Effect of a pleasure-oriented intervention on the nutritional quality of midafternoon snacks and on the relationship between food liking and perceived healthiness within mother-child dyads

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Abstract

The aims of the present study are to assess the impact of a pleasure-oriented intervention on the nutritional quality of midafternoon snacks chosen by mother-child dyads and to evaluate the evolution of the relationship between the liking and perceived healthiness of the food items offered for the snack choices. Data were collected at two laboratory sessions (T1 and T2), during which children and mothers were separately asked to choose two food items (among 10) for a midafternoon snack, first for themselves and then for the other dyad member. Participants also rated their liking and perceived healthiness of the 10 food items. After T1, dyads were randomly assigned to an experimental group (N=94) with an in-home pleasure-oriented intervention to stimulate the pleasure of consuming healthy foods or to a control group (N=93). Our study shows the lack of a significant effect of the intervention on the nutritional quality of snacks chosen at T2. However, for the children in the experimental group, the absence of significant relationship between liking and perceived healthiness at T1 (τ_{median} = -0.05, P = 0.56) became a significant and positive link at T2 (τ_{median} = 0.13, P = 0.002). Moreover, this increase of the relationship in T2 was significantly higher for the experimental group compared to the control group (P = 0.05). For mothers, the existing relationship between liking and perceived healthiness at T1 (τ_{median} = 0.27, P < 0.001) increased significantly between T1 and T2 (P = 0.006) only in the experimental group, even if this increase was not significantly higher compared to the control group (P = 0.21). Since the relationship between food liking and perceived healthiness in mother-child dyads increased after the intervention, one could argue that this higher positive attitude towards healthy foods could constitute the first step in a behavioural change in favour of healthier choices.

Keywords

Home-based intervention; nutritional quality; snack choices; liking; healthiness; attitude

1. Introduction

In France, midafternoon snack is a frequent habit; 62% of children aged 1 to 17 years old consume a midafternoon snack daily, while six out of ten adults regularly take a midafternoon snack (Anses, 2017). This midafternoon snack is usually taken between 4.30 p.m. and 5.30. p.m. (INPES, 2004). Nevertheless, these snacks are far from adequate from a nutritional point of view (Anses, 2017). Nutritional information can drive healthier choices by children and their mothers, but at the expense of pleasure (Poquet et al., 2019). Since pleasure is a strong driver of food choice, particularly for midafternoon snacks (Tibère, Rochedy, & Sarrat, 2018), the aims of the present study are to assess the impact of a pleasure-oriented intervention on the nutritional quality of midafternoon snacks chosen within mother-child dyads and to evaluate the evolution of the relationship between food liking and perceived healthiness for the different food items offered as snack choices.

The French National Nutrition and Health Program (PNNS; Programme National Nutrition Santé) recommends that midafternoon snacks include one to two food items among three categories: fruits, cereal products and dairy products. However, recent observations have highlighted that French children up to 10 years of age consume 25% of their total daily sugar intake during the midafternoon snack and that the snacks often include pastries, cakes and sweet biscuits (Anses, 2017). Eating a midafternoon snack is also a frequent habit among French adults (Si Hassen et al., 2018a). Overall, fatty, sweet products such as pastries, cookies, and chocolate contribute most to the energy intake (33%) from midafternoon snacks among French adults (Si Hassen et al., 2018a). A recent study showed that in women, having children in the household was associated with a lower contribution of fruits and a higher contribution of sugary products and fatty sweet foods to the total energy intake from snacks compared to those of women living without children (Si Hassen et al., 2018b). Thus, it seems relevant to identify strategies to orient midafternoon snack choices towards healthy foods in mother-child dyads.

It has been shown that providing a nutritional message can drive healthier midafternoon snack choices in mother-child dyads (Marette et al., 2016). A recent study also showed that the nutritional quality of

mothers' and children's snack choices was higher when food products were labelled with the Nutri-Score, a front-of-pack nutritional labelling system, than when they were not (Poquet et al., 2019). However, health information may not always achieve the expected effect, because it may negatively impact taste expectations. For instance, it was found that children aged 9-11 years rated a new drink with a health label as less pleasant than the same drink presented without any health label (Wardle & Huon, 2000). Another study showed that preschoolers rated crackers as less tasty and consumed fewer of them when they were presented as instrumental in achieving a health goal than when crackers were not associated with a message (Maimaran & Fishbach, 2014). In adults, the counterproductive effects of health messages or nutrition information have also been observed. For example, French consumers were more likely to choose unhealthy foods when an advertisement with a health message was present, whereas their choice of healthy foods doubled in the absence of a message (Werle & Cuny, 2012). Moreover, consumers tend to believe that healthiness and tastiness were negatively correlated, as described by the 'unhealthy=tasty' intuition (Raghunathan, Walker, & Hoyer, 2006), and may in turn reject the foods that were associated with a nutritional message. Nevertheless, an opposite association was observed in French students, for whom a food product described as healthy was considered tastier, more pleasurable and of better quality than a food product described as unhealthy (Werle, Trendel, & Ardito, 2013). Finally, Poquet et al., (2019) found that the increase in the nutritional quality of midafternoon snacks chosen within the mother-child dyads when nutritional information was provided was associated with a significant decrease in the liking of the snacks. This result was interpreted as a hedonic cost associated with changes in favour of heathier snack choices in children as well as in mothers. Since pleasure is one of the main determinants of children's food choices (Nguyen, Girgis, & Robinson, 2014; Waddingham, Shaw, Dam, & Bettiol, 2018), it seems relevant to identify strategies to orient mothers' and children's choices towards healthy foods using the pleasure of consuming healthy foods as a lever.

To the best of our knowledge, only one study has examined the effects of a message focusing on the pleasure of healthy eating compared to a message focusing on the health benefits of healthy eating on food choices from a buffet (Trudel-Guy et al., 2019). The results of this study showed that both types

of messages were effective in improving the nutritional quality of food choices, but only among a sample composed of participants with a suboptimal diet quality. Moreover, this study only targeted adults and not children. Even if the literature is scarce on the topic, some authors suggest that focusing on eating pleasure might be an ally with regard to healthy eating among children. A recent review emphasized that pleasure from eating could constitute an opportunity to promote healthy eating in children (Marty, Chambaron, Nicklaus, & Monnery-Patris, 2018). The authors identified three dimensions of pleasure from eating during childhood: the sensory dimension, which refers to pleasure from sensory sensations during food consumption; the interpersonal dimension, which relates to pleasure from the social context of food consumption; and the psychosocial dimension, which refers to pleasure from cognitive representations of food (Marty et al., 2018). Moreover, it was found that children with more hedonic-based attitudes towards food were more likely to choose healthy food options in a buffet, while children with nutrition-based attitudes chose less healthy foods (Marty et al., 2017).

Thus, the first aim of our study was to test the efficiency of a pleasure-oriented intervention targeting the three dimensions of pleasure from eating on the nutritional quality of midafternoon snacks chosen within mother-child dyads. This intervention has been implemented in the home because it has been previously shown that a familiar setting should constitute a logical location to promote healthier food choices in mother-child dyads (Snuggs, Houston-Price, & Harvey, 2019). To assess the impact of this pleasure-oriented intervention on the nutritional quality of midafternoon snacks, we used an experimental design in which the participants, before and after the intervention, were faced with the same variety of food items and were asked to choose midafternoon snacks among them. Our first hypothesis was that after the pleasure-oriented intervention, the snack choices of the mothers and children would be of better nutritional quality than their snack choices before the intervention in the experimental group but not in the control group. We also examined the evolution of the difference in the nutritional quality of the children's snacks when chosen by the child or by their mother. This comparison seems relevant since mothers are still mostly in charge of food purchases in French households (Mathé & Hébel, 2013), but they also take into account the desires of their child when

offering them foods for their midafternoon snack (Marette et al., 2016; Tibère, Rochedy, & Sarrat, 2018). In addition, since mothers have been described as 'indulgent' when choosing a lower number of healthy foods for their child than for themselves (Marette et al., 2016), we also examined the effect of the intervention on the difference in the nutritional quality of the snacks chosen by the mothers for themselves and for their children.

Since a food-pleasure orientation can lead to healthier food choices than a health/nutrition orientation in children (Marty et al., 2017), one could assume that stimulating the pleasure of consuming healthy foods could increase their liking. Thus, the second aim was to assess for the first time the relationship between food liking and perceived healthiness of a range of sweet food items for children and mothers and to determine whether this potential link could be modified by an intervention promoting the pleasure of consuming healthy foods. Our second hypothesis was that after the pleasure-oriented intervention, the relationship between liking and perceived healthiness of the food items would increase among participants of the experimental group compared to those of the control group.

2. Materials and Methods

General design

The experiment was performed in Dijon, Burgundy, France from February to June 2018. The general design is presented in Fig. 1 and summarized below. In total, 187 mother-child dyads participated in the present study. Mothers were included in the study because, as indicated previously, they are still mostly in charge of food purchases in French households (Mathé & Hébel, 2013). Data were collected during two sessions conducted in the laboratory at T1 (February) and T2 (April). During these two sessions, participants were invited to choose two out of ten food items for their own midafternoon snacks. Then, they were asked to choose two food items among the same set of ten food items for the midafternoon snack of the other dyad member. The participants also rated their liking and perceived healthiness of the ten food items. At the beginning of the session, the participants were informed that one of the two chosen snacks, i.e. the snack chosen by the participants for themselves and the one chosen by the other dyad member would be randomly selected to be consumed on site in another

friendly room. This specific procedure was used because the random draw reinforced the participants' direct involvement since the participants will consume the selected snack immediately after the session. This immediate consequence is supposed to ensure the sincerity of the participants' choices in accordance with their preferences. After T1, the dyads were randomly assigned to either an experimental group, in which they received a pleasure-oriented intervention aimed at stimulating the pleasure of consuming healthy foods for a midafternoon snack, or a control group, in which they received a programme focused on table decoration. A snack booklet, in which the participants had to note beverages and food items consumed during the midafternoon on the two weekend days following the receipt of the booklet, was sent at T1, T2, and T3 (June) to each participant (results not shown in the present paper).

<table>
<tr><th colspan="2">T1</th><th>Intervention</th><th colspan="2">T2</th><th>T3</th></tr>
<tr><td colspan="2">February</td><td>March</td><td colspan="2">April</td><td>June</td></tr>
<tr><th>Laboratory</th><th>Home</th><th>Home</th><th>Laboratory</th><th>Home</th><th>Home</th></tr>
<tr><td rowspan="2">Choices
Participants chose 2 food items for their own midafternoon snacks. Then, they were asked to choose 2 food items among the same set of 10 food items for the midafternoon snack of the other dyad member

Online questionnaire
Participants rated liking and perceived healthiness of the 10 food items for themselves and for the other dyad member</td><td rowspan="2">1st snack booklet</td><td>Experimental group
Participants received 3 boxes targeting the 3 dimensions of pleasure from eating to stimulate the pleasure of consuming healthy foods</td><td rowspan="2">Choices
Participants chose 2 food items for their own midafternoon snacks. Then, they were asked to choose 2 food items among the same set of 10 food items for the midafternoon snack of the other dyad member

Online questionnaire
Participants rated liking and perceived healthiness of the 10 food items for themselves and for the other dyad member</td><td rowspan="2">2nd snack booklet</td><td rowspan="2">3rd snack booklet
+
Questionnaire
Participants indicated involvement in the intervention</td></tr>
<tr><td>Control group
Participants received 3 boxes concerning the table decoration</td></tr>
</table>

Fig. 1. General design of the longitudinal study

2.1. Food items selected for the laboratory sessions at T1 and T2

Table 1 shows the ten food items selected for the two laboratory sessions and their nutritional scores based on the algorithm used to determine the Nutri-Score (a French nutritional labelling system officially chosen by the French government to be displayed on food products), providing an assessment of their nutritional quality (Ministère des solidarités et de la santé, 2017). It must be noted

that the Nutri-Score was not displayed on the packages of the food items when the participants were making their choices. At least one food item with good nutritional quality belonged to each of the three categories (fruits, cereal products and dairy products) recommended by the PNNS as a midafternoon snack (INPES, 2004). All food items were available in individually portioned packaging.

Table 1. Food items proposed for snack choices and their nutritional scores

Food items	Nutritional scores*
Applesauce - Pom'potes ®	-3
Banana	-2
Cereal bar - NAT&vie ®	0
Strawberry yogurt drink - Yop ®	1
Fruit salad - Douceur du verger ®	2
Squeezable strawberry yogurt - Pom'potes ®	3
Chocolate biscuit - Prince ®	15
Chocolate brioche - Pitch ®	18
Chocolate crepe - Whaou ®	22
Chocolate bar - Kinder Bueno ®	27

Note: *The higher the nutritional score, the lower the nutritional quality.

2.2. Participants

Participants were recruited from the population registered in the ChemoSens Platform database. This database has been declared to the relevant authority (Commission Nationale Informatique et Libertés – CNIL – n°1148039). Participants were also recruited with the help of a consumer recruitment company. For children, the inclusion criterion was a grade level of 3rd, 4th or 5th grade. An information sheet was sent to mothers and their child in which they were told that the study will aim to better understand the food choices of children and mothers. They were informed that they will have to participate in two laboratory sessions, that they will receive 3 boxes at home and that they will have to fill in different questionnaires in the laboratory and at home and give some feedback about the box content. Mothers and their children provided written consent to participate in this experiment, and the study was reviewed and approved by the ethics evaluation committee of Inserm (IRB00003888). One hundred and eighty-nine dyads were recruited, but data from two dyads were excluded because they participated only in the first session. Thus, data from 187 mother-child dyads were included in the

present paper. The mothers were compensated for their participation with a €40 gift voucher distributed at the end of the second session.

After T1, all dyads participating in sessions on the same day were randomly assigned to either the experimental or control group by an experimenter who was not present during the sessions. The experimental group was composed of 94 dyads, and the control group was composed of 93 dyads. Table 2 summarizes the sociodemographic characteristics of our sample. There was no significant difference between the two groups in terms of gender or grade level of the children, and in terms of age, educational level or household monthly net income of the mothers.

Table 2. Sociodemographic characteristics of the participants

	Experimental (N=94 dyads)	Control (N=93 dyads)
Child gender (%)		
Female	48.9	48.4
Male	51.1	51.6
Child mean age (years)	9.5*	9.3*
Child grade level (%)		
3rd grade	34.0	41.9
4th grade	40.4	33.3
5th grade	25.5	24.7
Mother age (%)		
≤ 40 years	60.6	67.7
> 40 years	39.4	32.3
Mother education (%)		
No diploma	2.1	0
General Certificate of Secondary Education (GCSE) under C Grade/Youth Training/Business and Technology Education Council (BTEC) First Diploma	7.5	10.8
Advanced level (A-level) qualification	21.3	19.4
Second-year or higher university-level education	67.0	67.7
Higher than Master 2	2.1	2.2
Household monthly net income (%)		
≤ 3000 €	52.1	47.3
3000 – 4000 €	30.9	33.3
≥ 4000 €	17.0	19.4

* Data were available for 93 children in the experimental group and for 87 children in the control group.

200 *2.3. Experimental procedure*

201 *2.3.1. Sessions conducted in the laboratory at T1 and T2*

202 The experimental procedure was based on a previously used protocol involving mother-child dyads
203 (Poquet et al., 2019). The mother-child dyads participated in two 1-hour sessions in the laboratory.
204 These sessions were scheduled in the afternoon, with a maximum of seven dyads per session. The
205 participants were not informed that the content of the second session would be the same as that of the
206 first session. During the experiment, mothers and children were placed in front of a computer.
207 Moreover, to avoid oral and visual interaction, the members of each dyad sat back to back, and screens
208 were installed between them at the centre of the room. Thus, the participants' choices were not made
209 in front of the experimenter. At the beginning of the session, instructions were given by the
210 experimenter. In these instructions, the experimenter insisted on the participants' freedom to choose
211 foods according to their preferences and in the absence of bad or good replies. During the sessions, the
212 concepts of pleasure and nutrition were not mentioned.

213 *2.3.2. Participants' selections of snacks for themselves and for the other dyad member*

214 One box containing ten real food items was distributed to each participant. Children and mothers were
215 asked to choose two food items for their own midafternoon snack. The two selected food items were
216 placed in a bag, and once filled, the bags were taken away by the experimenters. A new box containing
217 the same set of ten real food items was distributed to each participant. Then, children and mothers
218 were asked to choose two food items for the midafternoon snack of the other dyad member. Thus, a
219 child chose two food items for his or her mother, and the mother chose two food items for her child.

220 The order of the different choices was not randomized. All participants began by choosing a
221 midafternoon snack for themselves, then for the other dyad member. This procedure has been used in
222 recent studies involving mother-child dyads (Marette et al., 2016; Poquet et al., 2019). As in these
223 studies, we have considered that it was more simple and ecological to ask children, as well as mothers,
224 to choose first for themselves and then for the other dyad member. This order seems "natural", since
225 participants naturally prefer to choose for themselves (Lusk, Marette, & Norwood, 2014). Moreover,

any potential compensation effect was reduced since, as mentioned above , the experimenters took away each bag containing the two selected food items by the participants for themselves in order that participants did not see any longer their first choices while selecting the food items for the other dyad member. Thus, with this procedure, the two steps (first choices for themselves, then choices for the other member) were clearly separated.

2.3.3. Liking and perceived healthiness questionnaires

The participants were invited to answer questions on a computer. First, they had to guess what the other dyad member had chosen for them during the last choice (results not shown). Then, the participants rated their own liking of each item ("How much do you like this food?") using a 5-point scale, with the left-most anchor labelled "I don't like it at all" and the right-most anchor labelled "I like it very much", as well as the expected liking for the other dyad member ("How much do you think your mom/child likes this food?") using a 5-point scale, with the left-most anchor labelled "My mother/child doesn't like it at all" and the right-most anchor labelled "My mother/child likes it very much". Subsequently, the participants rated the perceived healthiness of each item, first for themselves ("How healthy do you think this food is for you?") using a 5-point scale, with the left-most anchor labelled "It is not healthy at all" and the right-most anchor labelled "It is very healthy" and then for the other dyad member ("How healthy do you think this food is for your mom/child?") using a 5-point scale, with the left-most anchor labelled "It is not healthy for my mom/child" and the right-most anchor labelled "It is very healthy for my mom/child". All responses were converted into values from 1 to 5 for the statistical analyses.

2.3.4. Random draws of snacks and consumption on-site

The participants were invited to indicate which snack they would like to have: the snack chosen by and for themselves or the snack chosen by the other dyad member for them (results not shown). Then, they randomly drew one token among two, one marked '1' and the other marked '2', and received the snack they had chosen for themselves if they drew the token marked '1' or the snack the other dyad member had chosen for them if they drew the token marked '2'. One could argue that the consumption

of one of the two chosen snacks on site reinforced the participants' involvement and thus that the participants' choices were more sincere, because they projected themselves into a real consumption situation. After drawing a token, the participants were asked to indicate their level of satisfaction using a 5-point scale, with the left anchor labelled "I am not at all satisfied" and the right anchor labelled "I am very satisfied" (results not shown). The midafternoon snack consumption took place on-site in another room in a convivial atmosphere.

2.4. Description of the intervention

2.4.1. Content of the boxes for the participants of the experimental group

Each dyad in the experimental group received three boxes at home, each targeting the three dimensions of pleasure from eating: 1) the sensory dimension; 2) the interpersonal dimension and 3) the psychosocial dimension (Marty et al., 2018) and aiming at stimulating the pleasure of consuming healthy foods for midafternoon snacks. Four focus groups (two with five mothers and two with five children who did not participate in the main experiment) had been previously conducted to test different kitchen utensils in order to collect opinions regarding their easy-to-use amongst mothers and to select those who stimulated the manipulation and playing in children. Moreover, mothers and children were asked to read the infographics in order to check that they were acceptable for children. The results of these focus groups allowed us to select kitchen utensils for the intervention in the experimental group. The first box focused on fruits, the second focused on cereal products, and the third focused on dairy products. These three categories are recommended by the PNNS for midafternoon snacks (INPES, 2004).

Each box contained a card about the five senses, which targeted the sensory dimension by describing with specific vocabulary the sensations and feelings experienced through the different senses when consuming fruits, cereal products or dairy products. Each box contained also one kitchen utensil, a recipe card and a culinary challenge. In the first box, there was an apple peeler and a set of bamboo picks to make fruit skewers, in the second box moulds for cereal bars and a set of six small jars to preserve cereals, and in the third box a set of small, pretty glasses (French "verrines"). In the first box

there was a banana-apple pie recipe, in the second box there was a cereal bar recipe with honey, and in the third box there was a recipe with white cream cheese ("fromage blanc") and caramelized apples in verrines. Two of the three recipes were low in sugar content. In fact, the banana-apple pie recipe contained only one packet of vanilla sugar, and the white cream cheese was caramelized with one spoon of powdered sugar. The recipes targeted the sensory dimension of pleasure from eating, giving participants the opportunity to consume a midafternoon snack with fruit, cereal products and dairy products. The culinary challenge invited each dyad to make a recipe for their midafternoon snacks with the kitchen utensils present in the box and to post a picture of the result on a dedicated blog. By involving the dyad in a common activity, which acted as a source of social interaction, the culinary challenge focused on the interpersonal dimension of pleasure from eating. Each box also contained a card explaining how to post the results of the culinary challenge on the dedicated blog. Two infographics about the history and origin of two foods belonging to the target category were present in each box. The two infographics in the first box described the histories of bananas and apples, those of the second box described the histories of wheat and oats, and those of the third box described the histories of milk and yogurt. To entertain children in order to engage them in the intervention, behind each infographic, there was a quiz composed of three questions, as well as a game (e.g., crossword puzzle or labyrinth). The two infographics targeted the psychosocial dimension of pleasure from eating. These infographics aimed to build knowledge on foods belonging to one of the target categories to modify participants' representations and thus increase their attraction to fruits, cereal products and dairy products. Overall, we have used different keys in order to operationalize the different dimensions of pleasure. The full set of cards included in the different boxes is presented in "Supplementary data A". The box content did not explicitly refer to the concepts of nutrition and health and did not emphasize explicitly that consuming healthy foods could bring pleasure.

2.4.2. Content of the boxes for the participants of the control group

Each dyad of the control group received three boxes at home that targeted table decoration and were aimed at involving participants in table decoration activities without stimulating the pleasure of consuming healthy foods. Similar to the boxes addressed to the participants in the experimental group,

each box also contained objects and cards. More precisely, each box contained one table decoration object, two infographics about table cutlery, one creative challenge, and one card explaining how to post the results of the creative challenge on a dedicated blog that was different from the blog for the experimental group.

2.5. Statistical analysis

Statistical analyses were performed with R software for Windows, version 3.4.2.

2.5.1. Assessment of the effect of the intervention on the nutritional quality of the snacks

To evaluate the nutritional quality of the chosen snacks, we used a nutritional score based on an algorithm designed to distinguish foods with favourable and unfavourable nutritional composition. This algorithm was built on the United Kingdom (UK) Food Standard Agency Nutrient Profiling System which was modified to derive the Nutri-score (Anses, 2016). To calculate this nutritional score, positive points from 0 to 10 are allocated for unfavourable components including energy density, saturated fatty acids, sugars and sodium, while negative points from 0 to 5 are allocated for favourable components including the percentage of fruits, vegetables and nuts, and the content in fibre and protein. The final score is calculated as the difference between the positive points and negative points and can range from -15 (the most favourable from a nutritional point of view) to + 40 points (the most unfavourable from a nutritional point of view). In other words, the lower the nutritional score, the better the food is in terms of nutritional quality. The nutritional score of each chosen snack used in the analyses was the sum of the scores of the two selected food items among our food offerings (see Table 1); it could range from - 5 to + 49.

To assess the effect of the intervention, we calculated, for each participant, the differences in the nutritional scores of the snacks chosen at T1 and at T2 (i.e., score at T2 - score at T1, hereafter referred to with the term 'change') for themselves and for the other dyad member. Then, the change was compared between the experimental and control groups using the Wilcoxon test for unpaired samples. The nutritional quality of the children's midafternoon snacks selected by themselves or by their mother as well as its change was compared after the intervention through paired-samples

Wilcoxon tests for each group. Finally, for both groups at T1 and T2, the nutritional quality of the choices made by the mothers for themselves was compared to the nutritional quality of choices they made for their child through paired-samples Wilcoxon tests. Then, the change between T1 and T2 was compared between the two groups through unpaired-samples Wilcoxon tests.

2.5.2. Effect of the pleasure-oriented intervention on the relationship between liking and perceived healthiness ratings for the ten food items

A new variable was defined in order to evaluate the link between the ten individual scores for food liking and the ten individual scores for perceived healthiness. This new variable was defined as the score obtained by the calculation of Kendall's tau (τ) between food liking and perceived healthiness ratings reported by each participant for the 10 products. This variable was calculated for mothers and for children of both groups at T1 and T2. Thus, altogether, eight variables were calculated. Wilcoxon tests for paired samples were used to investigate the difference between T1 and T2 of this new variable for children and mothers of each group. Furthermore, individual differences between T1 and T2 obtained for the experimental group and for the control group were compared using Wilcoxon tests for unpaired samples.

3. Results

Descriptive analyses on the liking and perceived healthiness ratings of the 10 food items are reported for the experimental and control groups at T1 and T2 in Supplementary data B (Fig. B.1). The distributions of the changes in liking and in perceived healthiness ratings in both groups are also presented in Supplementary data B (Fig. B.2). In this following section, we will first present the results related to the effect of the intervention on the nutritional quality of the snacks. Then, the evolution of the relationship between food liking and perceived healthiness in both groups will be presented. For all analyses, the results of the two groups (experimental and control) will be compared.

3.1. Analyses of the nutritional quality of snack choices

355 *3.1.1. Effect of the pleasure-oriented intervention on the nutritional quality of choices made by the*
356 *participants for themselves*

357 Contrary to our hypothesis, no significant difference was found between the experimental and control
358 groups regarding the change in nutritional scores of the snacks chosen by the children for themselves
359 (P = 0.58) or by their mothers for themselves (P = 0.19). In fact, the median nutritional score did not
360 evolve in any group (Fig. 2): it was approximately 28 for the children and approximately 16 for all
361 mothers except for those at T2 in the control group, where it was equal to 20. As shown in
362 Supplementary data D (Fig. D.1), in both groups, approximately 70% of the children chose the
363 chocolate bar at T1 and at T2. When looking at the composition of the snack, we observed that at T1,
364 50% of the children who chose the chocolate crepe complemented their snack with one healthy food
365 item. An improvement was observed at T2: 75% of the children who chose the chocolate crepe
366 complemented their snack with one healthy food item. This improvement was not found in the
367 children who chose the chocolate bar: 76.3% of them chose one healthy food item at T1, and 75.4%
368 chose one healthy food item at T2.

369 Despite no significant changes in the nutritional quality of the snack choices, it is worth noting that the
370 liking for one healthy item, the cereal bar, increased significantly between T1 and T2 in the
371 experimental group (P = 0.003), whereas the liking did not change in the control group (P = 0.94). In
372 contrast, the liking decreased between T1 and T2 among the children in the experimental group for
373 two unhealthy items, the chocolate brioche (P = 0.04) and the chocolate bar (P = 0.003), whereas the
374 liking did not change in the control group (P = 0.87 and P = 0.28, respectively). No other significant
375 changes were observed between the two groups.

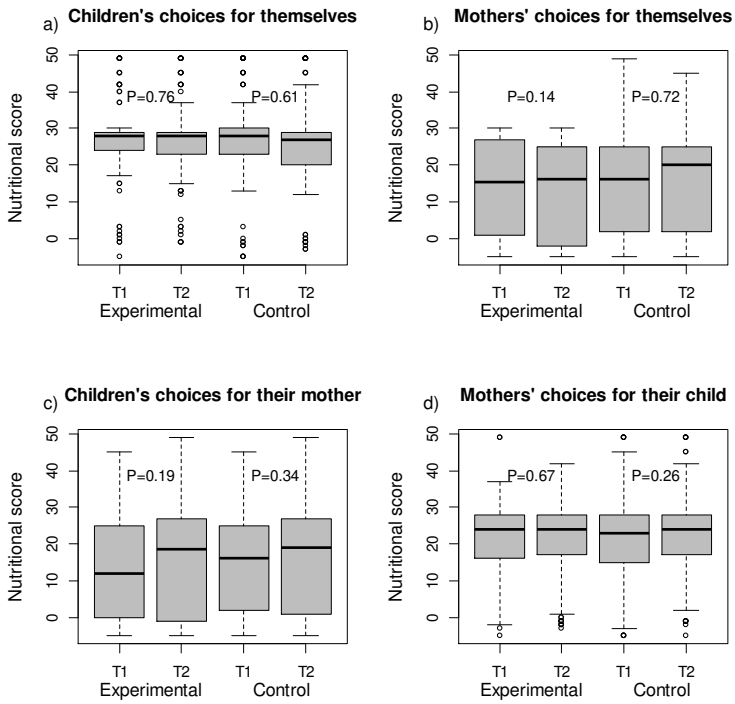

Fig. 2. Distributions of the nutritional score of the choices made by the children and the mothers for themselves (a, b) and for the other dyad member (c, d) at T1 and T2 in the experimental and control groups. The higher the nutritional score, the lower the nutritional quality.

3.1.2. Effect of the pleasure-oriented intervention on choices made by the participants for the other dyad member

Concerning snack choices made by the participants for the other dyad member, there was no significant group difference in the change in the nutritional score among either the children (P = 0.19) or mothers (P = 0.57). In fact, as shown in Fig. 2, the median did not evolve in any group.

3.1.3. Nutritional quality of the children's midafternoon snacks selected by themselves or by their mother and its evolution after the intervention

The results showed that in the experimental group, the children chose snacks of lower nutritional quality for themselves than their mothers did for them at T1 and T2 ($P < 0.001$). The median of the differences was equal to 1 at T1 and T2. Similar results were observed in the control group at T1 ($P < 0.001$) and T2 ($P < 0.05$). The median of the differences was equal to 5 at T1 and 2 at T2. In addition, the higher nutritional quality of the choices made by the mothers compared to those made by the

children was not affected by the pleasure-oriented intervention. Indeed, there was no significant difference between the changes in the nutritional score of snacks chosen by the children for themselves and by the mothers for their child at T2 compared to T1 in the experimental group (P = 0.48) or in the control group (P = 0.08); see Supplementary data C (Fig. C.1).

3.1.4. Assessment of mothers' indulgent behaviour

To check if the mothers were "indulgent" as previously shown (Marette et al., 2016), we compared the nutritional quality of the choices made by the mothers for themselves to those they made for their child. In the experimental and control groups, the mothers' choices for their child were significantly more oriented towards products with low nutritional quality than the mothers' choices for themselves at T1 and T2 (all *Ps* < 0.0001). The median of the differences was -2 at T1 and -5.5 at T2 in the experimental group. In the control group, the median of the differences was -4 at T1 and -3 at T2. These results corroborated the "indulgent" behaviour of the mothers observed in Marette et al. (2016).

This trend was not modified by the pleasure-oriented intervention. In fact, no significant change was found in the difference in the nutritional scores of the snacks chosen by the mothers for themselves and those chosen for their child at T2 compared to T1 in the experimental (P = 0.21) or control group (P = 0.68); see Supplementary data C (Fig. C.2).

3.2. Effect of the pleasure-oriented intervention on the relationship between liking and perceived healthiness ratings for the ten food items

For the children in the experimental group, the median of the individual correlations between liking and perceived healthiness of the food items was not different from zero at T1 (τ_{median} = -0.05, P = 0.56), increased significantly between T1 and T2 (*P* < 0.001), and became significantly positive at T2 (τ_{median} = 0.13, P = 0.002). Thus, at T2, the higher the perceived healthiness, the higher the liking of the food item was. For the children in the control group, the median of the individual correlations was not different from zero (τ_{median} = 0.03, P = 0.42) at T1, did not change between T1 and T2 (P = 0.23) and was still not different from 0 at T2 (τ_{median} = 0.09, P = 0.06). Moreover, the increase in the individual

correlations between liking and perceived healthiness ratings between T1 and T2 was significantly higher among the children in the experimental group than among the children in the control group (P = 0.05). Thus, as hypothesized, the relationship between liking and perceived healthiness ratings was reinforced only in children who received the pleasure-oriented intervention.

For the mothers in the experimental group, the median of the individual correlations between liking and perceived healthiness of the ten food items was different from zero at T1 (τ_{median} = 0.27, P < 0.001), increased significantly between T1 and T2 (P = 0.006), and thus was also significantly positive at T2 (τ_{median} = 0.35, P < 0.001). In contrast, for the mothers in the control group, no significant increase was observed. In fact, the median of the individual correlations between liking and perceived healthiness of the food items was positive at T1 (τ_{median} = 0.28, P < 0.001) and remained significantly positive at T2 (τ_{median} = 0.30, P < 0.001) but did not change between T1 and T2 (P = 0.26). However, the increase in the median of the individual correlations between liking and perceived healthiness ratings between T1 and T2 was not significantly higher among the mothers in the experimental group than among the mothers in the control group (P = 0.21).

4. Discussion

To the best of our knowledge, this is the first study to investigate the impact of an in-home intervention based on the three dimensions of pleasure from eating on midafternoon snacks chosen within mother-child dyads. Contrary to our first hypothesis, we did not find a significant impact of the pleasure-oriented intervention on the nutritional quality of the choices made by the participants for themselves and for the other dyad member during the experimental session in the laboratory. One could argue that this result may be due to low participants' involvement. However, to ensure participants' involvement, they were invited to post photos of their completed recipe and associated comments on a dedicated blog. In a sense, this result is particularly realistic since participants may forget a part of the content of the intervention and/or they may not connect this content with their effective choices in T2. This absence of connections between the intervention and the effective choice is a major problem for nutritional interventions (DeCosta, Møller, Frøst, & Olsen, 2017).

Another explanation regarding the absence of impact concerning the intervention to improve the nutritional quality of the chosen snack could be due to the attractiveness of the Kinder Bueno® chocolate bar. Even if this food item was not significantly more liked than healthy foods such as a banana or applesauce (see Supplementary data C), it was more frequently selected than these two highly liked products by children and mothers before and after the pleasure-oriented intervention, as shown in Supplementary data D (Fig. D.1). It was also more frequently selected than the chocolate crepe, while both products were liked similarly by the children. This suggests that food choices were not only driven by the liking of them. Thus, we could suggest that the Kinder Bueno® chocolate bar, which is a pleasure-oriented product in terms of communication, seems to drive a specific desire and/or disinhibited behaviour. Indeed, it must be noted that this bar was the most commonly consumed chocolate bar in France during the survey period, i.e., from 2015 to 2018 (Statistica Research Department, 2019a). The attractiveness induced by the Kinder Bueno® chocolate bar can also be due to the brand and its extensive marketing. In fact, the producer of this chocolate bar was amongst the first 10 TV advertisers in France in 2018, and was the 1st one for food products (Statistica Research Department, 2019b). Robinson et al. (2007) showed that children preferred the tastes of foods and beverages when the McDonald's brand was indicated on the packaging, demonstrating that brand identity can influence young children's taste perceptions. Whereas more children who chose the chocolate crepe were likely to complement their snack with one healthy food item after the intervention compared to before, no improvement was observed for the chocolate bar since, in most cases, the children who chose this product already balanced their snack with one healthy food item at T1, which limited the possibility of improvement. One explanation for why no effect of the intervention on the nutritional quality of snack choices was observed could be that the choices were made in a laboratory setting, whereas the intervention was implemented at home. In the same way that it can be difficult to transfer the effects of an intervention away from home on in-home habits (DeCosta et al., 2017), one could argue that the reverse effect is also possible, especially when an attractive product is proposed. Despite the absence of a significant impact regarding the intervention on the nutritional quality of the choices, the increase in liking ratings for one healthy food (the cereal bar) and the decrease in liking ratings for two unhealthy foods (the chocolate brioche and the

chocolate bar) observed only in the children who were exposed to the pleasure-oriented intervention could constitute a first step in the modification of attitudes which could, in turn, increase intrinsic motivation for healthy options and consequently favour long-term behavioural modification.

The results of our study confirmed previous data on "indulgent" behaviour observed in mothers while choosing snacks for their child (Marette et al., 2016). Even if the mothers are 'indulgent' by choosing snacks of lower nutritional quality for their children than for themselves, children chose snacks of lower nutritional quality for themselves than their mothers did for them. This result was different from those of Marette et al. (2016), who showed that children chose the same number of healthy foods (i.e., two out of five) for themselves than the mothers did for their child. This difference could be due to methodological differences between the two studies. In fact, in the present experiment, the items were chosen for an immediate consumption whereas in Marette et al. (2016) the products were brought at home. In conclusion, providing the opportunity for children to choose the foods they want to consume would elicit greater food enjoyment and might enhance their autonomy (Altintzoglou et al., 2015). However, offering children a large selection of foods with varying levels of nutritional quality could decrease the nutritional value of their choices (Beets et al., 2014).

At T1, we observed no relationship between liking and perceived healthiness among children in both the experimental and control groups. This result is consistent with those of a study showing that perceived taste and healthfulness ratings were not correlated for either healthy or unhealthy foods in children aged 7-12 years old (Heard, Harris, Liu, Schwartz, & Li, 2016). Concerning mothers at T1, we found a positive correlation between liking and perceived healthiness, which is in line with previous results indicating that for French consumers, a food product that was described as healthy was considered tastier, more pleasurable and of better quality than when it was described as unhealthy (Werle et al., 2013). This positive correlation found for adults in the experiment conducted by Werle et al. (2013) and in our experiment, which is in contradiction with the unhealthy=tasty intuition could be explained by cultural differences. In fact, Fischler & Masson (2008) showed that when Americans and French were asked what food meant to them, they did not use the same concepts in the responses they gave. Indeed, while for Americans, food was spontaneously approached in terms of nutrition, the

499 French's responses were more related to the concepts of sociability, commensality and even
500 conviviality. It is noticeable that this opposition between healthy and tasty is mainly observed in
501 Anglo-Saxon cultures, but is not systematic in studies with French participants (Werle, Trendel, &
502 Ardito, 2013). At T2, in accordance with our second hypothesis, we found that, for children, the
503 relationship between liking and perceived healthiness became positive after the pleasure-oriented
504 intervention only in the experimental group. For the mothers, the positive relationship between liking
505 and perceived healthiness was reinforced only in the experimental group. Since the positive
506 relationship between liking and perceived healthiness was observed before the intervention only for
507 the mothers, there was more room for improvement among the children than among the mothers. In
508 addition, this is encouraging since maternal positive attitudes towards healthy foods could constitute a
509 lever that could be reinforced through a pleasure-oriented intervention, which could in turn favour
510 positive attitudes in children towards healthy foods.

511 The present study has several limitations. First, unlike an intervention conducted in laboratory, it is
512 more difficult to control participants' involvement at home. To challenge this limit and to favor
513 participants' involvement, the participants were invited to post a photo of their recipe and associated
514 text on a dedicated blog. In total, among the 94 participants of the experimental group, 61 posted at
515 least one photo on the blog. Moreover, it was possible that this involvement rate was underestimated
516 since some participants could have realized a recipe without posting a photo on the blog. Interestingly,
517 the analysis of the mothers' verbatim responses on the blog indicated that the intervention was well
518 received by the dyad. For example, this analysis revealed that the cereal bar molds were an exciting
519 discovery for the participants, which could partly explain the increase in the liking ratings for the
520 cereal bar among the children in the experimental group. The second limitation is linked to the
521 inclusion of the very well-liked chocolate bar Kinder Bueno® which has a very attractive power, which
522 may have impeded the potential and possible subtle effect of the pleasure-oriented intervention on the
523 global nutritional quality of the snacks selected by the participants. Other highly liked foods offered
524 during the sessions did not lead to such frequent choices in children, which raises a methodological

issue. Thus, in future study it could be worth to ask participants to rate not only their liking but also their wanting or desire towards food items.

Conclusion

Our experiment showed that a pleasure-oriented intervention conducted at home did not improve the nutritional quality of the midafternoon snacks chosen in a laboratory session in mother-child dyads, probably because of the presence amongst the food offerings of highly attractive food that was chosen anyway. This observation raises questions concerning the marketing of unhealthy foods. Banning the advertising of some emblematic and unhealthy foods could be considered, or even a more radical policy consisting of limiting the access to these products via banning vending machines in some places or limiting shelf space in supermarkets. Alternatively, the use of marketing to promote healthy foods, such as fruits, could be a good way to increase their attractiveness among children and thus promote their consumption.

Since our food pleasure-oriented intervention increased the relationship between food liking and perceived healthiness in the mother-child dyads, one could argue that this higher positive attitude towards healthy foods could constitute the first step of a future behavioural change in favour of healthier food choices. Further research is needed to assess whether such a modification in attitude could induce healthier choices in the long term. In order to learn pleasure from healthy foods, children need repeated experiences in positive social contexts with these foods, as well as eating occasions to observe others enjoying healthy foods, and an environment that creates positive expectations. Thus, developing programmes where children and their parents would have the opportunity to increase their knowledge and sensory experience with healthy foods in a pleasant and arousal context, could be a way to promote the consumption of healthy foods.

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