Appetite 142 (2019) 104346

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

A cross-cultural analysis of children's vegetable preferences

Karinna Estay[a,b,*], Shuliang Pan[c], Fang Zhong[c], Chloé Capitaine[d], Jean-Xavier Guinard[a]

[a] Department of Food Science and Technology, University of California Davis, 392 Old Davis Rd, Davis, CA, 95616, USA
[b] Departamento de Agroindustria y Enología, Facultad de Ciencias Agronómicas, Universidad de Chile, Santa Rosa, 11315, La Pintana, Chile
[c] School of Food Science and Technology, Jiangnan University, Wuxi, 214122, PR China
[d] Centro de Aromas y Sabores, DICTUC, Av. Vicuña Mackenna, 4860, Macul, Santiago, Chile

ARTICLE INFO

Keywords:
Children
Vegetable liking
Sensory modalities
Age
Gender
CATA

ABSTRACT

The successful promotion of vegetable consumption by children requires a deep understanding of children's vegetable preferences as well as the factors shaping them throughout childhood. This study analyzed children vegetable liking in four different age ranges (5–6, 7–8, 9–10 and 11–12 years old) in Chile, China and the United States. Three hundred and eighty-four children completed this study. All participants tasted and rated 14 different vegetables for liking and described the samples using Check-All-That-Apply (CATA). We found significant differences in degree of overall liking among children from the three countries ($p < 0.001$). Specifically, children in China gave higher overall liking scores than children in the US, and in the US higher than in Chile. Child age and gender did not influence children's vegetable overall liking across the three countries. Across all countries and age groups, liking of taste and texture were the best predictors of children overall liking. The penalty analysis of CATA selections by children showed that the mean impact of the attributes that children used to describe the samples on their liking varied among countries, with the descriptors having the least impact on liking for Chinese children.

1. Introduction

According to the World Health Organization, low vegetable consumption is an issue of major concern, due to its association with higher risk of certain non-communicable diseases (WHO, 2003). Specifically, researchers have found that vegetable consumption can reduce the risk of some cancers (esophagus, breast, lung and colorectum), ischemic stroke and Type 2 Diabetes (Boffetta et al., 2010; Cooper et al., 2012; Joshipura et al., 1999). Moreover, The Global Burden of Disease Study included low fruit and vegetable consumption into the top ten risks for global mortality (Forouzanfar et al., 2015).

Many interventions look to increase vegetable consumption early in life (Benton, 2004; Evans, Christian, Cleghorn, Greenwood, & Cade, 2012; Laureati, Bergamaschi, & Pagliarini, 2014; Savage, Fisher, & Birch, 2007), considering that eating behavior established in childhood tends to persist into adulthood (Branen & Fletcher, 1999; Lytle, Seifert, Greenstein & MacGovern, 2000; Nicklaus & Remy, 2013). To develop successful strategies for the promotion of healthy diets in childhood, a deep understanding of the development of food preferences as well as the factors that shape them is required (Birch, 1999; Eestmans, Baeyens & Van de Bergh, 2001). Food preferences are the product of the interaction between genetic predispositions with the eating environment (Birch, 1999; Birch, Gunder, Grimm-Thomas, & Laing, 1998). Many interrelated factors play a role in the modeling of food preferences. Among them, liking has been described as the most important factor in children's food acceptance (Drewnowski, 1997; Gibson, Wardle, & Watts, 1998; Marty, Chambaron, Nicklaus, & Monnery-Patris, 2018; Nguyen, Girgis, & Robinson, 2015): "Children eat what they like". In this sense, to increase vegetable intake in childhood, it is necessary to understand how children's food preferences develop (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987; Cooke, 2007). Moreover, there is a consensus that food exposure is a fundamental factor in the development of food preferences (Barends, de Vries, Mojet, & de Graaf, 2013; Birch et al., 1998; Harris, 2008; Menella & Beauchamp, 2005; Wardle, Herrera, Cooke, & Gibson, 2003). As a child's age increases, so does his/her exposure to foods. However, the exposure itself does not ensure an increase in food acceptance (Newman & Taylor, 1992). This is because food preferences tend to develop in positive contexts (Marty et al., 2018), which can be also culture-dependent. Personal factors that can influence vegetable intake in children have been studied primarily in the US and Europe (e.g. gender and age) (Ahern et al., 2013; Brug, Tak, te Velde, Bere, & De Bourdeaudhuij, 2008; Perry et al., 1998; Rasmussen et al., 2006; Reynolds et al., 1999; Zeinstra, Koelen, Kok, & De Graaf, 2007). Considering that what people like and eat varies

* Corresponding author. Dept of Food Science and Technology, 392 Old Davis Rd, Davis, CA, 95616, USA.
E-mail address: kestay@ucdavis.edu (K. Estay).

https://doi.org/10.1016/j.appet.2019.104346
Received 6 December 2018; Received in revised form 19 June 2019; Accepted 2 July 2019
Available online 03 July 2019
0195-6663/

greatly with nationality and culture (Rozin, 2006), cross-cultural studies provide a useful source of variance in the study of consumer preferences for specific foods. In order to avoid generalizing specific findings to different population groups, there is a need for international comparative studies that analyze children's vegetable preferences under different settings (Rasmussen et al., 2006).

The main objective of this study was to analyze children's vegetable liking in three different countries – Chile, China and the United States - considering the effect of age, gender, sensory appeal of specific modalities, and perceived sensory features of the vegetables for secondary objectives. Specifically, we hypothesized that:

1. The magnitude of children's vegetable liking differs among the different countries analyzed.
2. Children's vegetable liking increases as children age.
3. Liking of each sensory modality (appearance, aroma, taste and texture) has a different impact on overall vegetable liking during childhood.
4. Children's CATA vegetable descriptions provide useful information in the understanding of children's preferences

2. Materials and methods

2.1. Tasting sessions with children

A two-part Central Location Test (CLT) was conducted with children in three countries, specifically in Santiago, Chile (CL), Wuxi, China (CN) and Davis, California, USA (US). During the tasting sessions, children tasted 14 vegetables in total, 7 per tasting session. In the three countries tasting sessions were offered between 11:30 a.m. and 5:30 p.m. during weekends and participants enrolled in two sessions spaced by one week. Specifically, 5 tasting sessions times were offered at day: 11:30am, 1pm, 2:30pm, 4pm and 5:30pm. On average, between 5 and 10 children participated in each session time, which lasted around 30 min. The sessions were performed in collective rooms in the three countries. In China and in the USA these rooms were located at the respective universities (UC-Davis and Jiangnan University). In Chile, the evaluations were done in a school and in the Pontifical Catholic University of Chile. The set of samples as well as their preparation (raw, cooked and/or seasoned) were chosen individually for each country, considering what was familiar in the diet of each specific place, and at the same time trying to cover the widest sensory spectrum possible. We made the conscious choice to respect cultural differences in the

Table 1
Vegetables tasted and their preparation in Chile, China and the Unites States.

Country	Sample	Preparation	Serving Temperature
Chile	Asparagus	Boiled with salt	Room temp
	Avocado	Served raw	Room temp
	Beets	Boiled with salt	Room temp
	Broccoli	Boiled with salt	Room temp
	Cabbage	Served raw and slightly seasoned with salt, lemon juice and sunflower oil	Room temp
	Carrots	Served raw	Room temp
	Corn	Boiled with salt	Room temp
	Cucumber	Served raw and slightly seasoned with salt, lemon juice and sunflower oil	Room temp
	Lettuce	Served raw and slightly seasoned with salt, lemon juice and sunflower oil	Room temp
	Mushrooms	Sautéed with salt sunflower oil	Warm
	Olives	Greek style naturally ripe black olives	Room temp
	Potatoes	Boiled with salt	Warm
	Sweet Peas	Boiled with salt	Room temp
	Tomato	Served raw and slightly seasoned with salt and sunflower oil	Room temp
China	Broccoli	Boiled with salt	Warm
	Bell Pepper	Sautéed with salt and soybean oil	Warm
	Carrots	Sautéed with salt and soybean oil	Warm
	Cauliflower	Sautéed with salt and soybean oil	Warm
	Celery	Sautéed with salt and soybean oil	Warm
	Corn	Boiled with salt	Warm
	Cucumber	Served raw and slightly seasoned with salt, vinegar and soy sauce	Room temp
	Eggplant	Sautéed with salt, soybean oil and water	Warm
	Mushrooms	Sautéed with salt and soybean oil	Warm
	Onions	Sautéed with salt and soybean oil	Warm
	Potatoes	Boiled with salt	Warm
	Spinach	Sautéed with salt and soybean oil	Warm
	Sweet Peas	Boiled with salt	Warm
	Tomato	Sautéed with salt and soybean oil	Warm
USA	Asparagus	Boiled with salt	Warm
	Avocado	Served raw	Room temp
	Bell Pepper	Served raw	Room temp
	Broccoli	Boiled with salt	Warm
	Carrots	Served raw (baby carrots)	Room temp
	Corn	Boiled with salt	Warm
	Cucumber	Served raw and slightly seasoned with salt, lemon and EVOO[a]	Room temp
	Lettuce	Served raw and slightly seasoned with salt, lemon and EVOO	Room temp
	Mushroom	Sautéed with salt and EVOO	Warm
	Olives	California-style black olives	Room temp
	Potatoes	Boiled with salt	Warm
	Spinach	Served raw and slightly seasoned with salt, lemon and EVOO	Room temp
	Sweet Peas	Boiled with salt	Warm
	Tomatoes	Served raw (cherry tomatoes)	Room temp

[a] EVOO: Extra Virgin Olive Oil.

Table 2
List of Check-All-that-Apply (CATA) descriptors in each country.

Chile		China		USA
Language:		Language:		Language:
English	Spanish	English	Chinese	English
Yummy	Rico	Yummy	好吃的	Yummy
Yucky	Malo	Yucky	难吃的	Yucky
Smelly	Hediondo	Smelly	难闻的	Smelly
Aromatic	Buen olor	Aromatic	清香的	Aromatic
Soft	Suave	Soft	软的	Soft
Crunchy	Crujiente	Crunchy	脆脆的	Crunchy
Mushy	Blando	Mushy	像泥一样的	Mushy
Sour	Acido	Sour	酸的	Sour
Sweet	Dulce	Sweet	甜的	Sweet
Bitter	Amargo	Bitter	苦的	Bitter
Salty	Salado	Salty	咸的	Salty
Spicy	Picante	Spicy	辣的	Spicy
Slimy	Viscoso	Slimy	滑滑的	Slimy
Hard/Firm	Duro	Hard/Firm	硬的	Hard/Firm
Fresh	Fresco	Fresh	新鲜的	Fresh
Juicy	Jugoso	Juicy	多汁的	Juicy
Dry	Seco	Dry	干的	Dry
Fun	Entretenido	Fun	有趣的	Fun
Boring	Aburrido	Boring	无聊的	Boring
Stringy	Fibroso	Chewy	嚼不烂的	Stringy
Flavorful	Sabroso	Umami	鲜美的	Flavorful
Creamy	Cremoso	Plain	清淡的	Mild
Satisfying	llenador (que satisface)	Good-looking	好看的	
		Ugly	丑的	

* During the tasting sessions, attributes were listed and explained only in the children's native language.

preparation and serving of the vegetables so as not to upset children's expectations in that regard, yet we minimized the impact of those preparation and serving protocols as much as possible to ensure that the responses measured were primarily about the sensory properties of the vegetables. The familiarity was assessed through focus groups of mothers from the three countries (data not published yet) and checking this information with the vegetables that were readily available at local grocery stores in each city from the three countries were the study was performed. From this list of possible vegetables and preparations, the final 14 samples for each country were selected jointly by the researchers from the three universities involved in this study (Pontifical Catholic University of Chile, Jiangnan University and University of California-Davis). Details of samples' preparation in each country are shown in Table 1. From the 14 samples, 6 samples were shared by all the three countries (broccoli, cucumber, corn, mushrooms, potatoes and sweet peas). The number of samples is consistent with what it is found in the literature on similar studies (Liem & De Graaf, 2004; Olsen, Ritz, Kraaij & Moller, 2012; Poelman. Delahunty & de Graaf, 2013). During the tasting sessions, children rated their degree of liking of the samples using a 7-point hedonic scale with numbers, words, and emoji faces. The number 1 on the scale corresponded to “dislike very much” and the number 7 to “like very much”. The use of this scale has been reported to be appropriate for the age range involved in the present study (Laureati, Pagliarini, Toschi, & Monteleone, 2015; Guinard, 2001). All samples were evaluated on five different dimensions, in the following order: appearance, aroma, taste, texture, and overall opinion. Before starting the evaluation, a researcher explained to the children how to perform the evaluation correctly. The children were told to start by “looking at the sample”, then “smell the sample” and finally “try the sample”. The instructions were given orally and with gestures that emphasized the information. One researcher in each country was in charge of giving the instructions before starting the evaluation and she gave the instructions for every single tasting session in each respective country. To do that the researcher walked with the participants through the whole questionnaire. The instructions were given in the official language of each of the three countries (Spanish in Chile, Mandarin Chinese in China and English in the US). During the tasting session, children also described the vegetables by using Check-All-That-Apply (CATA) questions with between 22 and 24 attributes (China = 24, Chile = 23 and US = 22). Among the attributes, 19 were shared by all three countries and the rest differed among them (Table 2). The attributes listed included sensory descriptors (descriptors of aroma, taste and texture) and hedonic descriptors (e.g. yummy, and yucky). All the attributes listed were explained and defined to children before the evaluation started. The use of CATA with children has been validated before (Laureati et al., 2017). The CATA terms used in this study were developed by the group of researchers in the three countries, and then tested in a trial tasting session in which 6 children, from the whole age range, participated. During this small pilot test, children tasted the samples and gave their answers using the questionnaire designed for the tasting session. This pilot test was observed by researchers in order to improve the real tasting sessions. Opinions of children that participated in the trial were also considered. During the tasting session children in the youngest age group (5–6 years old) were assisted by an adult, who sat with them and read the whole list of attributes to them each time that they needed. Also, there were trained assistants available to help older children anytime they asked for help. Participants tasted the samples in a counterbalanced serial monadic sequence, and the sample order was balanced using a Williams Latin square design (Williams, 1949). For each sample the hedonic evaluation was performed first and then the CATA description. Children's hedonic and CATA data were collected on paper questionnaires. Children were accompanied by their mothers during the whole study, however children were sitting alone and answered questions by themselves. All the children had the consent of their mothers to participate in the study. American participants included in this study signed a consent form. Participants in Chile and China received the information verbally and their consent was obtained verbally as well. Participants in the three countries were compensated for completing the study. This study was approved for the use of human subjects by the Institutional Review Board of the University of California, Davis (IRB ID: 930546–1).

2.2. Children

This study was performed in three countries (Chile, China and US), in which children between 5 and 12 years old were invited to participate. The age of the children was decided by taking in account the cognitive abilities required to use hedonic scales during consumer testing (Guinard, 2001). Participants were eligible based on not presenting any allergy to vegetables, to have been born in each of the countries included in this study, and to be in the range of age 5–12 years. It was also required that the mother of the participants had a higher educational diploma/or were currently university students, in order to reduce the effect of sociodemographic between the different samples. Specifically, the majority of the mothers of the children that participated in this study had earned a higher educational diploma (CL: 96.2%, CN: 95.4% and US:100%), and others were currently completing their higher diploma (current university students: CL: 3.8%, CN:4.6%). In each country, the recruitment process was performed through the University networks by emails and flyers, and in primary schools of each city (Santiago-Chile, Wuxi-China and Davis-California-US) by using emails, personal invitation in classrooms and flyers. Four age groups were considered for this study: 5–6 (Kindergarten level); 7–8 (2nd grade level); 9–10 (4th grade level); 11–12 years old (6th grade level). In each country, between 30 and 38 children completed the study in each age group. The sample size was calculated based on a fixed ANOVA model with interactions using the software G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007), considering a significance level of 5%, power of 95% and an effect size of 0.2. The factors considered were Countries, child's age, child's gender and the common samples. The effect size was based on an expected difference on liking between countries, considering differences on children’ vegetable intake between different cultural groups analyzed in previous studies

(Kim et al., 2014). Considering these assumptions hundred and twenty children were required for each country. Specifically, the Chilean children population sample (n = 130) was composed of 45% female and 55% male, the Chinese children population (n = 130) of 50% female and 50% male, and the American children population (n = 124) of 45% female and 55% male.

2.3. Data analysis

All ANOVA tests and correlations were performed using R Studio based on R version 3.3.3. (R Development Core Team 2015). Penalty analysis tests were run in XLSTAT-Sensory® (Addinsoft, 2019). The level of significance was chosen at 5%.

A mixed model Analysis of Variance (ANOVA) with interactions was run across all children's overall liking values for the 6 common vegetables samples tasted. The factors included were: country (Chile, China and US), child's age (5–6 years old, 7–8 years old, 9–10 years old and 11–12 years old), child's gender (female or male) and product (broccoli, corn, cucumber, mushrooms, potatoes and sweet peas). Only female and male options were considered on the gender analysis, as no participants selected the options “other gender” or “prefer not to answer”. Subjects were treated as random effect, nested within the interaction of country, age and gender, repeated across all products. For mean comparison, Fisher's least significant difference (LSD) multiple comparison test was used.

To analyze the specific country effects on children's overall liking, an individual mixed model ANOVA with interactions for each country was run. The factors included were: Child's age (5–6 years old, 7–8 years old, 9–10 years old and 11–12 years old), child's gender (female or male) and product (the 14 vegetables tasted in each country). Subjects were treated as random effect, nested within the interaction of age and gender, repeated across all product. For mean comparison, LSD multiple comparison test was used.

To analyze the relationship between overall liking and the liking for each specific sensory modality correlations and regressions were used. The Pearson's correlation coefficient between overall liking and each sensory modality for each country and for each specific age range was run. Regressions were performed for each child and each sensory modality to model overall liking based on the 14 vegetables scores. The slopes and correlation coefficients of the regression were extracted, one for each child and each sensory modality. An ANOVA was performed on the slopes using sensory modality, country and child age as factors and all two-way interactions. LSD tests were computed for the significant main effects and interactions (Andersen, Brockhoff & Hyldig, 2019).

Penalty analysis was used to analyze the importance of different sensory and hedonic descriptors on children's vegetable liking. All the attributes that children checked on the CATA questions were analyzed for each specific country and for each specific age range. The penalty analysis results are presented on Mean Impact charts, which included only the attributes that showed significant mean impact on children overall liking assessed by Cochran's Q test.

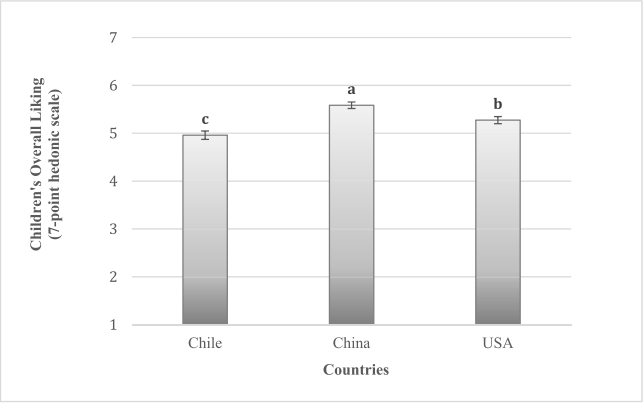

Fig. 1. Mean ratings on the 7-point hedonic scale and standard error of the mean for children's vegetable liking in Chile (n = 130), China (n = 130) and the US (n = 124), for the 6 common vegetables samples tasted (broccoli, corn, cucumber, mushrooms, potatoes and sweet peas). Means with different superscripts are significantly different at $p < 0.05$.

3. Results

3.1. Comparison of children's hedonic ratings across the three countries

When children's vegetable liking for the 6 common vegetables samples tasted (broccoli, corn, cucumber, mushrooms, potatoes and sweet peas) was compared, we found significant differences in hedonic rating among countries ($F_{[2, 361]} = 12.43$, $p < 0.001$). Specifically, children's preferences ratings were significantly higher in China (M = 5.59, SE = 0.06), followed by the US (M = 5.27, SE: 0.07) and finally Chile (M = 4.95, SE = 0.08 (Fig. 1). Also, significant differences in the evaluation of the different products ($F_{[5, 1869]} = 61.48$, $p < 0.001$) and the interaction between country and products was found ($F_{[10, 361]} = 2.32$, $p < 0.001$) (Fig. 2). No significant differences were found for either child's age group or gender.

3.2. Hedonic ratings for each country

Analysis of children's overall liking for vegetables showed significant differences among samples within each of the three countries (Chile: $F_{[13, 1677]} = 42.78$, $p < 0.001$; China $F_{[13, 1677]} = 27.71$, $p < 0.001$; USA: $F_{[13, 1598]} = 22.13$, $p < 0.001$) (Figs. 3–5). There was no significant difference in child age and child gender, nor were there significant differences in the interaction of the factors evaluated for any of the three countries.

Specifically, across the three countries the vegetables that were rated as “like moderately” or more (mean score of 5 or higher) were: lettuce, tomato, potatoes and avocado (in Chile); corn, potatoes, cucumber and cauliflower (in China); corn and carrots (in the US). While the vegetables that were rated as dislike (mean score of 4 or below) were: asparagus and mushrooms (in Chile); eggplants (in China); and mushrooms (in the US).

3.3. Regressions and correlation between overall liking and sensory modalities

The results showed that in the three countries the ratings for overall liking were statistically significantly correlated with the rating of liking for each sensory dimension evaluated (appearance: 0.728, aroma: 0.760, taste 0.915 and texture 0.863) ($p < 0.05$). This result was consistent for all child's age ranges analyzed ($p < 0.05$) (Table 3). The analysis of the regression slopes show that taste and texture were more closely related to liking, with slopes around 0.85, compared to about 0.73 for smell and appearance. Moreover, there was a trend for older children to give modality scores more related to overall liking than younger ones.

3.4. Penalty analysis

The drivers of vegetable overall liking of Chilean children based on the CATA questions answered by children are plotted by age range on Fig. 6. In Chile the main attributes that showed significant mean impact on increasing overall liking ($p < 0.05$) were: “yummy”, “fun”, “aromatic”, “flavorful” and “fresh”, while the attributes that showed significant impact on decreasing overall liking were: “boring” and “yucky”. The age group 11–12 years old showed more significant attributes that increase overall liking than the other age groups, and was the only group of age that did not show significant attributes able to decrease overall liking. All the attributes that showed significant mean

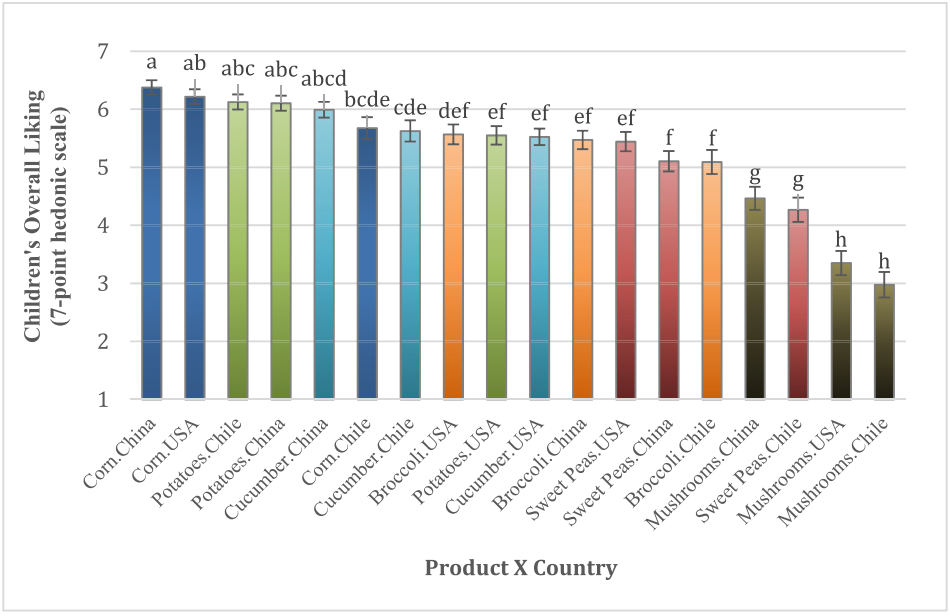

Fig. 2. Mean ratings on the 7-point hedonic scale and standard error of the mean for children's vegetable liking on the 6 common vegetables samples tasted across Chile, China and the US (CL n = 130; CN n = 130; US n = 124). Means with different superscripts are significantly different at $p < 0.01$.

impact on Chilean children overall liking fluctuated between −4.5 and 4.5 point of the 7-point hedonic scale (for the four age groups analyzed).

Fig. 7 showed the significant drivers of vegetable overall liking for Chinese children according to the CATA questions answered by children and their degree of overall liking of the samples. Specifically, for Chinese children the attributes that showed significant mean impact on increasing overall liking ($p < 0.05$) were: “fresh”, “yummy”, “good looking” and “soft” (5–6 years old); “good looking”, “yummy” and “juicy” (7–8 years old); “umami”, “yummy”, “good looking”, “sweet”, “fresh”, “juicy” and “aromatic” (9–10 years old); and “fun”, “fresh” and “yummy” (11–12 years old). Only the age range 9–10 years old showed a significant attribute able to decrease overall liking, which was “yucky”. All the attributes that showed significant mean impact on Chinese children overall liking fluctuated between −1.5 and 1 point of the 7-point hedonic scale (for the four age groups analyzed).

In the US, the main drivers of vegetable overall liking that showed significant impact on increasing children's overall liking ($p < 0.05$) were: “yummy”, “fun”, “sweet”, “flavorful”, “fresh” and “juicy” (Fig. 8). The attributes that showed significant impact on decreasing overall liking varied according to the different age groups: “mushy”, “smelly”, “boring” and yucky” (5–6 years old); “mushy” and ““yucky” (7–8 years old); and “yucky” (9–10 years old). No significant attributes that decrease overall liking on 11–12 years old were found. All the attributes that showed significant mean impact on American children overall fluctuated between −3.5 and 3.5 point of the 7-point hedonic scale (for the four age groups analyzed).

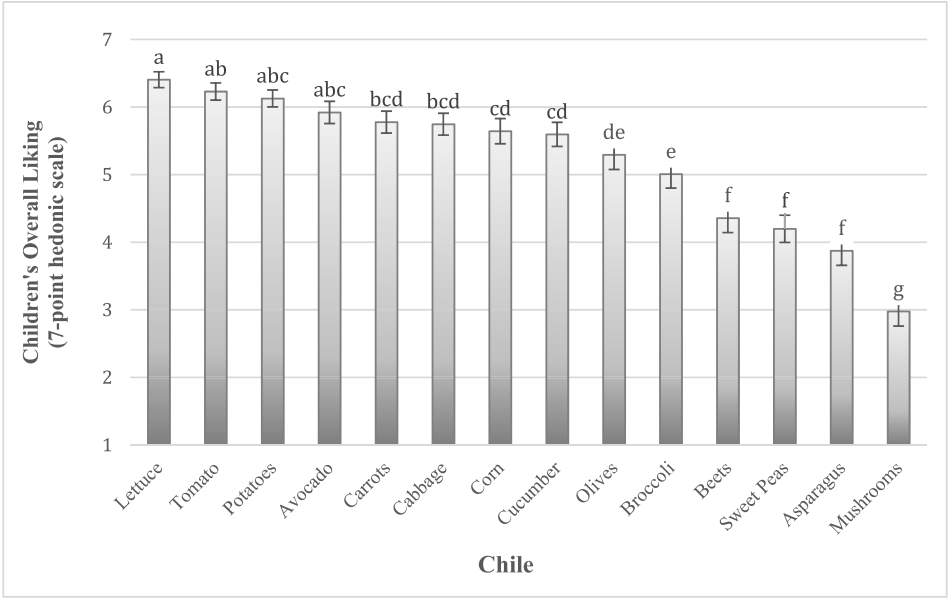

Fig. 3. Samples' mean ratings on the 7-point hedonic scale and standard error of the mean of Chilean children's liking (n = 130) for the 14 vegetable samples tasted. Means with different superscripts are significantly different at $p < 0.01$.

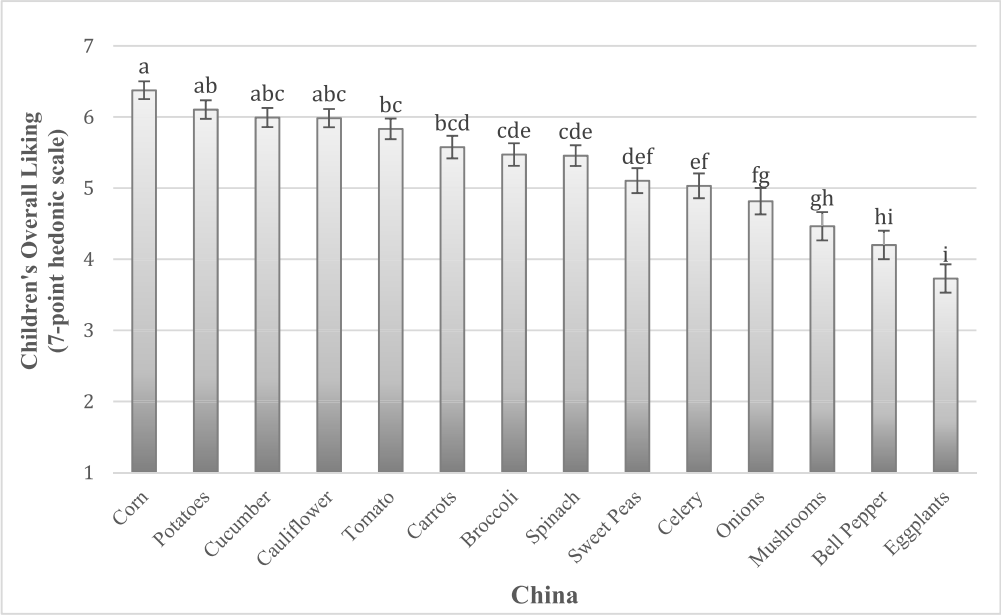

Fig. 4. Samples' mean ratings on the 7-point hedonic scale and standard error of the mean of Chinese children's liking (n = 130) for the 14 vegetable samples tasted. Means with different superscripts are significantly different at $p < 0.01$.

4. Discussion

4.1. Children's vegetable liking - the effect of different cultures and products

This study showed differences in children's vegetables preferences as a function of country of origin. Specifically, when children's vegetable overall liking was compared among the 3 countries, we found that in China children liked vegetables more than in the US, and in the US more that in Chile. Those differences could indeed be due to children liking less the vegetables in Chile than in the US, and in the US less than in China, or to children using the hedonic scale differently in these countries. The use of the hedonic scale in different countries has been compared between American adult consumers and Asian adult consumers, with Americans using a wider range of the scale, while Asians tended to avoid the extremes of the scale (Yao et al., 2003; Yeh et al., 1998). Our results are not in agreement with these findings, which can be due to the fact that we studied children instead of adults. However, considering that children are less influenced by cognitive factors that could affect the use of the hedonic scale by adult populations, it is possible that children's answers were not influenced by cultural differences in the use of scales. In this regard, we think that the differences in overall liking scores between countries found in this study were due to real differences in overall liking.

The higher overall liking scores given by Chinese children versus American children can be due to Chinese children liking a wider variety of vegetables than American children. When we compared the 6 common samples tasted in the three countries it was possible to see that 3 of these 6 samples were liked moderately or more in China (corn, potatoes and cucumber), versus only one sample that was liked moderately or more in the US (corn). From this same list of 6 samples, there were no samples that were rated with a “disliked” by Chinese children, while American children rated one sample as disliked (mushrooms).

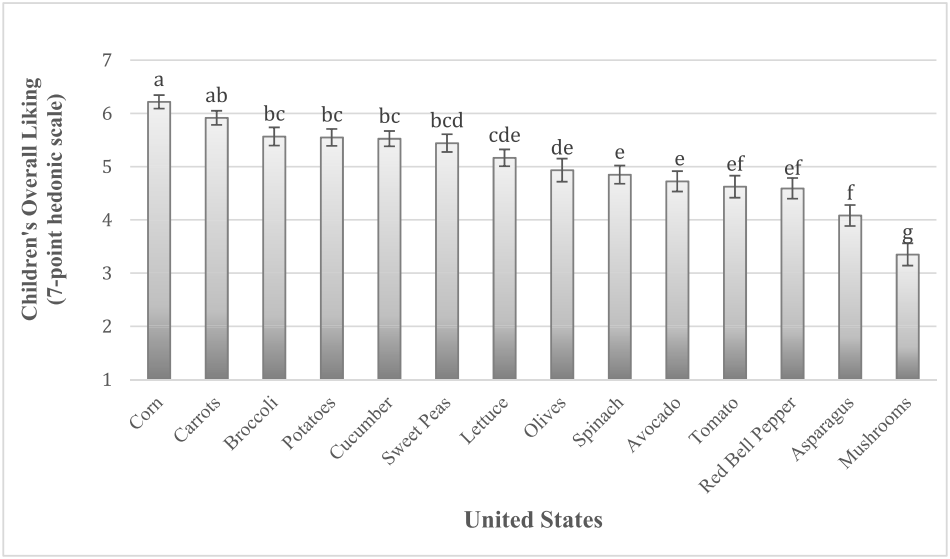

Fig. 5. Samples' mean ratings on the 7-point hedonic scale and standard error of the mean of American children's liking (n = 124) for the 14 vegetable samples tasted. Means with different superscripts are significantly different at $p < 0.01$.

Table 3
Pearson's correlation coefficient of each modality-specific liking to overall liking by children's age (5–6 yrs n = 104, 7–8 yrs n = 94, 9–10 yrs n = 95, 11–12 yrs n = 91). All correlations were statistically significant ($p < 0.05$). * Regression slopes of overall liking and liking of each sensory modality. ** Regression slopes of overall liking and liking by sensory modalities at different age ranges. Means with different superscripts are significantly different at $p < 0.05$.

	5–6 yrs.	7–8 yrs.	9–10 yrs.	11–12 yrs.	Regression slope*
Correlation Overall liking-Appearance	0.705	0.736	0.754	0.741	0.739^{b}
Correlation Overall liking-Aroma	0.724	0.775	0.778	0.787	0.735^{b}
Correlation Overall liking-Taste	0.902	0.904	0.932	0.939	0.841^{a}
Correlation Overall liking-Texture	0.845	0.867	0.878	0.885	0.868^{a}
Regression slope**	0.766^{b}	0.78^{ab}	0.818^{a}	0.82^{a}	

Analyzing all the samples tasted in each country, we observed that in the US 8 samples (of the 14) were rated with "like slightly" or higher, in comparison with 10 samples in Chile and 10 samples in China. The comparison between the number of samples that obtained score 4 or less ("neither like or dislike" or less) were 8 in the US, and 4 in Chile and 4 in China. Therefore, if we compare the three countries, American children liked a smaller variety of vegetables (measured as overall liking) than Chilean and Chinese children. On the other hand, the lower overall liking scores given by Chilean children was not due to a smaller variety of vegetables liked. Rather, their scores were lower than the scores given by children in the other two countries.

The statistics of children's vegetable consumption support the results of our study, Specifically, according to the Health and Nutritional Survey of China on 2009–2010 Chinese children (6–17 years old) consume on average 226 g of vegetable at day. For the same period of time, the National Health and Nutrition Examination Survey of the United States State reported that American children (5–18 years old) consume on average 95 g of vegetable at day. For the case of the National Health survey of Chile, the group of 15–24 years old is the youngest age group surveyed, which vegetable consumption is reported on 104 g at day for the same period of time. The different age group assessed in Chile does not allow to make a direct comparison with China and the US. Even though it is clear that China is the country that shows the highest level of vegetable intake, which support the higher level of vegetable liking found in our study.

Between the samples that were liked moderately or more by children were: lettuce (CL), tomato (CL), potato (CL and CN), corn (CN and US), cucumber (CN), cauliflower (CN) and carrots (US), while the samples that were disliked were: Asparagus (CL), mushrooms (CL and US) and eggplants (CN). All the samples liked moderately or more, are not bitter and some of them are sweet (carrots), and others are starchy (potato and corn). One of the reasons that has been used to explain the low vegetable intake by children has been the intrinsic sensory characteristics of the vegetables. Vegetables usually are not sweet, sometimes are bitter (Drewnowski & Gomez-Carneros, 2000), and generally have low energy density (Gibson & Wardle, 2003). The analysis of the liking of vegetables that are exceptions of these sensory characteristics and a comparison with other samples can be interesting from the promotion of vegetable consumption point of view. For instance, it could be assumed that children would prefer potato to other vegetables

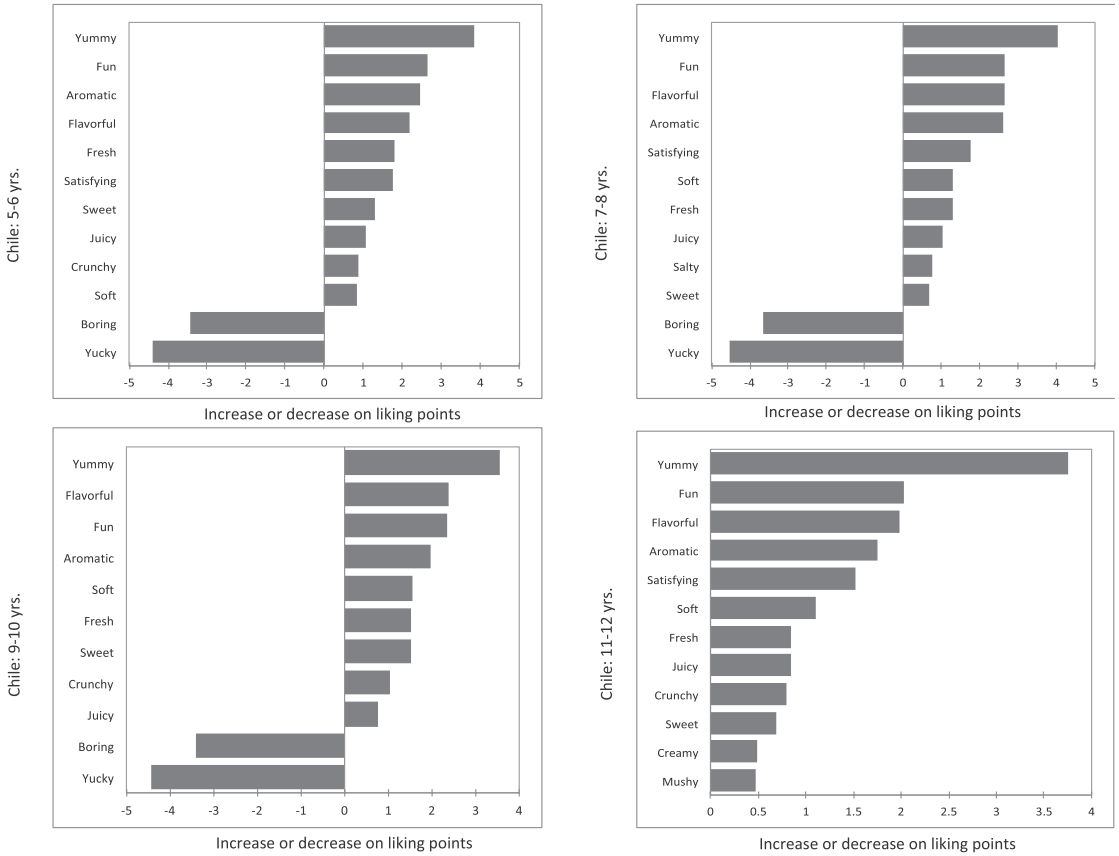

Fig. 6. Mean impact chart for Chilean children at four different age ranges. Mean impact chart shows the attributes with a significant mean impact ($p < 0.05$) on children overall liking scores based on the attributes that children used to describe the samples (CATA) and their overall liking scores (n = 130).

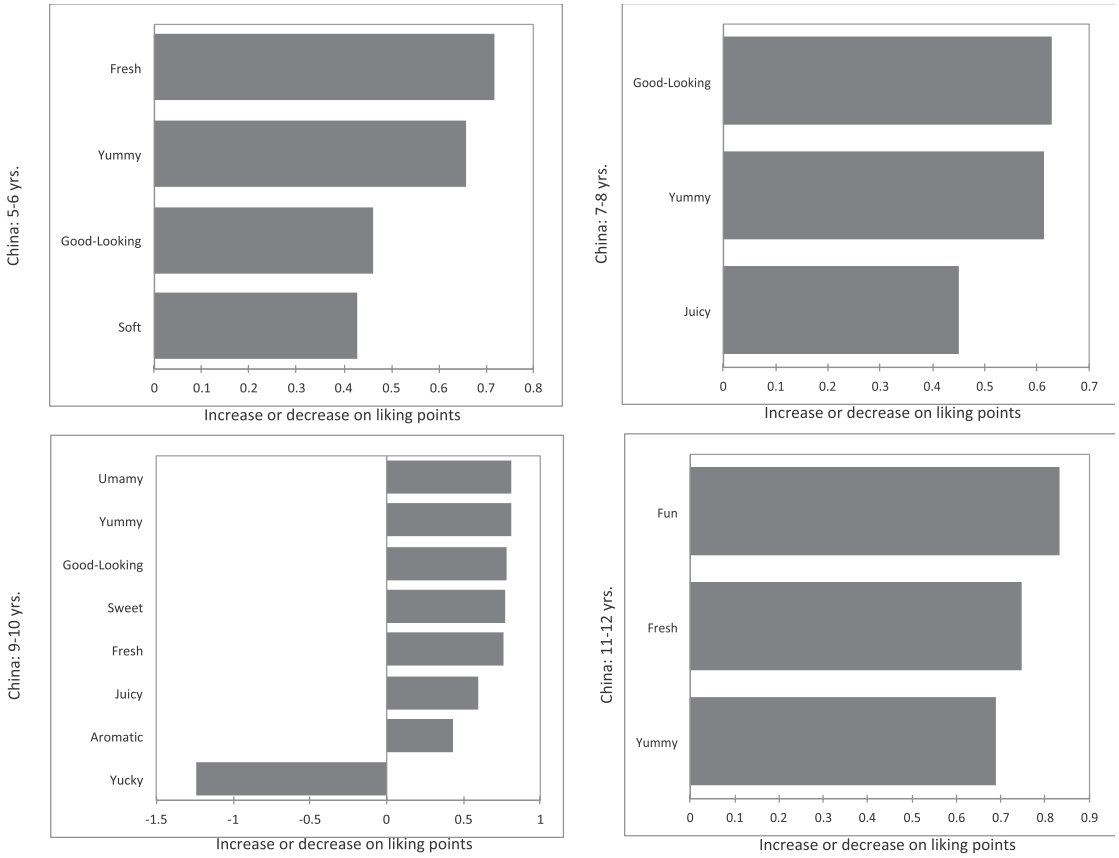

Fig. 7. Mean impact chart for Chinese children at four different age ranges. Mean impact chart shows the attributes with a significant mean impact ($p < 0.05$) on children overall liking scores based on the attributes that children used to describe the samples (CATA) and their overall liking scores (n = 130).

samples, considering its higher energy density (Gibson & Wardle, 2003). However, our results showed that potato was liked the same (measured as overall liking) as lettuce (CL), tomato (CL), cucumber (CN), cauliflower (CN) and broccoli (US). It is possible to think that strategies oriented increasing intake of vegetable that are liked the same as potatoes can be more successful. However, more information is needed to corroborate this idea. Also, it is important to highlight that specific population have different vegetable preferences, in this sense, the results of these study reflect the preferences of an educated population of children in Davis (California) in Santiago (Chile) and in Wuxi (China).

When the effect of child age on vegetable overall liking was analyzed there were no significance differences found. Previous studies have shown the importance of food exposure in the development of food preferences (Barends et al., 2013; Birch et al., 1998; Birch & Marlin, 1982; Harris, 2008; Menella & Beauchamp, 2005). According to this, as children get older, they have more chances to try different kinds of vegetables and thus they can increase their vegetable liking. However, our results did not support this idea. This can be because increased exposure is not the only factor involved in liking. Marty et al. (2018) have observed that liking increases based on a positive exposure, which can be more difficult to achieve with vegetables, considering the intrinsic sensory characteristics previously described (bitterness, low sweetness and low energy content). Even if a significant effect of child age was not observed on the vegetable overall liking, it is possible that a trend was present (considering an almost significant effect found in Chile: p-value 0.056).

The effect of child gender on the overall vegetable liking rating was not observed to be significant in our study. The literature is not conclusive about the effect of gender on children's food preferences. Despite that, it seems that the majority of the studies show a higher association of vegetable intake in girls than in boys (Brug et al., 2008; Perry et al., 1998; Rasmussen et al., 2006; Reynolds et al., 1999). However, the majority of these studies assess children's vegetable liking using surveys only, while in our study children tasted the vegetables. It is possible that these different results were found due to the different kind of methodology used.

4.2. Degree of liking of different sensory modalities and the factors involved

Children's degree of liking was evaluated on four different sensory modalities: appearance, aroma, taste and texture. When the correlation between the rating of overall liking and the degree of liking of each sensory dimension was evaluated, the results of our study showed consistent results between the three countries analyzed and for the four age groups. All the correlations were positive and significant, and taste and texture were more correlated with overall liking than aroma and appearance. This result is supported by the work of Moskowitz and Krieger (1993), who studied the effect of different sensory modalities on consumer acceptance, finding that taste/flavor is consistently the best predictor of overall liking for consumers. In contrast with our study, their study was done with adults, specifically with American women and using the terms of taste and flavor interchangeably. The term of “taste” is commonly used by consumers to denote the concept of flavor, which includes a more complex group of sensations, including taste and olfaction (Birch, 1999). In this sense it is likely that children in our study also evaluate taste as the combination of taste and retro-nasal olfaction. The results of our study showed that texture is equally important as taste/flavor in the evaluation of children's overall vegetable liking. This result is supported by previous studies that have found that texture is a sensory modality intimately related to children's food preferences (Russell & Worsley et al., 2013; Werthmann et al., 2015).

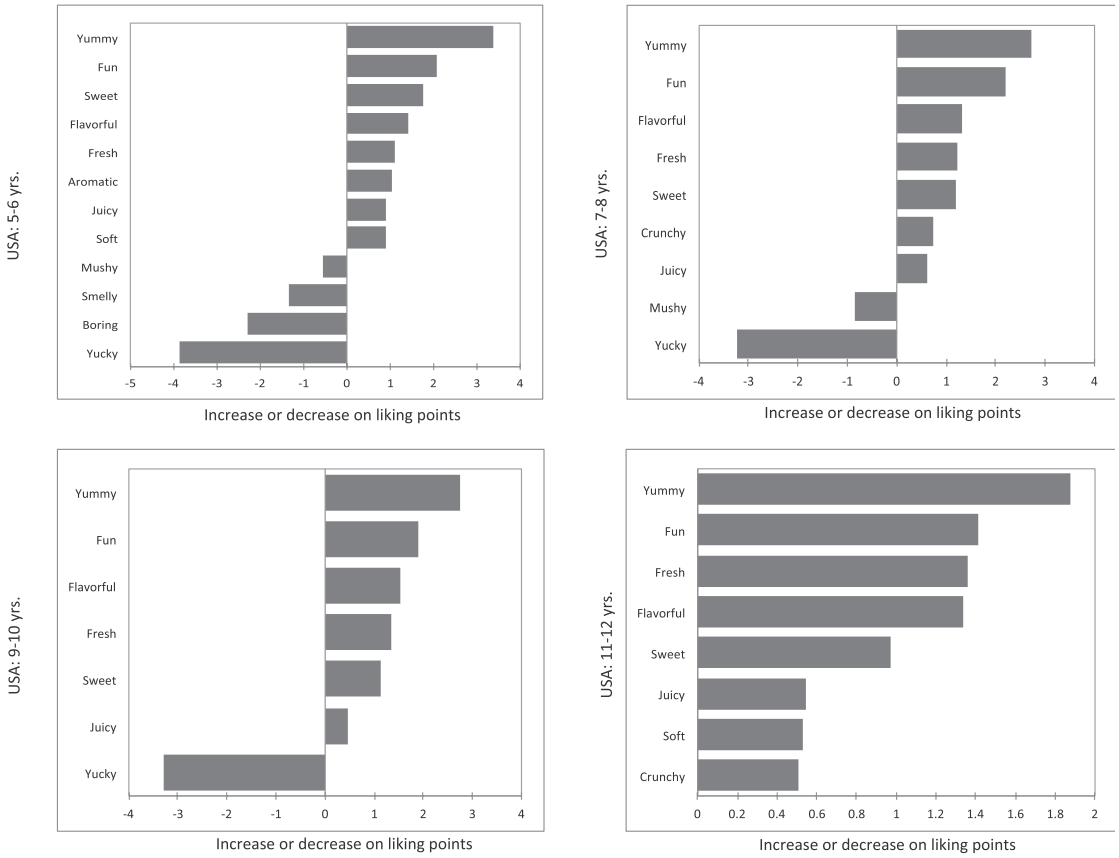

Fig. 8. Mean impact chart for American children at different age ranges. Mean impact chart shows the attributes with a significant mean impact ($p < 0.05$) on children overall liking scores based on the attributes that children used to describe the samples (CATA) and their overall liking scores (n = 124).

Moreover, texture has been described as an import sensory modality in determining food rejection in adults (Martins & Pliner, 2006). Vegetables are commonly rejected by children, and this can be part of the explanation of the importance of texture in understanding children's vegetable preferences.

4.3. Children's descriptions of vegetables and its influence on overall liking

In this study we examined the sensory and hedonic attributes that children used to describe the samples using CATA and how these attributes related with children's vegetable overall liking in the three countries analyzed. The use of CATA has been found to be an interesting method that can be used to understand drivers of overall liking in childhood (Laureati et al., 2017; De Pelsmaeker, Schouteten, & Gellynck, 2013). Moreover, by using hedonic CATA attributes in our study we were able to validate the use of CATA descriptors by our sample of children in the three countries by observing that children were using the hedonic CATA attributes consistently with the overall liking scores. Across the three countries children used the hedonic attributes “yummy” and “fun”, and the sensory attributes “fresh”, “sweet” and “juicy” to describe the samples that they liked. Among the attributes negatively correlated with overall liking, across the three countries children used the hedonic attributes “yucky” and “boring” and the sensory attributes “dry” and “smelly”. Even if children in the three countries tasted different vegetables and under different preparations they coincided with the use of the sensory descriptors “fresh”, “sweet”, and “juicy” as important positive attributes that correlated with their overall liking preferences, this can be interesting information in the design of messages to promote children's vegetable intake. The use of messages to promote healthy eating habits in children has been analyzed under different conditions (De Droog, Valkenburg, & Buijzen, 2010; Maimaran & Fishbach, 2014). Studies have shown that messages that emphasized the good taste of a food are more effective on increasing children's consumption than messages that encourage the consumption using messages based on positive consequences post consumption (e.g. get stronger, bigger or healthier) (Maimaran & Fishbach, 2014; Marty et al., 2017). From the list of positive attributes that children used to describe vegetables that they like in this study, sweet is an attribute that is not very common in the vegetables. However, fresh and juicy are attributes that are applicable to a wider range of vegetables. The potential use of sensory attributes to promote vegetable consumption in children can be an interesting topic to analyze in future studies.

When we analyzed the significant drivers of overall liking for the three countries and for the four different age groups, by the use of penalty analysis with CATA, we observed an important difference in the impact of the hedonic scale between the different countries analyzed. Specifically, in Chile and in China the attributes that children used to describe the samples that showed significant impact on children overall liking, showed and impact between −4 and 4 points in the 7-point hedonic scales. While in China the impact of the attributes was in the range of −1.5 to 1 point. In this sense, the attributes used by Chinese children to describe the samples showed a lower impact on their overall liking than the attributes used by Chilean and by American children. Therefore, it is possible that these sensory attributes are not as affective to promote vegetable consumption in Chinese children, in comparison with the attributes used by children in Chile and in the US.

The analysis of significant drivers of overall liking based on CATA showed differences across the different age ranges analyzed. For the three countries children in the range of age 11–12 years old did not show any attributes with negative impact on children overall liking. While for the group of ages 5–6, 7–8 and 9–10 we found at least one

significant attribute that decrease overall liking only hedonic attributes (in China, it was only observed for the group 9–10 years old). This can be explained by a reduction tendency of food neophobia during childhood (Hursti & Sjoden, 1997), which have been related with levels of pickiness. However, we need to be cautious with this analysis, considering that our data is not able to support an increase of liking as children age, and it only suggested a possible trend.

In this study we used a large number of CATA descriptors. In order to support children on using the whole list of attributes, many trained assistants were used during the tasting sessions. During the tasting sessions, trained assistants were in charge of helping children to perform their evaluation. Especially, for the younger group (5–6 years old) there were assistants that sat with the children and read to them the list of the descriptors. Our results showed that the strategy used was successful. Specifically, we found significant attributes to describe the samples at the beginning, middle and end of the list (the order of the CATA terms used in the three countries was fixed). Therefore, children successfully read (or were helped to read) successfully the whole attribute list. For future studies we suggest taking into account that a higher number of descriptors needs a higher number of assistants helping participants to perform the task.

5. Conclusions

Food preferences are key drivers of children's vegetable intake (Drewnowski, 1997; Gibson et al., 1998). The understanding of how these preferences develop during childhood is fundamental to the successful promotion of vegetable consumption. This study sought to contribute to a broader understanding of children's vegetable preferences through childhood, by including the analysis of three different cultural groups in their own country. Our results showed that culture is an important factor that influences children's vegetables preferences. However, child gender and child age did not have a significant impact on children's overall liking of vegetables. Specifically, when the 6 common vegetable samples were analyzed we found that children in China liked these vegetables samples more than children in the US, and in turn, children in the US liked these vegetable samples more than children in Chile. Moreover, children in the US liked a smaller variety of vegetables than children in Chile and in China. Liking of taste and texture were the sensory modalities that showed the highest level of correlation with overall liking of the samples, for all four age groups. Across the three countries the use of the attributes “fresh”, “sweet” and “juicy” to describe the samples was significantly related with an increase in overall liking. These attributes could be used in messaging that aims to promote vegetable consumption in children.

Acknowledgements

The authors would like to thank all participants (mothers and children) who took part in this research in Chile, China and the US. We also would like to thank Jeremia Halim and Pauline Lestringant for their assistance with statistical analysis and Eduardo Agosín for facilitating the participation of the Centro de Aromas y Sabores of the Catholic University in Chile for this study. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Addinsoft (2019). *XLSTAT statistical and data analysis solution.* NY, USA: Long Island. https://www.xlstat.com.

Ahern, S., Caton, S., Bouhlal, S., Hausner, H., Olsen, A., Nickaus, S., et al. (2013). Eating a Rainbow. Introducing vegetables in the first years of life in 3 European countries. *Appetite, 71*, 48–56.

Barends, C., de Vries, J., Mojet, J., & de Graaf, C. (2013). Effects of repeated exposure to either vegetables or fruits on infant's vegetable and fruit acceptance at the beginning of weaning. *Food Quality and Preference, 29*, 157–165.

Benton, D. (2004). Role of parents in the determination of the food preferences of children and the development of obesity. *International Journal of Obesity, 28*(7), 858–869. https://doi.org/10.1038/sj.ijo.0802532.

Birch, L. (1999). Development of food preferences. *Annual Review of Nutrition, 19*, 41–62.

Birch, L., Gunder, L., Grimm-Thomas, K., & Laing, D. G. (1998). Infants' consumption of a new food enhances acceptance of similar foods. *Appetite, 30*(3), 283–295.

Birch, L., & Marlin, D. W. (1982). I don't like it; I never tried it: Effects of exposure on two-year-old children's food preferences. *Appetite, 3*(4), 353–360.

Birch, L. L., McPhee, L., Shoba, B. C., Pirok, E., & Steinberg, L. (1987). What kind of exposure reduces children's food neophobia?: Looking vs. tasting. *Appetite, 9*(3), 171–178.

Boffetta, P., Couto, E., Wichmann, J., Ferrari, P., Trichopoulos, D., Bueno-de-Mesquita, H. B., et al. (2010). Fruit and vegetable intake and overall cancer risk in the european prospective investigation into cancer and nutrition (EPIC). JNCI. *Journal of the National Cancer Institute, 102*(8), 529–537. https://doi.org/10.1093/jnci/djq072.

Branen, L., & Fletcher, J. (1999). Comparison of college students' current eating habits and recollections of their childhood food practices. *Journal of Nutrition Education, 31*(6), 304–310.

Brug, J., Tak, N. I., te Velde, S. J., Bere, E., & De Bourdeaudhuij, I. (2008). Taste preferences, liking and other factors related to fruit and vegetable intakes among schoolchildren: Results from observational studies. *British Journal of Nutrition, 99*(S1), S7–S14.

Cooke, L. (2007). The importance of exposure for healthy eating in childhood: A review. *Journal of Human Nutrition and Dietetics, 20*(4), 294–301.

Cooper, A. J., Sharp, S. J., Lentjes, M. A. H., Luben, R. N., Khaw, K.-T., Wareham, N. J., et al. (2012). A prospective study of the association between quantity and variety of fruit and vegetable intake and incident Type 2 Diabetes. *Diabetes Care, 35*(6), 1293–1300. https://doi.org/10.2337/dc11-2388.

De Droog, S. M., Valkenburg, P. M., & Buijzen, M. (2010). Using brand characters to promote young children's liking of and purchase requests for fruit. *Journal of Health Communication, 16*(1), 79–89.

De Pelsmaeker, S., Schouteten, J., & Gellynck, X. (2013). The consumption of flavored milk among a children population. The influence of beliefs and the association of brands with emotions. *Appetite, 71*, 279–286.

Drewnowski, A. (1997). Taste preferences and food intake. *Annual Review of Nutrition, 17*(1), 237–253.

Drewnowski, A., & Gomez-Carneros, C. (2000). Bitter taste, phytonutrients, and the consumer: A review. *American Journal of Clinical Nutrition, 72*(6), 1424–1435.

Eestmans, A., Baeyens, F., & Van den Bergh, O. (2001). Food likes and their relative importance in human eating behavior: Review and preliminary suggestions for health promotion. *Health Education Research, 16*(4), 443–456. https://doi.org/10.1093/her/16.4.443.

Evans, C. E., Christian, M. S., Cleghorn, C. L., Greenwood, D. C., & Cade, J. E. (2012). Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. *American Journal of Clinical Nutrition, 96*(4), 889–901. https://doi.org/10.3945/ajcn.111.030270.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175–191.

Forouzanfar, M. H., Alexander, L., Anderson, H. R., Bachman, V. F., Biryukov, S., Brauer, M., et al. (2015). Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990–2013: A systematic analysis for the global burden of disease study 2013. *The Lancet, 386*(10010), 2287–2323. https://doi.org/10.1016/S0140-6736(15)00128-2.

Gibson, E. L., & Wardle, J. (2003). Energy density predicts preferences for fruit and vegetables in 4-year-old children. *Appetite, 41*(1), 97–98.

Gibson, E. L., Wardle, J., & Watts, C. J. (1998). Fruit and vegetable consumption, nutritional knowledge and belief in mothers and children. *Appetite, 31*, 205–228.

Guinard, J. X. (2001). Sensory and consumer testing with children. *Trends in Food Science & Technology, 11*, 273–283.

Harris, G. (2008). Development of taste and food preferences in children. *Current Opinion in Clinical Nutrition and Metabolic Care, 11*(3), 315–319.

Hursti, U. K. K., & Sjoden, P. O. (1997). Food and general neophobia and their relationship with self-reported food choice: Familial resemblance in Swedish families with children of ages 7–17 years. *Appetite, 29*(1), 89–103.

Joshipura, K., Ascherio, A., Manson, J., Stampfer, M., Rimm, E., Speizer, F., et al. (1999). Fruit and vegetable intake in relation to risk of ischemic stroke. *Journal of the American Medical Association, 282*(13), 1233–1239.

Kim, S. A., Moore, L. V., Galuska, D., Wright, A. P., Harris, D., Grummer-Strawn, L. M., et al. (2014). Vital signs: Fruit and vegetable intake among children—United States, 2003–2010. *MMWR. Morbidity and mortality weekly report, 63*(31), 671.

Laureati, M., Bergamaschi, V., & Pagliarini, E. (2014). School-based intervention with children. Peer-modeling, reward and repeated exposure reduce food neophobia and increase liking of fruit and vegetables. *Appetite, 83*, 26–32.

Laureati, M., Cattaneo, C., Lavelli, V., Bergamaschi, V., Riso, P., & Pagliarini, E. (2017). Application of the check-all-that-apply method (CATA) to get insights on children's drivers of liking of fiber-enriched apple purees. *Journal of Sensory Studies, 32*(2), e12253.

Laureati, M., Pagliarini, E., Toschi, T., & Monteleone, E. (2015). Research challenges and methods to study food preferences in school-age children: A review of the last 15 years. *Food Preference and Quality, 46*, 92–102.

Liem, D. G., & De Graaf, C. (2004). Sweet and sour preferences in young children and adults: Role of repeated exposure. *Physiology & Behavior, 83*(3), 421–429.

Lytle, L. A., Seifert, S., Greenstein, J., & McGovern, P. (2000). How do children's eating patterns and food choices change over time? Results from a cohort study. *American*

Journal of Health Promotion, 14(4), 222–228.
Maimaran, M., & Fishbach, A. (2014). If it's useful and you know it, do you eat? Preschoolers refrain from instrumental food. *Journal of Consumer Research, 41*(3), 642–655.
Martins, Y., & Pliner, P. (2006). Ugh! That's disgusting!": Identification of the characteristics of food underlying rejections based on disgust. *Appetite, 46*(1), 75–85.
Marty, L., Chambaron, S., Nicklaus, S., & Monnery-Patris, S. (2018). Learned pleasure from eating: An opportunity to promote healthy eating in children? *Appetite, 120*, 265–274.
Marty, L., Miguet, M., Bournez, M., Nicklaus, S., Chambaron, S., & Monnery-Patris, S. (2017). Do hedonic-versus nutrition-based attitudes toward food predic food choices? A cross-sectional study of 6- to 11-years olds. *International Journal of Behavioral Nutrition and Physical Activity, 14*(1), 162–172.
Menella, J. A., & Beauchamp, G. K. (2005). Understanding the origin of flavor preferences. *Chemical Senses, 30*(Supplement 1), i242–i243. https://doi.org/10.1093/chemse/bjh204.
Moskowitz, H., & Krieger, B. (1993). What sensory characteristics drive product quality? An assessment of individual differences. *Journal of Sensory Studies, 8*(4), 271–282.
Newman, J., & Taylor, A. (1992). Effect of a means-end contingency on young children's food preferences. *Journal of Experimental Child Psychology, 53*(2), 200–216.
Nguyen, S., Girgis, H., & Robinson, J. (2015). Predictors of children's food selection: The role of children's perceptions of the health and taste of the foods. *Food Quality and Preference, 40*, 106–109.
Nicklaus, S., & Remy, E. (2013). Overeating: Tracking between early food habits and later eating patterns. *Current Obesity Reports, 2*, 179–184.
Olsen, A., Ritz, C., Kraaij, L. W., & Møller, P. (2012). Children's liking and intake of vegetables: A school-based intervention study. *Food Quality and Preference, 23*(2), 90–98.
Perry, C. L., Bishop, D. B., Taylor, G., Murray, D. M., Mays, R. W., Dudovitz, B. S., et al. (1998). Changing fruit and vegetable consumption among children: The 5-a-Day power plus program in st. Paul, Minnesota. *American Journal of Public Health, 88*(4), 603–609.
Poelman, A. A., Delahunty, C. M., & de Graaf, C. (2013). Cooking time but not cooking method affects children's acceptance of Brassica vegetables. *Food Quality and Preference, 28*(2), 441–448.
Rasmussen, M., Krolner, R., Klepp, K., Lytle, L., Brug, J., Bere, et al. (2006). Determinants of fruit and vegetable consumption among children and adolescents: A review of the literature. Part I: Quantitative studies. *International Journal of Behavioral Nutrition and Physical Activity, 3*(1), 22.
Reynolds, K. D., Baranowski, T., Bishop, D. B., Farris, R. P., Binkley, D., Nicklas, T. A., et al. (1999). Patterns in child and adolescent consumption of fruit and vegetables: Effects of gender and ethnicity across four sites. *Journal of the American College of Nutrition, 18*(3), 248–254. https://doi.org/10.1080/07315724.1999.10718859.
Rozin, P. (2006). The integration of biological, social, cultural and psychological influences on food choice. In R. Shepherd, & M. Raats (Vol. Eds.), *The psychology of food choice: Vol. 3*, (pp. 19–40). Cambridge: Cabi.
Russell, C. G., & Worsley, A. (2013). Why don't they like that? And can I do anything about it? The nature and correlates of parents' attributions and self-efficacy beliefs about preschool children's food preferences. *Appetite, 66*, 34–43.
Savage, J. S., Fisher, J. O., & Birch, L. L. (2007). Parental influence on eating behavior: Conception to adolescence. *Journal of Law Medicine & Ethics, 35*(1), 22–34.
Wardle, J., Herrera, M. L., Cooke, L., & Gibson, E. L. (2003). Modifying children's food preferences: The effects of exposure and reward on acceptance of an unfamiliar vegetable. *European Journal of Clinical Nutrition, 57*(2), 341.
Werthmann, J., Jansen, A., Havermans, R., Nederkoorn, C., Kremers, S., & Roefs, A. (2015). Bits and pieces. Food texture influences food acceptance in young children. *Appetite, 84*, 181–187.
Williams, E. (1949). Experimental designs balanced for the estimation of residual effects of treatments. *Australian Journal of Chemistry, 2*(2), 149–168.
World Health Organization (WHO) (2003). *Fruit and vegetable promotion initiative, meeting report 25-27/08/03*.
Yao, E., Lim, J., Tamaki, K., Ishii, R., Kim, K. O., & O' Mahony, M. (2003). Structured and unstructured 9-point hedonic scales: A cross cultural study with American, Japanese and Korean consumers. *Journal of Sensory Studies, 18*(2), 115–139.
Yeh, L. L., Kim, K. O., Chompreeda, P., Rimkeeree, H., Yau, N. J. N., & Lundahl, D. S. (1998). Comparison in use of the 9-point hedonic scale between Americans, Chinese, Koreans, and Thai. *Food Quality and Preference, 9*(6), 413–419.
Zeinstra, G. G., Koelen, M. A., Kok, F. J., & De Graaf, C. (2007). Cognitive development and children's perceptions of fruit and vegetables; a qualitative study. *International Journal of Behavioral Nutrition and Physical Activity, 4*(1), 30.