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Strategies to improve the Willingness to Taste: The moderating role of children's Reward Sensitivity

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ABSTRACT

The present study investigates the effectiveness of different strategies to improve Willingness to Taste disliked vegetables and the moderating role of Reward Sensitivity. Preschool children ($N = 204$; age: $M = 4.48$, $SD = 1.01$) were randomly allocated to one of four different Willingness to Taste strategies. The findings indicate that first, Willingness to Taste is higher in the modelling and reward strategies compared to neutral instructions. Second, there is a differential effect of Willingness to Taste strategies dependent upon individual differences: children high in Reward Sensitivity were more likely to taste immediately when rewarded, while children low in Reward Sensitivity were more willing to taste when verbally encouraged, but with hesitation. This article thus highlights the roles of both individual differences and behavioral techniques for promoting a healthy diet in children.

1. Introduction

It has been shown that the intake of healthy food contributes to an overall sense of well-being (Blanchflower, Oswald, & Stewart-Brown, 2013) and the prevention of diseases (U.S. Department of Health and Human Services, 2010; U.S. Department of Health and Human Services/U.S. Department of Agriculture, 2005; World Health Organisation, 2003). For young children, healthy food is particularly essential to achieve age-adequate growth and cognitive development (du Plessis, Naude, & Swart, 2016), and may help to decrease energy intake by reducing the consumption of energy dense (i.e. high in sugar and fat) products (Spill, Birch, Roe, & Rolls, 2011). Furthermore, childhood is an important period for shaping children's food preferences and eating habits, which may continue into adulthood (Nicklaus, Boggio, Chabanet, & Issanchou, 2004; Nicklaus & Remy, 2013). Nevertheless, the consumption of vegetables in preschool children is far below the minimum food-based dietary guidelines (Huybrechts et al., 2008; Kim et al., 2014; Storey & Anderson, 2016).

Two frequently identified obstacles to achieve the recommended amount of vegetables in childhood are food neophobia (i.e. the rejection of novel or unknown foods) (Birch & Fisher, 1998) and picky/fussy eating (i.e. the rejection of familiar foods) (Galloway, Lee, & Birch, 2003). Irrespective of these psychological determinants of food rejection and their underlying mechanisms (for review see Lafraire, Rioux, Giboreau, & Picard, 2016), children are generally not eager to consume foods they dislike (Baxter & Thompson, 2002; Birch & Fisher, 1998; Cullen et al., 2003). Since vegetables happen to be the least-liked food category (Cashdan, 1998; Skinner, Carruth, Bounds, & Ziegler, 2002), methods are needed to improve children's liking for vegetables. The most common strategy for developing liking is Repeated Exposure with which children are repetitively exposed to the taste of certain food items. Several studies have proven this strategy to be effective in increasing children's liking and consumption of an initially disliked vegetable (Ahern, Caton, Blundell, & Hetherington, 2014; Anzman-Frasca, Savage, Marini, Fisher, & Birch, 2012; Caton et al., 2013; de Wild, de Graaf, & Jager, 2013; Hausner, Olsen, & Moller, 2012). However, no consensus has been reached on the amount of taste exposure necessary to increase liking. Despite this discrepancy, it has been generally agreed that at least one taste exposure is necessary. In other words, children can never benefit from the Repeated Exposure effect if they refuse to taste. Since it has been shown that a large proportion of children might be unwilling to taste vegetables in a Repeated Exposure intervention (Lakkakula, Geaghan, Zanovec, Pierce, & Tuuri, 2010), willingness to taste seems a crucial first step in the process of learning to like a food item. In the current study, we see Willingness to Taste as an initial

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approach behavior with specific antecedents and consequences, while considering liking as a more cognitive affective correlate of learning. Although past research has taken considerable interest in how to improve overall liking and consumption of vegetables, relatively little information is available concerning the strategies that can help children to enhance their Willingness to Taste.

Possible strategies to improve Willingness to Taste can be derived from evidence-based strategies for developing liking and increasing the consumption of vegetables. One possible way to improve Willingness to Taste is providing a good role model. Children are more likely to eat vegetables when they witness someone consuming them (Greenhalgh et al., 2009). Not only do adults (familiar as well as unfamiliar) seem to be effective role models (Hendy & Raudenbush, 2000), peers (Greenhalgh et al., 2009; Hendy, 2002) and even cartoon characters also have a positive influence on children's eating behavior (Harris & Baudin, 1972). After all, the Social Cognitive Theory (Bandura, 1977) has suggested that modelling can be very influential in establishing learning and behavioral change. Although modelling is more likely to be effective in the presence of a similar (e.g. peers), or familiar (e.g. parent or teacher) model (Bandura, 1977), adult strangers were also found to have a positive influence on children's food acceptance (Harper & Sanders, 1975).

Secondly, providing a reward might also be effective to encourage children to taste a disliked food item. Although this strategy has been broadly studied in the context of liking and consumption of vegetables, opinions are divided when it comes to the consequences of using rewards. According to the Social Determination Theory (SDT), a reward serves as an extrinsic motivator and it can undermine the intrinsic motivation (Deci, Koestner, & Ryan, 1999). Indeed, some studies have shown that the preference and liking of food decreases when children are offered a reward (Birch, Marlin, & Rotter, 1984; Newman & Taylor, 1992). However, the relation between rewards and liking or consumption of food is more complex than stated in the SDT. Rewards can become powerful tools in the process of developing the liking for healthy food provided they are used appropriately. It has indeed been shown that exposure + reward parings have positive short and long term effects on liking and consumption (Cooke, Chambers, Anez, Croker, et al., 2011). Similar to Repeated Exposure, no consensus has been reached on the number of exposure + reward parings necessary to change liking and consumption. Overall, the effectiveness of rewards depends on the outcome variable (consumption vs. liking), the extent to which the child originally liked the food item, and the type of reward (for review see, Cooke, Chambers, Anez, & Wardle, 2011). In most studies, rewards are found to have positive effects on *consumption*. However, their effects on liking can be counterproductive, when the food item was already liked prior to the administration of the reward. Furthermore, the type of reward is important. Offering sweets as a reward seems to provoke negative effects: it enhances the preference for the sweets (Newman & Taylor, 1992). On the other hand, various studies have demonstrated that both non-food tangible rewards (e.g. stickers) and non-tangible rewards (e.g. praise) enhance children's liking and consumption of disliked food items (Lowe, Horne, Tapper, Bowdery, & Egerton, 2004; Nicklas et al., 2001; Vereecken, Keukelier, & Maes, 2004). However, compared to a non-tangible reward (i.e. praise), tangible rewards seem to be more powerful in facilitating tasting (Cooke, Chambers, Anez, Croker, et al., 2011).

Verbal encouragement can be seen as a third possible strategy to enhance Willingness to Taste. It is a commonly used strategy to positively encourage individuals to provide an optimal effort in different types of behavior (Andreacci et al., 2002), including eating behavior. Verbal encouragement by food service staff is associated with higher fruit and vegetable consumption in elementary school children (Perry et al., 2004). Even at younger ages (12–17 months), children are more likely to accept food when their caregivers provide positive verbal encouragement (Dearden et al., 2009). Verbal encouragement needs to be differentiated from verbal coercion or pressure, which is inversely related to the consumption of fruit and vegetables (Brown, Ogden, Vögele, & Gibson, 2008; Galloway, Fiorito, Francis, & Birch, 2006). While verbal coercion is a negative form of verbal prompting in which the child feels pressured to eat, verbal encouragement is a less intrusive form of verbal instruction in which precautions are made to prevent the child from feeling obligated to taste (e.g. child-friendly tone).

1.1. Child characteristics

Previous studies mainly examined the effectiveness of different strategies in improving *liking*, *consumption* or *acceptance* of vegetables in general. However, children may react differently to different strategies, depending on their personal characteristics (Blissett, Bennett, Fogel, Harris, & Higgs, 2016). Personality theories assume that unique individual characteristics play a role in the expression of (eating) behavior (Block, 1993; Davis et al., 2007). Recently, it was shown that the effectiveness of strategies to facilitate the acceptance of a novel fruit depended on food responsiveness: physical prompting strategies in combination with modelling facilitated the acceptance of a novel fruit, but only in food-responsive children (Blissett et al., 2016). It was also shown that the effectiveness of strategies to increase consumption of a moderately-liked vegetable is linked to bitter-sensitivity: bitter-sensitive preschoolers consumed significantly more broccoli after being repeatedly exposed to broccoli with dressing than when served plain. In contrast, the dressing did not promote consumption among bitter-insensitive preschoolers (Fisher et al., 2012). This differential sensitivity to different strategies highlights the importance of individual characteristics.

While research has suggested that we take into account a child's individual Reward Sensitivity as a biological predisposition that guides human learning and behavior (Beaver et al., 2006), little is known about the specific role of a child's Reward Sensitivity in learning to like and consume vegetables. Reward Sensitivity is assumed to reflect the sensitivity of a neuropsychological system referred to as the Behavioral Approach System (BAS) (Gray, 1981, 1987, 1990). The BAS responds to positive, rewarding environmental stimuli by activation of the dopaminergic system (Depue & Collins, 1999; Gray, 1994), which causes the initiation of "approach" behavior in order to obtain the rewarding goal (Kane, Loxton, Staiger, & Dawe, 2004). In following the definition of Reward Sensitivity, children high in Reward Sensitivity are expected to respond more strongly to rewarding environmental stimuli compared to those lower in Reward Sensitivity. Consequently, a Willingness to Taste strategy with a rewarding aspect is probably most effective in children higher in Reward Sensitivity.

1.2. The current research

Past research has examined different strategies to increase the liking and consumption of healthy foods such as modelling, reward learning and verbal encouragement. Willingness to Taste, however, has been less researched, even though it is a first crucial step in the process of developing liking for healthy food. Thus, the current study first aims to investigate which strategy is effective in increasing children's Willingness to Taste a disliked vegetable. We expect that modelling, rewarding and encouragement are more effective to improve Willingness to Taste than neutral instructions.

Second, we aim to explore whether Willingness to Taste depends on children's characteristics under different conditions. We

expect that children high in Reward Sensitivity have a higher Willingness to Taste in a reward strategy than children low in Reward Sensitivity. More specifically, we believe that children's Reward Sensitivity will predict their Willingness to Taste only when a reward is given.

2. Method

2.1. Participants

A total of 214 preschool children were recruited via kindergartens in the neighborhood of Ghent, Belgium. The recruitment letter specifically requested the participation of children who disliked at least one vegetable. Upon arrival in the laboratory, 10 children did not want to participate. The final dataset comprised 204 participants. Demographics were obtained via parent self-report and included child age, sex and highest household educational attainment (see Table 1). Data were collected in May 2014 and May 2015.

2.2. Material

2.2.1. Behavioral Inhibition System/Behavioral Approach System (BIS/BAS) scales

In order to assess Reward Sensitivity, mothers completed the BAS scale of the BIS/BAS scales (Carver & White, 1994) adapted for parent report (Vervoort et al., 2015). The parent version was based on an age-downward adaptation of the original scales (Muris, Meesters, de Kanter, & Timmerman, 2005). The BAS scale (BAS_Total) consists of 13 items on 4-point Likert Scale from 1 (not true) to 4 (very true) and can be further subdivided in 3 subscales. The Reward Responsiveness subscale (BAS_RR, 5 items) includes statements as “Your child gets very excited when s/he would win a contest”. The Fun Seeking subscale (BAS_FS, 4 items) includes statements as “Your child craves for excitement and new sensations”. The Drive subscale (BAS_D, 4 items) includes statements as “When your child wants something, s/he usually goes all the way to get it”. The BAS-scales of the BIS/BAS parent version were found to have meaningful relations with other instruments assessing Reward Sensitivity (Vervoort et al., 2015): the SR-scale of the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) positively correlated with BAS_Total ($r = 0.61$, $p < 0.001$), BAS_RR ($r = 0.43$, $p < 0.001$) and BAS_D ($r = 0.59$, $p < 0.001$). Secondly, the associations between BAS scales and Child Behavior Questionnaire (CBQ) are generally consistent with RST assumptions on temperament and personality: higher levels of parent-reported Reward Sensitivity were related to higher levels of Surgency/Extraversion (BAS_Total: $r = 0.58$, $p < 0.001$; BAS_RR: $r = 0.39$, $p < 0.001$; BAS_D: $r = 58$, $p < 0.001$). Internal consistency in the present sample was good for the BAS_D subscale (Cronbach's $\alpha = 0.83$) and the BAS_Total score (Cronbach's $\alpha = 0.80$), but poor for BAS_FS subscale (Cronbach's $\alpha = 0.52$) and BAS_RR subscale (Cronbach's $\alpha = 0.60$). Therefore, the individual subscales BAS_FS and BAS_RR were not included in the analyses.

2.2.2. Vegetable Liking List (VLL)

The VLL was developed by our research group and assesses children's liking of 10 vegetables in steamed or boiled form. The selection of vegetables is based on literature concerning taste development (e.g. Ventura & Worobey, 2013); vegetables with higher chance to be disliked (i.e. bitter or sour flavor, distinct flavor, difficult texture) were included in the list. The mother indicated the extent to which her child likes each of the vegetables. The response options were: “Like”, “Just OK”, “Dislike”, “Never ate it or I don't know”. The vegetable used in the taste experiment was one the child dislikes. Descriptive statistics for the VLL are depicted in Table 2.

2.2.3. Child food neophobia scale (CFNS)

The CFNS (Pliner, 1994) assesses the extent to which children reject novel or unknown foods and originally consists of 10 items, including statements as “My child does not trust new foods” and “My child is afraid to eat things s/he has never had before”. The items are scored on a 4-point Likert Scale from 1 (strongly disagree) to 4 (strongly agree). Higher scores indicate higher food neophobia. We used the 6-item version, as this version is more adapted to the age range of our sample (Cooke, Wardle, & Gibson, 2003; Cooke et al., 2004). The scale has been validated against a behavioral measure of food neophobia (i.e. children's actual Willingness to Taste when confronted with ten unfamiliar foods) (Pliner, 1994). Internal consistency in the present sample was good (Cronbach's $\alpha = 0.80$).

2.2.4. Hunger Rating Scale

At the start of the taste experiment, the degree of hunger was assessed by means of three cartoon faces: the child had to indicate whether he or she was very hungry, slightly hungry or not hungry.

Table 1
Descriptive statistics and association of demographic and food-related variables to Willingness To Taste.

Variable	All ($N = 204$) N (%) or M (SD)	Tasted immediately ($N = 98$) N (%) or M (SD)	Tasted after hesitation ($N = 61$) N (%) or M (SD)	Did not taste ($N = 45$) N (%) or M (SD)	p
Demographic variables					
Age in years	4.48 (1.01)	4.69 (1.05)	4.53 (0.97)	3.95 (0.80)	0.00
Sex					0.22
Male	104 (51.0)	46 (44.2)	30 (28.8)	28 (26.9)	
Female	100 (49.0)	52 (52.0)	31 (31.0)	17 (17.0)	
HHEA					0.38
Bachelor or higher	162 (86.2)	75 (46.3)	52 (32.1)	35 (21.6)	
High school graduate	25 (13.3)	13 (52.0)	6 (24.0)	6 (24.0)	
Not a high school graduate	1 (0.5)	0 (0.0)	0 (0.0)	1 (100.0)	
Food-related variables					
Degree of hunger					0.33
Not hungry	82 (40.8)	33 (40.2)	28 (34.1)	21 (25.6)	
Slightly hungry	43 (21.4)	25 (58.1)	12 (27.9)	6 (14.0)	
Very hungry	76 (37.8)	39 (51.3)	21 (27.6)	16 (21.1)	
Food neophobia	14.79 (3.46)	13.79 (3.21)	15.65 (3.33)	15.80 (3.61)	0.00
Vegetable type					0.11

Note. HHEA = Highest Household Educational Attainment.

Table 2
Descriptive statistics for the Vegetable Liking List.

Vegetables	Like (%)	Just OK (%)	Dislike (%)	Never ate it/I don't know (%)	Selected for the study (%)
Brussels sprouts	7.8	39.2	44.6	8.3	4.9
Broccoli	64.2	22.1	11.7	2.0	2.5
Cauliflower	44.1	38.7	16.2	1.0	2.5
Chicory	13.2	19.1	61.8	5.9	23.2
Fennel	13.7	18.6	23.0	44.7	6.4
Leek	28.9	31.9	33.8	5.4	20.2
Mushrooms	23.0	17.2	55.4	4.4	20.2
Peas	58.3	23.5	13.7	4.5	8.9
Spinach	58.3	22.5	16.7	2.5	3.9
Zucchini	31.4	31.9	25.0	11.7	7.4

2.3. Procedure

After the informed consent was obtained and the questionnaires were filled out, mother and child were invited to the Tasting Lab at Ghent University for participation on any of the 17 days with 16 moments on each day. In advance, each day was assigned to a specific condition through simple randomization (by throwing a dice). The Randomized Controlled Design permitted between-group analyses of the different strategies. Each child was tested individually without the mother's presence by a trained research assistant following a standardized protocol (protocol available upon request). To put the child at ease, the experimenter first socialized with him or her for 5 min. Then, the child was seated at a children's table and the child's degree of hunger was assessed. In every condition, the child was offered a small portion (±4 g) of bite-sized steamed or boiled vegetable that he or she dislikes. The vegetable was unseasoned and was served on a neutral plate. The way in which the instruction to taste was given differed according to four different strategy conditions: in the neutral instructions condition which was a control condition, the experimenter asked the child neutrally to taste the vegetable ("If you want, you are allowed to taste"). In the modelling condition, the tasting behavior was modeled by the experimenter along with the words "Mmm! This vegetable is delicious! If you want, you are also allowed to taste". In the reward condition, the experimenter promised the child a small tangible reward worth approximately 1 dollar (e.g. a toy of choice such as stickers, toy bears, colored pencils, jumping ropes, bubble blowers, coloring books, toy cars, balls, colored chalk, paint) if he or she tasted ("If you taste, you can choose a toy from this box!"). In the encouragement condition, the experimenter verbally encouraged the child to taste ("Come on, you can do it!"). The sentences were voiced in a positive, child-friendly tone. Furthermore, in every condition, we made efforts to prevent children from feeling obligated to taste ("You can choose whether you taste or not. I won't be angry if you don't taste"). An important note is that no verbal encouragement was offered in the reward and the modelling conditions. To control for visual exposure, the child was exposed to the food 1 min before he or she was allowed to taste. After 1 min during which the child was supplied with the relevant instructions, the experimenter gave the child a spoon and a fork, along with the words: "Now you can taste". Each session was video recorded and lasted approximately 10 min. Afterwards, the children and the parents were thanked for their cooperation and debriefed by e-mail; each child received a small toy and the parent(s) were given two information brochures about healthy food. This procedure was approved by the Institutional Ethical Committee.

2.4. Video scoring

Based on the video recordings, Willingness to Taste was assessed by two independent raters who were blinded to the purpose of the study. The children were classified in one of three categories: "tasted immediately", "tasted after hesitation" and "did not taste". The taste session was rated as "tasted immediately" if the child deliberately took the fork or spoon, and put the food in the mouth without hesitation. The taste session was rated as "tasting after hesitation" when the child was observed to play with the food and/or go slower or stop the motion before putting the food in the mouth. The taste session was rated as "did not taste" if the child refused to taste. Since preschool children can differ in motor reactions, it was considered important to measure the time till the child was willing to taste instead of how long it took until the food reached his or her mouth.

2.5. Plan of analysis

In order to check if Willingness to Taste was reliably assessed, we computed interrater reliability with kappa statistics. Discrepancies were discussed until total agreement was reached.

Variables of interest (i.e. condition, BAS_D and BAS_Total), demographic variables (i.e. age, sex, highest household educational attainment) and food-related variables (i.e. degree of hunger, food neophobia and vegetable type) were summarized: categorical and continuous variables were expressed as frequency (percentage) and mean (*SD*) respectively. The relation between Willingness to Taste and possible confounding variables (i.e. demographic and food-related variables) was examined using chi-squared tests for categorical variables and analysis of variance for continuous variables. Besides standard demographic variables (i.e. age, sex, and highest household educational attainment), three food related variables (i.e. food neophobia, degree of hunger and vegetable type) were a priori selected as possible confounding variables. Food neophobia was selected because it peaks in this age group (Dovey, Staples, Gibson, & Halford, 2008), and because it is inversely related to food consumption (Cooke, Carnell, & Wardle, 2006). Degree of hunger was selected because the experiments were conducted on different times of the day. It seems logical to assume that children who have eaten very recently, might be less eager to taste. Previous research also showed a link between degree of hunger and eating behavior (Brunstrom & Fletcher, 2008; Guerrieri, Stanczyk, Nederkoorn, & Jansen, 2012). Vegetable type was selected as a possible confounding variable because it is an experimental manipulation that varies between children. Variables with $p < 0.10$ were considered confounding variables and included in the main analyses.

In order to confirm that the randomization procedure resulted in comparable groups, between-group baseline differences on all independent variables included in the main analyses were examined using one-way ANOVAs.

To examine the research questions, 3 Multinomial Logistic Regressions (MLRs) were conducted. An MLR breaks the regression up

into a series of binary regressions comparing each group to a baseline group, which we determined to be the "did not taste" group. In order to examine our first research question, we conducted an MLR with strategy (with 4 conditions: modelling, reward, encouragement, neutral instructions) as factor, Willingness to Taste (with 3 levels: tasted immediately, tasted after hesitation, did not taste) as dependent variable and age and food neophobia as control variables. Two more MLRs building upon the first MLR were conducted to examine whether the effectiveness of each strategy depends on Reward Sensitivity; BAS_D and BAS_Total were added as continuous predictors in the second and third MLR respectively. If Odds Ratio (OR) > 1, effect sizes of the associations were evaluated as small if OR = 1.68, medium if OR = 3.47 and large if OR = 6.71. If OR <1, effect sizes were evaluated as small if OR = 0.59, medium if OR = 0.28 and large if OR = 0.14 (Chen, Cohen, & Chen, 2010).

3. Results

3.1. Preliminary analyses

Regarding the assessment of Willingness to Taste, a substantial agreement was found between the two raters ($\kappa = 0.84$, $p < 0.001$).

Table 1 shows that age, $F(2,198) = 8.42$, $p < 0.001$; and food neophobia, $F(2,201) = 8.43$, $p < 0.001$, were significantly related to Willingness to Taste. Therefore, they were placed in the MLR models as control variables.

Analyses on baseline differences showed that the four conditions did not significantly differ on age, $F(3,197) = 0.49$, $p = 0.68$; food neophobia, $F(3,200) = 0.85$, $p = 0.46$; BAS_D, $F(3,200) = 1.73$, $p = 0.16$; or BAS_Total, $F(3,200) = 0.94$, $p = 0.42$ (see Table 3 for descriptives).

3.2. Effect of strategy

The first MLR was conducted to examine which strategy is more effective than neutral instructions to improve children's Willingness to Taste (see Table 4 for descriptives, and Table 5 for the analysis).

Regarding the control variables; with increasing age, children were more likely to taste immediately (b = 0.86, Wald$\chi^2(1) = 14.78$, $p < 0.001$) or taste after hesitation (b = 0.72, Wald$\chi^2(1) = 9.55$, $p = 0.002$) compared to not taste at all. Furthermore, with decreasing food neophobia, children were more likely to taste immediately (b = −0.21, Wald$\chi^2(1) = 11.36$, $p = 0.001$) compared to not taste at all. The magnitude of the significant associations were small for age and food neophobia with effect sizes ranging from 0.80 to 2.37. No significant difference was found regarding food neophobia when comparing "tasting after hesitation" with "not tasting" ($p = 0.45$).

Regarding the factor strategy; the MLR made comparisons between neutral instructions (i.e. the control condition) and the three other strategies. There was a main effect of reward when comparing "tasting immediately" with "not tasting" (b = 1.55, Wald$\chi^2(1) = 6.78$, $p = 0.009$) and "tasting after hesitation" with "not tasting" (b = 2.04, Wald$\chi^2(1) = 10.09$, $p = 0.001$), indicating that children in the reward condition were more willing to taste (i.e. immediately and after hesitation) compared to the control condition. The magnitude of the significant associations of the reward condition were moderate to large with effect sizes ranging from 4.74 to 10.18. There was also a main effect of modelling when comparing "hesitating to taste" with "not tasting" (b = 1.20, Wald$\chi^2(1) = 3.99$, $p = 0.04$), indicating that children in the modelling condition (vs. control condition) were more willing to taste after hesitation than not tasting. There was a trend approaching significance for modelling when comparing "tasting immediately" with "not tasting" (b = 1.00, Wald$\chi^2(1) = 3.46$, $p = 0.06$). The magnitude of the significant associations of the modelling condition were moderate with effect sizes ranging from 3.31 to 3.43. We found no differences on Willingness to Taste when comparing the encouragement strategy with the control condition (all p's > 0.1) (See Fig. 1 for percentages of Willingness to Taste in each strategy). Overall, this MLR model explained a small to moderate amount of the variance in Willingness to Taste, as indicated by Cox & Snell $R^2 = 0.20$ and Nagelkerke $R^2 = 0.23$ (see Table 5).

3.3. Effect of strategy × Reward Sensitivity

Next, two MLRs were conducted to examine whether the effectiveness of the strategy depends on children's Reward Sensitivity. The difference between the latter two MLRs is the inclusion of either BAS_D or BAS_Total as measures of Reward Sensitivity (see Table 4 for descriptives, and Table 5 for the analyses). We expected a moderating role of Reward Sensitivity in the reward condition. A significant interaction effect was found between the reward strategy and Reward Sensitivity (BAS_D: b = 0.55, Wald$\chi^2(1) = 4.79$, $p = 0.02$; BAS_Total: b = 0.26, Wald$\chi^2(1) = 4.83$, $p = 0.02$), indicating that children with a higher Reward Sensitivity were more likely to taste immediately in the reward condition compared to the control condition. This interaction effect could not be found when comparing "tasting after hesitation" with "not tasting". Additionally, an interaction effect was found between the encouragement strategy and BAS_D (b = −0.65, Wald$\chi^2(1) = 5.05$, $p = 0.02$), suggesting that children with a lower BAS_D were more willing to taste after hesitation when encouraged compared to the control condition. This interaction effect could not be found with BAS_Total or when comparing "tasting immediately" with "did not taste". No further interaction effects of Reward Sensitivity × strategy were observed. The significant interaction effects were small with effects sizes ranging from 1.30 to 1.74. Overall, the second and third MLR model explained a moderate amount of the variance in Willingness to Taste, as indicated by Cox & Snell R^2 values of 0.28 and 0.25 and Nagelkerke R^2 values of 0.32 and 0.29 (see Table 5).

Table 3
Descriptive statistics for control variables and variables of interest in each condition.

Variable	Modelling *M* (*SD*)	Reward *M* (*SD*)	Encouragement *M* (*SD*)	Neutral instructions *M* (*SD*)
Age in years	4.35 (0.98)	4.50 (1.07)	4.55 (0.97)	4.57 (1.04)
Food neophobia	15.01 (3.65)	15.16 (3.67)	14.13 (3.40)	14.62 (2.91)
BAS_D	10.63 (2.69)	9.46 (2.75)	9.86 (3.14)	9.83 (2.86)
BAS_Total	34.57 (5.93)	33.05 (5.57)	32.91 (5.71)	33.45 (5.75)

Table 4
Descriptive statistics for the variables of interest.

Variable	All ($N = 204$) N (%) or M (SD)	Tasted immediately ($N = 98$) N (%) or M (SD)	Tasted after hesitation ($N = 61$) N (%) or M (SD)	Did not taste ($N = 45$) N (%) or M (SD)
Strategy				
Modelling (%)	58 (28.4)	29 (50.0)	17 (29.3)	12 (20.7)
Reward (%)	60 (29.4)	30 (50.0)	23 (38.3)	7 (11.7)
Encouragement (%)	43 (21.1)	20 (46.5)	13 (30.2)	10 (23.3)
Neutral instructions (%)	43 (21.1)	19 (44.2)	8 (18.6)	16 (37.2)
BAS_D	9.96 (2.86)	10.18 (2.78)	9.14 (2.62)	10.57 (3.15)
BAS_Total	33.54 (5.74)	33.85 (5.96)	32.31 (5.03)	34.54 (5.99)

Table 5
Association between Willingness to Taste and the variables of interest – adjusting for confounding variables – as described by Odds Ratios (ORs) for Multinomial Logistic Regression (MLR) Models.

Variable	MLR1		MLR2		MLR3	
	Tasted immediately vs. not tasting	Tasted after hesitation vs. not tasting	Tasted immediately vs. not tasting	Tasted after hesitation vs. not tasting	Tasted immediately vs. not tasting	Tasted after hesitation vs. not tasting
	OR (95% Confidence Interval)					
Age	2.37 (1.52–3.68)***	2.06 (1.30–3.27)***	2.29 (1.45–3.60)***	1.95 (1.20–3.16)***	2.26 (1.45–3.53)***	1.94 (1.22–3.10)***
Food Neophobia	0.80 (0.71 – 0.91)***	0.95 (0.84–1.07)	0.81 (0.71 – 0.92)***	0.97 (0.85–1.10)	0.80 (0.71 – 0.91)***	0.96 (0.84–1.08)
Strategy						
Modelling	2.72 (0.94–7.79)*	3.34 (1.02–10.91)**	2.79 (0.94–8.26)*	3.43 (1.03–11.32)**	2.76 (0.93–8.13)*	3.31 (1.00–10.95)**
Reward	4.74 (1.46–15.29)***	7.74 (2.19–27.38)***	7.17 (1.74–29.47)***	10.18 (2.29–45.25)***	5.61 (1.56–20.18)***	8.62 (2.21–33.58)***
Encouragement	1.83 (0.58–5.78)	3.06 (0.87–10.72)	2.80 (0.77–10.18)	2.79 (0.62–12.48)	2.17 (0.64–7.34)	2.52 (0.63–10.11)
Neutral instructions	–	–	–	–	–	–
RS			0.88 (0.67–1.15)	0.98 (0.71–1.35)	0.91 (0.79–1.04)	0.96 (0.82–1.13)
Strategy × RS						
Modelling × RS			1.09 (0.75–1.57)	0.89 (0.58–1.36)	1.07 (0.89–1.29)	0.99 (0.81–1.22)
Reward × RS			1.74 (1.06–2.86)**	1.22 (0.73–2.05)	1.30 (1.02–1.64)**	1.11 (0.87–1.41)
Encouragement × RS			0.84 (0.54–1.30)	0.51 (0.29 - 0.91)**	0.98 (0.78–1.22)	0.80 (0.61–1.05)
Neutral instructions × RS			–	–	–	–

Note: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
RS = Reward Sensitivity.
In MLR2, BAS_D is included as a measure of RS; in MLR3, BAS_Total is included as a measure of RS.
MLR1: $R^2 = 0.20$ (Cox & Snell), 0.23 (Nagelkerke). Model $\chi 2\ (10) = 45.28$, $p < 0.001$.
MLR2: $R^2 = 0.28$ (Cox & Snell), 0.32 (Nagelkerke). Model $\chi 2\ (18) = 66.31$, $p < 0.001$.
MLR3: $R^2 = 0.25$ (Cox & Snell), 0.29 (Nagelkerke). Model $\chi 2\ (18) = 59.95$, $p < 0.001$.

4. Discussion

The first aim of the current study was to investigate which strategies are effective in improving preschool children's Willingness to Taste disliked vegetables. The results suggest that, compared to neutral instructions, children were more willing to taste ("tasting immediately" and "tasting after hesitation" vs. "not tasting") when they are rewarded for tasting with a non-food token (i.e. reward) and taste more after hesitation (compared to not tasting) when the tasting behavior is modeled by a stranger (i.e. modelling). A trend approaching significance in the same direction was further found in the modelling condition when we compared "tasting immediately" with "not tasting". The size of the effects were moderate to large for the reward condition and moderate for the modelling condition. The findings thus confirm that non-food rewards can be useful in convincing children to engage in the rewarded behavior (Cooke, Chambers, Anez, & Wardle, 2011). The effectiveness of modelling supports the Social Cognitive Theory (Bandura, 1977) stating that a role model motivates children to imitate behavior. On the whole, the results imply that the modelling and the reward strategies are more effective than giving neutral instructions in encouraging children to taste.

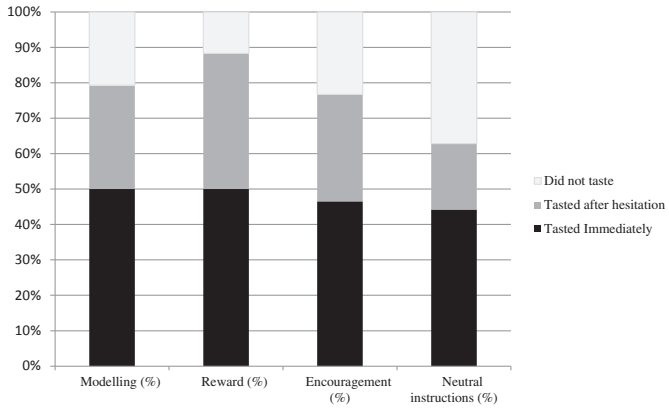

Fig. 1. Percentages of Willingness to Taste in each strategy.

We could not demonstrate that, in comparison to neutral instructions, children are more willing to taste ("tasting immediately" and "tasting after hesitation" vs. "not tasting") when verbally encouraged by a stranger. As a result, we are unable to confirm the idea that verbal encouragement convinces individuals to make an effort (Andreacci et al., 2002). The absence of significant effects might suggest that the motivational aspect in the encouragement strategy is not strong enough to make children taste more than

when neutral instructions are given. An alternative explanation of the null findings is that the children were verbally encouraged by a stranger instead of a familiar adult which might have less impact.

Our second aim was to examine whether the effectiveness of strategies depends on children's Reward Sensitivity. We found the expected moderating effect of Reward Sensitivity: children higher in Reward Sensitivity were more likely to taste immediately when given a tangible non-food reward compared to the control condition (i.e. neutral instructions). It should however be noted that the size of this effect was small. This significant interaction effect is consistent with Gray's RST (Gray, 1981, 1987, 1990), which says that individuals with a more active BAS system tend to react more heavily to rewards and they are more likely to activate behavior in order to obtain rewards. However, we could not find the interaction effect when comparing "tasting after hesitation" with "did not taste". This unexpected finding might be explained by impulsivity, as this personality factor is positively correlated with Reward Sensitivity (Torrubia, Avila, Molto, & Caseras, 2001). Put another way, children high in Reward Sensitivity are more likely to be impulsive: if their BAS system is activated, they will not hesitate to obtain their reward, which means they taste immediately. Future research should incorporate impulsivity to confirm this speculation.

To sum up, our results suggest that a tangible non-food reward can convince children to taste immediately, but only if they are highly sensitive to reward. In this sense, it is not impulsivity, but indeed Reward Sensitivity that drives their Willingness to Taste, because if impulsivity were the main determinant, children high in Reward Sensitivity would be more likely to taste immediately in all conditions, not only when a reward is presented. This finding is of paramount importance, since Reward Sensitivity has been previously shown to be a significant predictor of preferences for palatable foods (Davis et al., 2007), intake of high energy products (De Cock et al., 2015) and overeating (Davis et al., 2007; Davis, Strachan, & Berkson, 2004; Loxton & Dawe, 2001; Small, 2009). In order to address the unhealthy eating habits of high reward sensitive children, it is possible that enhancing their preference for healthy food may help them to forego temptations and move towards more healthy eating patterns. Therefore, it might be important to find effective strategies to enhance the Willingness to Taste disliked vegetables for those children high in Reward Sensitivity.

Rather unexpectedly, children lower in Reward Sensitivity (i.e. BAS_D) were more willing to taste after hesitation when verbally encouraged compared to the control condition. The size of this interaction effect was small. A possible explanation is that children low in Reward Sensitivity might be less extravert and less impulsive, compared to those high in Reward Sensitivity (Muris et al., 2005; Torrubia et al., 2001); they may need verbal encouragement as a motivation to react in an unknown situation. This explanation concurs with our finding that the interaction effect was only present when "tasting after hesitation" was compared with "not tasting". In other words, low reward sensitive children needed some time and encouragement to overcome their shyness. It is possible that this effect would not be present when a familiar adult would feed the child. Future research should replicate the design with a familiar adult to shed light on this issue.

Another noteworthy result is that the interaction effect with verbal encouragement was found in relation to BAS_D and not to BAS_Total. It could be that BAS_Total captures more than we intended to measure (i.e. Reward Sensitivity). According to several studies (Dawe, Gullo, & Loxton, 2004; Dawe & Loxton, 2004; Verbeken, Braet, Lammertyn, Goossens, & Moens, 2012), BAS_D is, in comparison to the other BAS scales, the best predictor of appetitive motivation and approach behavior, and it purports to closely reflect individual differences in the activity of brain reward circuitry (Pickering & Gray, 1999).

We believe our results have contributed to broadening the understanding of Willingness to Taste, as a first step in improving children's liking for vegetables and consumption. Past research has hardly studied Willingness to Taste in the context of disliked foods. The importance of the concept is nevertheless crucial; children who refuse to taste can never benefit from the effects of Repeated Exposure, a strategy proven to be very effective in learning to like vegetables (Ahern et al., 2014; Anzman-Frasca, Savage, et al., 2012; Caton et al., 2013; Hausner et al., 2012). Our study, however, does not explore the underlying reason for disliking vegetables. Although this issue is beyond the scope of the study, it is interesting to make some speculation. It might be that a child dislikes the vegetable because of the food texture (i.e. picky/fussy eater), which might indicate over-responsivity to tactile stimuli. It might also be that he or she is highly food neophobic. It could also be the case that the child is not a picky/fussy eater and has no food neophobia, but simply does not like a particular vegetable. Irrespective of the underlying reason for disliking vegetables, our investigation on how children can be motivated to taste holds a key to promoting a balanced diet in children.

Our study focus on Willingness to Taste has unveiled a number of strategies which can be employed to increase healthy eating behavior in toddlers. Moreover, the current results show that children differ regarding time of tasting; some children are immediately convinced to taste (i.e. immediate tasters), while other children need some more time to be convinced (i.e. tasters after hesitation). These results underscore the importance of not giving up when your child does not want to taste immediately. Another innovative aspect of this study is that we addressed an individual factor by linking the effectiveness of strategies to encourage tasting to children's Reward Sensitivity. Within some strategies, time of tasting (i.e. immediate or after hesitation) seems to depend on the child characteristic Reward Sensitivity. These findings imply that we cannot make a general intervention in encouraging all children to taste. Instead, interventions need to be adapted to individual child characteristics. Future research should extend the current research by investigating, next to Reward Sensitivity, the moderating role of other individual factors that are predictive of obesity, such as poor self-regulation (Francis & Susman, 2009), low negative affectivity (Darlington & Wright, 2006) and high emotionality (Haycraft, Farrow, Meyer, Powell, & Blissett, 2011) (for a review of these factors see, Anzman-Frasca, Stifter, & Birch, 2012).

We investigated Willingness to Taste in an experimental laboratory setting. By doing so, we maximized the likelihood that the effects have been produced by our manipulations. Despite our cautiousness to ensure the rigor of such an experimental procedure, the external validity of the findings might be challenged because the children were not in their natural eating environment in which a familiar adult asks them to taste. This might account for the high number of children who were willing to taste a disliked vegetable, even in the control condition. Despite our efforts to prevent children from feeling obligated to taste, children might have been overwhelmed or felt under pressure, which might have had an effect on their tasting behavior. Also, shyness could be a confound since children have different levels of socialization with strangers (Kagan, Reznick, & Snidman, 1988). We further acknowledge that the vegetable consumption history of the children might have been constrained by the Vegetable Liking List which did not inform us about the frequency of tasting the vegetable or about pickiness. Furthermore, we do not have validity coefficients of the Hunger Rating Scale. Also, it is possible that parents of children with higher levels of food neophobia were more likely to participate, which would suggest that the sample is not representative of Flemish preschool children. Based on these limitations, it is

certainly recommended that future research set up a more ecologically valid study involving, for instance, home meals, school meals, meals in child care centers, with a broader assessment using validated measures for preschool children.

The participants in our study were preschool children without previously known problems in their eating behavior. However, individually tailored Willingness to Taste strategies might also be particularly applicable to clinical groups with maladaptive eating behavior (i.e. children with a restrictive or selective eating disorder). In addition, our findings on the differential sensitivity might have implications for developing strategies to improve *liking* and *consumption* of vegetables. One could investigate whether liking and consumption of an initially disliked vegetable increases faster in high Reward Sensitivity children when offered repeatedly the vegetable with a reward strategy. Furthermore, future research could explore these Willingness to Taste strategies within the domain of the reinforcing value of food. This concept refers to how hard an individual is willing to work to obtain food (Epstein, Leddy, Temple, & Faith, 2007). It is plausible that the reinforcing value of a disliked vegetable increases after a Willingness to Taste strategy has been (repeatedly) applied. Eventually, the initially disliked vegetable might be able to compete with a more intrinsically liked food. Since the reinforcing value of food is higher in high Reward Sensitivity children (Rollins, Loken, Savage, & Birch, 2014), this learning process might occur faster with the reward strategy in these children.

Based on the current results, it can be concluded that modelling and rewarding are effective strategies to improve Willingness to Taste in preschool children. However, as presented earlier, the effectiveness of the reward and encouragement strategies depends on Reward Sensitivity, which suggests that based on a child's Reward Sensitivity, an individually tailored approach is needed for helping children to taste disliked vegetables. When these findings are incorporated in the existing evidence-based guidelines to increase liking for and consumption of healthy food and translated comprehensively to caregivers of young children, they will contribute to promoting healthy eating. Finally, we maintain that the principal process to teach and train children to like and consume a new vegetable has proven to be repeated taste exposure. To facilitate the tasting process, we summarize and recommend the strategies as follows: (1) modelling and reward generally increase the likelihood that a child tastes, and (2) if the child still refuses to taste, a strategy in accordance with the Reward Sensitivity of the child is proposed: a low Reward Sensitivity child may benefit from a verbal encouragement strategy, while a high Reward Sensitivity child may benefit more from a reward strategy.

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