Feeling the Flavour: Exploring Children's Touch–Taste Correspondences and Willingness to Try Unknown Foods for Child–Food Interaction Design

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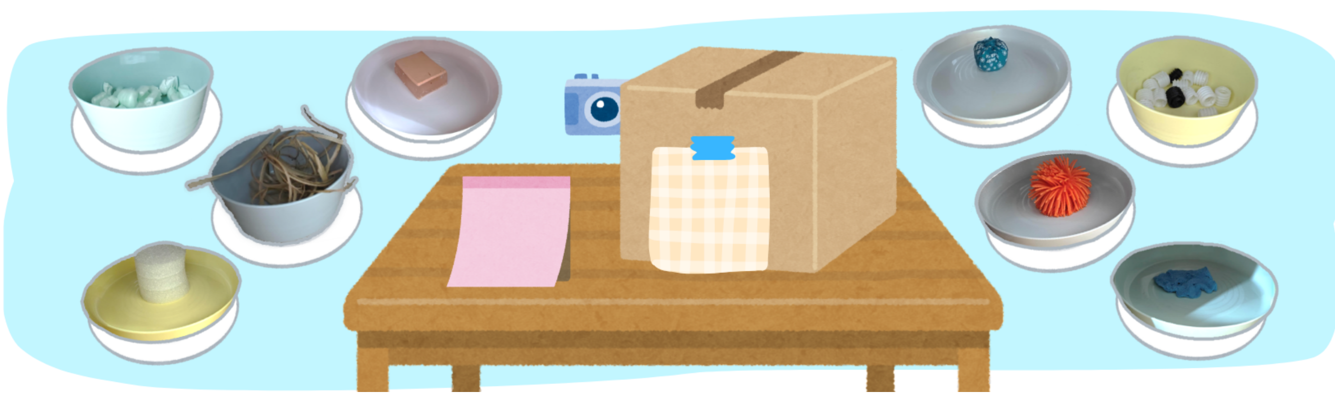

Figure 1: Stylized image depicting study set up and the eight materials placed in the mystery boxes.

Abstract

How can we leverage taste expectations to create novel food-based experiences for children? Eating is an embodied process that engages multiple senses. Cross-sensory correspondences may offer educational and recreational opportunities to design interactive applications that encourage diversifying encounters with food. We present a study with 64 children (ages 10–11) who explored eight textured materials hidden inside mystery "food" boxes and reported both their expected tastes and willingness to eat. Our findings provide evidence of touch–taste cross-sensory correspondences in children – sweetness with weak-hard-brittle and strong-soft-brittle materials, and saltiness with a weak-soft brittle material – and how these mappings influenced children's openness to unknown foods. These results provide empirical grounding for cross-sensory interaction design with children, demonstrating how texture could scaffold curiosity and learning. We outline design implications for cross-sensory food interfaces, non-edible public exhibits, and playful educational technologies that could broaden eating experiences and enable new forms of virtual food interaction.

CCS Concepts

• **Human-centered computing** → *Interaction paradigms*; *Interaction design theory, concepts and paradigms*; **Human computer interaction (HCI)**; **Interaction design**; • **Hardware** → *Emerging technologies*.

Keywords

touch-taste correspondences, food texture, cross-sensory interaction, child-food interaction, human-food interaction.

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1 Introduction

Food and taste education is important not only to promote healthy eating, but also to foster sociocultural awareness and opportunities for critical reflection [76]. Sensory food education encourages children to explore flavours and engage with both familiar and unfamiliar foods through the five senses [67]. While this curriculum has typically been designed for primary school children across various countries worldwide [10, 22, 27, 40, 59, 61], older children and adults who did not participate in such programs may also benefit from expanding their vocabulary for articulating taste perceptions and enhancing their food literacy through exposure to a wider diversity of foods. As bodily senses are interconnected, discovering and working with cross-sensory correspondences[1] may enhance or deter from these food-based experiences by supporting existing expectations or creating unpleasant conflicts. However, cross-sensory interactions between touch and taste remain understudied in the field of human-computer interaction [56].

The role of tactile feedback on taste perception may offer novel interaction design opportunities in human–food interfaces, with prior works intending to reinforce product marketing (e.g., [48, 49, 72]). Furthermore, existing literature have focused on adult perspectives. Although prior food behaviour research with children have examined their tactile interactions, sensitivities, and textural preferences for food [12, 41, 43, 69], there has been little focus on uncovering children's own cross-sensory experiences and rationale when inferring tastes from tactile properties, nor how these could be harnessed in interactive technologies to support children eating behaviours. In addition to individual textural preferences, it may be possible children anticipate that certain tactile sensations will have an unappealing flavour (e.g., bitterness), thereby influencing their willingness to try unfamiliar foods. There remains limited understanding of why children decide to reject certain unknown foods without tasting them and how interactive systems might intervene by purposefully aligning or playfully challenging tactile and/or taste expectations.

Extending this research trajectory, there remains several gaps in (1) systematically examining touch-taste correspondences without the influence of visuals, (2) understanding reasoning for taste expectations and preferences through cross-sensory association strategies, and (3) including children's perspectives. A better understanding of children's cross-sensory strategies may open new design spaces in food-related interaction where tactile cues act as playful proxies for taste, supporting food acceptance and the willingness to try new foods. As interest in multisensory experiences and cross-sensory interactions grows, it is essential to examine how we may potentially leverage correspondences between sensory modalities as a design material [13, 33, 37, 50, 74]. For example, considering the use of technologies like virtual reality and haptic proxies to engage children and people across generations in playful interactions that enable them to "taste" foods through touch and scent, without judging by appearances. Existing work have explored sound-enhanced gustatory experiences [6, 7]; touch-taste correspondences may offer complementary avenues to shape expectations, curiosity, and confidence with unfamiliar foods.

To explore this topic, we address the two following research questions:

(1) How do children interact with and assign tastes to food-like materials of different textures?
(2) How do these touch-taste correspondences relate to children's willingness to try eating unknown foods?

We examine children's (n=64, ages 10–11) touch-taste perceptions and preferences through a playful activity involving a series of eight mystery boxes containing unknown "foods" – inedible materials selected across a variety of textures (e.g., soft, hard, squishy, etc.). For each stimuli, we identify children's interactions, reactions, expected tastes, willingness to try, and cross-sensory association strategies. Our study contributes evidence of children's cross-sensory touch-taste correspondences and suggests correlations between these associations and children's willingness to eat unknown foods. These findings articulate children's tactile/taste reasoning as a new interaction design consideration, with potential to support food education and facilitate novel eating experiences in contexts such as schools and museums. We propose opportunities including designing food-based interfaces, playful applications, virtual dining, and gustatory illusions that benefit from intentionally crafted cross-sensory correspondences.

2 Related Work

2.1 Food Education

Sensory food education programs (e.g., Sapere [67]) have been disseminated in several countries including France, Sweden, Denmark, Finland, Japan, and the Netherlands [27, 40, 61]. The Sapere method [67] involves lessons around tasting foods using the five senses, discovering differences in taste perception to move beyond unexplained preferences (i.e., "I like/dislike it"). Other countries have also explored similar pedagogical approaches, such as a vegetable education program in Australia [59] and applying the Reggio Emilia approach in Italy [10]. Although the philosophical grounding of taste education can be interpreted differently, the foundation of the Sapere method has been described to encourage individuals to seek their own *goût juste* [76], where food is a neutral medium and children can reflect on their subjective tastes to seek a fair balance of given foods and situations. In order for children to be capable of critically reflecting on their experiences, they need opportunities to explore diverse experiences and tastes. According to the United Kingdom department for education [22], sensory food education aims to evoke curiosity to explore foods and empower children as "no one has to try" and "no one has to like" offered foods.

Prior work have employed sensory food education to promote healthy eating behaviours, such as encouraging children to eat more vegetables (e.g., [59]) and to try new foods (e.g., [61]). Food neophobia has been defined as the rejection or reluctance to eat new foods [1, 58]. Related to this concept, *picky eating* is characterized by the aversion of both familiar and new foods, leading to a limited and repetitive diet [18]. The present study involves *unknown* foods, which children may perceive as familiar or unfamiliar. Texture is

[1] We distinguish between two related notions of *multisensory* and *cross-sensory* interaction. *Multisensory interaction* broadly refers to systems that integrate multiple sensory modalities (e.g., vision, audition, somatosensation, olfaction, gustation) for input and output, often to enhance immersion, realism, or accessibility [50]. We use the phrase *Cross-sensory interaction* to refer to design practices that intentionally leverage systematic correspondences between sensory modalities, moving beyond the co-presentation of multiple senses to purposefully shape perception and experience through their interaction [33, 37, 74].

a sensory experience that can affect people's perceptions of foods [65], resulting in aversion or acceptance. In a large-scale survey of adults, Pellegrino and Luckett [54] found that unpleasant sensory attributes were the primary motivation for food rejection, with participants identifying texture as the second most frequent reason for food avoidance after unpleasant flavour. Aversive food texture descriptors identified by participants included terms such as slimy, mushy, squishy, and rubbery; however, food rejection could result from any single texture attribute or combination thereof.

Food neophobia studies involving children have tended to rely on parent reports (e.g., [2, 5, 39, 57, 80]), self-report questionnaires (e.g., [14, 32, 34, 66]), and forced choices (e.g., [9, 32, 69]) such as choosing between apple slices or apple sauce to determine preferences for hard or soft textures. These constrained contexts may contribute to a limited understanding of children's reasoning behind their willingness to eat certain foods and their aversive responses toward others. Moreover, preferences for certain sensory attributes are not necessarily the only determinants for children's willingness to try new foods. Since the senses are interconnected (i.e. exhibiting potential cross-sensory effects [72]), it is important to explore cross-sensory correspondences to taste in children. Technologies may support the exploration of diverse food experiences and provide a useful resource to support parents and guide children at home.

2.2 Child-Food Interaction

Existing human-computer interaction literature has proposed numerous prototypes for mediating children's eating behaviours and food choices, many of which involved gamified approaches (e.g., [4, 11, 30, 70]). For example, FlavourGame [11] is a serious hybrid game (mobile application and board game) designed to promote nutrition literacy and encourage children to try new foods, hence improving their diversity of food choices. Trying different foods was embedded in the game mechanics, which Costa et al. [11] attributed to increasing participants' willingness to try unfamiliar foods. Conversely, although technological interventions may prove effective in studies, their practical implementation and adoption in real-world settings may present significant challenges.

To better understand the feasibility of in-home integration, Chen and Yen [8] investigated parents' perceptions of various technological interventions for children's eating behaviours: augmented utensils (e.g., [23]), screen-based designs (e.g., [31]), and smart objects (e.g., [68]). The study identified screen-based technologies as the most appealing choice to incorporate into current parenting practices, due to their affordability, ease of use, and greater practicality. Beyond research contexts, digital applications may present a marketable product to help facilitate healthier eating. However, they may pose challenges in maintaining positive mealtime environments, which often recommends limiting distractions such as by reducing screen usage.

Child-food interactions may be further enhanced by multisensory experiences engaging in senses beyond taste. FeastyMaze [4] engaged young children with visual, auditory, olfactory, and tactile stimuli, aiming to improve food literacy and eating habits. The multisensory puzzle game garnered positive feedback from both children and their parents, while simultaneously improving children's understanding of nutrition, balanced diets, and cultivating positive attitudes toward food. Nonetheless, Cai et al. [4] emphasize the importance of considering the limitations of a child's cognitive load by consciously balancing the multisensory interactions to avoid overwhelming the child. While visual and auditory cues were found to be most helpful, incorporating additional sensory stimuli could enhance accessibility of the educational experience. Applying cross-sensory correspondences may augment the experience by reinforcing the same information in multiple modalities rather than concurrently conveying details that may be differently perceived.

Beyond conventional mealtimes, Gayler et al. [24] investigated design opportunities for eating experiences through a systematic literature review and interviews with professional chefs. This in-depth research suggests the multisensory integration of both external and *internal* senses (e.g., in mouth interactions). Additionally, no prior work on human-food interaction was found to have reported exploring sensory deprivation [24]. The absence of a commonly used sense may intensify other senses; there is a gap in human-food interaction research on how sensory deprivation may be leveraged in novel eating experiences. Simultaneously, there is an opportunity to explore the effects of cross-sensory correspondences on food-based interactions.

2.3 Taste & Cross-sensory Correspondences

Prior research has explored correspondences between touch and taste. One study [71] investigated tactile-taste interactions with a focus on perceived taste intensity. Slocombe et al. [71] found that adults perceived foods with rough surfaces as significantly more sour than if they were smooth. These experimental results suggest that texture can influence taste perception in foods that are otherwise identical.

However, other research (e.g., [48, 49, 72]) have primarily been conducted within the context of product marketing and/or focused solely on shapes. For example, Spence and Gallace [72] highlighted correspondences between food properties, sound symbolism, and shapes, suggesting the alignment of semantic associations between branding and product. Meanwhile, Obrist et al. [49] mapped tastes to physical objects of various shapes and found that participants tended to experience the sweet taste as smooth and rounded with protruding elements. Texture can also influence consumer behaviour, such as decreasing product satisfaction when the packaging texture is incongruent with the food product's features [21]. Nevertheless, these studies exclude the perspectives of children, who may have fewer experiences than adults on which to base their taste associations.

In addition to associations with taste, tactile interaction with food textures prior to ingestion can also contribute to food acceptance. Nederkoorn et al. [44] found that children who engaged in tactile play of feeling a texture with their hands were more accepting of foods sharing similar textures, as evidenced by greater intake. Potential interventions for food neophobia and exploratory interactions between children and food may be enhanced through the integration of other senses. When encountering unknown foods, children may form expectations based on anticipated hedonic experiences. For example, a child may expect chips from an unfamiliar brand to taste good if they anticipate a familiar, preferred flavour – demonstrating an association with prior positive experiences.

Cross-sensory association strategies refer to reasons individuals provide to explain their judgements on a cross-sensory correspondence task, such as touch to taste, and have been used in related work (e.g., [20, 33, 37, 46, 47, 74]). Types of rationale from cross-sensory judgments include: (1) embodied action, (2) grasping for another sense, (3) personal connection, (4) sensory features, (5) valence, (6) vocalization, and (7) familiar experience [62]. An examination of these strategies can inform how individuals develop connections across senses and assess the efficacy of communication for various sensory modalities. Furthermore, identifying cross-sensory association strategies in the present study may offer insight about why children accept or reject certain unknown foods.

3 Method

Our study aimed to explore children's perceptions and willingness to try unknown foods based on tactile sensations, using cross-sensory and playful interaction as a guiding methodology. We set up eight boxes containing different materials for children to touch, accompanied by an instruction sheet. The children interacted with each of these boxes and gave responses to a camera, predominantly unsupervised but guided by instructions provided by the researcher.

3.1 Mystery "Food" Boxes

To gain a broad understanding of touch-taste correspondences, we sought to present children with a diverse set of textures to interact with. Therefore, we did not limit the "foods" to any single type of material. The boxes' contents were selected to represent each of the eight behaviours in food materials as derived from Rosenthal and Chen [63]'s three dimensions of solid food textures: strong-weak, hard–soft, and brittle–plastic. *Strong-weak* refers to fracture strain (i.e., ability to withstand force), *hard-soft* to fracture stress (i.e., force to deform), and *brittle-plastic* to the breakdown characteristic of food (i.e., crumbly or spreadable).

As our goal was to collect a variety of different textures, we were inspired to represent each of the eight possible solid food texture combinations according to the cubic model of Rosenthal and Chen [63]. Below are the eight combinations along with the corresponding "food" materials used for our study, as depicted in Figure 2. The following enumerations will be the referred box number (e.g., B1, B2, B3, etc.).

(1) Weak-hard-brittle – broken packing peanuts
(2) Weak-hard-plastic – playdough packed in a textured balloon
(3) Weak-soft-brittle – long thin strips of bark
(4) Weak-soft-plastic – a piece of elastisand
(5) Strong-hard-brittle – a white styrofoam cylinder
(6) Strong-hard-plastic – small 3D-printed TPU hollow bellows
(7) Strong-soft-brittle – a rectangular block of silicone
(8) Strong-soft-plastic – a spiderball

We interpreted these food textures and found representations from materials readily available in our lab that matched the descriptions. Breakdown characteristics were imagined for objects that were not easily destructible with human hands. These boxes did not contain edible items because real food would introduce an olfactory component, can be easily broken down, and may be digested by participants. During the sessions, we regularly checked the contents and replaced items whenever their defining texture or structural properties had been altered or damaged by the children's interactions. The "food" items were placed on a plastic plate or bowl, covered by a cardboard box taped securely to the table. The box had two holes: one for the participant to reach into (covered by two overlapping pieces of cloth), and one so that the camera could capture the participants' interactions with the "food."

Figure 2: Materials for the eight mystery "food" boxes in sequence (i.e., Box 1, 2, 3) from left to right, top to bottom.

Figure 3: Instruction sheet provided beside each box.

An instruction sheet (see Figure 3) with simple child-appropriate language was also taped onto the table adjacent to the box (see Figure 4). During the study, participants were asked to sit in front of the instruction sheet. A GoPro camera was set up in front of each box so that both the "food" interactions and the participant were visible within the same frame.

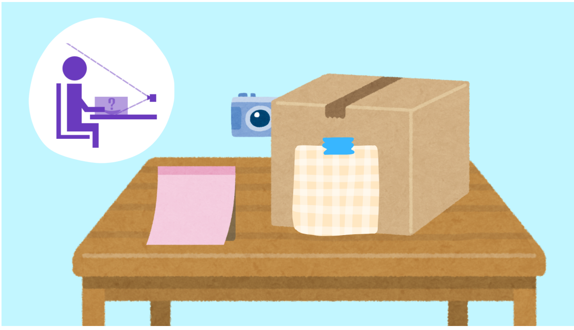

Figure 4: Mystery box set up facing participants with an instruction sheet taped beside it on the table.

3.2 Study Procedure

The study was approved by the university research ethics board; consent from participants and assent from their parent or guardian were obtained in advance. 64 children (ages 10–11, 28 girls and 36 boys) from the same school participated in a university-sponsored research event. This study was part of the event and took place in a large room at the university, with each of the eight mystery boxes spaced out across the room. Each mystery box was paired with an instruction sheet, which children were told to sit in front of. Groups of four to five children participated in each 30-minute session throughout the event but interacted with each box individually. Following a within-subjects design, each child interacted with all eight boxes. During each session, every child started randomly at a different box, but rotated across the eight stations in the same sequence of boxes 1, 6, 8, 4, 5, 7, 2, and 3.

One researcher facilitated the sessions and explained the procedure once a group entered the room, providing a short demonstration. The context provided was that the participants were food reviewers trying alien foods and giving their feedback. Participants were directed to say their answers out loud to the camera located at each station. First, participants were asked to put on headphones playing white noise, as a measure against sounds made by interacting with the mystery "food" and to limit distractions from peers. Next, participants sat in front of different boxes and individually reached into the box and touched the "food." They were asked to describe to the camera what it felt like, what it could taste like, and why. A list of four basic flavours were provided: sweet, salty, sour, and bitter. Umami was omitted because this word is less familiar and can be difficult for children of this age group to identify [19, 40].

Participants then provided a Likert scale rating from 1 to 5 of how much they would want to try the mystery "food," with 1 meaning "I absolutely do not want to eat it" and 5 meaning "I really want to eat it." This "willingness to try" scale is consistent with existing literature [36]. Finally, they were asked to explain their response (i.e., "*What do you like or dislike about it?*"). Each participant interacted with each box for approximately 2 minutes before being asked to proceed to the next box. At the end of their individual explorations, the researcher led a group discussion to summarize perspectives for each box (e.g., "*What do we think this mystery food tastes like? Why?*", "*Does anyone have other ideas?*", "*Raise your hand if you would want to eat what's in here.*").

3.3 Data Collection and Analysis

The participants were audio and video recorded by the GoPro cameras set up at each box. The final group discussions were recorded by the researcher using a handheld GoPro camera. A total of 116 videos with approximately 56 hours of footage was collected and analyzed. We organized the videos by the box they captured. Since data was collected predominantly unsupervised, not all participants answered all the questions. Therefore, quantities of responses differed for each box and each question.

In a spreadsheet, we extracted participants' initial reactions, taste associations (sweet, salty, sour, bitter, multiple, other), ratings, and deductively coded their association strategies for each response. We also included descriptions of specific tastes for "multiple" (e.g., sweet and salty) or "other" (e.g., spicy) categories. Direct verbatim quotes were included for all responses.

The total of eight categories of association strategies were selected from a predetermined list as proposed by prior research on cross-sensory correspondences and children [46, 62] (see Table 1): embodied action, grasping for another sense, personal connection, sensory features, valence, vocalization, familiar experience, and cannot explain. To deductively code these, we considered the metaphors and justifications explained by the participants. For example "it's sticky!" would be categorized as associating from sensory features whereas "ewww" would be considered vocalization.

Strategy	Description	Example
Embodied action	Using gestures with hands or body with their explanation.	"It feels like this," then making a grabbing motion.
Grasping for another sense	Using words from a different modality, such as non-food items to describe taste.	"It feels like something I would buy for stress relief."
Personal connection	Using a specific, personal story with their explanation.	"It reminds me of when my mom baked cookies."
Sensory features	Using physical features with their explanation.	"Because it's too hard."
Valence	Using terms to denote positive and/or negative qualities.	"It's just not nice. I dislike it."
Vocalization	Using a sound/noise instead of words to describe an item.	"Ughhh, what is that?!"
Familiar experience	Comparing to a common object, emotion, texture, etc.	"It's like pizza dough."
Cannot explain	Not providing any justification.	"It just does."

Table 1: Eight categories of association strategies, their descriptions, and examples. Table adapted from [62].

Two researchers were involved in extracting responses and quotations from the videos. The two researchers independently coded association strategies deductively based on the extracted information and resolved any ambiguities by discussing the assigned codes. We conducted descriptive statistics to provide a comprehensible overview of the data and identify trends. A chi-square test of independence was performed for each box's taste associations and willingness to eat ratings. The Bonferroni correction was applied for a total of 8 tests, resulting in a corrected alpha level of 0.006.

4 Findings

We first provide an overview of how children interacted with the eight textures, the tastes they expected them to have, and their willingness to try eating the "foods". We then focus on cross-box patterns in texture–taste correspondences and willingness to eat, before examining the association strategies children used to explain their perceptions.

Table 2 provides a summarized overview of findings for the eight boxes. To make references more interpretable, we refer to each texture by both its box number and a short descriptive label derived from children's own comparisons. As demonstrated by the frequently associated tastes, participants tended to expect the "foods" to taste either sweet or salty, often making comparisons to familiar foods (e.g., popcorn, cake, pasta). However, their willingness to try the "foods" tended to be negative and were more frequently influenced by the materials' sensory features (e.g., squishy, crunchy, rough). As not all participants gave clear responses to every question, we refer to responding participants (i.e., respondents) as a subset of the total participants.

4.1 Interaction Patterns Across Texture Combinations

Across all eight boxes, children engaged actively with the hidden materials, often continuing to manipulate them until prompted to move on regardless of whether they said they liked or disliked the material. However, their interaction styles clustered according to texture combinations.

Hard–brittle textures such as *soft popcorn* (B1) and *rough sponge* (B5) elicited grabbing, hitting, and breaking behaviours. Participants scooped B1 by the handful, likening it to popcorn with "a soft inside but a kind of crunchy outside," while B5 was repeatedly used to hit the bowl or other surfaces and described as "really hard," "spongy," and "very rough". Likewise, participants tried to stick *gooey jelly* (B7) onto surfaces and attempted to rip it apart.

Hard–plastic textures such as *crunchy hoops* (B6) and *squishy lump* (B2), invited squeezing, squashing, and/or threading fingers through holes. Participants described B6 as "really small and a little bit soft," and "bouncy and itchy," with many children pushing fingers through the holes and compressing it both vertically and horizontally. B2 was described as "it feels really hard but you can squish it real easily."

Some textures were explored more delicately: children ran pieces of *dry noodles* (B3) between their fingers, collected small bundles, and commented on them being "crunchy", "thin", and "curly". In contrast, soft–plastic textures like *sandy crumbs* (B4) and *stringy slime* (B8) prompted pinching, gathering, and stretching. B4, in particular, elicited strong vocal reactions ("eughhh," "what the!!! Is it poo?!") and was described as "sandy" and "grainy." B8 was stretched and squeezed, with several children commenting on its "stringy" and "sticky" feel.

4.2 Touch-Taste Correspondences

Participants made taste associations with statistically significant correlations for three textures: *soft popcorn* (B1), *dry noodles* (B3), and *gooey jelly* (B7), while the remaining boxes showed more mixed or ambiguous mappings. *Rough sponge* (B5; $\chi^2(4)$=13.95, p=0.007) was only significant without Bonferroni correction ($\alpha = 0.006$). Figures 5 and 6 depict results of the chi-square test of independence and standardized residuals of taste associations for the eight boxes. **Familiar experiences** were the dominant association strategy for explaining these taste correspondences (e.g., popcorn, pasta, cake), as shown proportionally in Figure 7.

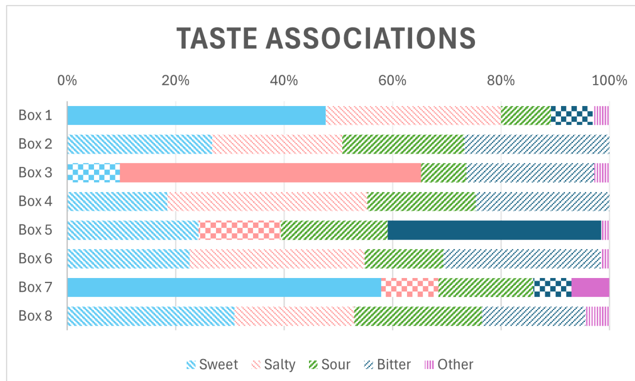

Figure 5: Overall taste associations across eight boxes. The solidly filled bars represent positive significant correlations (residuals >2). The checkered pattern bars represent negative significant correlations (residuals <-2). E.g., Box 1 is most positively associated with sweetness, but least with bitterness.

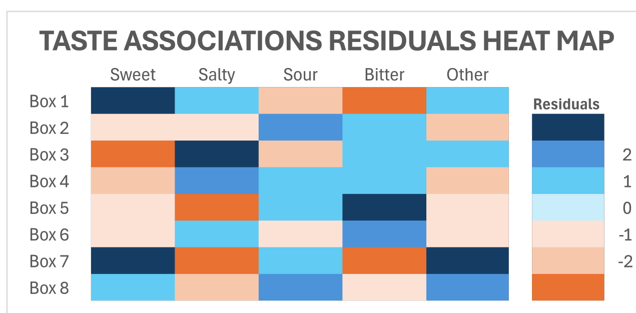

Figure 6: Heat map of overall taste associations chi-square test standardized residuals across eight boxes. E.g., Box 1 has a significant positive residual for sweetness and negative residual for bitterness.

Box	Frequently Associated Taste	Taste Association Strategy	Percentage of Positive Willingness Ratings >3/5	Willingness Association Strategy
(B1) Soft popcorn (weak-hard-brittle)	Sweet	Familiar experiences E.g., "*It reminds me of popcorn.*"	58.0%	Familiar experiences E.g., "*I like popcorn.*"
(B2) Squishy lump (weak-hard-plastic)	Mixed	Familiar experiences E.g., "*a gone-off orange,*" "*potato,*" "*mochi*"	26.3%	Sensory features E.g., "*too squishy,*" "*the stretchy part,*" "*very hard*"
(B3) Dry noodles (weak-soft-brittle)	Salty	Familiar experiences E.g., "*curly fries,*" "*dried pasta,*" "*spaghetti*"	35.7%	Sensory features E.g., "*crunchy,*" "*spiky,*" "*crispy*"
(B4) Sandy crumbs (weak-soft-plastic)	Salty	Familiar experiences E.g., "*crumbs after a crisp packet,*" "*sand,*" "*citric acid*"	30.0%	Valence / Familiar experiences E.g., "*Because I love biscuits [...] and it would smell nice*"
(B5) Rough sponge (strong-hard-brittle)	Bitter	Familiar experiences E.g., "*It reminds me of a dried up cake*"	23.5%	Sensory features E.g., "*it feels too rough for my liking and too hard*"
(B6) Crunchy hoops (strong-hard-plastic)	Salty	Familiar experiences E.g., "*uncooked pasta,*" "*swirly crisps*"	42.6%	Sensory features E.g., "*it has holes*"
(B7) Gooey jelly (strong-soft-brittle)	Sweet	Familiar experiences E.g., "*jelly,*" "*cake,*" "*gummy bear,*" "*fudge*"	45.3%	Valence E.g., "*I'm gonna play with both of my hands, I like it, I'd eat this all the time. I love it.*"
(B8) Stringy slime (strong-soft-plastic)	Sweet	Familiar experiences E.g., "*spaghetti and meatballs,*" "*a bit like sushi,*" "*edible slime*"	32.7%	Valence / Sensory features E.g., "*it seems to be quite sweet like a fruit*"

Table 2: Overview of interactions, associated tastes, average ratings, and association strategies for each of the eight boxes. Yellow highlights statistically significant correlations (χ^2, *p*<0.05, Bonferroni corrected $\alpha = 0.006$).

4.2.1 *Sweet, soft, and gooey.* *Soft popcorn* (B1) and *gooey jelly* (B7) were most strongly associated with sweetness. For B1 ($\chi^2(4)$=16.63, *p*=0.002), participants most frequently associated with a sweet taste (residual = 2.78) and least associated with a bitter taste (residual = -2.51). 31 of 49 respondents linked B1's texture to sweet tastes, and more than 73% of respondents (*n*=36) applied familiar experiences as an association strategy, referencing popcorn or small sweets (e.g., "it feels like popcorn so I think it might be sweet and salty").

B7 ($\chi^2(4)$=33.83, *p*<0.001) was similarly mapped to "fudge", "gummy bear", and other squishy confections, with many relating to familiar experiences "like brownies, the gooey inside would be a brownie." Unlike with other boxes, no participants reported multiple taste associations for B7. More than 57% of respondents (*n*=33) associated the feeling solely to a sweet taste. Participants most frequently associated B7 with a sweet taste (residual = 4.03) and "other" tastes (residual = 2.18). In contrast, they least associated B7 with salty (residual = -2.60) and bitter (residual = -2.46) tastes.

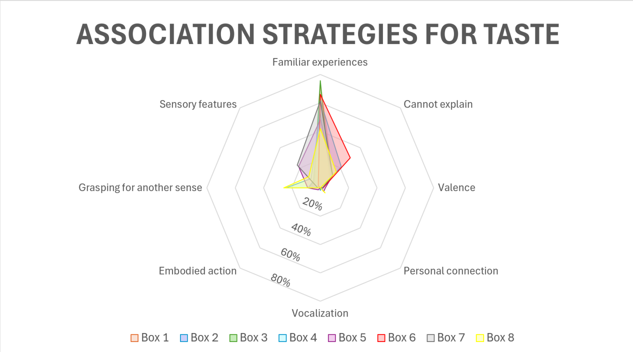

Figure 7: Percentage proportions of cross-sensory association strategies used for touch-taste correspondences across eight boxes (e.g., more than 75% of Box 3 participants described familiar experiences).

4.2.2 Salty, crispy, and snacks. *Dry noodles* (B3; $\chi^2(4)$=29.83, p<0.001) showed a strong salty association: more than 64% of respondents (n=40) expected it to taste salty, frequently comparing it to fries, crisps, or dried pasta (e.g., "it would taste salty, like fully salty. It reminds me of chips"). Participants most frequently associated B3 with a salty taste (residual = 4.16) and least associated it with a sweet taste (residual = -3.05). The next most commonly reported flavour was bitterness, which was selected by 16 respondents – less than half the number for saltiness.

Similar familiar experiences with snacks were made for other materials frequently associated with saltiness. *Sandy crumbs* (B4) were compared to foods like "crumbs after a crisp packet" and "crushed up biscuits." *Crunchy hoops* (B6) were described as "I think it tastes salty because it reminds me of crisps and crisps are salty."

4.2.3 Bitter, hard, and inedible. *Rough sponge* (B5; $\chi^2(4)$=13.95, p=0.007) was the only material that was most frequently associated with bitterness (residual = 2.91). In contrast, participants associated B5 the least with a salty taste (residual = -2.10). From 56 respondents, a total of 26 expected the material to taste bitter. Participants linked its hardness and roughness to overcooked or stale foods ("a dried cake," "really burnt scotch cakes," "stale bread") or to something they "don't think we can eat", framing it as likely to taste unpleasant or unsafe.

One participant said, "I think it would taste bitter because it's hard and hard things like, if bread goes old and mouldy, it'll be hard and bitter." *Sandy crumbs* (B4) had bitterness as the next most associated taste after saltiness, and a participant also believed it would taste bitter because "it might kill you."

4.2.4 Ambiguous or mixed. *Squishy lump* (B2; $\chi^2(4)$=4.45, p=0.35), *sandy crumbs* (B4; $\chi^2(4)$=6.00, p=0.20), *crunchy hoops* (B6; $\chi^2(4)$=2.72, p=0.61), and *stringy slime* (B8; $\chi^2(4)$=4.35, p=0.36) did not show statistically significant taste–texture correlations, though trends were observable (e.g., B4 leaning towards salty, B6 towards salty/bitter). Participants had varied conflicting perspectives regarding these materials. Although over 61% of B2 respondents (n=35) reasoned their taste perceptions by referring to familiar experiences, these comparisons varied broadly with examples ranging from "bread mixed with soft candy" to "a rotten type of fruit" and "animal poop." This wide range of comparisons corresponded to a scattered distribution of single and multiple taste associations from a total of 57 respondents: 19 sweet, 17 salty, 16 sour, 19 bitter, and 0 other.

Compared to other boxes, more B6 respondents (n=33) were unable to explain their taste association (30% "cannot explain"), giving responses of "I don't know." Likewise, B8 taste association responses (n=62) were nearly evenly distributed across categories including multiple selections, totalling 21 sweet, 15 salty, 16 sour, 13 bitter, and 3 other ("orange," "none," and "doesn't taste like anything"), reflecting uncertainty of categorizing this material as food.

4.3 Willingness to Eat

Participants gave ratings from 1–5 for their willingness to try eating each mystery "food." Across all boxes (refer to Appendix A for graphs of each box), willingness to eat followed a clear pattern: participants were more willing to try textures they imagined as sweet and familiar, and less willing to try those they expected to be bitter, sour, dangerous, or unpleasant (Figures 8, 9). Children used **sensory features** (e.g., hardness, roughness, stickiness), **familiar experiences** (e.g.,), and **valence** (e.g., "fun to play with but I would not eat it", "it makes me uncomfortable") as the main rationales for their association strategies (see Figure 10).

As seen in Figure 8, participants comparatively provided the most positive ratings (58%) for *soft popcorn* (B1, weak-hard-brittle; $\chi^2(2)$=10.75, p=0.005) and the most negative ratings (62.7%) for *rough sponge* (B5, strong-hard-brittle; $\chi^2(2)$=5.78, p=0.056). However, only B1 had statistically significant willingness ratings.

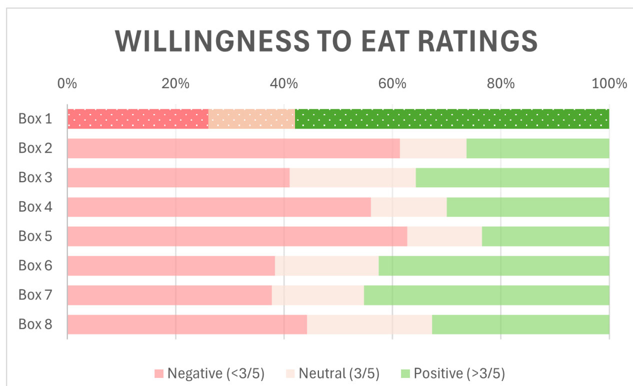

Figure 8: Overall willingness to eat ratings across eight boxes. The dark patterned bars represent significant correlations (p<0.05, Bonferroni corrected α = 0.006). E.g., 58% of Box 1 participants reported positive ratings.

Subsequently, we compare these willingness ratings with the taste associations made by participants (see Figure 9). Highly significant correlations were found for **sweet** ($\chi^2(2)$=38.79, p<0.001) and **bitter** ($\chi^2(2)$=32.00, p<0.001) tastes. Correlations for perceived sourness was marginally non-statistically significant ($\chi^2(2)$=5.96, p=0.051). Overall, most participants seemed more willing to try eating unknown food materials perceived as sweet and less willing to try unknown food materials expected to taste bitter.

Throughout the eight boxes, participants tended to use **sensory features** as an association strategy to justify their willingness to eat ratings (see Figure 10). Other trending strategies were familiar experiences and valence.

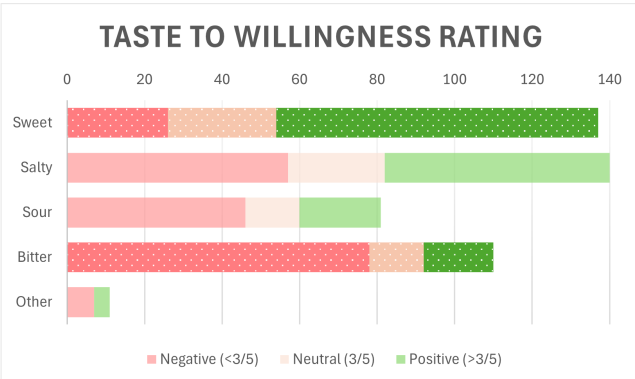

Figure 9: Overall taste associations compared with willingness to eat ratings, combined from all eight boxes. The dark patterned bars represent significant correlations (p<0.05). E.g., over 60% of participants were positive about tasting sweetness, while nearly 80% were negative about tasting bitterness.

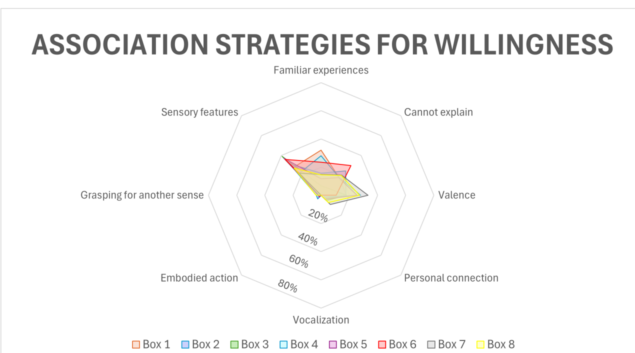

Figure 10: Percentage proportions of association strategies used for willingness to eat ratings across eight boxes (e.g., nearly 40% of Box 3 participants referenced sensory features).

4.3.1 *Highest willingness: sweet, soft, and edible.*

When participants associated sweetness, they tended to be more willing to try the unknown "food" materials ($\chi^2(2)$=38.79, p<0.001; see Appendix A for taste willingness graphs for each box). *Soft popcorn* (B1) received the most positive ratings, with 58% of respondents scoring their willingness above 3/5. Participants frequently linked these ratings to both familiar snacks ("I rate it a 4 because I like popcorn") and to sensory cues that felt "soft" and "edible." When participants expected B1 to taste sweet or salty, they were overwhelmingly willing to try it. From a total of 46 respondents, 25 gave a positive rating for a sweet association, which is greater than 89% of total respondents who perceived sweetness (n=28). Similarly, of the 21 respondents who perceived saltiness, 14 were more willing to try the "food."

4.3.2 *Lowest willingness: bitter, unprepared, and unsafe.*

When participants anticipated bitter tastes, they tended to be less willing to try the unknown "food" materials ($\chi^2(2)$=32.00, p<0.001; see Appendix A for taste willingness graphs for each box). Overall, *rough sponge* (B5), *squishy lump* (B2), and *sandy crumbs* (B4) attracted the most negative ratings. For B5, over 60% of 51 respondents (n=32) were unwilling to eat it, citing its roughness, hardness, and "prickliness" as reasons. Despite differences in taste correspondences for B2, more than 60% of 57 respondents (n=35) agreed that they would be unwilling to eat B2. 18 of these respondents explained their negative response with unpleasant sensory features such as "it's hard to grab because it hurts your hand" or "I dislike the hard part that's mixed with the squish. That is just not satisfying." For B4, 56% of 50 respondents (n=28) rated willingness below 3/5, with explanations such as "DISGUSTING" or prior negative experiences (e.g., "I've already ate [sand]. It don't taste nice").

Participants were also unwilling to eat materials they framed as dangerous or harmful (e.g., "it might kill you" regarding B4, "it's going to hurt me" regarding B3). Some participants were less willing to try *dry noodles* (B3) because it was perceived to be dangerous: "It just would *ruin my whole mouth*. My taste buds would not like this and it would just ruin all of them", "I don't like that it was in circles and like it *might give me a splinter* if I tried to eat it" and "I dislike everything about it. It's hard and not fun. *It's going to hurt me.*"

4.3.3 *Ambivalent willingness: expectations and preparation.*

For *gooey jelly* (B7), respondents (n=53) had mixed preferences with 24 rating positively and 20 rating negatively. Participants described conflicting perspectives like "I absolutely do not want to eat it. Ew, but it is fun to play with" and "I love it, the sides are like squishy." However, 18 out of 30 respondents who associated B7 with sweetness were willing to try eating it. The sweet taste also had more respondents (n=30) than the other basic flavours for B7 (and compared to other boxes, which were more evenly distributed), with the next highest response being sourness (n=9).

Comparably diverse views were found for *dry noodles* B3: from a total of 56 respondents, 20 rated it above 3, 13 gave it a rating of 3, and 23 rated it below 3. 16 of these respondents perceived it as bitter, 75% of which (n=12) gave it a negative rating. One B3 respondent explained, "It feels really bitter and I don't like bitter foods, I like foods with flavour," rating it negatively with 2/5.

Similarly, *crunchy hoops* (B6) had 47 respondents give varied opinions, with 20 rating it greater than 3/5 (positive), and 18 rating it less than 3/5 (negative). 10 out of 18 respondents who perceived saltiness gave positive willingness ratings. Correspondingly, 10 out of 17 respondents who expected bitterness gave negative ratings. One B6 respondent suggested specific flavours:

> "I don't think it'll be *sweet*, only if it's sweet chili. That would be a good flavour. That's why I think it'd be sweet. The *salty* may be *sour* cream and onion or *salt* and vinegar. Maybe *bitter* if it has no flavour, it might be original. But I don't think it would be because it might have flavour. I would eat it. So I say a 4."

A few participants referred to specific expectations of materials imagined as food. For example regarding *squishy lump* (B2), "it's lumpy and *undercooked* or *not baked properly*," "it feels like something you have to *peel* and eat," and "I wouldn't eat the *outside* of it, but I would eat the *inside* of it." Likewise, food properties also played a role in respondents' willingness to eat *dry noodles* (B3): "If it was *boiled and cooked*, I would probably eat it and rate it a 4. But if it's not, I'd probably rate it a 2." One *stringy slime* (B8) respondent also mentioned, "I like how sticky it is and I don't know just *how* sweet it is." For these unfamiliar "food" materials, participants' willingness often hinged on expectations and imagined preparation or flavour intensity rather than the base texture alone.

5 Discussion

In this paper, we examined how children form cross-sensory associations between touch and taste, and how these associations shape their understanding and expectations of food. While prior work has explored sensory correspondences primarily in adults, our study extends this inquiry to children, revealing imaginative and playful reasoning. Our findings highlight how children tend to associate taste grounded in familiar experiences, but also base their willingness to eat foods on sensory features (i.e., importance of food textures in aversion [54]).

In the following discussion, we gradually build from empirical reflections to broader implications. First, we consider the perceptual associations children made between textures and tastes. We then reflect on how these associations influence children's expectations and openness towards trying unknown "foods." Finally, we discuss the design and application opportunities that emerge from using texture to expand children's food experiences.

5.1 From Texture to Taste: Children's Cross-sensory Mappings

5.1.1 Flavour Identification. Six out of eight boxes were classified by participants as either salty or sweet. The exceptions were *squishy lump* (B2, weak-hard-plastic) and *crunchy hoops* (B5, strong-hard-brittle): the former was linked to a variety of basic tastes, while the latter was associated most often with bitterness. Participants also showed greater willingness to try foods they expected to taste sweet. The smoothness/roughness of food textures have been found to influence taste perception in adults [71], and the pairing of sweetness with softness is congruent with prior work with adults [73].

Sourness did appear as a taste association, but it was never the dominant response for any of the boxes. One possible reason is that sour foods often share textures with more familiar sweet foods. For example, sliced citrus fruits resemble oranges in texture, and children may more frequently encounter sweet oranges than sour lemons or bitter grapefruits. As a result, they may default to sweetness when faced with similar textures. This pattern, along with the prevalence of salty and sweet expectations, suggests that children's taste associations may mirror the most common flavours in their everyday diets, highlighting the importance of broadening children's exposure to diverse tastes.

There is a need for food education that includes exposure to a variety of foods and opportunities to learn how to identify different flavours. Aligning with prior work on sensory food education, we suggest supporting children with taste identification by presenting them with a range of diverse foods that engage multiple senses while leveraging cross-sensory interactions. Prior work [75] found that blindfolded participants were most able to identify vegetables when provided with taste, smell, and texture (87.5%), compared with only taste cues (38.3%) or only smell cues (39.4%). This finding highlights the important role texture plays on food identification and the need to include texture in food education. In our study, participants were presented only with texture and were less willing to try foods that felt hard, which tended to be associated with perceived unpleasant tastes (e.g., bitter). Taste identification activities can be facilitated by tools such as an educational mobile application to guide children through a gamified process to explore in their own homes. At school, teachers can be supported by tactile shape-changing interfaces to represent foods, which can be beneficial in circumventing potential allergens in classrooms.

Interestingly, some children suggested unusual pairings, such as comparing bitterness to butter or expecting dried pasta to taste sour. Existing research has shown that children sometimes confuse basic tastes, for example, mistaking bitterness for sourness [25]. Future studies could consider brief training sessions to familiarize children with taste categories before the task, reducing potential mislabelling. Simultaneously, challenges remain in how children articulate taste experiences. Prior work on participants 16 years of age or older by Pistolas and Wagemans [56] examined how four distinct textures (soft, crispy, crunchy, sandy) could be associated with four basic tastes, which found congruency in sweet-soft and salty-crispy pairings. Similarly, our study found that children also used words such as "crunchy" or "crispy" to describe textures that they anticipated to taste salty. However, as Varela et al. [78] note, flavour descriptors are highly variable across cultures with terms such as "crispy" and "crunchy" are understood differently depending on the population studied. This cultural and linguistic variability may further complicate children's ability to consistently identify and communicate taste associations.

5.1.2 Flavour Familiarity. *Squishy lump* (B2, weak-hard-plastic) and *rough sponge* (B5, strong-hard-brittle) were perceived most negatively, with B5 receiving the lowest willingness-to-eat ratings. Because real foods often involve complex blends of basic tastes (e.g. butter is not easily categorized as purely sweet, salty, sour, bitter, or umami), children may have experienced B2 as a confusing mix. Bitterness is often particularly difficult for children to identify [19], which may explain why B5 was so consistently disliked. Children's aversion to bitterness is well documented [28, 45], and in our study this aversion appeared alongside reluctance toward unfamiliar textures they could not easily anchor in previous experiences. Participants tended to prefer foods that resembled something familiar, suggesting that new foods may be better received if presented in familiar forms. For example, preparing cauliflower or zucchini to mimic the texture of rice or pasta.

Texture-based educational tools may support the gradual introduction of unfamiliar foods to young learners with food neophobia. For example, using a tangible shape-changing interface to represent different materials. In a classroom context, a technological application may supplement introductory food education by enabling students to safely interact with new food textures while eliminating the possibility of triggering allergies.

Some children also struggled to explain their taste associations. When uncertain, children produced a wider spread of associations across different flavours (e.g., for B2, B6, and B8). *Squishy lump* (B2) in particular prompted unusual comparisons ranging from "a gone-off orange" to "mochi" and even "animal poo." These variations likely reflect differences in individual prior experiences, such as caring for a pet or exposure to culturally specific foods. Another explanation is that children may perceive varying levels of flavour sensitivity and intensity (e.g., [29, 79]).

5.1.3 Towards a Cross-Sensory Touch–Taste Map. This study explored only eight examples of textures within the solid food texture dimensions outlined by Rosenthal and Chen [63]. Future work could expand this set systematically, such as including foods with varying degrees of softness within the hard–soft spectrum, to build a more detailed cross-sensory "map" of touch-taste correspondences.

The two materials that elicited the strongest reactions, *soft popcorn* (B1) and *rough sponge* (B5), were both designed as hard and brittle textures but differed in fracture strain (*weak*-hard-brittle vs. *strong*-hard-brittle). This subtle variation may explain why children associated the weaker texture with sweetness but the stronger one with bitterness. Extending this approach could allow researchers to examine whether such texture–taste associations hold across different age groups, not only in children but also in adults. Large-scale studies might also leverage controlled fabrication methods such as 3D printing to generate dozens of precise, reproducible texture variations for systematic testing.

Cross-sensory interactions between texture and taste may be leveraged to enhance certain tastes, such as increasing the perception of saltiness with roughness. This has been explored in prior work with other cross-sensory modalities (e.g., enhancing gustatory experiences with sound [6, 7]) and may be applicable for people who need to limit their salt and/or sugar intake. As a specific example, low sodium snacks could be manufactured with a rougher texture to elicit a saltier perception. Furthermore, there is potential to create new culinary experiences that make use of textural expectations through 3D printings (e.g., [55]) and materials that change in texture throughout consumption (e.g., [16, 17]). For example, producing a playful dining experience where flavours are perceived to change in the mouth; food enjoyment may be enhanced through leveraging multisensory and cross-sensory interactions.

5.2 Food Expectations and Designing Edibility

5.2.1 Designing intuitive interfaces. Children's willingness to try the mystery "foods" was shaped not only by taste expectations but also by perceived edibility and assumptions about how the foods should be eaten. This finding aligns with prior work on disgust rejection [65] and aversive food textures in adults [54], underscoring how sensory properties beyond flavour (particularly texture and breakability) play a central role in acceptance. Future studies could examine how children approach unfamiliar foods of different textures, for example whether they attempt to cut, tear, or bite directly into them. Such observations can inform the design of intuitive interaction strategies in child–food contexts, where usability depends as much on embodied handling as on flavour.

Some materials elicited strong negative reactions. For instance, *rough sponge* (B5, strong-hard-brittle) was frequently judged as inedible; children struck it against other objects or used it as a tool, describing it as "too hard" or "unbreakable." Similar behaviours appeared with other brittle or resistant textures, such as tearing apart Box 1 (weak-hard-brittle), trying to rip *gooey jelly* (B7, strong-soft-brittle), and pulling hard at *stringy slime* (B8, strong-soft-plastic). These behaviours illustrate that children expect edible substances to be easily broken down, supporting earlier accounts that breakability distinguishes edible from inedible materials [64].

In some cases, participants also expressed danger rejections [65], framing foods as unsafe. For instance, *sandy crumbs* (B4) were said to "taste bitter because it might *kill* you" or "*hurt* me." Such embodied and affective expectations illustrate how food rejection can stem from texture-based cues of safety. These findings suggest design opportunities in both physical and digital contexts. For example, interactions with food textures, such as stabbing a piece of grilled meat versus gently lifting a flaky pastry, might inspire new forms of gesture-based interactions or the material design of haptic controllers in virtual food experiences (e.g., virtual reality).

We suggest that food-based virtual experiences can reinforce children's learning about food preparation processes in a safe environment. Food preparation involves many physical acts that sometimes require directly touching different textures, from chopping onions to kneading dough or marinating meat. Designing interactions with digital foods can also benefit from understanding how people expect to interact with foods based on presentation (e.g., needing to peel an orange before eating it). Foods that are typically eaten with hands should also convey textural information in the process (e.g., feeling toasted bread on a sandwich). Future food-based experiences can be augmented by tactile interfaces.

5.2.2 Exploring unfamiliar foods with senses. Participants articulated expectations for how unfamiliar foods might be prepared to make them more palatable, offering suggestions like "if it was *boiled and cooked*, I would probably eat it". Common preparation methods such as boiling, baking, peeling, seasoning, or adding toppings, were frequently invoked as strategies to transform unfamiliar materials into recognizable foods. These expectations highlight opportunities to leverage children's existing schemata of food preparation when designing educational or interactive experiences.

Allowing children to participate in preparation can further reduce food neophobia and increase willingness to try new flavours and textures. A quasi-experiment in primary schools showed that greater involvement in preparation (e.g., peeling, seasoning, topping) was associated with reduced food rejection [35]. Similar evidence suggests that participation fosters ownership, curiosity, and positive associations with food [51, 60, 77]. Embedding food preparation as a playful and hands-on activity can therefore make new foods less intimidating while also contributing to food education.

Beyond mealtime, these expectations can be extended into interactive contexts such as food museums or sensory exhibits, where children are invited to explore preparation-like actions without the pressure of eating. Designing for sensory exploration through touch, smell, or playful transformation, can scaffold curiosity and create opportunities to reframe unfamiliar foods as approachable, rather than aversive. In a museum context, visitors may be unfamiliar with food customs from other cultures. These virtual experiences can offer opportunity to educate how people interact with food differently (e.g., eating curry with hands). It can provide a safe space for learning without judgment of inappropriate or embarrassing behaviour in a public restaurant.

5.3 Expanding Food Experiences Through Non-Edible and Virtual Interactions

5.3.1 Public non-edible food education. Multisensory and cross-sensory technologies provide opportunities to engage with food beyond consumption, opening up playful and educational experiences for broader audiences. In particular, food-based museums and cultural exhibits could use such technologies to enrich how visitors encounter food traditions. For example, a study of food tourist motivations found that visitors were drawn to museums by expectations of sensory engagement across sight, sound, touch, smell, and taste, as well as demonstrations and tasting areas [52]. While demonstrations and sampling can add authenticity, incorporating such dining experiences may risk transforming the museum into more of a restaurant than an educational environment.

Our findings on texture–taste associations suggest that tactile and cross-sensory artifacts could play an important role in bridging this gap. Designing non-edible but sensorially evocative food artifacts could enable visitors to experience culturally important dishes through touch, sound, or smell, without requiring consumption. Cross-sensory technologies (e.g., touch–taste, sound–taste, smell–taste) could thus create hands-on, non-edible interactions that both educate and engage, offering museums new ways to balance authenticity with accessibility.

We suggest that food-based interactions in physical exhibits or virtual reality take advantage of taste expectations without necessitating consumption. Rather than a system that replicates flavours for the user to taste, perhaps they can experience food through other sensory modalities. For example, applying texture expectations for basic tastes (e.g., soft for sweetness).

5.3.2 Playful virtual eating experiences. Introducing new foods to children often requires repeated exposure, yet this can be difficult due to cost, preparation demands, or outright refusal. Interactive applications and multisensory devices may offer a complementary pathway by allowing children (and adults) to explore novel foods virtually. Such experiences could simulate sensory properties like texture, smell, and sound, helping children form expectations before encountering the real foods. This aligns with prior findings that repeated exposure even without consumption can build familiarity and reduce food neophobia (e.g., [15, 44]).

For children with sensory sensitivities or selective eating habits, virtual environments may provide controlled, low-stakes contexts for gradually exploring challenging textures. While participants in our study showed reluctance to eat unfamiliar materials, children nevertheless remained highly engaged with them (e.g., sustained physical contact), suggesting potential for playful learning through multisensory exploration. Food interactions in virtual reality remain relatively underexplored. Harris et al. [26] propose that adding olfactory cues can make eating experiences more convincing in virtual reality; we suggest that combining multiple modalities such as texture, sound, and smell, could further enhance immersion. This approach could extend not only to supporting food education but also to offering cultural experiences, enabling children to "taste" authentic foods from distant places in playful, non-edible ways. Future work should explore how technology-mediated eating interactions might scaffold curiosity, promote food acceptance, and introduce new forms of engagement with food.

Designers can also create unexpected experiences to provoke discussion about food textures, such as by enforcing mismatched pairings for familiar foods (e.g., a crunchy cake, a squishy chip). Akin to how a tilted room can feel unsettling, museums can explore sensory illusions beyond optical and auditory. Gustatory illusions can be evoked through cross-sensory interactions. "Pseudo-gustation" work by Narumi et al. [42] explored the use of augmented reality to alter flavour perceptions of a plain cookie by changing its appearance and scent. We propose that manipulating food textures (e.g., roughness) may also influence flavour perceptions; there is potential to explore these interactions with shape-changing materials.

5.4 Limitations

Our study used found materials to represent food textures, rather than systematically engineered ones such as 3D-printed samples (e.g., designing 3D-printed food textures [55]). While effective for eliciting playful responses, this approach limits replicability and precision. Some children also made comparisons that did not align with the intended texture categories, reflecting both the abstraction of using non-edible materials and the interpretive flexibility of children's associations. However, this invites future work to design with non-edible material to engage food-based interaction. Further investigations could explore more realistic inedible replicas, as used in prior research on food choice behaviour [3, 38], to balance engagement with educational value.

Finally, current findings have limited generalizability. Our participants were drawn from a single school in the United Kingdom, which may limit cultural diversity in touch-taste associations. Children from different cultures may have different everyday diets that can influence their common perceptions of expected tastes and intensity of flavours. For instance, chewy foods might be seen as more familiar and accepted to people accustomed to foods like mochi or tteokbokki, while others may find the texture unusual or off-putting. Given that food texture acceptance is shaped by cultural contexts [53], future studies should investigate cross-cultural differences in children's sensory mappings. Furthermore, intergenerational comparisons may offer diverse perspectives to discuss in public contexts such as museums.

6 Conclusion

We examined how children form cross-sensory associations between touch and taste, and how these associations shape their understanding, expectations, and willingness to try eating unknown foods. Across our study, we have demonstrated how children not only form but also explain touch-taste associations by grounding them in familiar experiences. We showed how children perceptually link textures with sweetness, saltiness, sourness, or bitterness.

Consequently, we showed how these correspondences inform judgments of edibility, safety, and preparation. Furthermore, we explored how these insights can inspire applications in both public and personal contexts, from non-edible food education in museums to playful sensory virtual dining. Our findings suggest that designing with children's cross-sensory correspondences in mind can not only enhance our understanding of taste perception in early development, but also inform the creation of more engaging, inclusive, and imaginative food-based technologies and experiences.

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A Appendix

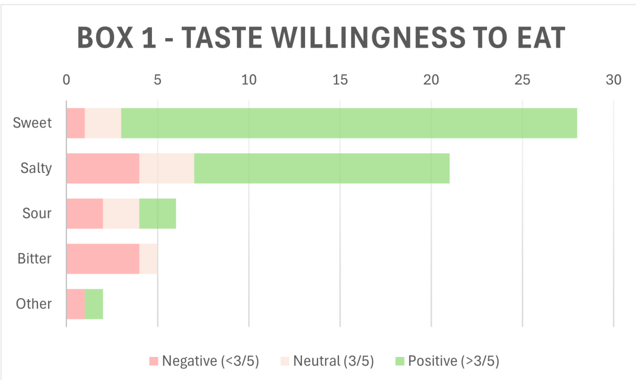

Figure 11: *Soft popcorn* (B1) willingness to try ratings (negative <3, neutral =3, positive >3) across associated tastes.

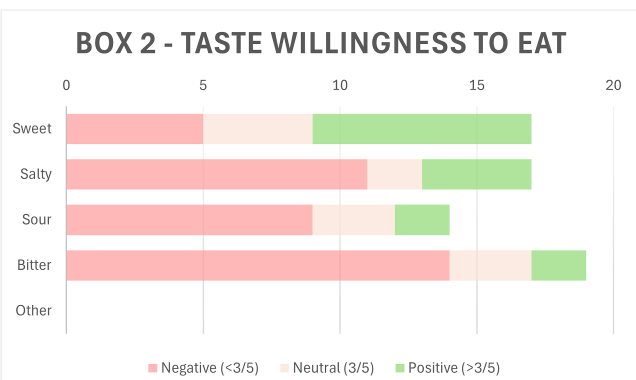

Figure 12: *Squishy lump* (B2) willingness to try ratings (negative <3, neutral =3, positive >3) across associated tastes.

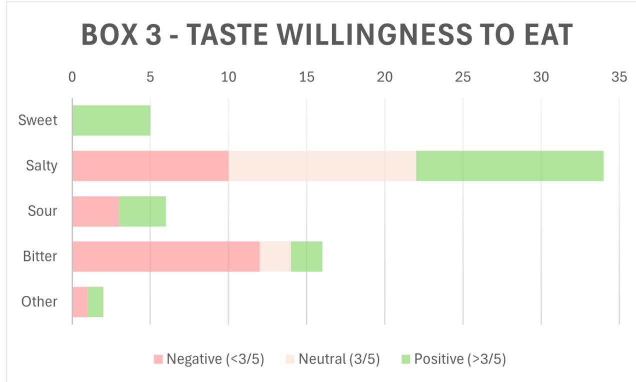

Figure 13: *Dry noodles* (B3) willingness to try ratings (negative <3, neutral =3, positive >3) across associated tastes.

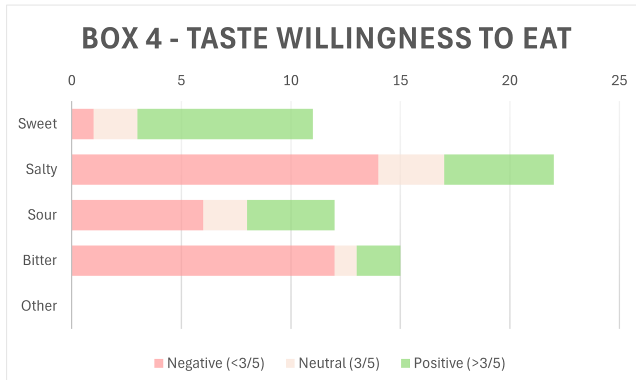

Figure 14: *Sandy crumbs* (B4) willingness to try ratings (negative <3, neutral =3, positive >3) across associated tastes.

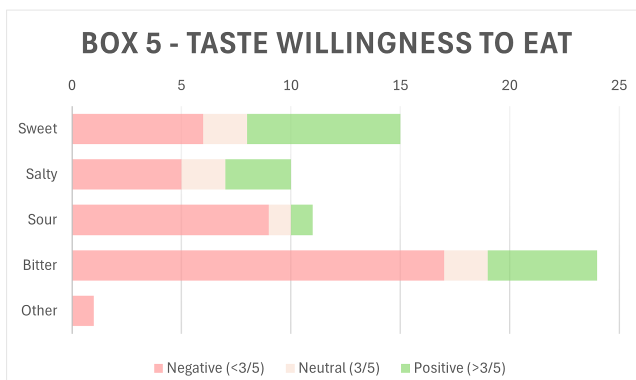

Figure 15: *Rough sponge* (B5) willingness to try ratings (negative <3, neutral =3, positive >3) across associated tastes.

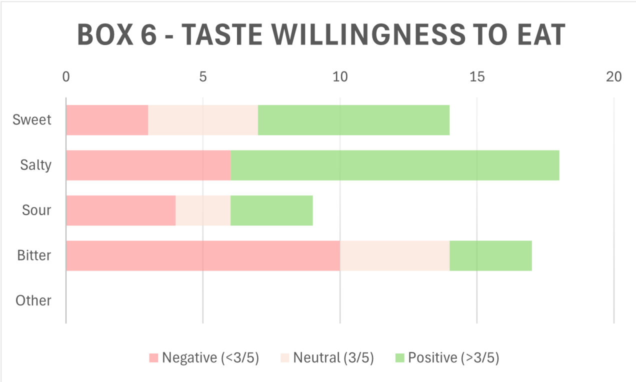

Figure 16: *Crunchy hoops* (B6) willingness to try ratings (negative <3, neutral =3, positive >3) across associated tastes.

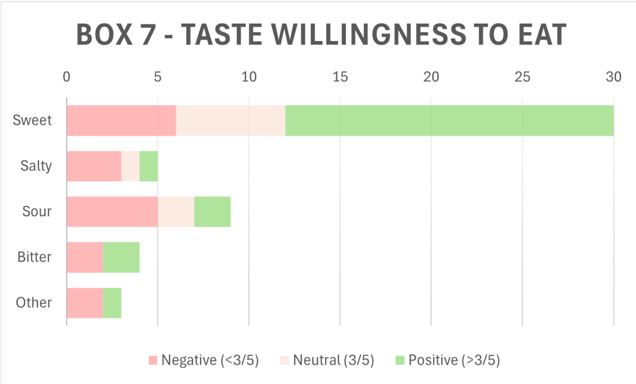

Figure 17: *Gooey jelly* (B7) willingness to try ratings (negative <3, neutral =3, positive >3) across associated tastes.

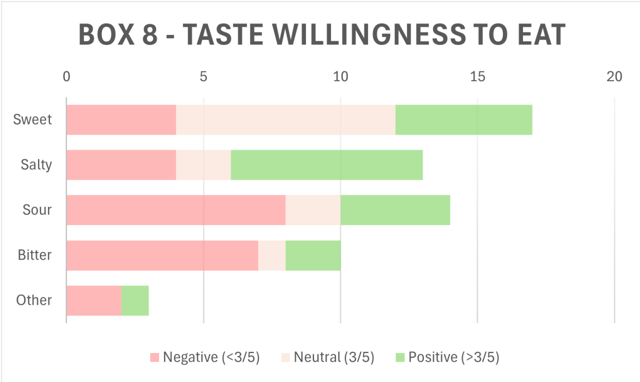

Figure 18: *Stringy slime* (B8) willingness to try ratings (negative <3, neutral =3, positive >3) across associated tastes.