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Reference:
D'hondt Jonathan, Briers Barbara.- The visual analogue scale as a child-friendly measure of the unhealthy = tasty intuition
Appetite: the journal for research on intake, its control and its consequence - ISSN 0195-6663 - 192(2024), p. 1-10
Full text (Publisher's DOI): https://doi.org/10.1016/j.appet.2023.107098
Full text (Publisher's DOI): https://doi.org/10.1016/J.APPET.2023.107098
To cite this reference: https://hdl.handle.net/10067/2006350151162165141

THE VISUAL ANALOGUE SCALE AS A CHILD-FRIENDLY MEASURE OF THE UNHEALTHY = TASTY INTUITION

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Formal Publication: https://doi.org/10.1016/j.appet.2023.107098

Acknowledgments: This work was supported by Fonds Wetenschappelijk Onderzoek Project grant G017120N. This project received positive ethical approval from the Committee for Research Ethics and Integrity at Vlerick Business School.

Author contributions: The authors confirm contribution to the paper as follows: study conception and design: Briers & D'hondt; data collection: Briers & D'hondt; analysis and interpretation of results: D'hondt with critical input from Briers; draft manuscript preparation: D'hondt with critical input from Briers.

Abstract:

Worldwide, obesity is a growing concern. The implicit belief that healthiness and tastiness in food are inversely related (the Unhealthy = Tasty Intuition or UTI) decreases healthy food consumption and increases the risk of obesity. Since also childhood obesity has increased at an alarming rate and a large component of adult obesity is established during childhood, questions about children's own food beliefs and preferences are important. However, methods currently used to assess the UTI are either unvalidated Likert scales or implicit measures that are time intensive and too complex to be used for children. Two studies presented here offer an alternative measurement - the simple visual analogue scale.

The findings show that this measure is more effective in predicting dietary quality in adults and the frequency of healthy food consumption in children compared to more traditional measures. This simple and effective tool could be used by academics and health practitioners alike to better understand children's food beliefs at an early age, which is a critical step when addressing the increasing obesity problem.

Keywords: Children, food attitudes, explicit associations, unhealthy = tasty intuition, measurement

The global obesity epidemic has become a major cause for concern, as evidenced by data from the Non-Communicable Disease Risk Factor Collaboration (NCD-RisC[1]), indicating a staggering surge in obesity prevalence among school-age children and adolescents worldwide. Over a span of just four decades, the number of affected children has risen significantly, increasing over tenfold from 11 million to 124 million. Moreover, an estimated 216 million children were classified as overweight but not obese during the same period (NCD Risk Factor Collaboration, 2017). In Europe, childhood overweight (BMI 25 – 30) and obesity (BMI > 30) rates ranged from 15.3% to 25.6% in 2016, showing substantial regional differences (Garrido-Miguel et al., 2019). Childhood obesity has a profound impact on both physical and mental health, including increased risks of developing asthma (Black et al., 2013) and diabetes (Drake et al., 2002), as well as a higher likelihood of being bullied (van Geel et al., 2014). While obesity is considered a multi-factor disease, diet plays a major role (Cutler et al., 2003; Nicolaidis, 2019; Wright & Aronne, 2012). A large cross-national European study revealed a trend of poor diet quality of children and adolescent, where nearly half of their food intake comprised of ultraprocessed foods (Lauria et al., 2021).

The low diet quality and the high prevalence of obesity may be rooted in our evolutionary history as humans have evolved to favor energy-dense foods (Pinel et al., 2000). Energy-dense foods are typically products with low water content and high fat and sugar content (Drewnowski, 2003). Humans evolved to like these sweet and savory tastes as they attracted us to foods that are rich in carbohydrates and protein that are important for growth and development. Conversely, our dislike for bitter tasting food has guarded us from consuming dangerous substances such as toxic plants (Cowart, 2005). This evolutionary

[1] https://ncdrisc.org/about-us.html consulted on 8th of August 2023.

benefit may be the reason taste has become the primary determinant of food choice (Glanz et al., 1998; Sullivan et al., 2015). However, this innate preference that once helped us survive when calories were scarce is now contributing to the current obesity epidemic, as high-calorie foods are easily accessible in modern societies. Due to this association between caloric density and palatability (Drewnowski, 1998), many people believe that tastiness and healthiness in food are inversely related, which Ragunathan et al. labeled "the Unhealthy = Tasty Intuition" (UTI). Because taste is the primary determining factor in food choice (Glanz et al., 1998; Sullivan et al., 2015), people who strongly adhere to the UTI may tend to choose unhealthy food since they perceive them to be tastier. Supporting this, Mai and Hoffmann (2015) found that consumers who strongly held UTI beliefs demonstrated less interest in healthy food and a greater interest in unhealthy food. Moreover, cross-national studies have found that stronger beliefs in UTI are associated with a higher body mass index (BMI) due to decreased consumption of healthy foods (Briers et al., 2020; Cooremans et al., 2017), indicating the UTI has significant and harmful downstream consequences. For children, the UTI may even be more harmful, because they have a higher sensitivity to taste preferences and a stronger tendency to prioritize immediate gratification over long-term health considerations than adults (Birch et al., 1984; Nguyen et al., 2015). This is due, in part, to the fact that the cognitive control center in their brains is not yet fully developed (Metcalfe & Mischel, 1999). Consequently, children may be even more vulnerable to the negative consequences of UTI; they may be more likely to follow their taste preferences and develop a liking for and choose unhealthy foods, which can have detrimental effects on their health and wellbeing. It is therefore important to investigate whether the same correlation between UTI beliefs and actual eating behavior exists in children, as observed in adults. Since childhood eating habits and food beliefs tend to persist into adulthood (Skinner et al., 2002), early identification of potentially harmful beliefs such as the UTI is important because it provides an opportunity to address this risk factor in a timely manner. In order to do so, the development of a reliable and valid measure for UTI among children is of primary importance.

1.1 Current methods used to assess UTI & their limitations

Studies frequently distinguish between explicit and implicit beliefs; Explicit beliefs are assumed to be formed through rational and conscious mental processing, while implicit beliefs are assumed to be automatic and spontaneous in nature (Greenwald et al., 1998). Studies addressing associations between taste and health are no exception, with the first article describing the UTI already showing that this intuition is also reflected at the implicit level. Consequently, researchers studying the UTI have relied on both explicit and implicit measures; most frequently the explicit, two-item Likert-type scale developed by Raghunathan and colleagues (2006) or an implicit taste versus health adaptation of the classic Implicit Association Test (IAT, Greenwald et al., 1998). The UTI scale contains the items "Things that are good for me rarely taste good" and "There is no way to make food healthier without sacrificing taste." Some studies (e.g., Mai & Hoffmann, 2015) have added a third item "There is usually a trade-off between healthiness and tastiness of food" to the original two-item scale by Raghunathan and colleagues (2006). The second, the IAT, is an instrument commonly used to measure the strength of automatic associations between constructs with reaction times and has been used in children before to measure their implicit food cognition (DeJesus et al., 2020). The IAT involves presenting participants with two categories, such as "healthy" and "unhealthy," as well as two attributes, such as "tasty" and "untasty." Participants are then required to categorize stimuli into the appropriate category, such as placing fruit into the healthy category and the word "yummy" into the tasty category. The basic assumption of the IAT is that two constructs (e.g., unhealthy and tasty) that are strongly associated will be easier and faster to process. The IAT has demonstrated predictive validity and test-retest reliability in its application with children, but strong domain differences were found (Rae & Olson, 2018).

However, both Likert scales and the IAT have potential problems. The original UTI Likert-type scale has not been subjected to proper psychometric validation, and Likert-type scales have received criticism on their susceptibility to response biases such as acquiescent responding and extreme option responding (Weijters et al., 2010, 2013) and social desirability (Kuncel & Tellegen, 2009). Acquiescent responding is the tendency to prefer answering on the positive side of the rating scale, regardless of the item content (e.g., Paulhus, 1991; Weijters et al., 2013). Social desirability refers to the tendency to respond in a manner that is consistent with what one perceives as desirable or acceptable by significant others (Kuncel & Tellegen, 2009).

The IAT has also faced criticism, with reviews finding it to have weak predictive validity and limited incremental validity compared to self-report measures (e.g., Blanton et al., 2009; Meissner et al., 2019). Oswald and colleagues (2015), for example, examined the predictive potential of the IAT regarding racial discrimination and state that "IAT scores are not good predictors of ethnic or racial discrimination, and explain, at most, small fractions of the variance in discriminatory behavior in controlled laboratory settings" (p. 562). Although, the IAT can exhibit predictive validity in children (e.g., Lemmer et al., 2015), this validity demonstrates notable differences across different domains (Rae & Olson, 2018). In a study conducted by Dejesus and colleagues (2020), a food IAT was employed to evaluate taste-health associations in children. Surprisingly, the IAT did not predict eating behavior effectively. Contrary to expectations, the results showed that children had a stronger positive association with vegetables compared to desserts. The authors speculated that the IAT might have captured more health-related knowledge rather than reflecting the children's intrinsic beliefs or preferences, emphasizing a noteworthy limitation of this instrument that has been repeatedly discussed in other studies assessing children's food beliefs using IAT (Brecic et al., 2022; DeJesus et al., 2020; van der Heijden et al., 2020).

Another potential flaw of the IAT is a design artifact called the block order effect. The block order effect refers to the influence of the order in which the stimulus categories are presented on the IAT results. Specifically, participants may perform differently on the IAT depending on whether the "target" category or the "attribute" category is presented first. This effect occurs because the order of presentation may affect the cognitive associations participants form between the target and attribute categories, leading to changes in response accuracy on subsequent trials (Greenwald & Nosek, 2001). For example, if the "healthy" category is presented first and followed by the "tasty" category, participants may be quicker to associate healthy foods with tastiness compared to if the "unhealthy" category was presented first. This block order effect can impact the validity and reliability of the IAT results (Klauer & Mierke, 2005). Although providing more practice trials can reduce this effect (Nosek et al., 2005), it also increases the length of the procedure.

Additionally, administering either of these measures to young children may not be appropriate due to their limited reading ability, understanding of tasks and scales, and attention span, as outlined by the ASTM guidelines for sensory consumer research with children (2021). Moreover, research indicates that young children tend to focus on a single attribute of food when making judgments rather than considering all sensory attributes (Guinard, 2000). For example, Moskowitz's (1994) study found that children often confused taste and texture attributes of ice cream, leading to overlapping and smearing judgments during sensory evaluation. This presents an issue for the original Likert-type scale and the IAT, which utilize both tastiness and healthiness as attributes in the question wording and design. In response, many studies assessing children's food attitudes rely on parent reports, for which mixed evidence has been found regarding its validity (Haycraft & Blissett, 2008;

Lewis & Worobey, 2011). Parent report measures can be useful in assessing a child's eating behavior; however, they may not accurately reflect a child's own beliefs and attitudes toward food. A validated, standardized metric that is simple enough for young children to use could help to overcome this issue.

The few studies examining children's self-reported associations between healthiness and tastiness in food research have used both these explicit and implicit measures (e.g., DeJesus et al., 2020; Ha et al., 2019). Additionally, certain studies employed an explicit rating task wherein children were presented with pictures of different foods and were asked to rate their tastiness (e.g., Ha et al., 2019; van der Heijden et al., 2020). By comparing the ratings of healthy and unhealthy foods, a UTI index score was calculated.

However, within the same studies, two different measures often point to different beliefs: explicit measures often indicate the UTI, while implicit measures often indicate a positive association between healthiness and tastiness in food ("healthy = tasty intuition"; HTI). To provide an overview of these findings, we present a summary of studies comparing explicit and implicit associations between healthiness and tastiness in primary school aged children in Table 1.

Table 1. Overview of studies assessing children's implicit and explicit UTI

Study	**Sample**	**Measure**	**Result**	**Implicit - Explicit correlation**
Van der Heijden et al., 2020	n = 37, Children with lower socioeconomic position, age [5 - 13]	Implicit: IAT	HTI; $d = 0.17^{*}$	

		Explicit: Rating task	UTI; d = -.72**	
		Explicit: UTI Scale	HTI; d = -.77*	r = .18 NS
		Explicit: VAS	UTI; d = -1.07***	
Dejesus et al., 2020	n = 123, age [4 - 12]	Implicit: IAT	HTI; d = .65***	b = .03, NS. Correlation not reported.
		Explicit: Sorting task	UTI; d = .75***	
Brecic et al. 2022	n = 1412, age [5 - 9]	Implicit: IAT	HTI; d = 0.19***	r = .27***
		Explicit: Rating task	UTI; d = .39***	

Note: UTI = "unhealthy = tasty intuition", HTI = "healthy = tasty intuition", * $p < .05$, ** $p < .01$, *** $p < .001$. To facilitate comparisons, results of the studies were converted into Cohen's d effect sizes using the formula outlined by Ruscio (2008). We included studies that assess taste-health trade off beliefs in a non-clinical, primary school aged child sample, by using both an explicit measure and the Implicit Association Test, and without manipulating the belief.

Given the inconsistent findings in these studies assessing children's food beliefs, there is a pressing need for standardized tools that can provide a more comprehensive understanding of children's individual food beliefs and preferences, especially tools that can be efficiently used in large-scale studies. A potential candidate is the Visual Analogue Scale (VAS). A VAS is a psychometric response scale that was first described in 1921, at the time, called a "graphic rating method" (Hayes, 1921). It is a continuous response scale that requires the respondents to indicate their opinion by placing a mark between two anchored extremes. Unlike the Likert scale, where the respondent chooses from a set of options, the VAS allows for a more nuanced representation of the respondent's attitude. VASs are known for their simplicity, speed, and reliability and are often used to measure explicit attitudes in political science and chronic disease research (e.g., Bijur et al., 2001; Maarj et al., 2022). Compared to the Likert-type scale, the VAS has been shown to be more reliable and valid (Alwin, 1997; Reips & Funke, 2008) and less susceptible to confounding factors and ceiling effects (Voutilainen et al., 2016). In addition, due to its minimum requirement of reading and writing skills and its quick and simple administration, we believe that this measure is a promising tool for assessing children's beliefs and preferences.

The VAS has been used in food research before, for example, as a measure of appetite (e.g., Brunger et al., 2015) and satiety (e.g., Keller et al., 2006). Also, recently, the VAS was used to investigate associations between food healthiness and tastiness among children and parents in a lower socioeconomic position (van der Heijden et al., 2020). While van der Heijden et al. claim to have found support for the UTI in children using the VAS measures, they do not report the correlations between the VAS and dietary habits and only had a limited sample size of 37 child-parent dyads, leaving a potentially interesting usage of the VAS unexplored.

The current paper investigates the validity of using VAS to measure associations between the healthiness and the tastiness of food. In the first study, we examine the VAS's potential by examining the correlation between the VAS and the existing UTI Likert scale in an adult sample to establish convergent validity. Additionally, our intention is to demonstrate that the VAS can also predict food consumption in adults, in line with previous studies (Briers et al., 2020; Mai & Hoffmann, 2015). In the second study, we test the usability of the VAS in a sample of primary school-aged (ages 6 to 13) children. For both studies, we will (1) compare the VAS with more traditional methods of measuring UTI, and (2) explore the measures' predictive potential for healthy food consumption. This is particularly relevant since previous research has suggested that believing in the UTI could lead to reduced consumption of healthy foods (Briers et al., 2020; Mai & Hoffmann, 2015).

2. Study 1

2.1 Methodology

2.1.1 Participants

Data and materials are available on the Open Science Framework (OSF). We recruited 201 participants on Prolific. All participants provided informed consent and were paid £1 for the study, estimated to last 5 minutes. All participants were UK residents. Fifty percent of the participants were male, 49% female and 1% preferred not to disclose their gender. The average age in this sample was 32.1, with a standard deviation of 4.0. A descriptive overview of the demographic variables is available on OSF. This study is part of a project that received positive ethical approval from the Committee for Research Ethics and Integrity at an anonymous business school.

2.1.2 Procedure

The study began with administering the explicit UTI scale based on Raghunathan et al. (2006), which consisted of three items ("Healthy food is usually less tasty", "Eating healthy means sacrificing taste", & "There is usually a trade-off between healthiness and tastiness of food") rated on a 7-point Likert scale (1 = "Strongly disagree" & 7 = "Strongly agree"). The scale had a reliability of .89 in our sample. We simplified the original two-item questions slightly and added a third item that was used by Briers et al. (2020). The UTI score was calculated by averaging the scores of three items (α = .89).

Next, participants were asked to complete the UTI-VAS, consisting out of two visual analogue scales (VASs) to assess their feelings about the taste of healthy and unhealthy food. The VAS (Figure 1) consisted of a continuous scale with three anchors: a negative smiley face at the minimum point of the scale, a neutral smiley face at the midpoint, and a positive smiley face at the maximum point. Participants were instructed to indicate their feelings about the taste of healthy food on the first VAS item and unhealthy food in the second VAS item by sliding a marker. The UTI-VAS index was then calculated by subtracting the first item score (healthy) from the second item score (unhealthy). Scores could range from -100 to 100, with a positive score indicating a stronger UTI.

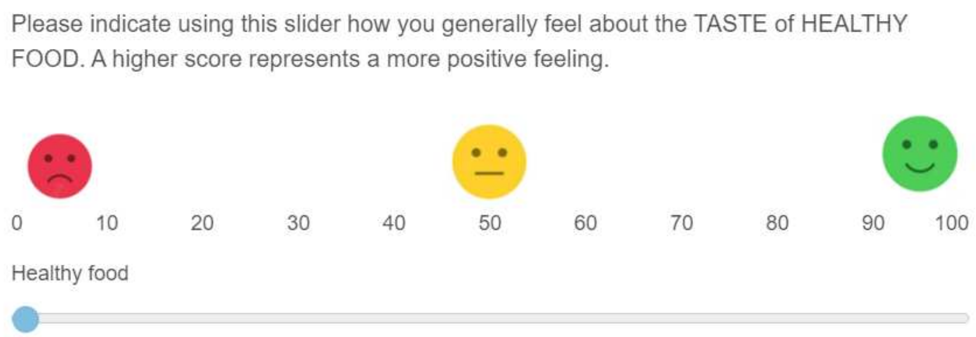

Figure 1. The first item of the UIT-VAS, The Healthy Food VAS.

After the UTI-VAS, the participants completed a validated short-form Food Frequency Questionnaire (SFFFQ; Cleghorn et al., 2016). In the SFFFQ, participants were asked to indicate how frequently they consumed 20 different food groups in an average week. For example, they were asked to indicate their frequency of eating fruit on an 8-point scale, ranging from "Rarely or never" to "5+ times a day." These scores were transformed into a

Dietary Quality Score (DQS), following the original authors' guidelines. The DQS score can range from 5 to 15, with a higher score indicating better dietary quality.

Additionally, in two separate open-ended questions, participants reported the average number of portions of both fruit and vegetables that they consumed on a daily basis because the average amount of these two categories is a frequent talking point in popular press articles[2].

Finally, participants provided demographic information such as age, gender, education level, yearly household income, length, and weight. We constructed a BMI score based on the self-reported length and weight information (kg/m^2). Participants who provided unrealistic BMI scores were removed from the dataset (BMI > 42, based on 2 SD from the mean, 11 participants). Excluding these participants did not change the conclusions of the study. The full questionnaire is available on OSF.

2.1.3 Analytical Approach

All analyses were conducted in JASP (JASP Team, 2023).

We aim to investigate the correlations between the UTI-VAS, UTI scale, and food consumption variables. As UTI has been shown to be a predictor of healthy food consumption, it is important to examine whether the UTI-VAS can capture this association.

In addition, we conducted two hierarchical regression analyses using DQS as the dependent variable. In Model 1, we included age, gender, and education as regressors, as these demographic variables have consistently been associated with dietary quality in previous studies (McGowan et al., 2016). In Model 2, we added the UTI scale as a predictor variable in addition to the demographic variables. To avoid multicollinearity issues, we fit the

[2] For example: Which fruits and vegetables should be in your '5 a day'? - The Washington Post

two UTI measures in separate models. In Model 3, we removed the UTI scale and added the UTI-VAS as a predictor variable.

To compare the models, we used two separate hierarchical regression analyses. In the first analysis, we compared Model 1 with Model 2 to examine the additional variance explained by UTI. In the second analysis, we compared Model 1 with Model 3 to see if the UTI-VAS can explain similar additional variance in DQS.

2.2 Results

Shapiro-Wilk tests were conducted on each variable to assess normality. Since the results showed that all variables have a non-normal distribution ($p < .05$ in all cases) and some variables are not continuous, we used Spearman's rho correlations, as suggested in previous research using similar measures (van der Heijden et al., 2020).

The UTI-VAS correlated significantly with the UTI scale (r = 0.47, $p <. 001$), fruit consumption (r = -0.21, $p = .004$) and DQS (r = -.21, $p = .003$). The results of the correlation analyses are shown in Table 2.

Table 2. Results of correlation analyses in study 1.

	N	M	SD	Range	1	2	3	4	5	6	7
1. UTI-VAS	190	11.54	23.31	-70 - 82	_						
2. UTI Scale	190	3.61	1.39	1 – 6.67	.47***	---					
3. Age	190	31.96	4.00	25 - 40	.04	.01	—				

4. BMI	185	26.02	4.47	18.35 – 41.61	-.04	.02	.08	—			
5. Vegetable consumption	190	2.37	1.14	0 - 6	-.13	-.28***	-.18*	-.05	—		
6. Fruit consumption	190	1.98	1.18	0 - 6	-.21**	-.17*	.04	-.17*	.18*	—	
7. DQS	190	9.89	1.67	7 - 14	-.21**	−.21**	-.01	−.13	.33***	.24***	—

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Correlations are Spearman's rho.

2.2.2 Hierarchical regression analyses

In the regression analyses predicting dietary quality, the first model proved non-significant, $F(6,181) = 1.07$, $p = .384$, adjusted $R^2 = .002$, with none of the demographic variables having significant predictive value.

Model 2 proved significant, $F(7,180) = 2.14$, $p = .042$, but the inclusion of the UTI Scale improved model fit, adjusted $\Delta R^2 = .039$. The UTI Scale was a significant predictor of DQS in Model 2, $\beta = -.21$, $p = .004$.

Model 3 proved non-significant, $F(7, 180) = 2.03$, $p = .054$, but the inclusion of the UTI-VAS improved model fit over model 1, adjusted $\Delta R^2 = .035$. The UTI-VAS was a significant predictor of DQS in Model 3, $\beta = -.20$, $p = .007$. See Table 3 for an overview of the regression analyses results.

Table 3. Hierarchical regression analysis of predictors of dietary quality in Study 1.

Predictor variables	Model 1	Model 2**	Model 3**
Gender (1, female; 0, male)	.08	.04	.05

Age	-.09	-.09	-.09
Education			
Secondary (1, yes; 0, no)	-.15	-.14	-.13
Vocational (1, yes; 0, no)	-.08	-.09	-.06
Some University (1, yes; 0, no)	-.05	-.07	-.06
Bachelor (1, yes; 0, no)	-.13	-.13	-.12
UTI Scale	/	-.21**	/
UTI-VAS	/	/	-.20*
Adjusted R²	.002	.041	.037
Adjusted R² Change		.039	.035

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Predictor values are standardized beta coefficients.

Exploration of gender differences in the data is available on OSF.

2.4 Discussion

The study found that the UTI-VAS showed a significant correlation with the Likert scale-based UTI measure. Additionally, it exhibited similar correlations with fruit consumption and diet quality as compared to the scale-based UTI measure. Furthermore, results from the regression analyses suggest that UTI is a stronger predictor for dietary quality than demographic variables such as age, gender and education. Surprisingly, the demographic variables did not significantly predict diet quality in this study. Altogether, these findings suggest that although the UTI-VAS is simpler, it has similar predictive power as the UTI scale, highlighting its potential utility as a valid and convenient tool for assessing the association between healthiness and tastiness of food.

In the second study, we want to replicate this among children. For this, the measure should be as simple as possible. So, we explored here whether we could reduce the UTI-VAS to only one single item by looking at the two UTI-VAS items separately. The Healthy Food VAS showed stronger correlations with the scale-based UTI measure ($r = -.59$, $p < .001$), the DQS ($r = .29$, $p < .001$), and the fruit ($r = 0.27$, $p <.001$) and vegetable ($r = .37$, $p < .001$) consumption variables, compared to either the scale-based UTI measure or the two-item UTI-

VAS. In an additional hierarchical regression, the Healthy Food VAS model was significant and improved model fit over Model 1, $F(7, 180) = 3.47$, $p = .002$, adjusted R^2 change = .085. The Healthy Food VAS proved to be a significant predictor in this regression model, $\beta = .30$, $p < .001$, with a higher beta value than the UTI Scale and the full UTI-VAS. These results suggest that the Healthy Food VAS by itself may be a good enough or even better predictor of the downstream effects of UTI. Notably, participants' responses on the Unhealthy Food VAS may have been influenced by their earlier response on the Healthy Food VAS, as it was presented first, and the items were not randomized. However, since the Healthy Food VAS was presented first, potential order effects would not apply to this measure. Because we identified the Healthy Food VAS as the primary measure of interest, we believe this limitation is less harmful for the overall conclusion of this research.

3. Study 2

3.1. Introduction

This study aimed to assess the Healthy Food VAS as a simple, time-efficient, and child-friendly measure of UTI. In this study, we adapted the Healthy Food VAS slightly and utilized it as a "feeling thermometer" to make it more engaging for the children, as operationalized by van der Heijden et al. (2020).

In contrast to Study 1, we added an implicit measure in this study. Implicit measures are sometimes included in child studies (e.g., Craeynest et al., 2005) because they are put forward as measures that can capture a distinct mental process (Greenwald et al., 1998), and as a result can predict behavior in a way that is either independent, additive or interactive with self-report measures (Dovidio et al., 1997). Furthermore, children are thought to often respond in socially desirable ways, which implicit measures are supposed to circumvent (Brody et al., 1985; Cvencek et al., 2011). In this study, we directly compare the potential of the Healthy Food VAS and an implicit measure to predict downstream consequences of the UTI, namely healthy food consumption.

For that purpose, we examine the correlations between the Healthy Food VAS and two other explicit UTI measures, an implicit UTI measure, parent reported food consumption, and BMI, all of which are explained below.

3.1. Methodology

3.1.1. Participants

Data and materials are available on OSF. A total of 158 children were recruited from a local Flemish elementary school, comprising 76 second-grade students (M_{age} = 6.82 years, SD_{age} = 0.51) and 82 fifth-grade students (M_{age} = 10.90 years, SD_{age} = 0.49). The selection of these specific age groups was made to facilitate a comparison between younger and older primary school students. We chose to concentrate on children of primary school age because this specific group could potentially encounter the most challenges with the current methods of assessing UTI. For instance, young children often exhibit a tendency for extreme responses when employing Likert scales (Chambers & Johnston, 2002). Additionally, their relatively limited cognitive development underscores the need for dedicated efforts in designing specialized measures tailored to their age group (Mellor & Moore, 2014). This age bracket is likely to derive the most benefits from this new measurement approach. Furthermore, this age group aligns with the samples of the studies presented in Table 1.

Prior to the testing day, the children were given an informed consent form and a questionnaire to take home and give to their parents. On the testing day, the children were given oral instructions for each question by two researchers in a group setting. Note that all questionnaires were administered in the participants' native language. We translated the questionnaires to English for the purpose of this article. This study is part of a project that received positive ethical approval from the Committee for Research Ethics and Integrity at an anonymous business school.

3.1.2. Parental questionnaire

The parents provided informed consent for their children, as well as their children's height and weight information, and the Food Frequency Consumption Questionnaire (FFCQ) (Block et al., 1986; as operationalized by Laureati et al., 2020). Parents were asked to report their child's food consumption frequency over the past month for 17 food categories. Response options included: "never," "1-3 times a month," "1-3 times a week," "4-6 times a week," "once a day," "multiple times a day," and "I don't know." To enhance comprehension, specific product examples were provided. We focused here on the frequency of fresh fruit and vegetable consumption since previous research has shown that reduced fruit and vegetable consumption is an important downstream consequence of the UTI (Briers et al., 2020; Mai & Hoffmann, 2015). See OSF for the full questionnaire and results.

Consistent with previous literature (e.g., Daly et al., 2011; Laureati et al., 2020) , we transformed the food consumption frequencies to Daily Frequency Equivalents (DFE). DFEs were calculated by assigning proportional values to the original frequency categories using a base value of 1.0, representing once a day consumption. DFE scores were assigned as followed: DFE of 0 = less than once a month or never, DFE of 0.07 = 1-3 times a month, DFE of 0.28 = 1-3 times a week, DFE of 0.71 = 4-6 times a week, DFE of 1 = once a day, and DFE of 2.5 = multiple times a day.

3.1.3. The paper and pencil IAT

Children started with a paper and pencil Implicit Association Test (Lemm et al., 2008). This version relied on participants' ability to correctly classify as many items as possible into corresponding categories within 25 seconds per block rather than measuring reaction times. Stimuli were used in a digital IAT before by van der Heijden et al. (2020); Food stimuli were validated for perceived caloric content, perceived healthiness, and liking among children and adults by Charbonnier and colleagues (2016). Tasty and icky symbols were developed by Rutland et al. (2005). We chose the paper and pencil IAT for its suitability in this context, as it is independent of language and reading abilities (Babcock et al., 2016) and it allows for data collection in group. Additionally, it circumvents potential differences in digital literacy between the different age groups (Jin et al., 2020). Studies comparing Paper-and-Pencil IATs with traditional Computer IATs have found similar response patterns and positive correlations (e.g., Chan et al., 2017; Mori et al., 2008).

The IAT procedure consisted of five blocks where participants assigned stimuli to one of two categories, with blocks 3 and 5 providing critical data. The stimuli were displayed at the centre of the page, accompanied by two answer columns positioned to the left and right of the stimuli. The first block contained the target of interest (the healthy category on the left side and the unhealthy category on the right side; food items as stimuli), the second block consisted of attribute items (the tasty category on the left side and the icky category on the right side; emoji symbols as stimuli), and the third block included both the target and the attribute items. To track order effects, we created two versions of the test: In the bias-consistent version, "tasty" and "unhealthy" were grouped on the same side in Block 3, while in the bias-inconsistent version, "tasty" and "healthy" were paired on the same side in Block 3. The fourth block was a repetition of Block 1, but with the position of target items reversed. Finally, Block 5 was a repetition of Block 3, but with the target items switched sides. See figure 2 for an example of Block 3 and Block 5, and OSF for the complete procedure.

During the testing, children were led by two researchers who provided standardized instructions and displayed clear examples on a large screen prior to each IAT block. The classification categories and corresponding stimuli were presented to the children before the start of each block to ensure a clear understanding of the task at hand. The researchers encouraged the children to work fast and reassured them that it was okay if they were unable to classify all items, as completing the entire page is challenging. The aim was to reduce frustration and maintain motivation levels.

The IAT score was calculated according to the guidelines provided by Lemm et al. (2008). Only the results from Blocks 3 and 5 were considered. The score was determined by calculating the number of correctly classified items in the bias-consistent block (X) and the bias-inconsistent block (Y). The final score was calculated using the formula $\frac{X}{Y}\sqrt{(X-Y)}$. In instances where the bias-inconsistent score exceeded the bias-consistent score, the final score was multiplied by -1. A score greater than 0 indicated a bias that was consistent with the "unhealthy = tasty" intuition, while a negative score indicated a bias that was consistent with the "healthy = tasty" intuition. We removed strong outliers for IAT correlations (n = 7, corresponding to more than three times the standard deviation from the mean in either direction (e.g., de Houwer & Bruycker, 2007). Removing these participants did not change the conclusions of this study.

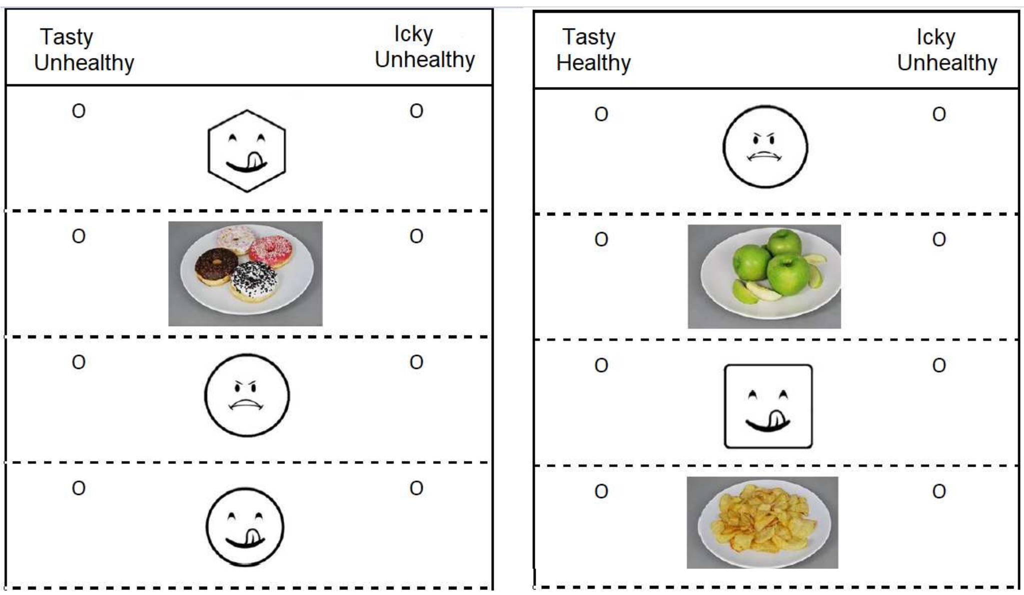

Figure 2. Block 3 (left) and Block 5 (right) of the IAT (Version A).

3.1.4. Explicit measures

After the IAT, three explicit measures of UTI were administered to the children: the UTI-VAS, a binary choice adaptation of the original UTI scale, and a food item rating task.

The first measure was the Healthy Food VAS, a simple VAS that appeared like a thermometer and measured the level of "cold" (negative) or "warm" (positive) feeling the children had toward healthy food. The researchers instructed the children to think about the taste of food that they think is healthy. The researchers then instructed the children to mark or color on the 100-point scale from left to right using a marker or pencil. Because our first study showed that the first item (Healthy Food VAS) performed best by itself, we dropped the second item (Unhealthy Food VAS) in this study.

To enhance comprehensibility and facilitate comparisons with the other measures, we transformed the Healthy Food VAS scores by subtracting them from the maximum score of 100. This way, all scores of all measures represent UTI in the same direction. For instance, a score of 80 on the Healthy Food VAS, indicating high liking for healthy food and thus a low UTI, would be transformed to 20. Conversely, a score of 20 on the Healthy Food VAS, indicating low liking for healthy food and thus a high UTI, would be transformed to 80.

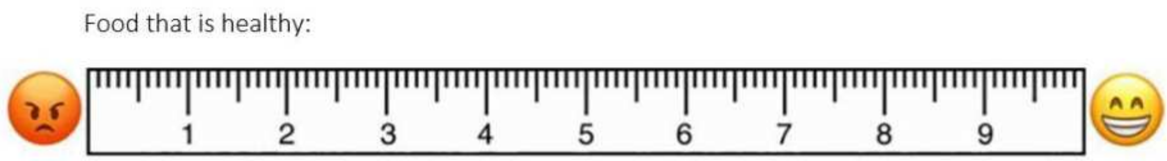

Figure 3. The Healthy food VAS used in study 2.

The next measure involved adapting the original UTI scale into a child-friendly format. The scale consisted of four binary questions: "Food that is (not) good for me" with response options of "tasty" and "not tasty"; and "Food that is (not) tasty" with response options of "healthy" and "not healthy" (Figure 4). The words "tasty" and "not tasty" were accompanied by positive or negative smiley faces, respectively. Children were asked to draw an arrow from the item to the answer options. Answers in line with the UTI were scored 1, while answers not in line with the UTI were scored -1. The total summed scores ranged from -4 to 4, with higher scores representing a higher UTI.

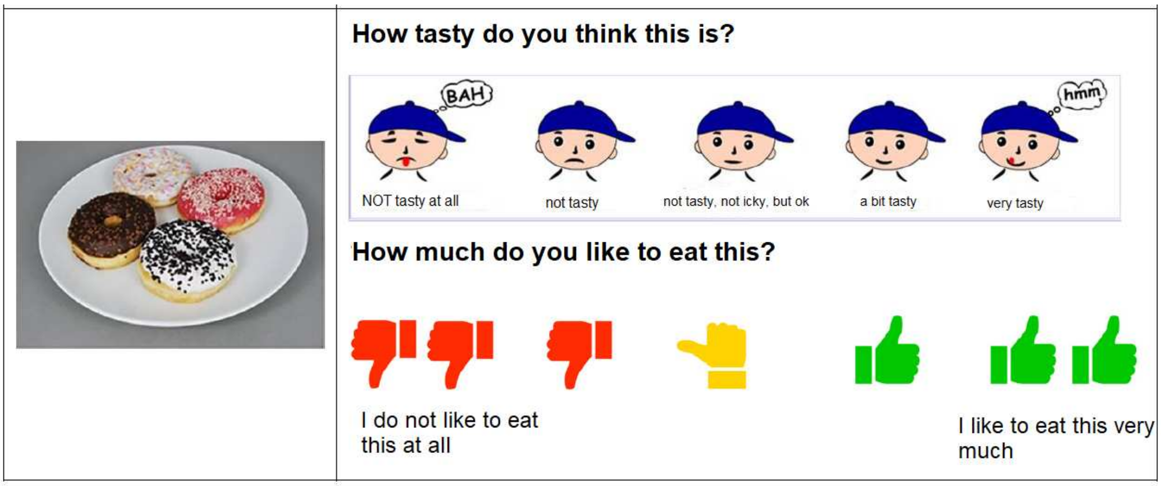

Figure 4. One of the four items from the adapted UTI scale used in study 2.

Finally, the children rated four healthy and four unhealthy food items (which were also used in the IAT, see Figure 5) on perceived tastiness and how much they would like to eat them using 5-point Likert scales accompanied by smiley faces (1 = "not tasty at all," 5 = "very tasty") or thumbs ranging from negative to positive (1 = "I do not like to eat this at all, 5 = "I like to eat this very much"). Scores were averaged for the unhealthy and healthy items separately, then the difference score was calculated as a UTI index. Scores could range from -4 to 4, with a higher score indicating a stronger UTI. An overview of scores per item can be found on OSF under supplementary results in Appendix C.

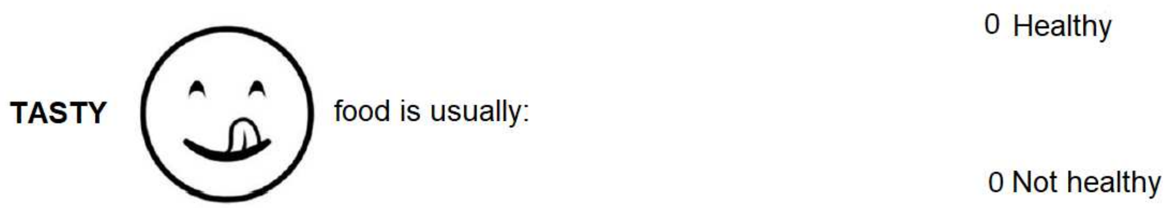

Figure 5. An example of rating task item used in study 2.

3.2. Aims & Analytical approach

Our primary objective was to examine the correlations between the Healthy Food VAS, the IAT, and other explicit measures of UTI. As food consumption is a crucial consequence of UTI, we also examined the correlation between the UTI measures and parent-reported fruit and vegetable consumption in line with Study 1.

Because the IAT is sensitive to order effects and quite complex for children, we will begin with testing order effects of the different IAT versions and the influence of age on the IAT scores. We did not have a priori hypotheses regarding these effects.

3.3. Results

3.3.1. Prescreening Paper-and-pencil IAT

We found a significant order effect in the IAT, such that children who had the bias-inconsistent version first (n = 74, M = -5.67, SD = 6.17) showed a lower UTI than the children who saw the bias-consistent version first (n = 73, M = -3.12, SD = 6.00), t(144.97) = -2.54, *p* = .012, d = -.42, 95% CI = [-.75, -.09].

While we did not find a significant difference between the IAT scores of the second-grade (M = -4.05, SD = 4.81) and sixth-grade children (M = -4.18, SD = 5.54), t*(*140.97) = -.14, *p* = 0.882, d = .03, 95% CI [-.30, 0.35], we find strong differences in the number of correctly classified items between these groups. Second-grade children significantly classified fewer items correctly in the bias-consistent block (M = 6.20, SD = 3.41) and bias-inconsistent block (M = 10.71, SD = 4.55) than sixth-grade children [bias-consistent block:

(M =10.86, SD = 4.37), t(142.9) = -7.31, *p* < .001, d = -1.20, 95% CI [-1.55, -.84]; bias-inconsistent block: (M = 16.42, SD = 5.88), *t*(142.5) = -6.63, *p* < .001, d = -1.09, 95% CI [-1.43, -0.74])].

3.3.2 Correlation analyses

The Healthy Food VAS correlated significantly with the frequency of vegetable (r = -.24, *p* = .003) and fruit consumption (r = -0.24, *p* = .003) and the other explicit measures [(UTI scale: r = .52, *p* < .001); Rating task: r = .38, *p* < .001)]. In contrast, the IAT score did not correlate significantly with either vegetable (r = -.08, *p* = .369) or fruit consumption (r = -.10, *p* = .250). Full correlation analysis results are shown in Table 4.

Table 4. Correlation table of study 2.

Variable	***n***	***M***	***SD***	**Range**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Healthy food VAS	156	23.64	23.30	0 - 85	—							
2 UTI Scale	157	.089	2.64	-4 - 4	$.52^{***}$	—						
3. UTI Food rating	154	.59	1.22	-4 – 3.88	$.38^{***}$	$.22^{**}$	—					
4. IAT score	147	-4.40	6.20	-30 – 16.8	$.20^{*}$	.15	.13	—				
5. Age	157	8.94	2.11	6 - 13	$.34^{***}$	$.29^{***}$	-.09	.00	—			

6. BMI	136	16.50	2.65	12.25 – 26.67	.13	-.12	-.11	-.06	.33***	—		
7. Vegetable consumption	155	1.08	.67	0 – 2.5	-.24**	-.22**	-.21**	-.08	-.12	.02	__	
8. Fruit consumption	155	1.13	.80	0 – 2.5	-.24**	−.27***	-.28***	-.10	-.16*	.04	.45***	__

Note: * *p* < .05, ** *p* < .01, *** *p* < .001. *Correlations are spearman's rho.*

3.4. Discussion

The Healthy Food VAS shows stronger correlations with the reported fruit and vegetable consumption frequency than the IAT. The three explicit measures each show similar correlations with the frequency of fruit and vegetable consumption. The brevity and ease of administration of the Healthy Food VAS make it particularly suitable for use with children.

In contrast, the IAT d-scores fail to show significant correlations with fruit & vegetable consumption frequency. Notably, (1) younger children exhibit lower accuracy rates than older children in completing the IAT, indicating its potential difficulty for this age group, and (2) we found a block order effect, lowering the potential validity of this measure.

4. General Discussion

Our two studies aimed to investigate the effectiveness of using a VAS as a simple indicator of UTI for both adults and children. Study 1 revealed a strong correlation between the Healthy Food VAS and the UTI scale, as well as a moderate correlation with vegetable consumption and dietary quality. In study 2, the Healthy Food VAS showed significant correlations with the frequency of vegetable and fruit consumption. Notably, study 2 also demonstrated that children as young as 6 years old were capable of using this measure.

In contrast to our explicit measures, the results of the Implicit Association Test (IAT) in our study suggest a slight tendency toward the "healthy = tasty" intuition. This dissociation is consistent with previous studies assessing children's implicit and explicit attitudes toward food (Brecic et al., 2022; van der Heijden et al., 2020). However, as there was no correlation between the IAT scores and consumption variables, it is uncertain whether the IAT truly assesses an inherent belief. This raises an ongoing discussion about whether the IAT measures an inherent personal belief or reflects children's knowledge of a broader cultural belief (e.g., Uhlmann et al., 2012). Given the rising obesity prevalence (Garrido-Miguel et al., 2019) and the suboptimal diet quality reported in children (Lauria et al., 2021), it seems unlikely that children have a positive association between healthiness and tastiness in food, though this remains speculative. While the discussion remains important, our main goal was to find a short, child-friendly measure that can be used to efficiently measure UTI and predict its downstream consequences such as food consumption. Our findings suggest that the IAT is less suited for this purpose.

Furthermore, completing the IAT can be challenging for younger children, which may impact the accuracy and reliability of the results. Additionally, we find that the IAT is vulnerable to the block order effect, a design artifact which can be difficult to avoid in studies involving children. However, it is worth noting we opted for a paper-and-pencil version of the IAT. While the paper-and-pencil IAT and the digital IAT have been shown to be positively correlated and resulted in similar response patterns (e.g., Mori et al., 2008), this is a limitation of this study. Future research should investigate the usability of the paper-and-pencil IAT in a food context, using different stimuli, samples, and settings.

The results of these studies indicate that Healthy Food VAS could be a valuable tool to use in future studies because (1) it provides a continuous measurement allowing for greater precision, (2) it is easy to use, reducing participant burden, which makes it a suitable measure for child research, (3) and it correlates better with downstream consequences of UTI compared to multiple choice scales. These results were obtained from a significant and difficult-to-reach sample of children, who were free from parental influences. These results have important implications for researchers and practitioners interested in understanding and addressing children's food beliefs. By demonstrating the utility of the visual analogue scale in measuring food beliefs and related behaviors, we provide valuable support for its use in future research and practice. National food consumption surveys among children [e.g., government-led projects such as the National Health and Nutrition Examination Survey (National Center for Health Statistics, 2020)] could particularly benefit from using this measure, since they typically recruit large samples for which a simple measure that requires little to no assistance would be advantageous. This instrument holds potential not only for researchers investigating children's beliefs but also for various stakeholders, including paediatric doctors, schoolteachers, dieticians, and child psychologists. By utilizing the VAS, these professionals can effectively identify vulnerable children with unhealthy food beliefs, enabling early interventions to promote healthier eating habits and combat childhood obesity more effectively.

However, it is worth noting that while the VAS appears to be a valuable tool for measuring food beliefs, further research is needed to confirm these findings and examine the scale's reliability and validity in different populations and contexts. In future studies, the VAS should be assessed with bigger sample sizes, a more extensive age range, actual food consumption rather than reported food consumption frequency, and appetitive traits such as uncontrolled eating and food responsiveness, as well as other demographic variables to provide a more complete picture of the characteristics in UTI development. Moreover, an area of particular interest lies in comprehending the role of family dynamics in the evolution of UTI beliefs, as suggested in the family consumer framework for childhood obesity of Moore and colleagues (2017). Investigating whether UTI beliefs are transmitted across generations and understanding the association between a child's UTI beliefs and those of their siblings and peers is potentially an intriguing avenue for future research. Subsequent studies should also use a longitudinal approach to examine the potential development and persistence of UTI beliefs from childhood to adulthood and its potential influence on dietary patterns and BMI in adulthood.

A first limitation of this study is that children’s food consumption frequency was reported by their parents. While this is common practice in the literature (e.g., DeJesus et al., 2020; Hoerr et al., 2009; Kiefner-Burmeister et al., 2014; Patrick et al., 2005), future research could benefit from using more observational food consumption data in order to get a more complete picture of children’s dietary habits.

A second limitation of this study is the absence of control for social desirability bias in the children's responses. It is plausible that the school context and the presence of teachers and researchers could have influenced children to answer in a socially desirable manner. However, children typically exhibit more social desirability bias in one-on-one interviews than in classroom assessments (Miller et al., 2015). Moreover, within the context of the UTI, it's possible that social desirability would lead children to over-report their positive feelings towards healthy food, potentially weakening our predictions. On the other hand, a notable strength of this research is its approach to data collection. By obtaining parent-child data separately, we circumvent the possibility of social desirability influence from parents on their children's responses, thus enhancing the integrity of our findings.

A third limitation of this study is tied to the nature of the VAS prompt, which investigates feelings towards the taste of healthy food in a broad context. Following the consumer socialization framework by John (1999, 2008), the younger children in our sample would typically align with the *perceptual* or early *analytical* stages of development. During the transition between these stages, children move from concrete to more abstract knowledge structuring. Recognizing this cognitive development, it's possible that the youngest participants might find a more concrete framing of the VAS more understandable. To address this aspect, we conducted a complementary study where we replaced the general healthy food prompt of the VAS with a specific, typical healthy food item, namely broccoli. Interestingly, this adjustment yielded outcomes consistent with the findings in Study 2. The VAS scores maintained their correlations with the frequency of both vegetable ($r = .20$, $p < .001$) and fruit consumption ($r = .24$, $p = .001$). This lends credence to the generalizability of our results and supports the validity of the VAS as an effective instrument in assessing even young children's food beliefs. A more detailed description of this study can be found on OSF under supplementary results as Appendix D.

Notably, none of the measures of UTI or healthy food consumption showed a significant correlation with BMI in this study. However, it is important to note that the BMI data were self-reported and not directly measured, which is a limitation of the study. Previous research has found that self-reported BMI data may be less reliable due to underreporting of weight and overreporting of height, leading to potentially inaccurate results (Gorber et al., 2007; Nawaz et al., 2001). The link between UTI and BMI has been established in other studies with more power (Briers et al., 2020; Cooremans et al., 2017) before, though, and was not a goal of the current study.

For now, the VAS shows to be a promising measure of the Unhealthy = Tasty Intuition in children due to its ease of use and stronger predictive power of food consumption compared to implicit measures.

5. Bibliography

Alwin, D. F. (1997). Feeling thermometers versus 7-point scales: Which are better? *Sociological Methods and Research*, *25*(3), 318–340. https://doi.org/10.1177/0049124197025003003

ASTM. (2021). *Standard Guide for Sensory Evaluation of Products by Children and Minors*. https://www.astm.org/e2299-13r21.html

Babcock, R. L., MaloneBeach, E. E., Hannighofer, J., & Woodworth-Hou, B. (2016). Development of a Children's IAT to Measure Bias Against the Elderly. *Journal of Intergenerational Relationships*, *14*(3), 167–178. https://doi.org/10.1080/15350770.2016.1195245

Bijur, P. E., Silver, W., & Gallagher, E. J. (2001). Reliability of the Visual Analog Scale for Measurement of Acute Pain. *Academic Emergency Medicine*, *8*(12), 1153–1157. https://doi.org/10.1111/J.1553-2712.2001.TB01132.X

Birch, L. L., Marlin, D. W., & Rotter, J. (1984). Eating as the "Means" Activity in a Contingency: Effects on Young Children's Food Preference. *Child Development*, *55*(2), 431. https://doi.org/10.2307/1129954

Black, M. H., Zhou, H., Takayanagi, M., Jacobsen, S. J., & Koebnick, C. (2013). Increased asthma risk and asthma-related health care complications associated with childhood obesity. *American Journal of Epidemiology*, *178*(7), 1120–1128. https://doi.org/10.1093/AJE/KWT093

Blanton, H., Jaccard, J., Klick, J., Mellers, B., Mitchell, G., & Tetlock, P. E. (2009). Strong Claims and Weak Evidence: Reassessing the Predictive Validity of the IAT. *Journal of Applied Psychology*, *94*(3), 567–582. https://doi.org/10.1037/A0014665

Brecic, R., Gorton, M., & Cvencek, D. (2022). Development of children's implicit and explicit attitudes toward healthy food: Personal and environmental factors. *Appetite*, *176*. https://doi.org/10.1016/J.APPET.2022.106094

Briers, B., Huh, Y. E., Chan, E., & Mukhopadhyay, A. (2020). The unhealthy = tasty belief is associated with BMI through reduced consumption of vegetables: A cross-national and mediational analysis. *Appetite*, *150*, 104639. https://doi.org/10.1016/J.APPET.2020.104639

Brody, L. R., Rozek, M. K., & Muten, E. O. (1985). Age, Sex, and Individual Differences in Children's Defensive Styles. *Journal of Clinical Child Psychology*, *14*(2), 132–138. https://doi.org/10.1207/S15374424JCCP1402_6

Brunger, L., Smith, A., Re, R., Wickham, M., Philippides, A., Watten, P., & Yeomans, M. R. (2015). Validation of an iPad visual analogue rating system for assessing appetite and satiety. *Appetite*, *84*, 259–263. https://doi.org/10.1016/J.APPET.2014.10.023

Chan, D. K. C., Lee, A. S. Y., Tang, T. C. W., Gucciardi, D. F., Yung, P. S. H., & Hagger, M. S. (2017). Paper vs. Pixel: Can We Use a Pen-and-Paper Method to Measure Athletes' Implicit Doping Attitude? *Frontiers in Psychology*, *8*, 876. https://doi.org/10.3389/fpsyg.2017.00876

Charbonnier, L., van Meer, F., van der Laan, L. N., Viergever, M. A., & Smeets, P. A. M. (2016). Standardized food images: A photographing protocol and image database. *Appetite*, *96*, 166–173. https://doi.org/10.1016/J.APPET.2015.08.041

Cleghorn, C. L., Harrison, R. A., Ransley, J. K., Wilkinson, S., Thomas, J., & Cade, J. E. (2016). Can a dietary quality score derived from a short-form FFQ assess dietary quality in UK adult population surveys? *Public Health Nutrition*, *19*(16), 2915–2923. https://doi.org/10.1017/S1368980016001099

Cooremans, K., Geuens, M., & Pandelaere, M. (2017). Cross-national investigation of the drivers of obesity: Re-assessment of past findings and avenues for the future. *Appetite*, *114*, 360–367. https://doi.org/10.1016/J.APPET.2017.04.010

Cowart, B. J. (2005). Taste, Our Body's Gustatory Gatekeeper. *Cerebrum*, *7*, 7–22.

Craeynest, M., Crombez, G., De Houwer, J., Deforche, B., Tanghe, A., & De Bourdeaudhuij, I. (2005). Explicit and implicit attitudes towards food and physical activity in childhood obesity. *Behaviour Research and Therapy*, *43*(9), 1111–1120. https://doi.org/10.1016/J.BRAT.2004.07.007

Cutler, D. M., Glaeser, E. L., & Shapiro, J. M. (2003). Why Have Americans Become More Obese? *Journal of Economic Perspectives*, *17*(3), 93–118. https://doi.org/10.1257/089533003769204371

Cvencek, D., Greenwald, A. G., & Meltzoff, A. N. (2011). Measuring implicit attitudes of 4-year-olds: The Preschool Implicit Association Test. *Journal of Experimental Child Psychology*, *109*(2), 187–200. https://doi.org/10.1016/J.JECP.2010.11.002

Daly, A. M., Parsons, J. E., Wood, N. A., Gill, T. K., & Taylor, A. W. (2011). Food consumption habits in two states of Australia, as measured by a Food Frequency Questionnaire. *BMC Research Notes*, *4*(1), 1–6. https://doi.org/10.1186/1756-0500-4-507/TABLES/8

DeJesus, J. M., Gelman, S. A., & Lumeng, J. C. (2020a). Children's implicit food cognition: Developing a food Implicit Association Test. *Cognitive Development*, *54*. https://doi.org/10.1016/J.COGDEV.2020.100889

DeJesus, J. M., Gelman, S. A., & Lumeng, J. C. (2020b). Children's implicit food cognition: Developing a food Implicit Association Test. *Cognitive Development*, *54*, 100889. https://doi.org/10.1016/j.cogdev.2020.100889

Dovidio, J. F., Kawakami, K., Johnson, C., Johnson, B., & Howard, A. (1997). On the Nature of Prejudice: Automatic and Controlled Processes. *Journal of Experimental Social Psychology*, *33*(5), 510–540. https://doi.org/10.1006/JESP.1997.1331

Drake, A. J., Smith, A., Betts, P. R., Crowne, E. C., & Shield, J. P. H. (2002). Type 2 diabetes in obese white children. *Archives of Disease in Childhood*, *86*(3), 207–208. https://doi.org/10.1136/ADC.86.3.207

Drewnowski, A. (1998). Energy Density, Palatability, and Satiety: Implications for Weight Control. *Nutrition Reviews*, *56*(12), 347–353. https://doi.org/10.1111/j.1753-4887.1998.tb01677.x

Drewnowski, A. (2003). The role of energy density. *Lipids*, *38*(2), 109–115. https://doi.org/10.1007/s11745-003-1039-3

Garrido-Miguel, M., Cavero-Redondo, I., Álvarez-Bueno, C., Rodríguez-Artalejo, F., Moreno, L. A., Ruiz, J. R., Ahrens, W., & Martínez-Vizcaíno, V. (2019). Prevalence and Trends of Overweight and Obesity in European Children From 1999 to 2016. *JAMA Pediatrics*, *173*(10), e192430. https://doi.org/10.1001/jamapediatrics.2019.2430

Glanz, K., Basil, M., Maibach, E., Goldberg, J., & Snyder, D. (1998). Why Americans Eat What They Do: Taste, Nutrition, Cost, Convenience, and Weight Control Concerns as Influences on Food Consumption. *Journal of the American Dietetic Association*, *98*(10), 1118–1126. https://doi.org/10.1016/S0002-8223(98)00260-0

Gorber, S. C., Tremblay, M., Moher, D., & Gorber, B. (2007). A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obesity Reviews*, *8*(4), 307–326. https://doi.org/10.1111/J.1467-789X.2007.00347.X

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*(6), 1464–1480. https://doi.org/10.1037/0022-3514.74.6.1464

Greenwald, A. G., & Nosek, B. A. (2001). Health of the Implicit Association Test at age 3. *Zeitschrift Fur Experimentelle Psychologie : Organ Der Deutschen Gesellschaft Fur Psychologie*, *48*(2), 85–93. https://doi.org/10.1026//0949-3946.48.2.85

Guinard, J. X. (2000). Sensory and consumer testing with children. *Trends in Food Science & Technology*, *11*(8), 273–283. https://doi.org/10.1016/S0924-2244(01)00015-2

Ha, O. R., Lim, S. L., Bruce, J. M., & Bruce, A. S. (2019a). Unhealthy foods taste better among children with lower self-control. *Appetite*, *139*, 84–89. https://doi.org/10.1016/J.APPET.2019.04.015

Ha, O. R., Lim, S. L., Bruce, J. M., & Bruce, A. S. (2019b). Unhealthy foods taste better among children with lower self-control. *Appetite*, *139*, 84–89. https://doi.org/10.1016/J.APPET.2019.04.015

Haycraft, E. L., & Blissett, J. M. (2008). Maternal and Paternal Controlling Feeding Practices: Reliability and Relationships With BMI. *Obesity*, *16*(7), 1552–1558. https://doi.org/10.1038/OBY.2008.238

Hayes, M. (1921). Experimental developement of the graphics rating method. *Physiol Bull*, *18*(92), 98–99. https://doi.org/10.5631/JIBIRINSUPPL1986.1997.SUPPLEMENT92_38

Hoerr, S. L., Hughes, S. O., Fisher, J. O., Nicklas, T. A., Liu, Y., & Shewchuk, R. M. (2009). Associations among parental feeding styles and children's food intake in families with limited incomes. *International Journal of Behavioral Nutrition and Physical Activity*, *6*(1), 55. https://doi.org/10.1186/1479-5868-6-55

Houwer, J. De, & Bruycker, E. De. (2007). Implicit attitudes towards meat and vegetables in vegetarians and nonvegetarians. *International Journal of Psychology*, *42*(3), 158–165. https://doi.org/10.1080/00207590601067060

JASP Team. (2023). *JASP (Version 0.17) [Computer software]*. https://jasp-stats.org.

Jin, K.-Y., Reichert, F., Cagasan, L. P., de la Torre, J., & Law, N. (2020). Measuring digital literacy across three age cohorts: Exploring test dimensionality and performance differences. *Computers & Education*, *157*, 103968. https://doi.org/10.1016/j.compedu.2020.103968

John, D. R. (1999). Consumer Socialization of Children: A Retrospective Look At Twenty-Five Years of Research. *Journal of Consumer Research*, *26*(3), 183–213. https://doi.org/10.1086/209559

John, D. R. (2008). Stages of consumer socialization : the development of consumer knowledge, skills, and values from childhood to adolescence. In H. Curtis P., H. Paul M., & K. Frank R. (Eds.), *Handbook of Consumer Psychology* (pp. 221–246). Psychology Press.

Keller, K. L., Assur, S. A., Torres, M., Lofink, H. E., Thornton, J. C., Faith, M. S., & Kissileff, H. R. (2006). Potential of an analog scaling device for measuring fullness in children: Development and preliminary testing. *Appetite*, *47*(2), 233–243. https://doi.org/10.1016/J.APPET.2006.04.004

Kiefner-Burmeister, A. E., Hoffmann, D. A., Meers, M. R., Koball, A. M., & Musher-Eizenman, D. R. (2014). Food consumption by young children: A function of parental feeding goals and practices. *Appetite*, *74*, 6–11. https://doi.org/10.1016/j.appet.2013.11.011

Klauer, K. C., & Mierke, J. (2005). *Task-Set Inertia, Attitude Accessibility, and Compatibility-Order Effects: New Evidence for a Task-Set Switching Account of the Implicit Association Test Effect*. https://doi.org/10.1177/0146167204271416

Kuncel, N. R., & Tellegen, A. (2009). A Conceptual And Empirical Reexamination Of The Measurement Of The Social Desirability Of Items: Implications For Detecting Desirable Response Style And Scale Development. *Personnel Psychology*, *62*(2), 201–228. https://doi.org/10.1111/j.1744-6570.2009.01136.x

Laureati, M., Sandvik, P., L. Almli, V., Sandell, M., Zeinstra, G. G., Methven, L., Wallner, M., Jilani, H., Alfaro, B., & Proserpio, C. (2020). Individual differences in texture preferences among European children: Development and validation of the Child Food Texture Preference Questionnaire (CFTPQ). *Food Quality and Preference*, *80*. https://doi.org/10.1016/J.FOODQUAL.2019.103828

Lauria, F., Dello Russo, M., Formisano, A., De Henauw, S., Hebestreit, A., Hunsberger, M., Krogh, V., Intemann, T., Lissner, L., Molnar, D., Moreno, L. A., Reisch, L. A., Tornaritis, M., Veidebaum, T., Williams, G., Siani, A., & Russo, P. (2021). Ultra-processed foods consumption and diet quality of European children, adolescents and adults: Results from the I.Family study. *Nutrition, Metabolism and Cardiovascular Diseases*, *31*(11), 3031–3043. https://doi.org/10.1016/j.numecd.2021.07.019

Lemm, K. M., Lane, K. A., Sattler, D. N., Khan, S. R., & Nosek, B. A. (2008). Assessing implicit cognitions with a paper-format implicit association test. *The Psychology of Modern Prejudice*, 121–146.

Lemmer, G., Gollwitzer, M., & Banse, R. (2015). On the psychometric properties of the aggressiveness-IAT for children and adolescents. *Aggressive Behavior*, *41*(1), 84–95. https://doi.org/10.1002/ab.21575

Lewis, M., & Worobey, J. (2011). Mothers and toddlers lunch together. The relation between observed and reported behavior. *Appetite*, *56*(3), 732–736. https://doi.org/10.1016/J.APPET.2011.02.011

Maarj, M., Pacey, V., Tofts, L., Clapham, M., Gironès Garcia, X., & Coda, A. (2022). Validation of an Electronic Visual Analog Scale App for Pain Evaluation in Children and Adolescents With Symptomatic Hypermobility: Cross-sectional Study. *JMIR Pediatr Parent 2022;5(4):E41930 Https://Pediatrics.Jmir.Org/2022/4/E41930*, *5*(4), e41930. https://doi.org/10.2196/41930

Mai, R., & Hoffmann, S. (2015). How to combat the unhealthy = Tasty intuition: The influencing role of health consciousness. *Journal of Public Policy and Marketing*, *34*(1), 63–83. https://doi.org/10.1509/JPPM.14.006/ASSET/IMAGES/LARGE/10.1509_JPPM.14.006-FIG3.JPEG

Meissner, F., Grigutsch, L. A., Koranyi, N., Müller, F., & Rothermund, K. (2019). Predicting Behavior With Implicit Measures: Disillusioning Findings, Reasonable Explanations, and Sophisticated Solutions. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/FPSYG.2019.02483

Mellor, D., & Moore, K. A. (2014). The Use of Likert Scales With Children. *Journal of Pediatric Psychology*, *39*(3), 369–379. https://doi.org/10.1093/jpepsy/jst079

Metcalfe, J., & Mischel, W. (1999). A hot/cool-system analysis of delay of gratification: dynamics of willpower. *Psychological Review*, *106*(1), 3–19. https://doi.org/10.1037/0033-295X.106.1.3

Miller, P. H., Baxter, S. D., Royer, J. A., Hitchcock, D. B., Smith, A. F., Collins, K. L., Guinn, C. H., Smith, A. L., Puryear, M. P., Vaadi, K. K., & Finney, C. J. (2015). Children's social desirability: Effects of test assessment mode. *Personality and Individual Differences*, *83*, 85–90. https://doi.org/10.1016/j.paid.2015.03.039

Moore, E. S., Wilkie, W. L., & Desrochers, D. M. (2017). All in the Family? Parental Roles in the Epidemic of Childhood Obesity. *Journal of Consumer Research*, *43*(5), 824–859. https://doi.org/10.1093/JCR/UCW059

Mori, K., Uchida, A., & Imada, R. (2008). A paper-format group performance test for measuring the implicit association of target concepts. *Behavior Research Methods*, *40*(2), 546–555. https://doi.org/10.3758/BRM.40.2.546

Moskowitz, H. R. (1994). Food concepts and products: just-in-time development. *Publications in Food Science and Nutrition (USA)*. https://doi.org/10.3/JQUERY-UI.JS

National Center for Health Statistics. (2020). *NHANES - National Health and Nutrition Examination Survey*. https://www.cdc.gov/nchs/nhanes/index.htm

Nawaz, H., Chan, W., Abdulrahman, M., Larson, D., & Katz, D. L. (2001). Self-reported weight and height: Implications for obesity research. *American Journal of Preventive Medicine*, *20*(4), 294–298. https://doi.org/10.1016/S0749-3797(01)00293-8

Nguyen, S. P., Girgis, H., & Robinson, J. (2015). Predictors of children's food selection: The role of children's perceptions of the health and taste of foods. *Food Quality and Preference*, *40 Pt A*(PA), 106. https://doi.org/10.1016/J.FOODQUAL.2014.09.009

Nicolaidis, S. (2019). Environment and obesity. *Metabolism: Clinical and Experimental*, *100*. https://doi.org/10.1016/J.METABOL.2019.07.006

Nosek, B. A., Greenwald, A. G., & Banaji, M. R. (2005). *Understanding and Using the Implicit Association Test: II. Method Variables and Construct Validity*. https://doi.org/10.1177/0146167204271418

Oswald, F. L., Mitchell, G., Blanton, H., Jaccard, J., & Tetlock, P. E. (2015). Using the IAT to predict ethnic and racial discrimination: Small effect sizes of unknown societal significance. *Journal of Personality and Social Psychology*, *108*(4), 562–571. https://doi.org/10.1037/PSPA0000023

Patrick, H., Nicklas, T. A., Hughes, S. O., & Morales, M. (2005). The benefits of authoritative feeding style: caregiver feeding styles and children's food consumption patterns. *Appetite*, *44*(2), 243–249. https://doi.org/10.1016/j.appet.2002.07.001

Paulhus, D. L. (1991). Measurement and Control of Response Bias. *Measures of Personality and Social Psychological Attitudes*, 17–59. https://doi.org/10.1016/B978-0-12-590241-0.50006-X

Pinel, J. P. J., Assanand, S., & Lehman, D. R. (2000). Hunger, eating, and ill health. *American Psychologist*, *55*(10), 1105–1116. https://doi.org/10.1037/0003-066X.55.10.1105

Rae, J. R., & Olson, K. R. (2018). Test–retest reliability and predictive validity of the Implicit Association Test in children. *Developmental Psychology*, *54*(2), 308–330. https://doi.org/10.1037/dev0000437

Raghunathan, R., Naylor, R. W., & Hoyer, W. D. (2006). The Unhealthy = Tasty Intuition and Its Effects on Taste Inferences, Enjoyment, and Choice of Food Products. *Journal of Marketing*, *70*(4), 170–184. https://doi.org/10.1509/jmkg.70.4.170

Reips, U. D., & Funke, F. (2008). Interval-level measurement with visual analogue scales in Internet-based research: VAS Generator. *Behavior Research Methods 2008 40:3*, *40*(3), 699–704. https://doi.org/10.3758/BRM.40.3.699

Ruscio, J. (2008). A probability-based measure of effect size: robustness to base rates and other factors. *Psychological Methods*, *13*(1), 19–30. https://doi.org/10.1037/1082-989X.13.1.19

Rutland, A., Cameron, L., Milne, A., & McGeorge, P. (2005). Social norms and self-presentation: children's implicit and explicit intergroup attitudes. *Child Development*, *76*(2), 451–466. https://doi.org/10.1111/J.1467-8624.2005.00856.X

Skinner, J. D., Carruth, B. R., Bounds, W., & Ziegler, P. J. (2002). Children's Food Preferences: A Longitudinal Analysis. *Journal of the American Dietetic Association*, *102*(11), 1638–1647. https://doi.org/10.1016/S0002-8223(02)90349-4

Sullivan, N., Hutcherson, C., Harris, A., & Rangel, A. (2015). Dietary Self-Control Is Related to the Speed With Which Attributes of Healthfulness and Tastiness Are Processed. *Psychological Science*, *26*(2), 122–134. https://doi.org/10.1177/0956797614559543

Uhlmann, E. L., Andrew Poehlman, T., & Nosek, B. A. (2012). Automatic Associations: Personal Attitudes or Cultural Knowledge? *Ideology, Psychology, and Law*. https://doi.org/10.1093/ACPROF:OSO/9780199737512.003.0009

van der Heijden, A., te Molder, H., de Graaf, C., & Jager, G. (2020). Healthy is (not) tasty? Implicit and explicit associations between food healthiness and tastiness in primary school-aged children and parents with a lower socioeconomic position. *Food Quality and Preference*, *84*, 103939. https://doi.org/10.1016/J.FOODQUAL.2020.103939

van Geel, M., Vedder, P., & Tanilon, J. (2014). Are overweight and obese youths more often bullied by their peers? A meta-analysis on the correlation between weight status and bullying. *International Journal of Obesity (2005)*, *38*(10), 1263–1267. https://doi.org/10.1038/IJO.2014.117

Voutilainen, A., Pitkäaho, T., Kvist, T., & Vehviläinen-Julkunen, K. (2016). How to ask about patient satisfaction? The visual analogue scale is less vulnerable to confounding factors and ceiling effect than a symmetric Likert scale. *Journal of Advanced Nursing*, *72*(4), 946–957. https://doi.org/10.1111/JAN.12875

Weijters, B., Baumgartner, H., & Schillewaert, N. (2013). Reversed item bias: An integrative model. *Psychological Methods*, *18*(3), 320–334. https://doi.org/10.1037/A0032121

Weijters, B., Cabooter, E., & Schillewaert, N. (2010). The effect of rating scale format on response styles: The number of response categories and response category labels. *International Journal of Research in Marketing*, *27*(3), 236–247. https://doi.org/10.1016/j.ijresmar.2010.02.004

Wright, S. M., & Aronne, L. J. (2012). Causes of obesity. *Abdominal Imaging*, *37*(5), 730–732. https://doi.org/10.1007/S00261-012-9862-X/TABLES/1