat, spesielt sukkerholdig mat. Menneskers holdninger og preferanser er de viktigste drivkreftene bak enhver beslutning, og manifesterer seg enten implisitt eller eksplisitt. Å forstå drivkreftene bak barns valg av mat, og vite hvordan man kan ekstrahere nyttig informasjon fra implisitte og eksplisitte tilnærminger, er avgjørende for å skape relevante tiltak for å forhindre fedmeepidemien.

Målet med denne masteroppgaven var å undersøke barns sukkerpreferanse og holdninger til søt mat gjennom implisitte og eksplisitte metoder. Mens eksplisitte metoder utføres med intensjon og bevissthet, opererer implisitte metoder på et ubevisst nivå; slik gir metodene komplimenterende, utfyllende informasjon. Deltakerne var 124 barn, fra 9 til 11 år (tidlig ungdom). Deltakerne gjennomførte fire eksplisitte tester og en implisitt test. Et spørreskjema som informerte om deres sukkerpreferanse, generelle helseinteresse, matatferd, kognitive og affektive holdninger ble besvart som en del av den eksplisitte testen. Barna gjennomførte også en blind preferansetest av to sjokolademelk (med og uten tilsatt sukker), samt en reell valgoppgave der de kunne velge og ta med seg en sjokolademelk hjem etter eget valg (med og uten tilsatt sukker). For den implisitte målingen ble det utført en tilnærming-unngåelsestest (approach-avoidance test) ved hjelp av en joystick for å skyve eller dra for forskjellige bildestimuli som etterligner den menneskelige bevegelsen, og dermed den potensielle ubevisste tiltrekningen til stimulusen. Fra en matbilde-database ble 18 matstimuli valgt og sammenlignet med 18 ikke-spiselige stimuli, basert på deres bildeegenskaper. Alle matvarene kunne spises som mellommåltid og representerte en normal porsjonsstørrelse. De ble valgt basert på kaloriinnholdet og opplevd sødme (lav-middels-høy). Forskernes antakelser om oppfattet søthet hos de ulike matstimulusene ble kategorisert på nytt, basert på deltakernes søthetsvurderinger.

Deltakere med og uten et tilnærmingsbias mot søt mat ble sammenlignet vedrørende deres preferanser, valg av sjokolademelk og eksplisitte holdninger. Deltakergruppen med et tilnærmingsbias for søt mat foretrakk sukkerholdig sjokolademelk betydelig oftere enn gruppen

uten tilnærmingsbias til søt mat i preferansetesten. Denne effekten ble ikke funnet når deltakerne valgte sjokolademelk som premie (valgoppgave). Sosial ønskverdighet kan være en grunn, så vel som det faktum at den sukkerfrie sjokoladedrikken i valgoppgaven inneholdt kunstig søtningsmiddel, i motsetning til den sukkerfrie sjokolademelken i preferansetesten. Signifikante forskjeller ble også observert i deltakernes belønningsatferd og generelle helseinteresse, mens det ikke var noen effekt på delskalaen "sug etter søt mat", eller affektive og kognitive holdninger.

Denne studien antyder at en tilnærmings-unngåelsestest kan være en passende og enkel implisitt test for å undersøke barns tilnærmingsatferd til mat. Resultatene øker vår kunnskap om barns matpreferanser og holdninger til søt og ikke-søt mat, og avviket og komplementariteten mellom implisitte og eksplisitte metoder for å vurdere forbrukernes holdninger.

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I hope you will enjoy reading.

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1 Preface

This Master project was part of a 2-year master's degree in food science at the Norwegian University of Life Sciences, Department of Chemistry, Biotechnology and Food Science, Ås, Norway.

During a 5-month period, 124 children, including children for pilot studies, conducted both implicit and explicit tests, representing the data collection for this master thesis. This study is closely linked to a project called Edulia coordinated by Nofima. Edulia is a part of an ITN-ETN Marie Curie Training Network funded by the EU, Marie Skłodowska-Curie grant agreement No 764985 (Edulia, 2020). It is a multidisciplinary training and research network, focusing on studying children's eating choices in order to use this in future product development.

There is still a big gap in knowledge regarding children's attitudes and perception of food, particularly on indirect methods, and methods of significant reliability with children. This thesis was aimed to contribute with more knowledge to help guiding children to healthier choices.

2 Introduction

According to World Health Organization (WHO), more than 1.9 billion adults, 40 million children under the age of 5 and 340 million children and adolescents aged 5-19 are overweight or obese as of 2016 (Levesque, 2018). The increasing prevalence of obesity is often seen in relation to a more sedentary lifestyle alongside an increased intake of foods high in fat and sugar. Obesity is not only causing more deaths than malnutrition but also has a huge financial impact due to higher risk of cardiovascular diseases, diabetes, osteoarthritis and cancer.

Regarding the obesity epidemic, the food industry is of significant importance, as they are responsible for the formulation of all the products going to the market (Levesque, 2018). WHO suggests that making good alternatives to foods high in sugar and fat, as well as ensuring that healthy and nutritious choices are available for everybody are essential measures to prevent obesity amongst all age groups. Which food is eaten ultimately relies on the consumer, so it is important to better understand attitudes and motivations underlying food choices.

Studies have shown that early taught eating habits and preferences are likely to carry on until the beginning of early adulthood (Issanchou, 2017). Recent evidence (Malik et al., 2006) suggests that the adolescent brain (10-19 years old) might lead to more short-sighted choices and therefore a greater risk of obesity. During adolescence, the brain is highly malleable due to ongoing maturation (Lowe et al., 2020). The prefrontal cortex, a region involved in cognitive behavior and decision making, is the final brain region to reach maturity. Lowe *et al.* (2020) report that because the developing prefrontal cortex has less capacity to exert control over reward driven behaviors, such as consuming unhealthy foods, the chance of overconsumption of palatable foods is particularly high. Excessive consumption of these foods might lead to cognitive and behavioral changes.

Investigating and understanding the factors that contribute to the formation of eating behaviors are therefore important for improving the health status of children and young adults, thus finding solutions for the obesity epidemic and illnesses that come along.

The main objective of this Master thesis was to investigate children's food preferences and attitudes towards sweet foods through a series of explicit and implicit methods in a preadolescent sample. Secondary objective was to explore if implicit testing could allow to investigate individual differences in implicit bias towards sweet food, and to explore differences in preferences and attitudes in children with distinct implicit responses.
The thesis discusses the relation between conscious and unconscious thoughts involved in decision making and reflects upon the importance of understanding different perspectives of food behavior.

3 Theory

It's been ascertained that an increased intake of calorie-dense foods that are high in fat and sugars could be a main contributor of childhood obesity, alongside genetics, environment and inactivity (Liem & De Graaf, 2004).

3.1 Food Preferences and Dietary Habits

Research shows that several factors, like taste, price, sensory appeal, health and convenience, play a role when deciding on what foods to buy and eat (Glanz et al., 1993). Among these factors, taste is the singular most important determinant (Roininen, 2001). For children, taste might be the only motive for their food choices, while matters like health are not taken into account (Cooke & Wardle, 2005).

Taste is defined as *"the sensation of flavor perceived in the mouth and throat in contact with a substance"* (Lexico, 2019). Taste receptors can recognize five different taste qualities, i.e. sweet, sour, bitter, salty and umami. From birth, the human taste system starts to develop. Studies have demonstrated possible innate taste preferences. With facial expressions and ingestion, Desor *et al.* (1973), Rosenstein & Oster, (2012) and Steiner *et al.* (2001) found a profound preference for sucrose solutions, and a rejection towards sour and bitter taste. Salty taste was also observed to elicit positive response with newborns.

Children's food choices and consumption are mainly driven by a hedonic judgement of taste quality decoded in a specialized area in the brain (Liem & De Graaf, 2004). Even though

positive hedonic judgements of taste are partly determined by nature, taste preferences are subject to change and do not operate statically. Changes in preference from childhood to adulthood, and also inter-individual variability, can result from different genetic disposition and psychological factors (Lanfer, 2012). During childhood, frequent exposure to new foods is more prominent than later in life. Through repeated exposure to a stimulus, a child's liking enhances, and they learn to accept new flavors. Social effects regarding food are also learned during childhood. Using foods as either reward or punishment generate associations that might lead to either liking or disliking (Wardle et al., 2003).

Eating behaviors that are shaped during early life stages, often follow through adolescence and into adulthood. Therefore, the demand for adequate information and sustainable measures to prevent obesity with young age is urgent and necessary (World Health Organization, 2018).

3.2 Conscious and Unconscious Aspects of Decision Making

Humans are constantly faced with decisions that are detrimental for our physical and mental health, in which different processing systems of our brains are activated and involved. Some authors (Ajzen, 2011; Deci & Ryan, 1985; Payne et al., 1993) argue that our conscious mind is the main contributor in decision making. Others (Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006; Levine et al., 1996; Wilson et al., 1993) emphasize the unconsciousness in decision making. Recent perspectives and empirical evidence advocate the importance of automatic cognitive processing (which tends to be associated with consciousness) *and* controlled cognitive processing (associated with unconscious mechanisms) on unhealthy eating and such behavior (Kakoschke et al., 2015).

Contrary to popular beliefs, empirical evidence reveals that obese children are typically equipped with a positive attitude towards healthy eating (Craeynest et al., 2005). Furthermore, Craeynest *et al.* (2005) found that obese children seem to have less positive attitudes towards unhealthy food compared to their normal peers. This inconsistency between attitudes and behavior can be explained with what is referred to as dual-processing.

A common way to conceptualize the construct of attitudes is the idea of it composing two processing systems, partially regulated by a deliberate mode and partially regulated by an automatic mode (Czyzewska et al., 2011)

The deliberate mode refers to what is known as explicit attitudes (Czyzewska et al., 2011). This reflective system is highly regulated and requires presence and consideration. Explicit attitudes involve conscious decisions, and may lead behavior in a controlled manner, such as goal setting, decision making, and self-regulation.
Implicit attitudes are characterized by the spontaneous mode, in which automatic, hedonic evaluations appear when associations in a memory system are activated (Czyzewska et al., 2011). This processing is fast and effortless, and will guide behavior in ways in which affection and motivation may operate, not guided by a person's self-concept.

Although both systems run independently, they can interact in a way that doesn't coincide, and evoke conflicting behavior tendencies (Kakoschke et al., 2015). This is called the implicit-explicit discrepancy (IED). Metcalfe and Mischel (1999) proposed that the relative strength of each processing system determines the outcome of a situation, meaning that the system most dominant at present time is dictating a person's response. For instance, when a person commits to an explicit achievement (like weight loss), but fails to reach the expected standard due to lack of strong implicit motive backing up the explicit attitude.

Little is still known regarding the behavioral implications of such discrepancy in attitudes towards food in children. A study by Marty *et al.* (2017) investigated the implicit and explicit attitudes towards food in overweight and normal-weight children. Marty and colleagues found that overweight children chose more nutritional categories than their lean peers on the explicit task. They also reported that discrepancy between implicit and explicit nutritional attitudes was more common in overweight children compared to normal-weight children. Thus, understanding the joint effect of the two behavioral dispositions is critical when analyzing and studying behavioral decision making and tailoring interventions.

3.3 Explicit Methods

Explicit methods are a form of direct measurements, which rely on individuals' self-reported evaluations and intentions regarding potential behavior or choices they are confronted with (Dimofte, 2010).

Explicit methods often comprise questionnaires about topics of relevance, for example attitudes, where responses are registered on Likert scales. The Likert scale is a rating scale to

which respondents express their level of agreement on a scale with five to seven response categories labeled with linguistic terms and numbers (e.g., acceptability from 1 = totally unacceptable to 7 = perfectly acceptable) (Tullis & Albert, 2013). Likert scales are also applied to obtain measures of product acceptance. However, for food acceptability and consumer testing, a 9-point hedonic scale is more commonly used. Jones *et al.* (1955) developed the scale with approximately equal psychological distance between the anchors of the scale, which enables for analyzing the responses as successive integer values. In consideration of the capacity of children to understand and respond to such scales, some authors (Wright & Asmundson, 2003) have reduced the number of response choices to a 3-point format.

Explicit methods are the standard measurement tool to investigate responses of consciously processed information. Various concerns related to explicit methods have, however, been acknowledged. Developed comprehension skills differentiate amongst and within all groups of children, and might affect the outcome of explicit methods in an undesirable way. Because explicit tests tap strategically edited responses, these methods raise critical problems regarding social desirability and serving an expected standard. For example, if parents are asked about their child's frequency of candy consumption, an expected response would be 1-2 times a week (weekends) regardless of the actual frequency, as this has been impregnated as socially desirable. More problematic is the fact that participants often do not have direct access to their attitudes, and instead voice non-attitudes (Verhulst & Lodge, 2013). Direct measurements therefore require that people have sufficient introspective abilities to respond accurately to a direct measure (Kraus & Piqueras-Fiszman, 2018a). Explicit research data will therefore often fall victim to self-presentation biases, as consumers might experience discomfort and fear of coming across as less sophisticated or educated than what is socially acceptable (Dimofte, 2010). For preadolescents, self-presentation bias is closely related to peer influences, which might interfere with their decision making (Guinard, 2000). In a study by Maison, Greenwald and Bruin (2001), preferences for low- versus high-calorie foods and consumption of these food choices were investigated. The results only showed a correlation between implicit and explicit attitudes towards low-calorie foods, and not foods of higher caloric density. Another issue of concern is lack of practice with using the scale which results in extremity in responses (Chambers & Craig, 1998; Chambers & Johnston, 2002; Guinard, 2000; Von Baeyer et al., 1997). The validity of explicit tests alone therefore suffers.

3.4 Attitudes Questionnaires

One type of self-report attitude questionnaire is the Likert type of verbal response, where research data are analyzed quantitatively. In Likert scaling, questions about one topic are grouped together, and measured using aggregated scales. This means that scores from all responses are added up. While representing multiple aspects of the same topic, aggregated scales make for a reliable single measurement of the concept under investigation (Roininen, 2001).

3.4.1 Health and Taste Attitudes Questionnaire

The Health and Taste Attitudes Questionnaires were developed to gauge people's orientations toward the health aspect and hedonic characteristics of food (Roininen et al., 1999). The Health and Taste Attitudes Questionnaire is divided into the two categories "health" and "taste" with six factors labelled as *"General health interest", "Light product interest", "Craving for sweet foods", "Natural product interest", "Pleasure"* and *"Using food as a reward"* (Table 1). Distribution of negatively and positively worded statements are balanced within the subscales.

***Table 1**: Subscales of the Health and Taste Attitudes Questionnaire*.

Health subscales	**Taste subscales**
General health interest	Craving for sweet foods
Light product interest	Using food as a reward
Natural product interest	Pleasure

Initial research on the Health and Taste Attitudes Questionnaire by Kowalkowska et al. (2018) showed successful completion with children aged 13-21, but is an area where still much research is needed.

3.4.2 Acceptance Tests

Acceptance tests involve explicitly rating the degree of liking for one or more stimuli on a hedonic scale. A Likert or rating scale is commonly used to establish the liking (usually 9-point hedonic scales). The respondents are often to rate overall liking, appearance liking,

texture liking, flavor/aroma liking and other attributes of interest (Lanfer, 2012). Stone *et al.* (2012) reported that the 9-point hedonic scale was a good measurement tool for children that were 9 years and older. Another scale used in acceptance testing is multiple versions of a smiley face scale where a series of faces with different expressions represent degree of agreement/liking/preference. This scale is particularly aimed at children, as they may face difficulties when using the 9-point hedonic scale. There are shared opinions whether or not the face scale is effective. While Kroll (1990) supports rating scales with children, but didn't find a superior effect with the face scaling, Roper (1989) advice against rating scales all together for children under the age of 7. In a study with 3-5-year-old children, Chen *et al.* (1996) used face scales with 3-5 facial expressions, and concluded with the scale being a successful measurement as long as the points were kept between 3 and 5. Guinard (2000) also conclude that children between 3-5 years old are capable of understanding simple scales, while children between 8-12 years manage to understand scaling concepts with adequate instructions.

3.4.3 Preference Test

A preference test refers to a consumer test in which the consumer is supposed to indicate which product they prefer the most, in a choice often consisting of two alternatives. This is called a paired preference test. A ranked preference test involves three or more stimuli, in which the task is to rate them from worst to best. Preference tests are valid methods to assess and predict children's food preferences; because of its simplicity, they are especially suited for children, who often have limited reading abilities and understanding, and different degrees of cognitive development. Preference tests are usually through self-administered questionnaires (Lanfer, 2012), and is also the most commonly used measurement method to look into affective response (Liem & De Graaf, 2004).

Preference tests are, however, restricted and only measure relative preference, not how much each product is liked. However, they may better represent real choice, as they mimic consumers behavior when purchasing (choosing among alternatives) (Lawless & Heymann, 2010).

3.5 Implicit Methods

Implicit attitudes have gained increased attention to serve as additional constructs for predicting and explaining health behaviors (Muschalik et al., 2019). Implicit methods are, as opposed to explicit methods, implicit methodologies where individuals are not able to process or correct their responses (Dimofte, 2010). Attitudes that are socially stigmatized, like racial discrimination, are often explored through implicit methods, which are expected to reveal more attitudinal discriminations than what explicit measures of same attitudes would have (Greenwald et al., 1998).

The metric to capture these associations is usually reaction time (RT) or the error rate. Congruent task instructions lead to a quicker RT, while incongruence leads to slow reaction time and a higher error rate (Bertram Gawronski et al., 2016; Kraus & Piqueras-Fiszman, 2018b). This has been observed with appetitive substances like unhealthy food (Brignell et al., 2009; Kemps et al., 2013; Kemps & Tiggemann, 2015), where participants were quicker to approach rather than avoid unhealthy food.

Even though implicit tests reveal responses that are not candid or adjusted to fit socially desirable answers, it is important to understand that implicit evaluations are not more genuine than explicit responses (Fiske & Macrae, 2012). It can be assumed that our choices are at least partially influenced by explicit decisions while implicit behavior is more predictive in conditions of reduced processing resources (Friese et al., 2008; Kraus & Piqueras-Fiszman, 2018b; Richard et al., 2017). Few studies have been done on actual choice behavior. Friese *et al.* (2008) investigated the impact of cognitive capacity during a choice task between chocolate and fruits, and the predictive validity of implicit and explicit attitude measures. The authors concluded with implicit measures contributing in cases of taxed processing resources, while explicit measures were more predictive when participants had ample processing resources. With that, both implicit and explicit perspectives represent a person's attitudes, in which there are shared opinions about which attitudes are more revealing.

There are various implicit tests, aimed to fit different purposes. The implicit association test (IAT) is the most commonly used implicit tests. The idea of the IAT is that it measures the association between two binary concepts represented by words or images (Figure 1). While the test allows to measure the association between any two concepts, it is most frequently

used to measure the association between a valence category (good/bad) and a second category (e.g. race or food differing in healthiness) (B Gawronski et al., 2011).

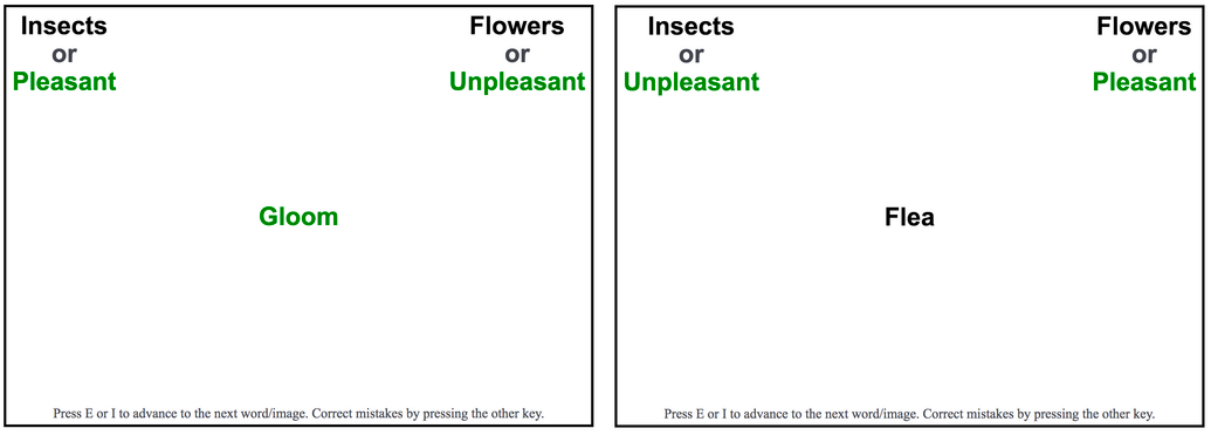

***Figure 1**: Example of an IAT. Someone who unconsciously sees flowers more positively than insects will be quicker to pair concepts in the right picture and slower when pairing concepts in the left picture (Carpenter et al., 2020).*

For this scope, the approach-avoidance task (AAT) is potentially a simpler task by assuming that implicit valence, which is represented by words in the IAT, is linked to pulling and pushing movements of pictures in the AAT (Figure 2). Especially for children where reading skills are not completely automized.

***Figure 2**: Example of an AAT with a relevant feature.*

3.6 Approach-Avoidance Task

A large body of research shows that humans have an automatic approach tendency towards attractive food cues and avoidance towards repellent stimuli (Piqueras-Fiszman et al., 2014). Humans are programmed to avoid what is uncomfortable as a way of protection and survival. Negatively valenced stimuli therefore tend to be pushed away quicker compared to positive stimuli, this is the basis for approach-avoidance tasks. One might have competing feelings to a goal (e.g. knowing the benefit of healthy eating, but also enjoying the taste of unhealthy food). The stronger feeling will conquer, creating the baseline for certain behavior. Unconscious control, like impulses, temptations and rejection, can be investigated by measuring approach and avoidance motivations (Kraus, 2014).

As a result of ambivalence in regards to attitude, the AAT has been successfully used as an indirect measurement for motivational tendencies towards food with adults. Kakoschke *et al.* (2015) for example, found an approach bias for food cues, indicated by a positive mean bias score and the tendency to pull rather than push the joystick faster for food cues (using animal pictures as distractions). The AAT relies on immediate perceptual input, and measures the subjects' RTs for pulling and pushing, e.g. with a joystick, assuming that a difference in RT of pulling and pushing equals either an approach or avoidance bias (Kraus, 2014).
A study by Cacioppo *et al.* (1993) supports the conception that flexor and extensor movements in a transferred sense can be interpreted as approach and avoidance motivations. In their study, flexion was most often associated with consumption of something desired (approach tendencies), whereas extension was linked to pushing away something unpleasant (avoidance tendencies).

There is evidence that state-dependent effects, such as hunger state, can have an impact on performance of both implicit and explicit measurements. Piqueras-Fiszman *et al.* (2014) reported in a study on explicit and implicit approach–avoidance motivations towards appealing and disgusting foods, that participants in the no-hunger group performed avoidance (vs. approach) movements significantly faster; and their approach movements towards positive (vs. negative) foods were significantly faster. Examining momentary circumstances on food related measurements is therefore important to understand individual differences and the relation between implicit and explicit behavior. Despite the simplicity of the AAT, it has not been used with children and food. However, the more difficult IATs has been simplified to study the implicit food behavior of children (e.g.: Explicit and implicit attitudes towards

food and physical activity in childhood obesity (Craeynest et al., 2005), Cognitive-motivational determinants of fat food consumption in overweight and obese youngsters: The implicit association between fat food and arousal (Craeynest et al., 2008)).

The AAT has scientifically been proven to fulfill the requirements of what is considered a good level of reliability and validity. A study brought by The Iowa State University Capstones to compare the validity of measures of implicit exercise associations, concluded with the AAT being the most valid indirect measurement of nine implicit measures (including the Go/no-go Association Task, the Evaluative Decision Task and the Single-Category Implicit Association Test) (Zenko, 2017).

3.6.1 Task Structure

In an AAT, participants are presented with stimuli of various kinds depending on the goal. Participants are instructed to pull or push in response to the presented stimuli. Methodological modifications, like the manikin task, use different tools to collect data, thus different instructions. They are built on the same principle, however. More information about the manikin task can be found in Krieglmeyer & Deutsch (2010), comparing the manikin task to two versions of the joystick task.

There are multiple ways for the setup. For accurate measurement, a lever of some sort, like a joystick, is commonly used. Participants are instructed to pull or push the joystick based on a criterion. With a task relevant criterium, participants react to stimuli based on image content. With a task irrelevant criterium, participants couple movement direction based on features that don't concern the content (e.g. blue frame versus green frame or a circle above the image versus a triangle above the image) (Lender et al., 2018). Lender *et al.* (2018) found a bias towards food only in relevant feature conditions, recommending the relevant feature version for measuring biases. The authors conclude with the reason for larger bias with a task relevant feature might be due to the role of attention, with the processing of image content.

Some tests include a zooming-in feature when pulling the joystick, giving the illusion of the stimuli coming closer to the respondent. When pushing the joystick, the item will shrink in size, indicating avoidance (Lender et al., 2018; Zenko, 2017).

4 Materials and methods

4.1 Study Design

To understand both conscious and unconscious levels in play in regards to children's food preferences and choices, in particular towards sweet foods, the study consisted of a series of explicit and implicit tests. Implicit attitudes towards sweet and non-sweet food were measured through an AAT. Children were grouped based on their implicit attitudes (children with or without bias towards sweet food) and these groups were characterized based on their explicit attitudes, preferences and choices. For this, their explicit attitudes towards health interest, sugar preference, food behaviors, affective and cognitive attitudes were measured through questionnaires and investigated in the two groups. To better understand if the children's implicit attitudes towards sweet foods were related to their choices, a real choice test and a blind preference test were conducted using chocolate milk as case study. Results were compared in children with and without implicit bias towards sweet food. A flowchart illustrating the study design can be seen in Figure 3.

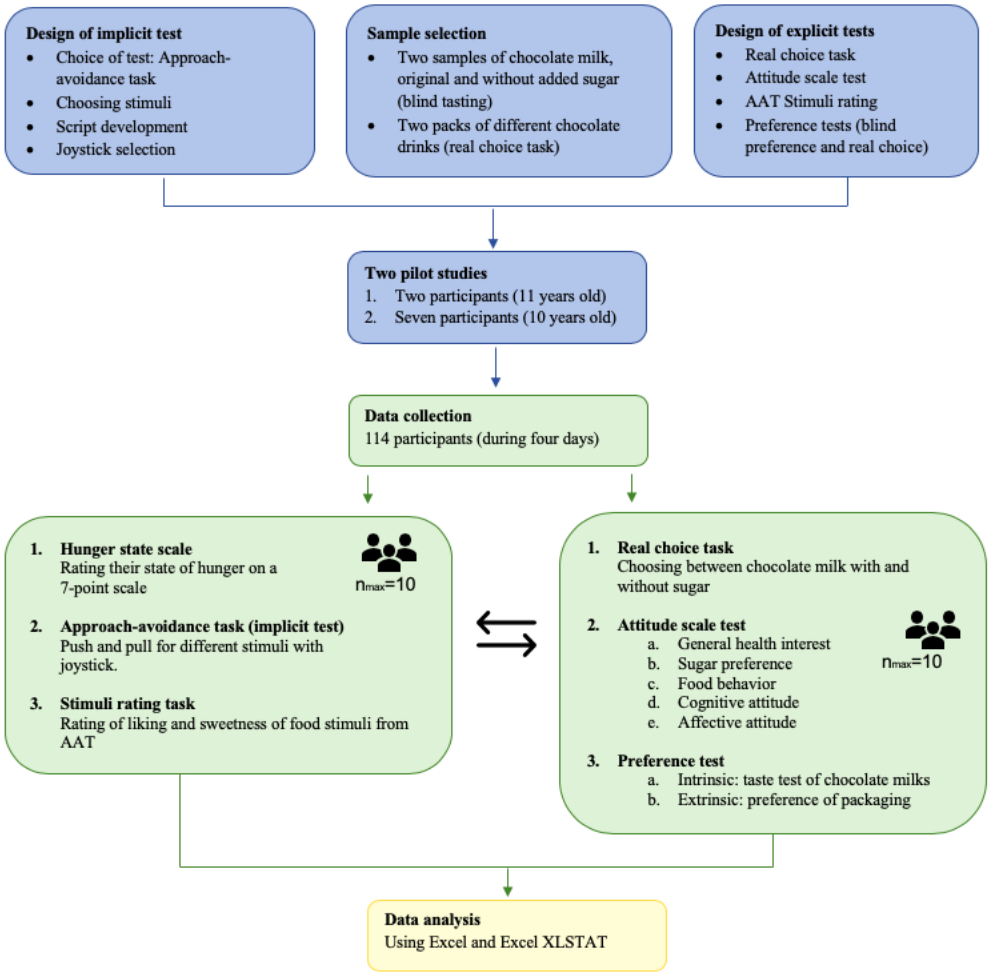

***Figure 3**: Flowchart illustrating the study design for the master thesis and the order of tests.*

4.2 Participants/recruitment

The study was conducted in collaboration with Vitenparken and Vitenskolen which teaches science and technology-based subjects for children in school. For this collaboration 4th and 5th grade classes were recruited. Depending on the size of the class (15-50 children) the pupils were split up differently. For bigger groups, one half attended the science lectures and workshops while the other half attended this experiment. A museum to play in at Vitenparken made the setup flexible, as the children could come and go as they were done.
One hundred and twenty-four children were recruited from five different primary schools in Ås municipality (Table 2 and Table 3). The recruitment was higher than the aimed selection of participants; it was taken into consideration that some of the respondents would have to be ruled out, due to incomplete data like long RT or too many wrong answers. This could mean they didn't understand the task properly, or lack of motivation or concentration.

***Table 2**: Recruitment for pilot studies.*

School	Participants	Grade
1	*2*	*5th*
2	*7*	*5th*

***Table 3**: Recruitment for real experiment.*

School	Participants	Grade
3	*26*	*4th*
4	*38*	*4th*
5	*34*	*5th*
6	*17*	*4th*

Children participating in the experiment were between 9-10 years old. Participants of particular age were chosen as this age is considered pre-adolescents (WHO, 2018), a

transition period where young people start controlling their own eating habits. Gender was nearly balanced (46,78 % boys and 53,23 % girls).

Thirty-four 5th graders were recruited along with 81 4th graders (Figure 4). A consent form was sent online for the parents to fill out and approve their child's participation (section 4.2.1 for details).

***Figure 4**: A class of 4th graders doing the explicit part. Faces are blurred for anonymity.*

As the experiment was done with chocolate milk, participants with milk allergy or lactose intolerance did not participate in the real choice task or the preference test, but conducted the rest of the tests. The participants had to be fluent in Norwegian, as the questionnaires were in Norwegian, purposely avoiding miscommunication or different interpretations. One participant had the teacher translate into English, but was later excluded from the results.

4.2.1 Consent Form

The experiment did not collect sensitive data, however, a protocol was presented to The Norwegian Centre for Research Data (NSD). The form was accepted 08.01.2020, reference 476380. Because the children of interest were under 18 years old, parents of all children were informed about the experiment, a consent form was also sent online to be signed by the parents of participating children before commencing the study.

Questions about the children's sugar consumption were included as the last part of the form (Figure 5). These questions were not mandatory, but highly recommended to answer. Due to high rate of missing data, it was not included as part of the results.

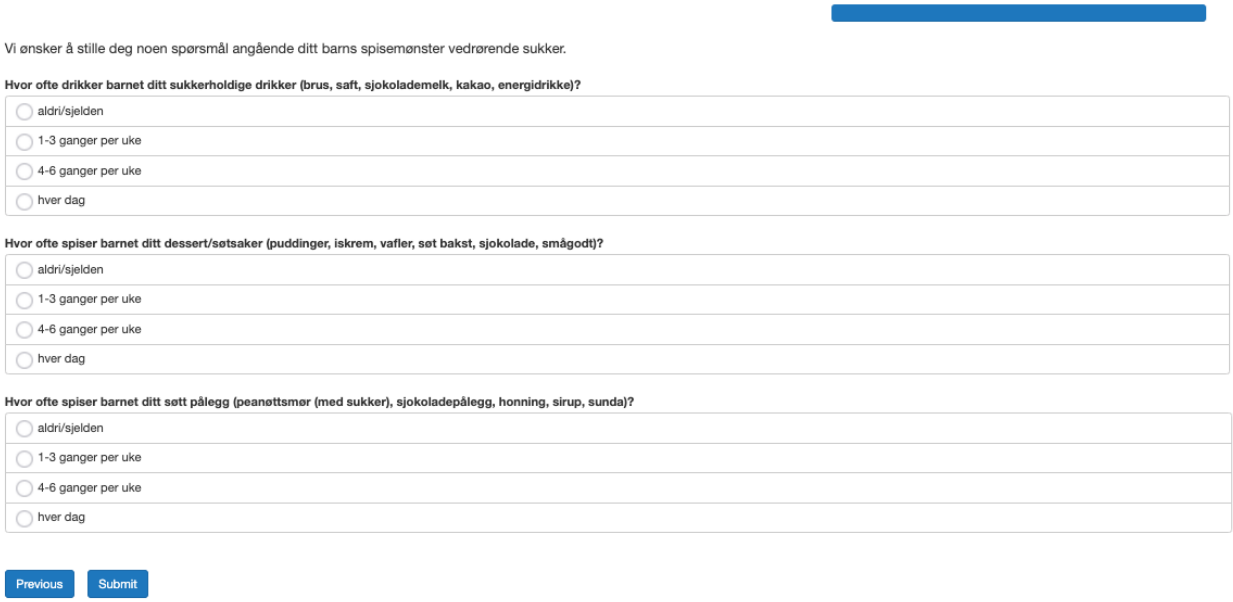

***Figure 5**: Questions that were included in the consent form about the children's sugar consumption.*

Some parents forgot to sign their consent. In discussion with the teachers who accompanied the pupils, and following EU (Regulation (EU) 2016/679) and Norwegian GDPR regulations, children with a missing consent from parents could still participate due to the anonymous setup of the test which did not allow the identification of the children and no collection of personal or sensitive data of any kind. Nevertheless, and in line with ethical considerations with participation of children in research, informed assent was required from the children prior to the test. All children were asked for their assent and lactose intolerance/milk allergies prior to the test. They were explained the test, and they were informed that they could leave the test whenever they wanted, if they felt uncomfortable or didn't want to participate.

4.3 Methods

4.3.1 Test Flow, Instructions and Grouping

Each group of children were split up into two smaller groups distributed between two rooms, as the equipment available didn't allow for more than 20 participants at a time (Figure 3 for overview).

Before the tests began, the participants were handed out a sticker with their identification number, to ensure that the data collection in the two rooms could later be connected, but no personally identifiable information could be linked to the participant's data (collected data was anonymous). Their code was registered digitally in a column as their first task, together with gender and age (Figure 6).

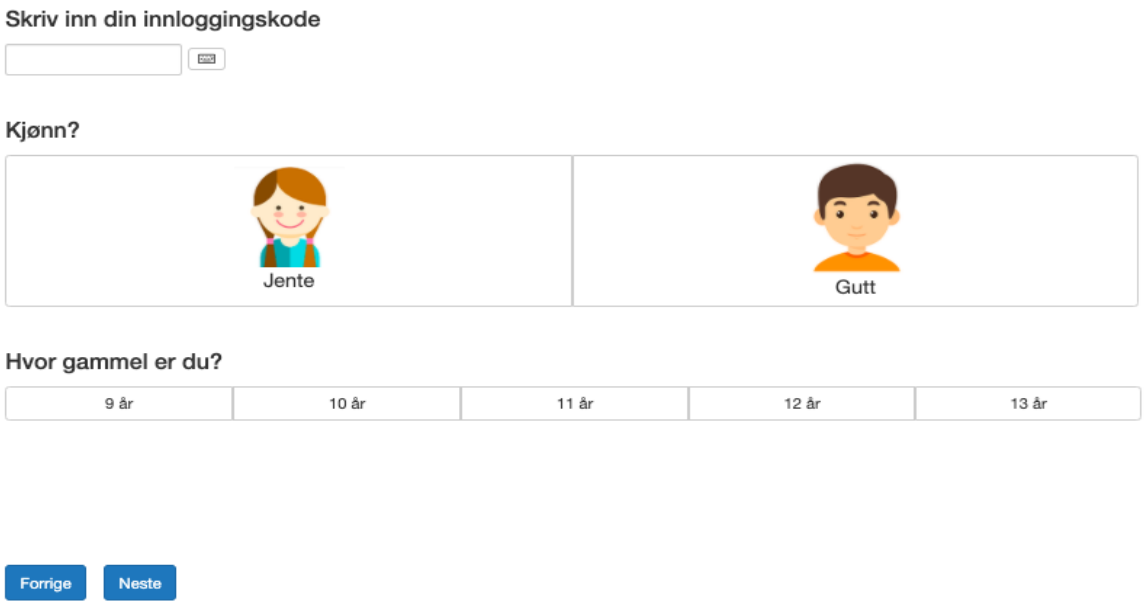

***Figure 6**: First page of the questionnaire, where the participants were to register their identification number, their gender and age.*

The participants in the first room started with the hunger scale questionnaire followed by the implicit test (Figure 7). As some children conducted the test before lunch and some after lunch, their state of hunger was asked prior to the implicit test to observe if hunger level had a significant effect on their responses. In this set up, the participants had one computer each with a connecting joystick for the AAT. After the implicit test, they were sent directly to the stimuli rating test. For the AAT part, participants got to try the resistance in the joystick by moving it back and forth and to the side before the test began. They were also taught how to

use the touchpad on the laptops which they needed for the hunger and stimuli rating questionnaires.

Figure 7*: Participants conducting the AAT. Space and equipment only allowed for ten children doing the implicit test at a time. Faces are blurred due to anonymity*.

The participants in the second room started with the explicit tests: real choice task followed by attitude scale questionnaires and blind preference test (Figure 8). After troubles detected during the pilot tests for the explicit part, a short power point instruction was presented at the beginning in the questionnaire room. The class teacher and one extra assistant teacher were also asked to help the children with the reading and understanding of the attribute questions. More obstacles were observed in regards to reading and understanding for participants in 4th

grade, compared to those in 5th grade.

***Figure 8**: Participants conducting the attitude test and blind preference test.*

To avoid bias in the AAT from the real choice task (take away of their preferred product choosing from two types of chocolate milk), the participants were told not to drink their chosen chocolate milk before completing all the other tests. After finishing all of the tests in one room, the groups switched rooms; all participants performed all tests.

When participants were divided into two groups, it was deliberately opted for an approximate equal share of boys and girls in each room, to have them more focused. An order effect in the attitude questionnaire and the AAT was also avoided this way. Participants who finished before their peers, were handed out a cross word while waiting for room switch.

All external precautions were taken to avoid bias during the AAT. Participants were seated boys and girls beside each other. The AAT involved flexion and extension of the arm. Because the participants were of various heights, pillows were stacked on the chairs to have them properly positioned against the joystick perpendicularly positioned to the table.

In regards to the setup, the joysticks had to be calibrated, which was done in the system operation of the computers. The joysticks were taped with duct tape to the table, making them unwavering (Figure 9). The duct tape was however easy to take on and off, enabling for

moving sides of the joysticks in case of left-/right-handed.

***Figure 9**: One participant conducting the AAT with the joystick taped to the table on the left side.*

Due to one long table, and ten charging cables from the computers laying in the middle, the cables were also taped together and to the table.

4.4 Implicit Part

The AAT represented the main part of the experiment. The hunger state question and the stimuli rating test were implemented as additional validity check for the AAT, rationale behind this is explained below.

4.4.1 Hunger Level Questionnaire

A single-item question of the participants' state of hunger was carried out on a laptop before conducting the implicit test. Questioning their hunger level was done to assess whether there were effects of hunger level on their implicit attitudes towards sweet food or not, a measure that commonly accompany implicit tests (Coricelli et al., 2019; Loeber et al., 2013; Nijs et al., 2010)

Participants responded to a 7-point Likert scale how hungry they were feeling at that specific moment. The scale ranged from “I am hungry” (1 point) to “I am full” (7 points) (Figure 10). Considering the age of the participants, the study used emoticons to record their expressed state of hunger. Thus, lower scores indicated higher level of hunger.

***Figure 10**: 7-point Likert scale used for hunger state question.*

4.4.2 AAT

The AAT was done to measure implicit attitudes with the participants. 18 food stimuli and 18 non-food stimuli were selected based on appearance (section 4.4.2.2). The RT of each stimulus were measured and compared, and used to calculate approach biases.

4.4.2.1 General

18 food stimuli and 18 non-food stimuli were chosen for the measurement trials, in which participants were instructed to either push or pull with a joystick for foods or non-foods. Halfway through the AAT (36x2 measurement trials), new instructions called on the participants to do the opposite of previously. To facilitate the understanding of the test, the AAT also included four pictures for practice trials that were repeated before commencing the actual task. Practice trials are usually implemented as part of the AAT to have participants ready for the measurement trials (Klein et al., 2011; Maas et al., 2017). This is especially valuable for children, so instruction text can be reduced to a minimum. After the pilot studies, the practice trials for the AAT were extended with an extra 16 trials, also after finishing block 1 when participants were to change direction of movement. This way, it was ensured that participants fully understood the task before commencing the measurement trials.

4.4.2.2 Choice of Stimuli

All pictures used for the implicit method were retrieved from the image database "Food-pics", designed for experimental research on eating and appetite (Blechert et al., 2014). The database also delivers an excel sheet with image properties that characterize the images' appearance such as contrast values, color values and size. Consumer ratings of the stimuli regarding familiarity, valence, recognizability and nutritional information were also in the database (Figure 12). The appearance values were used for pairing the food picture to the respective non-food picture (object) (Figure 11). The study was a food/non-food discrimination task, in which the food stimuli were targets and non-food stimuli worked as distractors. Having them match in shape and color was done purposely to avoid a ceiling performance. However, it was expected an interaction between the different outcomes of the AAT and individual characteristics measured through attitude questionnaires and preferences.

After choosing the food stimuli and object stimuli by eye, the pictures were compared based on color combination. Also, the familiarity and recognizability ratings were checked. Matching the stimuli like this was done in Lender *et al.* (2018), but different comparison parameters were chosen. All matching images were less than 0,1 color units apart, besides the grapes. All images, except the leaves and the lamb sockets, had a familiarity score of 90 % or higher. Apart from the lamb sockets and the tape, all pictures also had a 90 % or higher recognizability score.

***Figure 11**: Example of food stimuli (muesli bowl) and the respective non-food stimuli (pin cushion).*

The reason for including these items, despite lower scores, was the clear understanding of lamb sockets, tape and leaves not being edible. Distinguishing between food and non-food was the most important task, and the main basis of the decisions that were made. The valence of each stimuli was also considered, especially non-food items. Stimuli with possible positive or negative valence were not considered (flower, sun, snake, spider).

Image no.	Item	Red	Green	Blue	Spatial frequencies	Recognizability	Familiarity,	Valence,	Arousal	Complexity,	Palatability	Craving
25	ice cream wi	0,43	0,30	0,27	15,81	99,17	98,57	53,11	44,23	48,70	60,72	44,66
1314	hot-air ballo	0,43	0,31	0,26	16,34	100,00	100,00	59,08	46,24	51,98		
153	gummi cand	0,52	0,29	0,19	15,14	100,00	94,93	37,61	23,59	26,56	40,41	22,60
1139	screw	0,41	0,33	0,25	17,40	97,92	99,96	42,43	20,44	38,77		
287	chocolate (ca	0,52	0,31	0,18	15,60	100,00	100,00	45,14	27,00	26,03	53,26	32,09
1004	shoe brush	0,53	0,31	0,16	15,81	99,54	100,11	30,26	6,50	35,80		
347	toast with ja	0,73	0,17	0,10	15,78	100,00	100,00	48,64	31,27	25,90	55,61	33,91
1080	shopping bag	0,80	0,10	0,10	14,54	100,00	93,75	43,01	18,45	9,48		
9	waffles	0,51	0,32	0,17	16,76	99,38	100,00	61,81	43,55	30,27	68,25	46,38
1060	breadbasket	0,49	0,31	0,20	16,33	100,00	100,00	47,04	12,98	31,60		
181	bowl of mue	0,47	0,33	0,20	16,85	100,00	98,65	54,49	29,91	47,53	52,95	28,13
1136	pin cushion	0,47	0,34	0,18	17,40	91,62	94,78	31,58	17,27	31,38		
593	toasted sand	0,50	0,29	0,21	15,70	100,00	100,00	47,03	38,49	31,05	63,13	42,34
1147	briefcase	0,49	0,31	0,20	15,82	100,00	100,00	43,12	24,26	38,74		
110	Nuts (cashev	0,50	0,36	0,14	14,80	100,00	99,73	52,16	38,27	29,42	61,89	35,25
1129	screw and nu	0,45	0,35	0,20	17,86	95,45	99,48	41,00	17,49	43,34		
26	chips	0,50	0,39	0,11	13,62	99,54	98,38	47,50	38,33	25,72	54,33	36,99
1208	broom	0,46	0,38	0,16	16,09	100,00	99,55	37,25	11,58	20,47		

***Figure 12**: Excerpt of the data collection provided by Food-pics.*

The selection of the food stimuli was based on sweetness perception and controlled for caloric content (Meule & Platte, 2016; Stoeckel et al., 2008). For a balanced design, three pictures from the following categories were used: snacks with high calorie content and perceived high, moderate and low sweetness, and snacks with low calorie content and perceived high, moderate and low sweetness. This was the researchers' priori classification. Participants' sweetness evaluations (section 4.4.3) were included in order to adjust these assumptions in case of deviations. This measure would have optimally and preferably been implemented after more pilot studies, but due to lack of time, this was not feasible. All the foods that were chosen for the test are usually eaten as a snack or in between meals in Norway (mellommåltid). They were all presented in what was considered a normal portion size (Figure 13).

***Figure 13**: Chocolate bar representing a high-calorie food stimulus with high perceived sweetness, and tomatoes representing a low-calorie food stimulus with low perceived sweetness.*

After constructive feedback from the participants in the pilot studies (5th graders), some stimuli for the AAT were changed. E.g. the ice cream was initially paired with a teapot. The participants didn't know if they should regard this as "something to eat or drink". The ice cream was later paired with an air balloon instead.

4.4.2.3 Script and Design

The AAT was constructed in Inquisit Millisecond 5.0 software. The task consisted of two blocks which contained 16 practice trials and 72 measurement trials each (Table 4). This made for 176 trials all together. Previous studies on implicit testing have typically had more than 200 trials (Klein et al., 2011; Meule, Lender, et al., 2019). This was modified in current test, as it was considered too long for children, risking distraction and boredom; 176 trials were however assumed to be sufficient, as other implicit studies like Maas *et al.* (2017) and Kakoschke *et al.* (2015) had less trials. The AAT with 176 trials took approximately 15 minutes for the children to finish.

The script was coded so that participants with an even numbered code were to first *push* the joystick away from themselves when presented a picture of a food or drink stimulus, and *pull* the joystick toward themselves for non-food/drink stimuli (block 1). Participants with an odd numbered code were to *pull* the joystick for food or drink stimuli first and *push* the joystick for non-foods/drinks (block 2) (Figure 14).

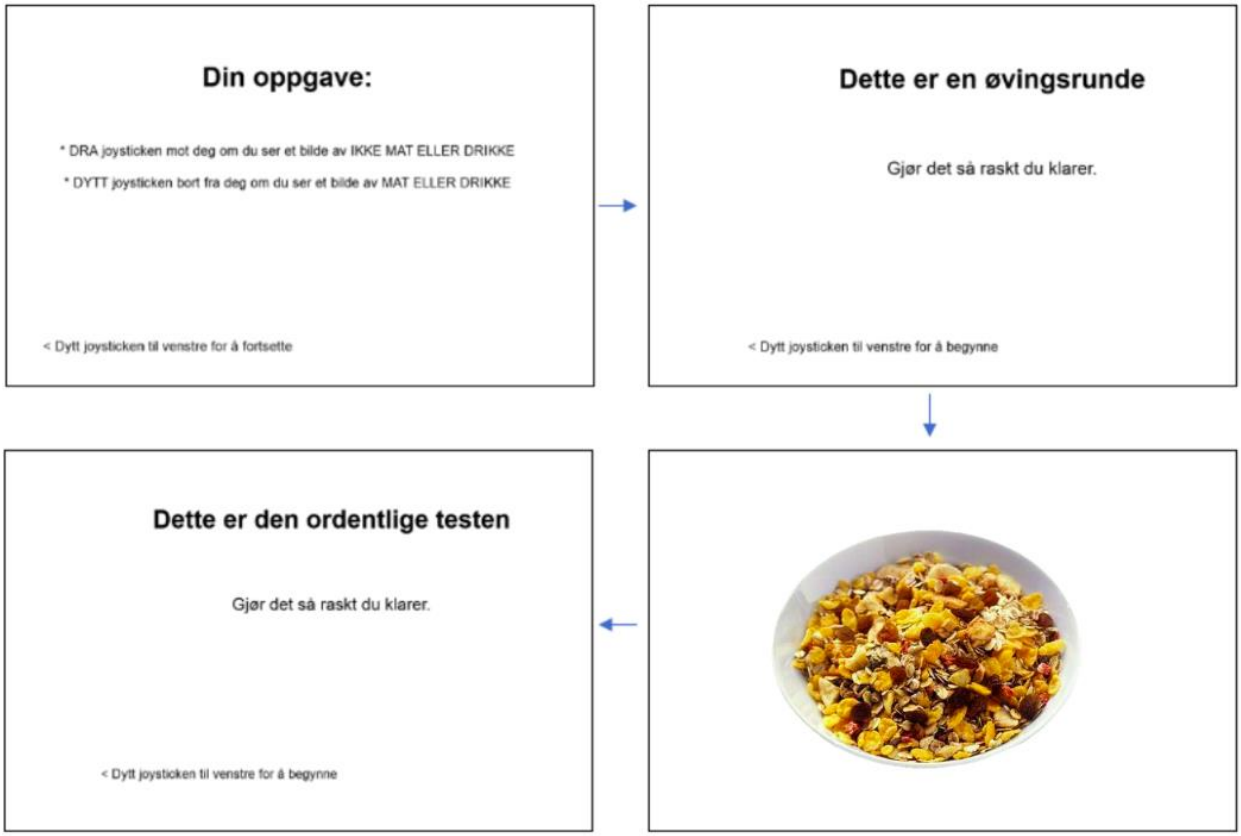

***Figure 14**: AAT instructions. After practice trials, the measurement trials begun with different stimuli. The muesli bowl in the picture was part of the measurement trials, but due to restricted use of pictures from the food-pic database, this is used as an illustration.*

This remained a counterbalanced design. A counterbalanced block structure across participants are often practiced in implicit testing (Kraus, 2014; Meule, Lender, et al., 2019). The script was also made so that the order of picture presentations was randomized within one repletion in a block (Meule, Lender, et al., 2019).

***Table 4**: Overview of number of stimuli in each block. Blocks were randomized across participants.*

	Block 1 (pull)	**Block 2 (push)**
Practice trials	4x4	4x4
Measurement trials	36x2	36x2

As seen in Klein *et al.* (2011), degrees of movement for the joystick were adjusted and integrated as part of the script, decided upon 30 degrees. A limited motion trajectory made for quicker RTs, and removed chances of lagging results. If pushing or pulling the wrong way, an error message appeared on the screen (Figure 15). This fix was installed after the pilot. The error message was intended to help the participants, in case they forgot during the test, thus avoiding completely random answers and irrelevant data collection.

Figure 15*: Example of an item being pushed/pulled the wrong way, and therefore getting an error message*.

The script was installed with a zooming effect on the items, that supported the illusion of increase or decrease of distance towards the stimuli. The stimulus became larger in size when the joystick was pulled towards oneself, and smaller in size when the joystick was pushed away.

Lender *et al.* (2018) found that a design with a relevant feature was more suited for AATs, which was therefore decided upon when constructing the AAT. A relevant feature meant that the participants responded to the image content, rather than a symbol or shape of the image.

The script was engineered to record the participant's speed of conduction and amount of right and wrong answers. To create a game-like setting, participants with a RT <1000 ms on average for each stimulus would get a last page with a medal saying "Great! You are very quick". Participants with an error rate <12 % would face a last page with a medal saying "Great! You are very sharp". Participants could also get both messages, if both quick and sharp (Figure 16).

***Figure 16**: Last page of a participant's test, conducting the AAT with an average reaction time <1000 ms per stimulus.*

4.4.3 Stimuli Rating Test

After the AAT, children were redirected to a questionnaire where they rated the food and drink stimuli explicitly regarding liking and sweetness (Figure 17). On the question about their liking ("How much do you like this product?"), the children answered with a 7-point Likert scale, ranging from 1 (not nice at all) to 7 (very nice), with smiley icons indicating the degree of liking. The explicit liking was assessed to see how much the explicit and implicit stimuli responses corresponded. When analyzing the data, this information was essential for categorizing and making groups within the selection. As important was their sweetness rating. In regards to the perceived sweetness of the product ("How sweet do you think this product is?"), there were four possible answers:1 - not sweet, 2 - a little sweet, 3 - pretty sweet and 4 - very sweet. As mentioned previously, there was not enough time to assess children's perception of sweetness prior to the test. The sweetness question was therefore included as a control to check if the stimulus selection by the researchers fitted to the children's perception of the sweetness level of the depicted product.

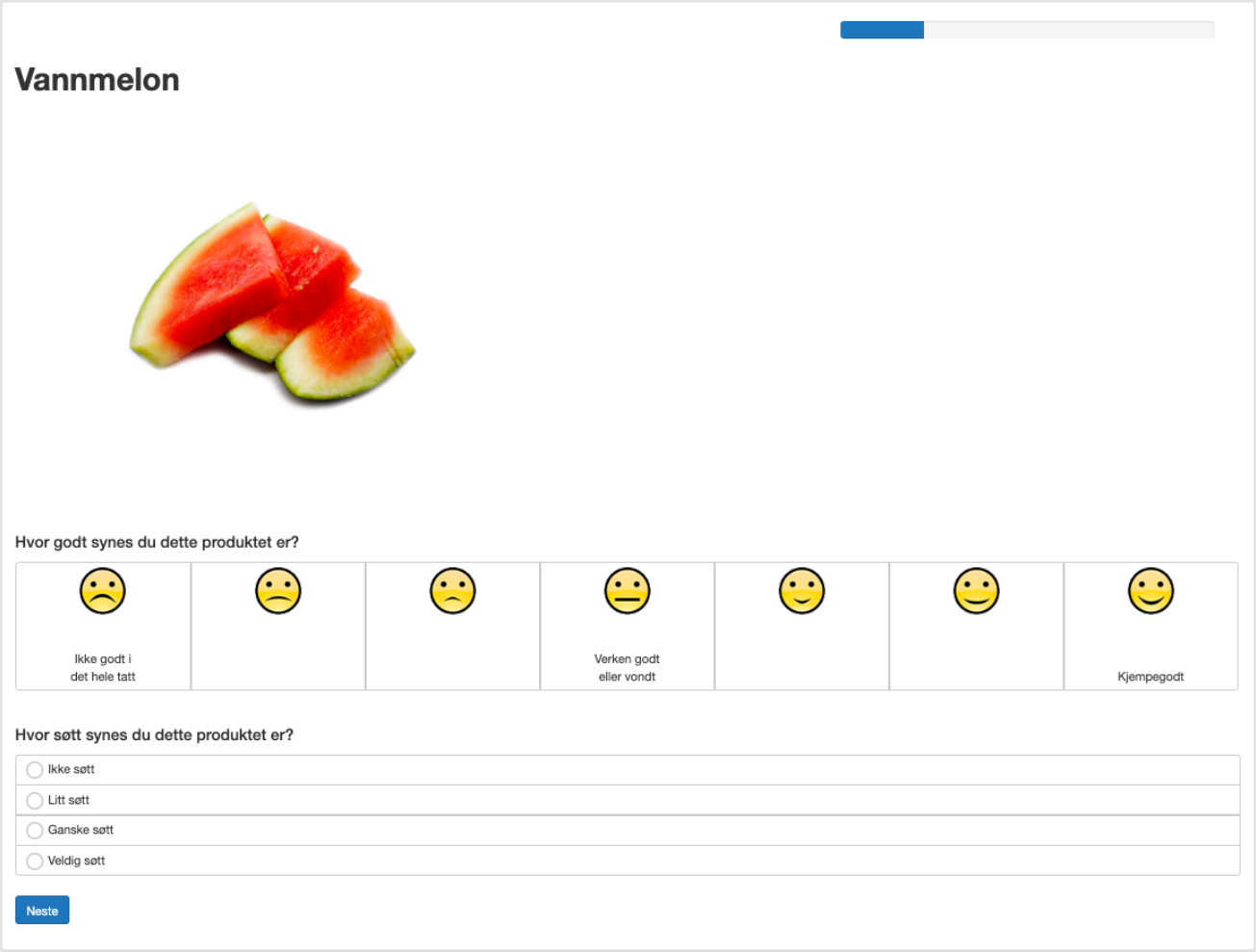

***Figure 17**: Illustration of one slide from the stimuli rating test.*

It was important that the stimuli were rated with a common understanding of the task. The participants were therefore instructed to base their answers on the food item presented in the picture, and not the food stimulus as a general idea. For example, the picture of nuts showed a handful of *cashew* nuts, thus rating this particular portion of nuts. The picture of muesli showed a version with oats and dried fruit. They were to rate this bowl of muesli, and not muesli or breakfast cereals in general.

4.5 Explicit Part

4.5.1 Real Choice Task

To better understand how children's attitudes were linked to their food choices, a real choice task was performed as a case study. The real choice task created a more realistic setup than what we would have reached with just the preference test or hedonic rating. The children had the choice between Litago® Original chocolate milk (with sugar) and a new Litago®

chocolate milk without added sugar (Figure 18). They were told that this was a token for their participation. In the questionnaire, the children indicated which chocolate milk they had chosen prior to the other test questions (Figure 19).

***Figure 18**: Chocolate milks from the first three experiments, stacked in two rows.*

For the first three schools, including the pilots, the chocolate milks were stacked in two rows on a table, standing in immediate sight while entering the room. The participants were informed that there were two different kinds, without any reference to the sugar content for the least amount of impact on their choice.

The participants from the next two schools had the two choices of chocolate milk placed on their desk and were instructed to pick one of them before the researchers in the room took the other one away. This change of direction was decided upon as the first procedure seemed to affect the results in a greater sense than expected; the researchers in this room had the impression that the children influenced each other in the choice on the table.

***Figure 19**: The page from the questionnaire asking about the participant's choice of product.*

The results were compared to their attitudes and implicit results. Implementing a consumer setup to compare implicit and explicit measures has been executed before (Genschow et al., 2017; Scarabis et al., 2006).

4.5.2 Attitude Scale Test

Three subscales from the Health and Taste Attitudes Questionnaires were used: general health interest, craving for sweet food and using food as a reward (Roininen et al., 1999) (Appendix 1). These were chosen based on the information we wanted to compare to the implicit results; attitudes towards sugary foods and sweet taste. "Natural products" and "Light products" subscales were excluded. Information about fatty foods and additives in food was not in the scope of this work, but also it was assumed to be too complex for the children's age group. Two subscales from a study conducted by Yuraki & Taejung (2017) were also collected to study affective and cognitive aspects. The cognitive attitudes refer to the beliefs and thoughts the participants had towards sweet food, and the affective attitudes captured the participants' emotional reactions towards sweet food (Appendix 2). A positive/high score on the cognitive scale would mean that the participants have a good understanding of how sweet food impact

their overall health. A positive/high score on the affective attitude scale indicates positive feelings and pleasure of consuming sweet foods. The participants were provided with iPads to perform the attitude scale test, with a total of 28 questions.

The Health and Taste Attitudes Questionnaire had been translated from English to Norwegian and back translated to English again, to make sure the translations correlated and were understood the same (back translation done by Nofima in a previous project). Questions from the Health and Taste Attitudes Questionnaire used for this study were however rewritten more simply to fit the participants' level of maturity and understanding. Rewriting was done by a Norwegian speaker and checked for understanding in pilot testing. After two pilots, the wording of three questions from the "general health interest" subscale were adjusted for understanding (Table 5).

***Table 5**: Questions from the Health and Taste attitude scale test that was reformulated for better understanding.*

Old formulation	**New formulation**
The healthiness of food has little impact on my food choices.	It is not important for me that the food I eat is healthy.
I am very particular about the healthiness of food I eat.	It is important for me that the food I eat is good for me.
I always follow a healthy and balanced diet.	I eat healthy and varied at all times.

All participants also troubled with the understanding of "craving" and "indulge". Four questions were reformulated for this reason. See revised questions in Table 6.

***Table 6**: Questions from the Health and Taste (craving for sweet foods) attitude scale test that was reformulated due to confusion.*

Old formulation	**New formulation**
In my opinion it is strange that some people have cravings for chocolate.	I think it's weird how some people all of a sudden want chocolate.
In my opinion it is strange that some people have cravings for sweets.	I think it's weird how some people all of a sudden want sweets.
In my opinion it is strange that some people have cravings for ice cream.	I think it's weird how some people all of a sudden want ice cream.
I indulge myself by buying something really delicious.	I eat something that tastes extra good when I think I deserve it.

From the subscales from the Health and Taste Attitudes Questionnaires, the following questions were not used, as they were regarded as not relevant or too comprehensive for 9-10 years old:

1. "It is important for me that my daily diet contains a lot of vitamins and minerals" (from general health interest).
2. "I do not avoid foods, even if they may raise my cholesterol" (from general health interest).

All questions were answered using a 7-point Likert scale, ranging from "strongly disagree" (1 point) to "strongly agree" (7 points) (Figure 20).

***Figure 20**: Questions measuring the participants' general health interest taken from the Health and Taste Attitudes Questionnaire, using a 7-point Likert scale.*

Due to negative items, scores for nine questions had to be reversed (Roininen et al., 1999). Table 7 shows the questions with reversed scores.

***Table 7**: Questions measuring the participants' food behavior.*

Using food as a reward	**R = reversed score**
I reward myself my buying something really tasty	
I avoid rewarding myself with food.	R
When I am feeling down, I want to treat myself with something really delicious.	
In my opinion, comforting oneself by eating is self-deception.	R
I eat some that taste extra nice when I think I deserve it	
I try to avoid eating delicious food when I am feeling down.	R

Reversing the score means that the numerical scoring scale runs in the opposite direction. "Strongly disagree" equals 7 points instead of 1, and "strongly agree" is 1 point instead of 7.

4.5.3 Blind Preference Test

The taste samples for the blind preference test were prepared 15 minutes before attendance, and therefore colder than room temperature as they had been stored in the refrigerator. Each child was provided with a glass of water and two black plastic cups on their table, filled with approximately 25 ml of two different chocolate milks: Litago® Original chocolate milk and Light Milk Cacao from Tine without added sugar and sweeteners. Ingredient list of the chocolate milks are provided in Table 8. As a substitute for sugar in the light version, the lactose is hydrolyzed to obtain an increased natural sweetness.

Due to color difference between the original chocolate milk and the one without added sugar, black shot glasses were used to minimize the bias effect of the color on the chocolate milks. The plastic cups were marked with either a cloud or a flower to identify the samples. The participants were not familiar with the difference between the samples or what the symbols represented. The participants were instructed to taste the samples and take note of which one they liked the most (Table 8). They were also advised to drink water in between tasting.

***Table 8**: Chocolate milks with ingredient lists and respective symbols used for the intrinsic part of the explicit tests.*

Sample	Symbol	Product	Ingredients
1		Light Milk Cacao from Tine without added sugar	Light milk, potato starch, cocoa, aroma, stabilizer (carrageenan), vitamin D
2		Litago® Original chocolate milk	Light milk, 4% sugar, 1% cocoa, stabilizer (carrageenan), aroma

Using symbols instead of number codes as identification, was done to simplify the task for the children. The flower and the cloud were selected based on their rounder shapes, making them equally attractive in order to prevent an influence on the preference rating by the children.

4.6 Data Analysis

4.6.1 Explicit Rating of the AAT Food Stimuli (pictures)

The sweetness rating of the food stimuli presented in the AAT, explicitly rated by children after the implicit part, was compared with the pre-assumed categories (low-medium-high sweetness), to check if the selection done by the researchers was in line with the children's perception. Based on the results, the three pre-assumed categories were converted into two (sweet food and non-sweet food) and 12 of 18 selected food stimuli were chosen for further analysis. These two categories of stimuli were used to analyze if children had an approach bias to sweet and non-sweet food.

4.6.2 Attitude Scale Scores

To analyze the responses from the attitude scale independently from the implicit test, the total sum of the children's responses on each subscale was calculated. The sum score of all participants' scores was averaged to compare to ranges in table 9.

***Table 9**: Overview of range of sum points for the attitude scale test, and attitude classifications based on points.*

Scale	Range (Points)	Attitudes (Points)		
		Negative	Neutral	Positive
General health interest	6-42	6-17	18-30	31-42
Craving for sweet food	6-42	6-17	18-30	31-42
Using food as a reward	6-42	6-17	18-30	31-42
Cognitive attitudes	4-28	4-11	12-20	21-28
Affective attitudes	2-14	2-5	6-10	11-14

Similar procedure is seen in Kowalkowska *et al.* (2018).

4.6.3 AAT

4.6.3.1 Data Pre-Processing

To clear the AAT dataset of errors, all participants with higher than 25 % error rate were removed (21,05 %). Next, all trials with extreme RT (< 200 ms or > 2500 ms) were removed (7,98 %). As a result, the data of 90 children (42 boys and 48 girls) between 9 and 10 years of age were used in subsequent analyses. This type of pre-processing is common in implicit testing (Kakoschke et al., 2015; Klein et al., 2011; Maas et al., 2017; Richard et al., 2018).

Participants with missing answers in the explicit task, e.g. children who did not taste the samples due to lactose intolerance (eight children), were excluded from the implicit dataset as well in order to combine the results.

4.6.3.2 Relation Between Implicit Attitudes to Food and Objects

The approach bias towards foods and objects were compared to investigate if the two stimuli categories were different. A paired t-test was performed on each of the children's average approach bias towards the objects and the food items. A significance level of 0,05 was used.

4.6.3.3 Biases and Grouping of Children Based on Their Implicit Attitudes

First, RT scores for every participant for each stimulus were calculated by taking the average of the two push RTs and the two pull RTs of the replicate trials (resulting in one approach value and one avoidance value for all stimuli per participant). The primary outcome measures utilized throughout the data analysis were approach bias for sweet food and approach bias for non-sweet food, which was calculated by subtracting the pulling RT from the pushing RT for each stimulus per participant (Kakoschke et al., 2015). A positive value meant that particular participant had an approach bias, because pulling closer is faster than pushing away. Correspondingly, a negative value indicated an avoidance tendency.

Participants were grouped based on their biases towards sweet and non-sweet food by averaging their approach bias values for sweet food (chocolate bar, gummy candy, ice cream, blueberries, watermelon and grapes) and their approach bias values for non-sweet food (cheese toast, nuts, muesli bowl, cucumber and carrot, tomatoes and milk). When positive values were obtained, the participants were grouped into "participants with an approach bias

towards sweet food" and if negative; "participants with no approach bias towards sweet food", the same for "participants with an approach bias towards non-sweet food" and "participants with no approach bias towards non-sweet food". It is important to distinguish between these, as no approach bias towards sweet food doesn't automatically mean an approach bias towards non-sweet food. The groups with approach bias/no approach bias towards sweet food were used for the rest of the data analysis when comparing implicit and explicit results, as the idea was to better understand preferences and attitudes in children with an unconscious attraction towards sweet food (participants with an approach bias towards sweet food). The approach bias/no approach bias towards non-sweet food were used to study the pattern.

4.6.4 Explicit and Implicit Response to Food Stimuli

Results from the explicit attitude tests were analyzed using the Student's t-test to investigate the differences between participants with and without an approach bias towards sweet food. An independent test was done for each subscale: general health interest, craving for sweet food, using food as a reward, cognitive and affective attitudes. An alpha value of 0,05 was used for all tests to determine significant p-values.

4.6.5 Hunger Level as Related to Implicit Attitudes

The rating of the hunger level was included as a validation in regards to the AAT, to check whether or not the participants' state of hunger had an effect on their implicit attitudes, as some participants conducted the test before lunch and some after. A two-tailed t-test was performed on the hunger ratings from the two groups of children with and without an approach bias for sweet food, using a 95 % confidence interval.

4.6.6 Real Choice, Blind Preference and Implicit Attitudes

The children's real choices of chocolate milk were documented as part of the explicit part. The significance of different choices between the two groups was measured with Chi-Square test, testing with a 95 % confidence interval. The distribution of choices between children with and without and approach bias towards sweet food was illustrated with a stacked column plot.

Results from the preference test for the children with and without an approach bias for sweet food were compared using contingency tables via Chi-Square test, also with a 95 % confidence interval.

4.6.7 Correlation Analysis

The average explicit liking rating of each of the food stimuli was compared to the average approach bias of each stimulus through a correlation to compare children's explicit and implicit responses. Pearson's correlation was also calculated to look at the correlation between average approach bias and liking of sweet food stimuli by children with and without an approach bias to sweet food.

4.6.9 Software

4.6.9.1 EyeQuestion

All explicit tests were constructed in the software EyeQuestion. EyeQuestion is often used as a tool for data collection in sensory and consumer research (Eyequestion, 2020). Using EyeQuestion allowed for a continuous line of tests, where the participants' identification number followed with. The way this was set up was a copy of the URL-link for the following test pasted into the advanced settings of the current test. When participants reached the end screen on one test, they were directly sent to the test of the pasted URL-code.

4.6.9.2 Millisecond

By means of the Inquisit Millisecond 5.0 software, the AAT script was programmed and presented. An Inquisit script of a joystick AAT task was first downloaded from www.millisecond.com and then adapted to fit the matter of interest. Inquisit is one of the most frequently used software for implicit tests and has the advantage that testing can be conducted web-based (Software, 2020). In order to conduct the tests remotely on different computers, a two-month license for Millisecond was purchased. Inquisit Player 5 which would be downloaded with the initiation of the test was downloaded on all laptops prior to the test in order to avoid losing time with the download during the test.

4.6.9.3 Excel and Excel XLSTAT

Data from all statistical tests were sorted and handled in Excel. XLSTAT, an add-on to Microsoft Excel 365, was used to run t-tests, Chi-Square tests and Pearson's correlations, as well as providing thorough graphs and summaries of data sets.

5 Results

5.1 Explicit Rating

5.1.1 Stimuli Rating

In order to make clear distinctions between groups of comparison in the implicit testing, the categories of stimuli in which their scores were registered had to be well-defined and validated. The choice of stimuli for further analysis was based on the participants' perception of sweetness of the different food items, based on the stimuli rating task. After analyzing the data, only 12 of the 18 food stimuli were used in further analysis. The three groups that the researchers had made before the test were reduced to two; sweet and not sweet, as the stimuli, as perceived by the children, were not discriminated by them in three clear groups (Figure 21). The concept of high and low calorie was kept, in order to balance this out in the stimuli set, choosing three food stimuli for each category (sweet and non-sweet/high- and low-calories). The high- and low-calorie categories were based on the calorie content per 100 grams of product (Table 10), as retrieved from the excel sheet from food-pics.

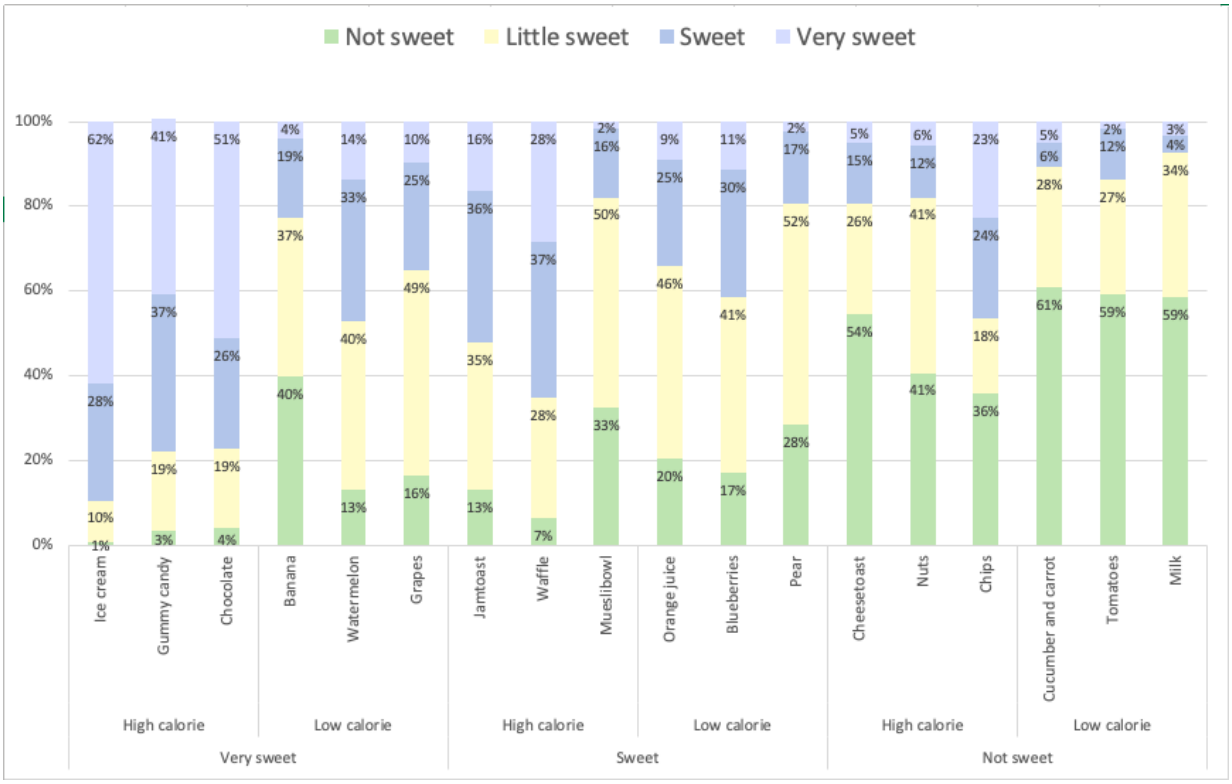

***Figure 21**: Results of the sweetness rating of all food stimuli.*

Figure 21 shows that chips, muesli bowl, pear and banana did not fit the pre-assumed categories, as selected by the researchers. Chips were generally rated sweeter than expected, with a higher sweetness score than jam toast, grapes and blueberries. Muesli bowl and pear were originally in the moderate sweetness category. The participants did, however, rate these items moderate to low sweetness. Banana, which was an item in the very sweet category to begin with, was rated not sweet, and therefore excluded from further analysis, as well as chips and pear. Muesli bowl was kept as an item to analyze further, but was moved to the low sweetness category, representing a high calorie stimulus. Waffle, orange juice and jam toast were ruled out seeing they were representing a midpoint in sweetness for children, and not belonging to either extremes of the sweetness scale.

***Table 10**: Calorie content of sweet foods per 100 grams of product (extracted from the image database food-pics), and average liking and sweetness rating.*

		Kcal/100g	Average liking	Average sweetness
High kcal/high sweetness	**Chocolate bar**	449	6,10	3,24
	Ice cream	160	6,34	3,50
	Gummy candy	343	5,75	3,16
Low kcal/high sweetness	**Blueberries**	41	5,21	2,35
	Watermelon	39	6,01	2,48
	Grapes	71	5,46	2,28
High kcal/low sweetness	**Nuts**	621	4,57	1,82
	Muesli bowl	343	4,26	1,86
	Cheese toast	200	5,44	1,69
Low kcal/low sweetness	**Tomatoes**	16	3,63	1,56
	Milk	65	4,87	1,52
	Cucumber and carrot	19,4	4,99	1,54

All snacks exceeded a liking score of 3.5 on average on a 7-point scale, meaning both sweet and non-sweet food stimuli were rated positively. However, as expected, the children liked sweet food significantly better than the non-sweet food ($p < 0,012$) as shown in Figure 22.

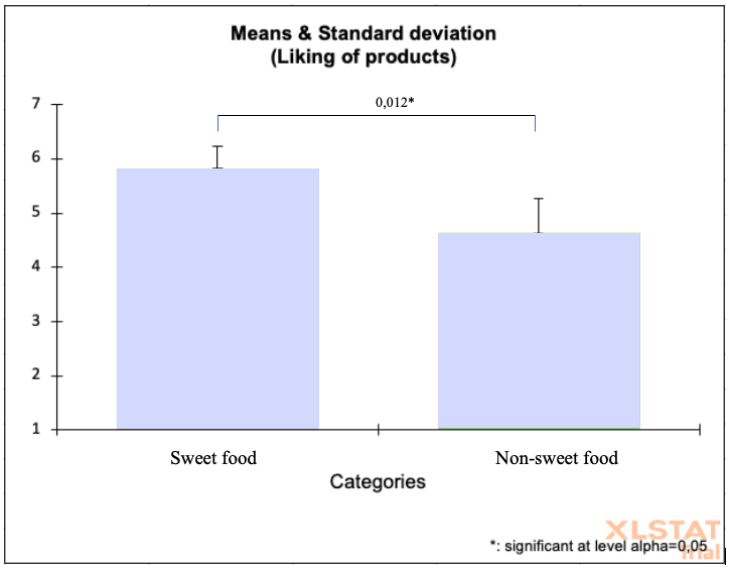

***Figure 22**: Bar plot illustrating the results of participants' liking rating of the stimuli.*

5.1.2 Average Sum Scores, Mean Values and Cronbach's Alpha of Attitude Scales

To compare the explicit results, the children's average sum scores of each scale as well as the mean value for all subscales were calculated. The internal consistency of all subscales was tested with Cronbach's alpha.

Average sum score and mean values for all participants of each subscale are presented in Table 11 as well as the Cronbach's alpha for the three subscales from The Health and Taste Attitudes Questionnaire.

***Table 11**: Average sum scores, mean values of attitude scales and internal consistency of The Health and Taste Attitudes Questionnaire subscales measured on a 7-point scale.*

	Average sum score	**Mean values**	**Cronbach's alpha**
General health interest	26,7	4,5	0,37
Craving for sweet food	28,7	3,7	0,72
Using food as a reward	24,4	4,1	0,66
Affective attitudes	7,9	3,9	-
Cognitive attitudes	21,1	5,3	-

Mean values of all responses showed that the children scored highest on cognitive attitudes and the lowest on craving for sweet food. Following the score range from Table 9, the children showed neutral affective attitudes towards sweet food, as well as neutral attitudes in each of the subscales from the Health and Taste Attitudes Questionnaire. The cognitive attitudes towards sweet food got a score representing positive attitudes.
Only "Craving for sweet food" had an acceptable internal consistency ($0,8 > \alpha \geq 0,7$), whereas "Using food as a reward had a questionable internal consistency ($0,7 > \alpha \geq 0,6$), and finally "General health interest" with a low internal consistency ($0,5 > \alpha$). Due to few questions in the affective and cognitive attitude scales, it was decided not to calculate the Cronbach's alpha for these, as the internal consistency of two questions doesn't tell much. The three attitude subscales consisted of six questions of which three were reversed, meaning

nine reversed questions in total. It was observed during the test that some children struggled reversing the scale to these questions.

5.1.3 Blind Preference and Real Choice Task

The number of children choosing chocolate milks with and without sugar in both blind preference and take-home task (real choice) is presented in Table 12. The tasted sample and the real choice sample without added sugar were not identical, as there were no sugar free chocolate milks without added sweetener available in right packaging form for children to pick as their take-home choice. For the choice task, Litago® Chocolate Milk Without Added Sugar was used, in which artificial sugars are added instead to make it sweeter. For the taste sample, Tine Light Milk Cacao was used. Nevertheless, being the preference test run on blind basis, children were unaware of this difference.

***Table 12**: Overview of how many children chose Litago® Original Chocolate Milk and Litago® Chocolate Milk Without Added Sugar for the real choice task, and which one they preferred between Litago® Original Chocolate Milk and Tine Light Milk Cacao during the blind preference test.*

	Blind Preference	**Real Choice**
Litago® Original Chocolate Milk	67	59
Chocolate Milk Without Added Sugar	16	21

For both tests, the original chocolate milk was chosen more often than the chocolate milk without added sugar.

5.1.2 Relation Between Approach Bias to Food/Objects and Sweet Food/Non-Sweet Food

Other than in the explicit stimuli rating, no significant difference between sweet and non-sweet stimuli regarding approach bias was found for the whole consumer group. No significant difference was found between the average approach bias to food (in general) and objects either.

5.2 Groups from Implicit Responses

It was of interest if individual differences in the approach bias would be linked to explicit attitudes and preferences for chocolate milk. As explained in chapter 4.6.3.3, the grouping of

children was based on their biases towards sweet and non-sweet food. The number of participants belonging to each group is presented in Table 13. From the 90 participating children, 54 had an approach bias towards sweet food, and 38 out of those also showed an approach bias towards non-sweet food.

***Table 13**: Number of participants having an approach bias towards sweet food, non-sweet food or both, and participants with no approach bias towards sweet food, non-sweet food or neither (Total n= 90).*

		Non-sweet food	
		No approach bias	**Approach bias**
Sweet food	**No approach bias**	15	21
	Approach bias	16	38

5.3 Hunger

With a two-tailed t-test, the children with an approach bias for sweet food and non-sweet food did not display a significantly higher hunger level with a significance level of 0,05.

5.4 Relation Between Implicit and Explicit Attitudes

The link between participants with and without an approach bias towards sweet food and their attitudes were calculated using a two-sided t-test.

An approach bias to sweet food was significantly linked to the two attitude subscales “general health interest” and “using food as a reward”. For “craving for sweet food”, cognitive and affective attitudes there were no significant effect found. An approach bias for the non-sweet food stimuli which was used as comparison, was not linked to any of the measured attitudes. Results are presented in Table 14. Figure 23 shows the average “using food as a reward” rating of the two groups.

***Table 14**: Overview of relation significance for participants with approach bias towards sweet food and for participants with approach bias towards non-sweet food and their explicit attitude responses.*

	p-value	
	Approach bias towards sweet food	**Approach bias towards non-sweet food**
Affective attitudes	0,237	0,467
Cognitive attitudes	0,509	0,321
Reward behavior	0,022*	0,918
Health interest	0,003**	0,585
Craving for sweet food	0,082	0,158

** = p<0,05*

*** = p<0,01*

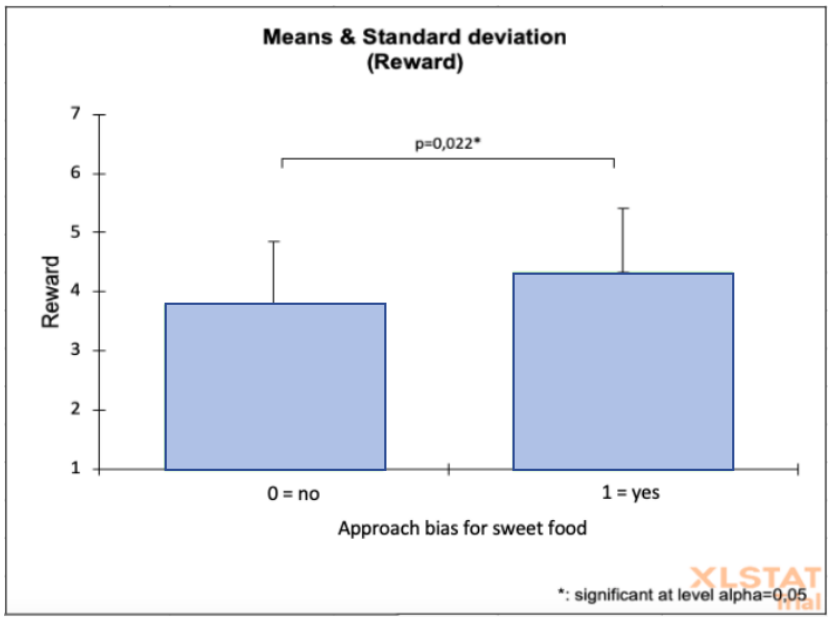

***Figure 23**: Bar plot showing the mean value and standard deviation for participants' reward behavior with and without an approach bias towards sweet food.*

Participants with an approach bias towards sweet food rated the questions regarding food as a form of reward higher.

Participants with no approach bias towards sweet food had a higher health interest score (Figure 24).

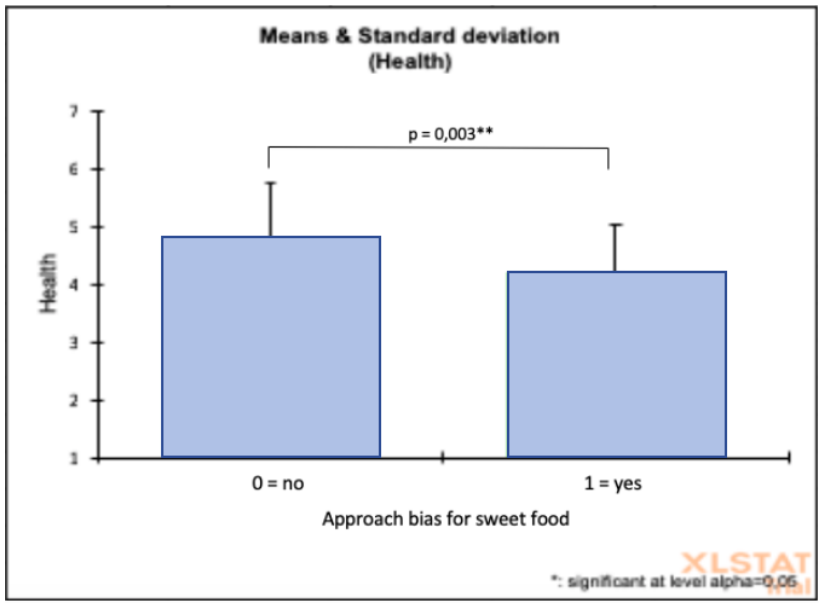

***Figure 24**: Bar plot showing the mean value and standard deviation of general health interest for participants with and without an approach bias towards sweet foods.*

5.5 Relation Between Implicit Biases and Chocolate Milk Preferences

The relation between participants with and without an approach bias towards sweet food and their preferences were calculated using a Chi-Square test.

Children with an approach bias for sweet food chose the original chocolate drink more often in the blind preference test while there was no link found to the real choice task of the chocolate drink (Table 15).

***Table 15**: Link between participants with and without an approach bias towards sweet and non-sweet foods and their blind preference and choice of chocolate milk.*

	p-value	
	Approach bias towards sweet food	**Approach bias towards non-sweet food**
Real Choice Task	0,756	0,962
Blind preference test	0,003**	0,650

** = $p<0,01$

There was no significant difference between children with and without an approach bias for sweet food in their choice of chocolate milk (Figure 25). Generally, the sweet chocolate drink was more often chosen.

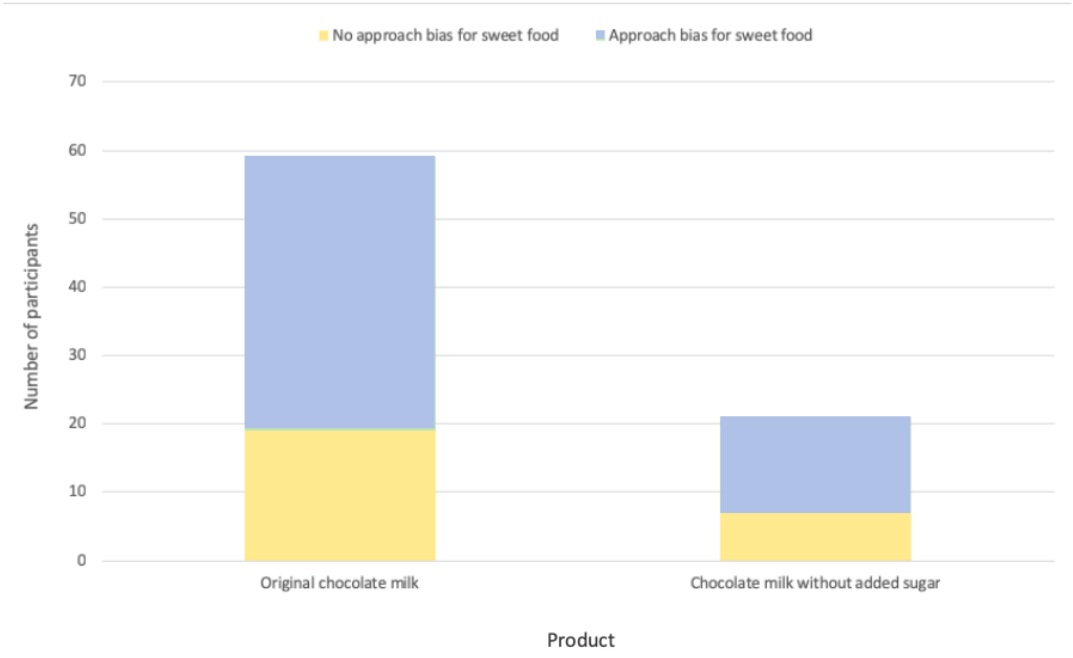

***Figure 25**: Stacked bar chart showing the number of participants choosing the original chocolate milk and the chocolate milk without added sugar. Blue field represents participants with an approach bias towards sweet food and yellow field being participants with no approach bias towards sweet food.*

A significant effect was found in participants' approach bias to sweet food and their blind preference. Figure 26 shows the result of the blind preference test for participants with and

without an approach bias towards sweet food and for participants with and without an approach bias towards non-sweet food.

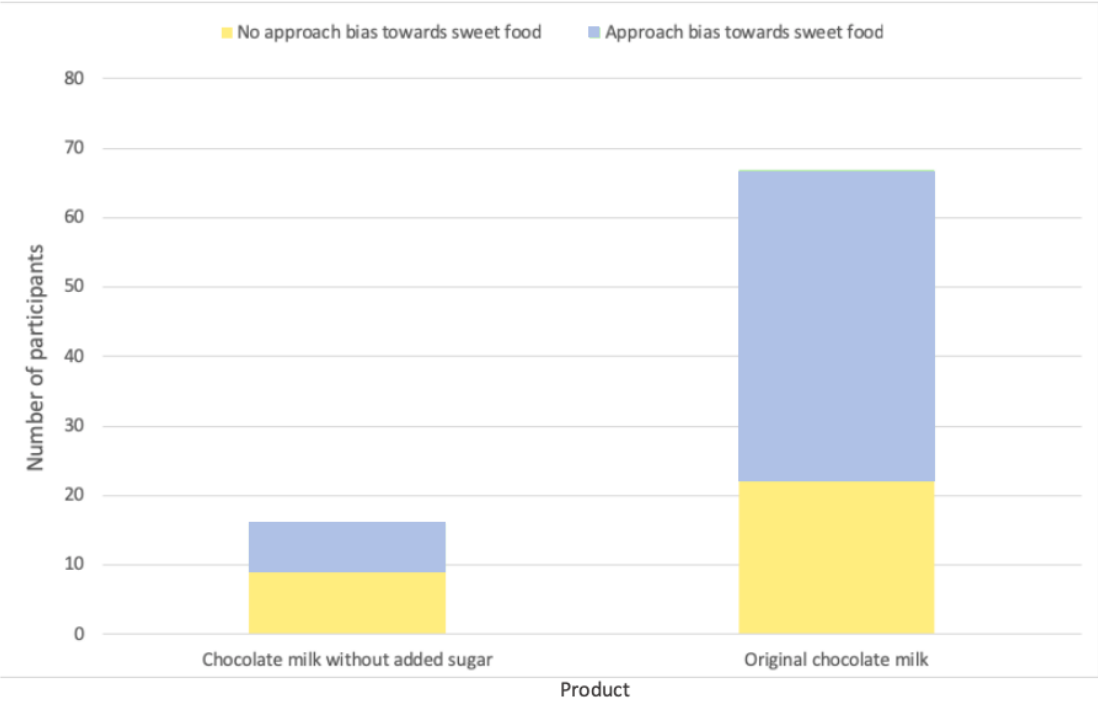

***Figure 26**: Stacked bar chart showing the number of participants preferring the original chocolate milk and the chocolate milk without added sugar. Blue fields represent participants with an approach bias towards sweet food and yellow fields being participants with no approach bias towards sweet food.*

More participants with an approach bias towards sweet food preferred the original chocolate milk compared to participants without an approach bias towards sweet food.

5.6 Correlation Between Implicit and Explicit Reactions to the Food Images of the AAT

To investigate the association between average approach bias scores for the sweet food stimuli and the average liking scores given by the children, Pearson's correlation was calculated between average approach bias score of each sweet food stimulus and the respective average liking score (Figure 27 and Figure 28).

Figure 27 shows the linear correlation of responses from participants with an approach bias towards sweet food, and Figure 28 shows the linear correlation of responses from participants without an approach bias towards sweet food.

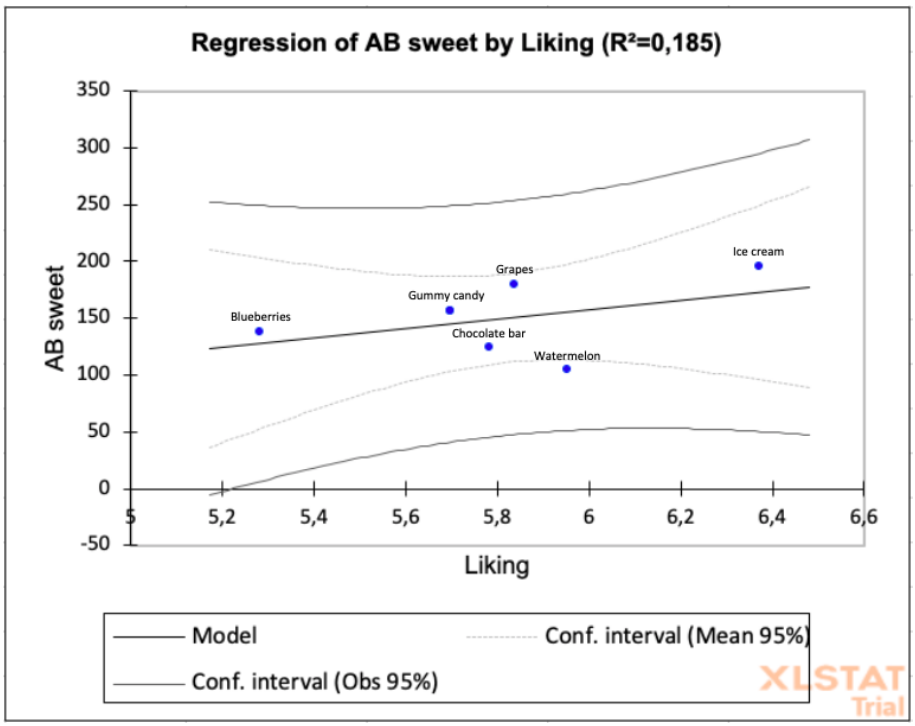

***Figure 27**: Correlation between average liking and approach bias for sweet food stimuli for participants with an approach bias towards sweet foods.*

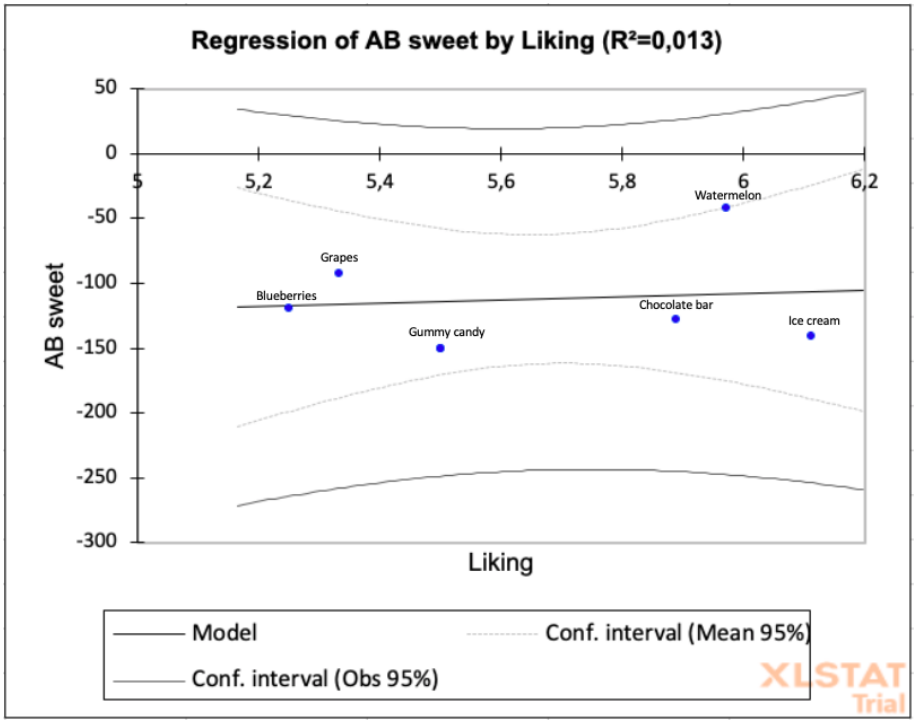

***Figure 28**: Correlation between average liking and approach bias for sweet food stimuli for participants without an approach bias towards sweet foods.*

The correlation coefficient between average liking and participants with an approach bias towards sweet food was Pr > F = 0,394, and Pr > F = 0,829 for participants without an approach bias towards sweet food.

The correlation between average liking and approach bias to all stimuli was calculated for all participants (Figure 29).

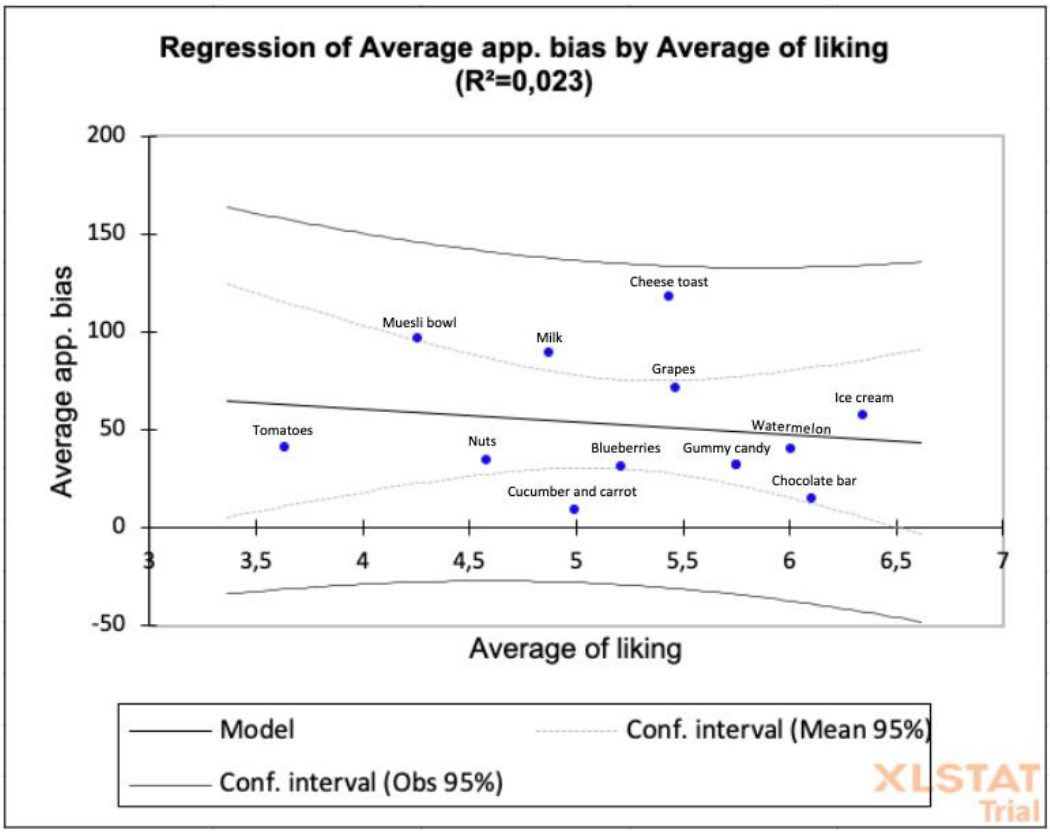

***Figure 29**: Correlation between average liking and approach bias for all stimuli for all participants.*

The correlation coefficient between average liking and approach bias for all food stimuli was Pr > F = 0,635.

6 Discussion

Much of the popularity of implicit measures in consumer psychology may stem from the promise that they contribute to insights that cannot be achieved with explicit measures. The objective of the thesis was to investigate children's food preferences, attitudes and eating behaviors through implicit and explicit methodologies. Following the finding by Yukari & Taejung (2017) which found that banana milk with the highest sugar concentration was preferred the most and feelings tended to be more positively as sweetness increased, we expected to see a greater liking for the sweet food category as opposed to the non-sweet food category. We hypothesized that children with an approach bias towards sweet food would have a higher score for craving for sweet food, a lower general health interest score, and also a higher preference for the sugar-added chocolate milk. The children without an approach bias towards sweet food were also expected to choose the chocolate milk without added sugar as a token more often than their peers. In this chapter, results are compared and discussed, focusing on the correlation between the results of explicit and implicit tests of participants with and without an approach bias towards sweet food and non-sweet food.

6.1 Preference for Sweetness

The rating of the picture stimuli was interesting information to see if the children's explicit ratings were in line with their implicit responses to the same stimuli. Results of the explicit rating task showed that all food stimuli were positively assessed (liking ratings higher than 3.5 (Figure 22)). Sweet food was however more liked than non-sweet food. These results correspond with literature claiming that preference for sweet food is innate, while simultaneously showing a rejection towards bitter foods as a defense mechanism (Liem & De Graaf, 2004; Mennella & Bobowski, 2015). Zandstra & De Graaf (1998) also found in their study that the mean pleasantness responses for sucrose, citric acid and orange flavor in orange juice were higher for children (6-12 years) than that for preadolescents, young adults, adults, older adults and elderly. When testing preferences with children between 4-16 years old, Cooke & Wardle (2005) also found when measuring food preferences that fatty and sugary foods were the most highly rated foods. This could explain why foods in the non-sweet food category, like tomatoes, nuts, cucumber and carrots were the least liked items. Research also suggests that the heightened liking of sweetness could be a result of the children's high growth rate (Mennella et al., 2014; Mennella & Bobowski, 2015).

In both the choice task and the blind preference test, the children chose the original chocolate milk over the chocolate milk without added sugar more often (Table 12). Independent of their biases in the implicit test, this show a clear preference for sweetness in their choices.

After averaging all sum scores of the subscales from the Health and Taste Attitude Questionnaire, all results pointed towards neutral attitudes. This was also found in Kowalkowska *et al.* (2018), where nearly three-quarters had neutral attitudes in the general health interest subscale and 54 % also had neutral attitudes in the reward behavior subscale. A possible ambivalence towards sweet food might explain the neutral attitudes, as many participants showed an approach bias towards sweet food in the implicit test.

6.2 Approach Bias to Sweet Food

The approach bias was not significantly higher for food items over objects. These results strain from previous research. Cring (2017) found when comparing food items and objects, a significant approach bias towards food. Meule *et al.* (2019) also found a significant effect of stimulus when comparing the reaction time between chocolate containing foods and matching objects, concluding with an approach bias towards food. No significant difference was found between the approach bias towards sweet food and non-sweet food either; contrasting the explicit responses, where there was a significant effect in the liking rating of the stimuli.

The other relations between the AAT and the explicit tasks were generally low. No significant link was found between participants' explicit liking rating of the stimuli and the average approach bias towards same stimuli for the general sample of consumers (Figure 29). However, we did find a higher correlation between participants without an approach bias towards sweet food and their liking of the sweet food stimuli, compared to those with an approach bias towards sweet food (Figure 27 and Figure 28). This discrepancy could be explained by the concept of dual-processing, but further studies on this specific would be interesting.

Care needs to be taken for other factors that can influence the implicit test outcome (as well as explicit). E.g. Czyzewska *et al.* (2011), Richard *et al.* (2018) and Seibt *et al.* (2007), showed that hunger had an influence. As half of our participants performed the test prior and half after

their lunch, we took this into consideration. No significant effect was found; thus, the variable was discarded as irrelevant for the current study.

Individual differences regarding approach bias to sweet food could be linked to sweetness preference and two attitude scales.

6.3 Link Between Approach Bias for Sweet Food and Attitudes

From our results, it is apparent that the hedonic motives are dominant for children with a bias towards sweet food both implicitly and explicitly, and that foods are thought of more as a source of pleasure rather than energy fuel. This was reflected in the scores for their reward behavior and general health interest (Table 14).

The children with an approach bias for sweet food seemingly practice more of a reward behavior compared to those without a bias (Figure 23). A reason could be that children with a bias for sweet food manifest more positively explicit attitudes towards unhealthy food, thus creating a stronger correlation between sweet food, good taste and enjoyment. In Lumeng & Fisher (2018), one can read that reward foods are often calorie dense and comprise high fats or sugar, and also that if people show higher liking for a food, this is a good prediction of their consumption. Thus, higher liking of sweet food could explain why these children use food more as a reward. Considering that the Cronbach's alpha for the reward subscale turned out questionable, a critical sense needs to be practiced when interpreting these responses.

As expected, a greater health interest was detected in children without an approach bias towards sweet food (Figure 24). While some individuals have a weak controlled system and are unable to inhibit responses to appetitive food cues, others with a strong controlled system manage to inhibit such responses. This would lead to different behaviors at the time of choosing. The health consciousness with children might also correspond to a higher degree of reflection and a stronger preference for long-term goals, which generate consumption of healthier choices. However, the internal consistency of the health subscale was low and not very reliable.

Furthermore, no relation was found between children with an approach bias towards sweet food and their cognitive or affective attitudes (Table 14). Nor their craving for sweet food was

found to be significant; a subscale that scored high on internal consistency and therefore reliable responses. This indicates a discrepancy between their implicit and explicit attitudes. We also found that more children with an approach bias towards non-sweet food were more dissonant, as their implicit and explicit attitudes (attitude scale and preferences) didn't correlate in any aspects.

There could be several explanations for this outcome. The two methods of assessing attitudes appear very different in both concept and actual measurements (Guyer & Fabrigar, 2015). Most implicit measures provide a continuous measurement which rely on the subconscious mind. The subconscious mind again depends on sensory input and responds to reality and imagination in the same way. The numerical scale in explicit testing, however, does not generate more than discrete information of an essentially qualitative underlying reality, and relies on an analytic, conscious assessment. Combining and comparing reaction times and self-reported attitudes might not necessarily give completely aligned results.

Another reason could be the aspect of social desirability and self-representation biases; how someone explicitly expresses their attitudes and eating habits knowing that their responses are something they might be held responsible for or be looked down upon, can hinder them from answering entirely honest and truthful (Hebert et al., 2008). Participants' explicit attitudes might therefore be a better representation of what they considered a respectable and expected answer, rather than a direct reflection of the concept asked in the question. When measuring implicit attitudes, the sense of judgement for their results disappear, opening for respondents to answer more freely.

The attitude scale also depends on the participants' introspective capacity to recognize what is asked for and then enunciate their emotions (Hofmann et al., 2005). This is especially important to take into account, as many participants seemed to struggle with the understanding of the attitude questions, let alone reflect, consider and implement them to their own situation. The particularly low internal consistency in 2/3 subscales might also explain the lack of relations.

There are other ways to interpret and analyze implicit results as well. In "*The Attraction of Sugar: An Association between Body Mass Index and Impaired Avoidance of Sweet Snacks*" Maas *et al.* (2017) evaluated the AAT data by looking at the difference in RTs of push and pull trials separately, to essentially analyze a possible impaired avoidance tendency rather than increased approach tendency. This data analysis could be interesting to follow for further studies.

6.4 Link Between Approach Bias, and Preference and Choice of Chocolate Milk

Approach bias for sweet food was linked with blind preference, but not with the real choice task.

We decided to do a take home preference test, where the real reason behind was unknown to the participants. According to our experimental design, the participants only saw the chocolate milk as a reward and didn't recognize this as part of the test, so they were free to choose the sugar version. However, we didn't find a link between their choice and biases. A reasonable explanation for lack of consistency between participants with and without an approach bias towards sweet food and their choice of chocolate milk could be the peer pressure that was observed, which is also documented by Guinard (2000).

The real choice task reflects that most children had hedonic-based explicit attitudes towards the chocolate milk, rather than cognitive. While some participants might have chosen their chocolate milk based on nutritional value, it seems most children based their choices on taste. The researchers' experience was that the unhealthy option was the cooler and expected choice among the children, but several times it was observed that overweighed children chose the sugar free drink. Many children without an approach bias towards sweet food, however, chose the original chocolate milk. This could mean that the children might have positive affective attitudes towards the chocolate milk with sugar, but negative associations because it is unhealthy, in which the affective attitudes overrode the cognitive attitudes.

Particularly being a price or reward to their work, the participants could have allowed themselves more indulgence. Weiss *et al.* (2010) found in their experiment looking at buying preferences, liking preferences and take-home preferences, that the take home choice between two types of chocolates (dark and milk chocolate) were almost equally the same, but that circumstances (feeling observed) when choosing affected the choice.

Because the sugar free chocolate milk contained artificial sweetener, this could potentially be a reason for driving away health conscious children from this option as artificial sweetener is frowned upon of many and perceived as less healthy than cane sugar.

There was a link between the implicit bias towards sweet foods and the results of the blind preference test (Table 15). Participants' with an approach bias towards sweet food liked the sweeter and richer original chocolate milk more than those without an approach bias, which means that their implicit attitudes and preferences were aligned.

It has to be noted that though the black plastic cups made for a less obvious difference in color of the chocolate milks, many participants still noticed that one was lighter than the other. Some participants may have already judged and decided upon which chocolate milk they preferred based on the color of the chocolate milks. With an understanding of the lighter chocolate milk being the healthier one, explicitly health-conscious participants might have chosen this as the preferred one for health reasons, but in this age group, such conscious choice seems unlikely to be the main driver.

This study showed implicit and explicit attitudes reflect different aspects of children's food behavior and perception, which is something that should be explored in further research.

6.5 Test Setup and Limitations

The AAT was decided upon as our implicit test assuming this was a generally easy task. Most children handled the test well and understood the concept of when to push and pull. The feedback from the children conducting the test was mixed. With 176 test and measurement trials all together, many children found it repetitive and tedious. Comparing the amount of trials to other implicit studies, ours fell somewhat in the middle. While less trials would make it easier for the children who struggled with concentration, this would make for less valid results. More trials could make for even more reliable results, but could also work the opposite as the children would be too bored and distracted, loose focus and answer blindly by pushing/pulling to get it done. A longer AAT would also call for extended time on each test, which was not possible with the arrangement from Vitenparken, and moreover restrict the

selection of participants. However, many children thoroughly enjoyed the game-like aspect of the test, and asked if they could redo the test for fun.

With the AAT, twenty-five participants made errors on more than 25 % of the trials, and 510 answers were excluded due to high or low RT. Error rate in our study are substantially higher compared to Kakoschke *et al.* (2015), which also tested on adults aging 9-12. This suggests that the stimuli in the AAT might not have been optimal, or that more trials could suffice for better understanding and grasping of the task. Performing the test in closed cabins could also make for less distractions, thereby lower error rate.

A limitation to the AAT was the simultaneously collective testing of children; 10 children with controllers at once seemed to be a distraction as many couldn't control their excitement and immersiveness during the test, which in turn made other children not concentrate on their own task, but rather watch their neighbors screen.

Our validation question to assess children's evaluation of sweetness proved to be important as it deviated from our assumptions. Sweetness categories would have been ideally defined in a pilot by children to match their perception, but a strict time management didn't allow for this. A difference in perceived sweetness could be explained because of more expanded experiences and matured taste buds with age, as well as differences in sensitivity (Drewnowski et al., 2012; Liem & De Graaf, 2004; V. et al., 1964).
Another reason could be a misunderstanding of the task for some children. Chips, which is often recognized as a salty food (Kongstad & Giacalone, 2020) received a high liking rating but also a high sweetness rating. This could be an intertwined perception, meaning that high liking would equal high sweetness, because high sweetness often equals high liking (Garneau et al., 2018), however they may not have recognized the picture. What goes for banana, pear and muesli bowl, their low ratings of sweetness could simply be a product of comparison with the sweeter products like chocolate bar and ice cream, which in turn is much sweeter and therefore affect the rating of remaining stimuli. According to Chambers & Johnston (2002), children are also more likely to use the scale more extremely than adults.

The attitude questionnaires were difficult for some children, particularly 9-year-olds. The pilot tests were conducted with children from age 10 to 11 and optimized with this age group in mind. The recruitment, managed by Vitenparken, invited however mainly children that were one year younger (9-10) which had a big influence regarding comprehension of the attitude questionnaires, particularly when using the scale for reversed questions.

This was also reflected in the internal consistency of the subscales. Only "craving for sweet food" got a Cronbach's alpha of > 0,7 (Table 11). When testing on adults (18-75 years old), the Cronbach's alpha for "craving for sweet food", "general health interest" and "using food as a reward" ranged from 0,67 to 0,89. The lowest limit of acceptability of reliability is 0.60 to 0.70 (Hair et al., 1998). It is therefore reason to believe that we can't fully rely on all the responses from the attitude scale.

Ideally, the tests should have been revisited to fit their level of cognitive understanding and critical sense, but this was not possible in the timeframe of the 30p master's thesis and the school visits to Vitenparken. More time would have made it feasible to have more pilots which would have made it possible to pin down what exact wording to use for the attitude scale, as well as more insight into how we should have made the perceived sweetness categories and which stimuli belonged to the different categories.

Further, the peer pressure during the participants' choice of chocolate milk could have been avoided to a greater extent if the children were to pick the milk one by one without any others in the room, but this was not possible with the set-up of the test in groups.

The sense of color bias of the chocolate milks could also have been avoided if color could have been masked. One can argue however, that appearance is part of the preference and hedonic experience.

7 Conclusion

The objective of this Master thesis was to investigate children's food preferences and perception of sweet foods through a series of explicit and implicit methods. It was a first attempt to study the link between conscious and unconscious behavior in a preadolescent consumer sample, and how these behaviors could be measured by the chosen methods (AAT

and explicit self-reported attitudes). Choice was measured by a real choice task, where the participants got to choose between a chocolate milk without added sugar and a chocolate milk with sugar, and a blind preference test was run with the same kinds of chocolate milks.

The implicit approach investigated (AAT) allowed to investigate individual differences in implicit bias towards sweet food, discriminating among children with and without approach bias towards sweet food, and to explore differences in preferences and attitudes in children with distinct implicit responses.

The results of the AAT showed that from the sample of children in this study, more children had an approach bias towards sweet food, but not of significance. Those with approach bias towards sweet food also showed less interest in the health aspects of food, used food as a reward more often than their peers and preferred the chocolate milk with sugar more often on a blind basis. This means that their implicit bias may reflect their blind preferences and some of their self-reported attitudes towards sweet foods (health interest and reward behavior). However, no relation was found for this group in other aspects of their stated attitudes (craving for sweet food, cognitive or affective attitudes). Very interestingly, even if the differences in blind preferences were highly significant, there was no difference in the groups with or without approach bias towards sweet food regarding their real choice of chocolate milk. This raises the question on the use of the "without sugar" claim in products targeted to children. Even those children that would prefer its' taste (in blind) would choose the sugar one because of the negative expectations or peer pressure raised by the claim. No significant differences were found between participants with or without an approach bias towards non-sweet food and the subscales of the attitude scale test.

During the study, we encountered difficulties with the children's understanding of the attitude questionnaires even after modifications and explanations by the interviewers, which suggest that an implicit task like the AAT could be a valuable alternative in measuring certain attitude traits in children. Despite a high error rate on the AAT, these responses can easily be ruled out as opposed to explicit tests where it is harder to distinguish who produces reliable responses and who just fills out the form as a result of not understanding.

Many factors are involved when making decisions on what foods to eat. From this study, it is clear that the hedonic aspects of foods are very important, especially for children with positive implicit attitudes towards sweet food. There were discrepancies between implicit and explicit attitudes for many participants, which can be explained with concerns of self-representation, peer pressure, lack of introspective capacity and task comprehension. These findings are consistent with dual-process models (Strack & Deutsch, 2004) which propose that behavior is determined by a combination of the impulsive and reflective system.

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APPENDIX 1

Attitude scale test

Subscales from The Health and Taste Attitudes Questionnaire used to assess participants' explicit attitudes, february/march 2020

(Participants answered the questions in EyeQuestion on a computer. Each of the subscales were compacted into one site, meaning that every new site the participants got on their screen was a new subscale).

General health interest

	Svært uenig	Uenig	Delvis uenig	Verken enig eller uenig	Delvis enig	Enig	Svært enig
Jeg spiser sunt og variert til enhver tid	○	○	○	○	○	○	○
Det er ikke viktig for meg at det jeg spiser er sunt	○	○	○	○	○	○	○
Når jeg spiser snacks bryr jeg meg ikke hvor sunne de er	○	○	○	○	○	○	○
Jeg spiser det jeg liker og tenker ikke så mye over hvor sunn maten er	○	○	○	○	○	○	○
Det er viktig for meg at det er lite fett i maten jeg spiser	○	○	○	○	○	○	○
Jeg er veldig opptatt av at maten som jeg spiser er bra for meg	○	○	○	○	○	○	○

Neste

Craving for sweet foods

	Svært uenig	Uenig	Delvis uenig	Verken enig eller uenig	Delvis enig	Enig	Svært enig
Jeg synes det er rart at noen plutselig har veldig lyst på sjokolade	○	○	○	○	○	○	○
Jeg har ofte veldig lyst på sjokolade	○	○	○	○	○	○	○
Jeg har ofte veldig lyst på godteri	○	○	○	○	○	○	○
Jeg har ofte veldig lyst på iskrem	○	○	○	○	○	○	○
Jeg synes det er rart at noen plutselig har veldig lyst på iskrem	○	○	○	○	○	○	○
Jeg synes det er rart at noen plutselig har veldig lyst på godteri	○	○	○	○	○	○	○

Forrige Neste

Using food as a reward

	Svært uenig	Uenig	Delvis uenig	Verken enig eller uenig	Delvis enig	Enig	Svært enig
Jeg spiser noe som smaker ekstra godt når jeg syns jeg fortjener det	○	○	○	○	○	○	○
Jeg prøver å unngå å spise noe godt når jeg føler meg nedfor	○	○	○	○	○	○	○
Når jeg føler meg nedfor har jeg lyst til å trøste meg selv med å spise noe som smaker nydelig	○	○	○	○	○	○	○
Jeg unngår å belønne meg selv med mat	○	○	○	○	○	○	○
Jeg belønner meg selv ved å kjøpe noe skikkelig godt	○	○	○	○	○	○	○
Jeg mener at man lurer seg selv ved å bruke mat som belønning	○	○	○	○	○	○	○

Forrige Neste

APPENDIX 2

Cognitive and affective attitudes

Subscales from the Yuraki & Taejung (2017) study were used to assess participants' cognitive and affective attitudes, february/march 2020

(Participants answered the questions in EyeQuestion on a computer. Each of the subscales were compacted into one site, meaning that every new site the participants got on their screen was a new subscale).

Cognitive attitudes

	Svært uenig	Uenig	Delvis uenig	Verken enig eller uenig	Delvis enig	Enig	Svært enig
Å spise for mye søt mat/søtsaker er ikke bra for meg	○	○	○	○	○	○	○
Søtsaker/søt mat er vanligvis usunt for meg	○	○	○	○	○	○	○
Dersom jeg spiser for mye søtsaker, vil jeg få hull i tennene	○	○	○	○	○	○	○
Jeg vil bli tykk etter å ha spist for mye søtsaker/søt mat	○	○	○	○	○	○	○

Affective attitudes

	Svært uenig	Uenig	Delvis uenig	Verken enig eller uenig	Delvis enig	Enig	Svært enig
Når jeg spiser søtsaker, føler jeg meg bra	○	○	○	○	○	○	○
Å spise søtsaker er en av mine favoritt ting	○	○	○	○	○	○	○

APPENDIX 3

Preference tests, february/march 2020

3.1 The slide in EyeQuestion where participants clicked on the symbol that represented the cup with the chocolate milk they preferred in the blind preference test.

3.2 The slide in EyeQuestion where participants clicked on which chocolate milk they chose as a token.

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