

Taste the feeling or feel the tasting

Citation for published version (APA):

Nederkoorn, C., Theißen, J., Tummers, M., & Roefs, A. (2018). Taste the feeling or feel the tasting: Tactile exposure to food texture promotes food acceptance. *Appetite*, 120, 297-301.
<https://doi.org/10.1016/j.appet.2017.09.010>

Document status and date:

Published: 01/01/2018

DOI:

[10.1016/j.appet.2017.09.010](https://doi.org/10.1016/j.appet.2017.09.010)

Document Version:

Publisher's PDF, also known as Version of record

Document license:

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Appetite

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Taste the feeling or feel the tasting: Tactile exposure to food texture promotes food acceptance

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ARTICLE INFO

Article history:

Received 25 January 2017

Received in revised form

25 August 2017

Accepted 13 September 2017

Available online 20 September 2017

ABSTRACT

The texture of food can be a reason why children reject it: It matters if food is crispy, slimy, smooth or has pips and bits in it. In general, mere exposure is the best method to increase acceptance of food: becoming more familiar with a food by repeated exposure increases liking for it. However, exposure to texture can be difficult, as children can be reluctant to try tasting it. In the current study, it is tested if acceptance of a food with a specific texture is improved after exposure to the feel of it, with hands only. Sixty-six children (between 3 and 10 years old) were randomly assigned to either the exposure or control condition. In the exposure condition, children played with an colourless and odourless jelly with their hands and in the control group, children played a board game. Afterwards, children were asked to taste 3 desserts (in balanced order): smooth strawberry yoghurt, strawberry yoghurt with pieces and strawberry jelly. Results showed that the children in the exposure condition ate specifically more of the jelly dessert - the texture of which they had been pre-exposed to - compared to the children in control condition. No group differences were found for the other two desserts. The results imply that feeling the texture of a food with hands increases the acceptance of food with the same texture. Playing with food with hands seems therefore be a first step in getting familiar with food and might help to increase variety of food intake.

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Sufficient intake of fruit and vegetables is important for a healthy diet. In young children, this is not always easy to achieve: children become more selective in eating around 2 years old, they start rejecting foods they previously liked and avoid new foods (Dovey, Staples, Gibson, & Halford, 2008; Jacobi, Agram, Bryson, & Hammer, 2003). Although most children grow out of this gradually (Nicklaus, 2009), variety between children is large and around 13–22% of children between 2 and 12 years can be considered picky or fussy eaters (Jacobi, Schmitz, & Agram, 2008; Mascola, Bryson, & Agram, 2010). This means that they reject a large proportion foods, both familiar and novel, which results in a diet which is characterised by a low variety of foods. A specific subset of picky eating is food neophobia, which refers to the rejection of novel or unknown foods (Dovey et al., 2008). Picky eating is related to insufficient intake of fruit and vegetables, a higher incidence of underweight and even malnutrition (Antonioni et al., 2015; Ekstein, Laniado, & Glick, 2010; Jacobi et al., 2003). Moreover, children who eat a less varied diet at a young age, tend to have less varied diets later in life,

especially when considering intake of fruit and vegetables (Nicklaus, Boggio, Chabanet, & Issachou, 2005; Skinner, Carruth, Bounds, & Ziegler, 2002). A varied diet at childhood might therefore help to establishing a healthy, nutritional diet at adulthood.

The decision of children to reject foods is not only based on taste, but also on how the food smells, looks or feels (Coulthard, Palfreyman, & Morizet, 2016; Monnery-Patris et al., 2015). Werthmann et al. (2015) asked children to taste several types yoghurts and varied the color, taste or structure of the yoghurts successively, while keeping the other two features constant. Variations in taste and color did not affect food acceptance, however, chances in food texture led to reduced food intake. They concluded that food texture is an important feature, influencing food acceptance in children. It seems that specifically food that has pieces in it, is tough, feels slimy or slippery is often rejected by children (Szczesniak, 2002), and food that looks mushy or slimy is more easily considered disgusting (Martins & Pliner, 2006). Children who enjoy tactile stimulation or tactile play less, are found to be pickier

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in eating (Nederkoorn, Jansen, & Havermans, 2015) and score higher on food neophobia (Coulthard & Sahota, 2016; Coulthard & Thakker, 2015; Smith, Roux, Naidoo, & Venter, 2005). This suggests that children who are more sensitive to tactile stimulation in general might reject foods more easily because they don't like the texture or mouth feel.

A common strategy to improve liking of foods is mere exposure. Frequent exposure to a stimulus makes it more familiar and enhances the attitude towards this stimulus (Zajonc, 1968). When children taste an unknown food several times, this increases the liking and acceptance of the food (i.e. Cooke, 2007; Hetherington et al., 2015; Maier-Nöth, Schaal, Leathwood, & Issanchou, 2016). Repeated exposure can also help to increase the liking of a familiar but previously disliked food (Wardle et al., 2003), showing that mere exposure can not only help to overcome food neophobic reactions, but also picky eating in general. If children dislike a food because of the texture, it seems logical that the children should be exposed to the texture, by having them eat the food with the specific texture, or at least tolerate it in their mouth. However, this is not always easy to achieve: children might be reluctant to try the food. Caregivers often report that their toddlers refuse to eat foods, spit it out and push or throw foods away (Lewinsohn et al., 2005). Parental pressure to taste or eat food can even have counterproductive effects and cause children to eat less (Galloway, Fiorito, Francis & Birch, 2005; Jansen et al., 2017). One solution is to gradually increase texture in food (Shore, Babbitt, Williams, Coe, & Snyder, 1998). Another solution could be to expose children to other sensory properties of food, without tasting. Dazeley and Houston-Price (2015) showed that if toddlers see, smell, touch or hear unusual fruits and vegetables during play activities, they touch and taste more of these foods during a taste test afterwards. It has also been shown that exposure to a variety of sensory aspects, including taste, increases the willingness to eat fruits and vegetables (Hoppu, Prinz, Ojansivu, Laaksonen, & Sandell, 2015; Witt & Dunn, 2012). Coulthard and Sealy (2017) looked more specifically at the role of exposure to the texture of food on acceptance of food. They showed that if children play with fruits and vegetables with their hands, they are more likely to eat them, compared to exposure to the sight of the same foods or playing a non-food sensory game. An explanation for this finding is that the children familiarized themselves with the foods, which is supported by the finding that the largest effects were found for less familiar foods, like pomegranate (Coulthard & Sealy, 2017).

It has not been tested yet however, if exposure to an isolated tactile aspect in non-food transfers to greater acceptance of that aspect in food. For instance, if playing with non-food jelly would increase consumption of a jelly pudding. This would show that the familiarity to the holistic concept of a food is not necessary to increase food acceptance, but that the increased familiarity of a single feature of food also helps to enhance consumption of food. Acceptance of this specific texture could then generalize to different foods with the same texture.

In the present study it was tested if tactile exposure to a non-food texture, by feeling it with the hands, could increase acceptance of food with the same texture. Half of the children were pre-exposed to the texture of odor- and colorless jelly, the other half not. Next, the children were asked to taste from three strawberry desserts, which either had a comparable jelly texture or a texture that differed in viscosity and consistency. We expected that the children in the exposure condition would become habituated to the jelly texture and therefore taste more of the strawberry jelly than children in the control condition. For the other two desserts, no pre-exposure took place and therefore no differences between groups were expected.

1. Method

1.1. Participants

The parents of the children of two preschools and one elementary school were informed about the current study and asked if their child could participate. An exclusion criterion was food allergy for strawberry yoghurt or jelly. Sixty-eight children participated. Two children refused to taste any food and were excluded from analyses. The remaining sample consisted of 36 boys and 30 girls, with a mean age of 5.8 (SD = 1.8, ranging from 3 to 10 years). The mean BMI z-score, based on a Dutch healthy weight norm population (TNO, 2016), was 0.51 (SD = 1.27), meaning the children weighed significantly more than the healthy weight norm group. The sample included 9 children with overweight, 4 children with obesity and 4 children with underweight. The child characteristics per condition are reported in Table 1.

1.2. Design

The study had a cross-sectional, mixed experimental design. The between-subject factor was the condition (tactile exposure or control), to which each child was randomly assigned. The within-subject factor was the texture of three foods, which differed in viscosity and consistency. One texture (jelly) matched the texture of the tactile exposure material, the other two (smooth yoghurt and yoghurt with pieces) differed. The desserts were presented in balanced order. The dependent measure was the number of spoonfuls (between 0 and 3) the child tastes of each dessert.

2. Materials

2.1. Exposure

Children were manually exposed to the tactile stimuli during individual sessions. Children were asked to play with a large bowl (ø 18 cm) filled with a colourless and odourless jelly (made of gelatin and water) in a semi-structured way. In the beginning, the children were free to play with the gelatin mass, as long as they used their whole hands in interaction with the jelly. After a few minutes the children were motivated to feel the texture by tasks like scooping the jelly with their hands into another bowl, finding hidden coins in the bowl and sculpting figures from the jelly (see Fig. 1). When children were shy or reluctant to touch the jelly during the free play, these tasks were initiated from the start. This way, the experimenter made sure that all the children touched the jelly for 10 min, in a playful way.

In the control group, children played an age-appropriate board game (Memory) with the experimenter, for 10 min.

2.2. Taste test

Children were asked to eat from three types of strawberry dessert, in balanced order: 1) Yoghurt with pieces: a pink colored strawberry yoghurt (low-fat) that contained small pieces of strawberry (brand: Albert Heijn, The Netherlands), 2) Smooth yoghurt: the same yoghurt, filtered to remove the pieces of strawberry, resulting in a smooth strawberry yoghurt and 3) Jelly: a red colored strawberry jelly pudding (brand: Dr. Oetker, The Netherlands). The desserts were presented in equal clear plastic bowls (ø 8 cm). The children were asked to taste a spoonful of the food and if they tried it, the experimenter asked if they would like another spoon. The children handled the spoons themselves, the experimenters supervised if the spoons were properly filled and helped the younger children when needed. The number of spoons

Table 1
Participant characteristics in the control and exposure condition.

	Control condition <i>n</i> = 33	Exposure condition <i>n</i> = 33	Test of group differences
Gender	18 girls/15 boys	12 girls/21 boys	<i>Chi-square</i> = 2.2, <i>p</i> = 0.14
Age	5.9 (SD = 1.9)	5.8 (SD = 1.7)	<i>t</i> = 0.272, <i>p</i> = 0.79
BMI	16.1 (SD = 1.6)	16.7 (SD = 2.7)	<i>t</i> = 1.2, <i>p</i> = 0.24
BMI z-score	0.32 (SD = 1.03)	0.69 (SD = 1.46)	<i>t</i> = 1.2, <i>p</i> = 0.25



Fig. 1. Exposure to the odor- and colorless jelly texture.

of a dessert a child ate was considered an index of acceptance of the food. Children were not pressured to eat if they did not want to. They could eat 0 to 3 spoonfuls (method based on Werthmann et al., 2015).¹ An average spoon contained 5 g of dessert.

2.3. Procedure

The study was approved by the Ethical Review Committee Psychology and Neuroscience of Maastricht University. The children were tested individually in a separate room at their school. First, the weight and height of each child was measured (without shoes). Next, they played a game or participated in the exposure procedure. Afterwards the taste test was performed, and finally, the child received a small present (pencil or sticker) for participation.

2.4. Statistical analyses

Tests indicated a normal distribution and that sphericity of variance could be assumed. Pearson's correlations were used to examine the relations between participant characteristics and the number of spoonfuls the children ate.

The data were analyzed in a 3 (dessert type: yoghurt with bits, smooth yoghurt, jelly) × 2 (condition: exposure vs control) mixed ANOVA for repeated measures, with the number of spoonfuls (range 0–3) as dependent measure. Simple contrast were specified to test the difference between the three desserts, with the smooth yoghurt as reference category. For the significant interaction effect,

follow-up independent samples t-tests were conducted for each type of dessert.

3. Results

The participant characteristics age, gender, BMI and BMI-Z were not related to the number of spoonfuls the children ate of the desserts (all *p*'s < 0.05).

The 3 × 2 mixed ANOVA showed a main effect of dessert type, $F(2, 128) = 8.69, p < 0.001, \eta^2_{\text{partial}} = 0.12$: overall the children ate more of the smooth yoghurt ($M = 2.18, SD = 0.93$) than both the yoghurt with pieces ($M = 1.67, SD = 0.89, F(1,64) = 20.7, p < 0.001, \eta^2_{\text{partial}} = 0.245$) and the jelly ($M = 1.76, SD = 0.98, F(1,64) = 6.95, p = 0.011, \eta^2_{\text{partial}} = 0.098$). This main effect was qualified by a significant interaction between condition and yoghurt type, $F(2, 128) = 5.64, p = 0.004, \eta^2_{\text{partial}} = 0.08$, see Fig. 2. In line with our hypothesis, for the consumption of jelly, a significant effect between conditions was observed: Children in the exposure condition ate significantly more spoonfuls of jelly than in children in the control condition, $t(64) = 3.56, p = 0.001, 95\% \text{ CI } [0.35, 1.23], M_{\text{exp}} = 2.15, SD = 0.97, M_{\text{con}} = 1.36, SD = 0.82$.

No differences between conditions were found for smooth yoghurt or yoghurt with pieces, $t(64) = 0.26, p = 0.79, 95\% \text{ CI } [-0.39, 0.52], M_{\text{exp}} = 2.21, SD = 0.96, M_{\text{con}} = 2.15, SD = 0.91; t(64) = -0.55, p = 0.59, 95\% \text{ CI } [-0.56, 32] M_{\text{exp}} = 1.55, SD = 0.94, M_{\text{con}} = 1.67, SD = 0.85$.

4. Discussion

In the present study, children were exposed to a specific texture (i.e. odor- and colorless jelly) with their hands, and it was tested if this increased their acceptance of desserts with the same texture in

¹ Seven children were accidentally allowed to eat more than three spoons. Their data was winsorized to a maximum of 3 spoons. When analysing without winsorizing the data or when excluding these participants, the same significant effects are found.

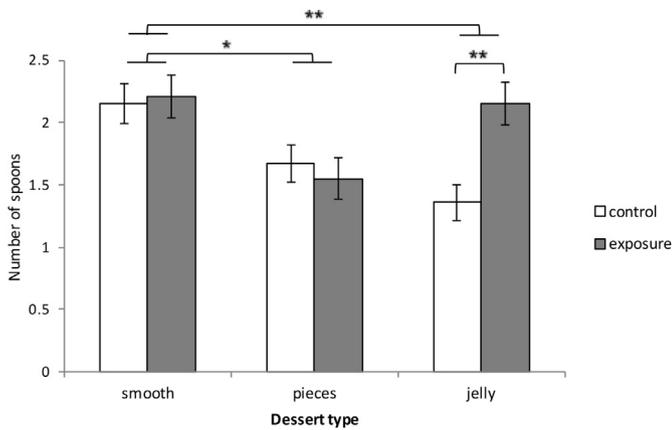


Fig. 2. Mean number of spoons (+/- SEM) children ate from 3 desserts with different textures (smooth yoghurt, yoghurt with pieces or jelly), after tactile exposure to the texture of jelly or a control condition.

a later test. Results showed that indeed this was the case: children in the pre-exposure condition ate more of the strawberry jelly dessert with the same texture, than did the children in the control condition. No differences between conditions were found for the desserts with other textures (i.e. smooth yoghurt and yoghurt with pieces) to which the children in the exposure condition had not been exposed. This suggests that habituation or familiarity to feeling a texture with your hands might generalize to greater acceptance of a food with the same structure. Previous research already showed that tactile exposure to food items promotes the willingness to taste them (i.e. [Coulthard & Sealy, 2017](#)). The current study shows that tactile exposure to non-food items with a specific texture also promotes the willingness to taste food with the same texture; it thus shows the effect of exposure to only one isolated characteristic of food. This suggests that if children learn to accept a specific texture, this might generalize to more food items with the same texture.

The study also showed that in general texture had a large influence on willingness to taste food: averaged over both conditions, children ate significantly more spoonfuls of the smooth dessert than the desserts with more difficult textures, namely with inconsistent texture (yoghurt with pieces in it) or increased viscosity (jelly pudding). This is in line with previous studies ([Szczeniak, 2002](#); [Werthmann et al., 2015](#)).

A limitation of the present study is the small sample size and replication with a larger group, other textures and food types is warranted, to confirm the potential positive effects of exposure to textures. Potential moderators, like hunger, were not measured and acceptance of the food was measured with one measure only, a behavioural tasting measure. Moreover, future research should study if pre-exposure to textures is also beneficial for a group of picky eating children. Previous research showed that this group is in general more tactile sensitive and lower enjoyment of tactile stimulation appeared related to higher scores on fussy eating ([Coulthard & Thakker, 2015](#); [Coulthard et al., 2016](#); [Nederkoorn et al., 2015](#); [Smith et al., 2005](#)). On hand, one might hypothesize that this group can benefit more from pre-exposure to food-related textures, as textures appear to play a larger role in their food acceptance. On the other hand, this group might habituate more slowly and need more exposure to have the same benefits as children who are low in picky eating.

In the present study, only one sensory aspect of food, namely the feel of it, was used for exposure, to study the isolated effect. Sweet desserts were used which in general were well accepted by

children. This ensured us that the foods were not disliked because of the taste, but especially for the texture, and enabled us to study the effect of exposure to texture. However, other sensory characteristics are also important in the acceptance of food. For instance, [Coulthard et al. \(2016\)](#) showed that the smell of a new food influenced the decision of a child to try and taste the food. [Jansen et al. \(2017\)](#) demonstrated that attractive presentation of fruit increased intake. And of course, taste has a large influence on liking of food, with children showing a profound preference for sweet tastes over bitter tastes (i.e. [Mennella & Bobowski, 2015](#)). Further research could consider how different sensory aspects of food interact. For instance: does exposure to a texture also increase liking for a food with a more difficult taste, like mushrooms? And will exposure to more features of food, like the structure, smell and taste, add to a larger effect on food acceptance? When trying to persuade picky eating children to eat fruit and vegetables, probably more sensory qualities should be considered besides texture.

In sum, the present study suggests that playing with a texture with hands, thereby exposing children to a similar texture as a specific food, might increase the acceptance of this food. This might be helpful, since children are often reluctant to put a disliked food in their mouth and to establish exposure might be difficult. Letting them feel the texture with their hands might be therefore be a first step in getting familiar with the food, increase acceptance and thereby help to increase variety of food intake.

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