The Effect of Multi-Sensorial Interface on Food Familiarity and Willingness to Try

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Food decisions are heavily influenced by the incipient exposure to its sensory attributes, the emerging vision, smell, sight, or even the touch before consumption. Engineers and designers have introduced a multisensorial methodology to digitally transmit sensory cues to human understanding. However, the technology is limited in replicating unique human sensory indicators, and the aversion of intervening in traditional food practices with novel technologies is known to impede its integration in everyday life. This study incorporated multisensorial technology into a device used for daily food selection: a self-ordering kiosk machine. It constructed a sensory design framework through an exploratory workshop and established a prototype of the framework. In an experiment with public participants, including those with 'food neophobia,' the fear or rejection of unfamiliar foods, to test how they perceived a novel food item upon multisensorial interactions, participants regardless of their characteristic displayed significantly increased levels of familiarity. We also found that the multisensorial interface recorded statistical significance in willingness to try, overall satisfaction, and post-food familiarity. The findings explain how multisensorial interactions elicit positive results on novel items and suggest that such tools can effectively educate and familiarize people with food products.

CCS CONCEPTS**: • Human-centered computing → Empirical studies in HCI; Ubiquitous and mobile computing design and evaluation methods; • Social and professional topics → User characteristics;**

Additional Keywords and Phrases: Multisensorial interface, experimental study, food neophobia, human-food interaction

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1 INTRODUCTION

Eating is the most multisensorial experience that the human race has practiced in its entire existence. It is multisensorial not only because of the multiple senses involved in ingesting the food but because its perceived flavor is also highly sensory dependent [1]. Flavor is a unitary multi-modal output of visual, olfactory, auditory, somatosensory, and gustatory interactions that emanate from the human central nervous system [2], so that all senses, not only taste, should be considered in food and perception. To decide what to eat largely depends on the repeated training of the brain to remember the particular taste [3] associated with the smell, touch, sound, and vision, and even the past emotions, all of which are unconsciously performed and rely entirely on inherent senses and practiced experiences.

Evidenced from such a natural series of trainings, familiarity is more intensely related to food preference [4] than most people would think. Through countless exposures to foods such as tomatoes and oranges, we become accustomed to and accept the food, trained for a lifetime that such food gives stability and familiarity, continuously choosing these items for consumption. Without exposure, it is likely that the food would remain unfamiliar, making it harder to be accepted and chosen to eat. Thus, those who exhibit a strong aversion toward unfamiliar or novel foods are 'food neophobic' [5]. People with such inclination require immense efforts and motivations to try certain foods, leading them to engage in different strategies for alleviation, such as hands-on activities, social facilitation, and sensory or nutrition education [6]. These programs are often conducted for periods of time. The biggest challenge for food neophobics is the initial trial. Recent studies claim that a sensory exposure with 'non-taste' properties can be an effective way to initiate the trying of certain foods [7,8]. Thus, it is worth finding out whether simple sensory exposures prior to a tasting experience are viable in everyday experience and whether this alone can induce the willingness to try.

Similarly, but with a different purpose, engineers and designers are currently manipulating sensory expectations [9] to remotely manifest certain sensory properties or to amplify hedonic senses felt from the experience [10]. Such an attempt is diverging into more advanced forms in the Human-Computer Interaction (HCI) community as multisensorial integration, such as a cocktail utensil that stimulates virtual flavor sensations [11], color-recognizing interface for the visually impaired [11], and taste-stimulating gustatory digital games [13], revealing that multisensory experiences, compared to unisensory ones, elicit more emotional and affective experiences as a whole [14,15].

Nevertheless, integrating multisensory technologies into daily lives seems far-fetched. Technologically manifesting the complex chemical and physical senses in a world dominated by audio-visual interfaces is intricate and questionable for an immediate operation [16]. Further, whether researchers can 'design' human senses for a complete, multisensorial experience is still yet to be discovered, despite its known values. Both for an immersive and cognitively enhanced experience in HCI, and for a heightened familiarity with novel items in the psychology and nutrition field, research testifying to the feasibility of a multisensorial everyday interface serves meritable significance. Therefore, this study primarily sought to explore the viability and acceptance of a multisensory interface. We assessed whether 'designing' the four human senses is achievable through a design workshop. We incorporated our design into an everyday kiosk interface and analyzed the statistical and experiential results from the public testers, including the food neophobic. The contributions of this study are as follows:

- It empirically designed human's four senses—vision, smell, sound, and touch—of a certain food item through a sensory workshop.
- It designed a multisensorial kiosk interface that could be incorporated and implemented in everyday situations.
- Through an experiment on general public, including those with food neophobia, it compared three types of interface that differed by the number of infused sensory stimuli.

- It analyzed public reactions and their level of familiarity with an unknown food according to each type of sensorial interface.

2 RELATED WORK

2.1 Eating as a multisensorial activity

Taste, not only categorized as the basic sweet, salty, sour, or bitter, is defined after a synthesis of sensory information from our brain. In fact, taste does not exist alone, as most times, it occurs within a flavor, which is essentially 'in the brain' [17]. This is often overlooked, as it is thought that taste dominates the flavor, when in fact, the smell, touch, and vision synthesize an outcome [2] before the perception that results in the flavor that we think we know. Reliance on these non-taste sensory elements is especially powerful before the consumption of food; physiological organs gather sensory input, and the brain generates expectations based on memories and impressions of the food [3, 18]. Along with such mechanisms, emotional and affective experiences are also deeply associated with the final judgment [19], which is especially related to smell and touch attributes, leaving the entire 'tasting' experience a whole, cooperative, and sensory-interactive journey rather than independent. Cooks and food scientists have long adapted to the theory and paid special attention to 'designing' non-tasting elements of the food that can not only induce customers to try the food but also assess it satisfactorily.

Unlike in restaurants or specific eating environments, however, manipulating sensory elements is not considered to be within an easy reach. In remotely describing the taste, advertising a food product, or arranging digital food-related programs, there have been the limitations of not being able to accurately deliver different notes of the smell, the taste, or the flavor [20]. Previously, food marketing or illustrations had focused on delivering the taste attributes through audio-visual methods, so that humans have no choice but to rely on the sound, vision, and past experiences to generate expectations and a judgment [16]. This gap is worth tackling, as each experience in life is hardly unisensory [21]. Beyond eating a sandwich, walking through the woods, looking at the rain, or reading a magazine involves more than one sensory cue to make that experience memorable. The power of multisensory integration is already justified and needed, making it a desirable topic in many interdisciplinary fields.

2.2 Food familiarity and neophobia

Familiarity is a cognitive concept that most people like what they know [4]. Novel stimulus provokes fear and avoidance in all organisms, leading to a natural discomfort toward unfamiliarity [22]. Being familiar is a powerful condition in decision making. In psychology, the familiarity heuristic contributes significantly to day-to-day decisions [23]. Conversely, mere exposure is a term coined by Robert Zajonc to describe repeated exposure to a novel item that can result in an improved preference. Simply exposed to a stimulus, namely one of the sensory stimuli, humans make the judgment without the cognitive process or conscious awareness. Mere exposure also affects the liking of edible substances, proposed by Pliner in 1982 [24, leaving 'food familiarity' an important factor in acquiring food preferences. Familiarity derives from either visual familiarity, flavor familiarity, or knowledge familiarity [4,25], which ultimately serves as the reason to eat or not to eat novel food items.

Those who present repulsion toward unfamiliar foods are food neophobic [5, 26]. Food neophobia is often linked with predilection toward 'effortlessly liked' and energy-related tastes (e.g., sweet and fatty) [27], low sensation seeking, less joy when consuming foods, and lower quality of diet [28,29,30]. It is considered a normal developmental stage for young children, and the intensity dilutes into adulthood; however, many have been reported to be neophobic even after full growth. This can ultimately cause nutritional problems, such as nutritional imbalance and obesity, when prolonged. The scale to

assess food neophobia is the food neophobia scale (FNS) designed by Pliner and Hobden [28], and to rate the acceptance of a novel food is typically the *willingness to try* [31].

2.3 Sensory exposure

The exact mechanisms or an optimal solution for food neophobia have yet to be discovered, but it is almost clear that food familiarity has a direct relation to food preference [4,32]. Mere exposure was used primitively to increase familiarity, but through time, it has been proposed that a more complicated and intentional approach is needed, such as hands-on activities like cooking, gardening, nutrition education [33,34,35], and sensory classes, such as the Classes du goût [36]. Another emerging tactic is exposure to non-taste sensory attributes, which accentuate the manipulation of elements unrelated to tasting [7,8]. Without invoking the distress of trying the food, prior exposure to non-tasting introduction leads to a smoother transition and a higher willingness to try [37], especially given that the hardest trait in food neophobia is to get to try the food [38,39].

The management of food neophobia is usually long-term; however, considering that adults too can be neophobic with less time for an adjustment, and that it requires direct face-to-face contact for implementation, a practical strategy used 'at a distance' could be a more inexpensive and less time-consuming option for many people. Such a notion has been proposed since 1997 [40], but the attempt to reduce neophobia and increase familiarity with certain foods for all people, not just a few who can afford the strategy, is yet to be adapted in real life. Especially in contemporary society, where services and businesses are transitioning to online and maintaining social distance [14], and food industries are adapting to environmental change with different forms of food sources [41], a new type of eating behavioral approach is needed for all. Thus, finding an effective and practical solution for food neophobia could be a way to adapt the general masses to newly emerging food sources, such as edible insects, cultured meat, or other foods that the majority express discomfort trying and are unfamiliar with [42]. Tackling food neophobia is not only a task for fussy or picky child eaters but could also be about preparing for larger groups of people in the future. Hence, it is worth finding out whether simple sensory exposures prior to a tasting experience are viable in everyday experience and whether this alone can induce the willingness to try.

2.4 Multisensorial approach in HCI

While sensory management in food psychology primarily aims to induce certain behavioral changes, multisensory research in HCI has centered on enhancing hedonistic experiences. Multisensory design is an attempt to consider human senses with a design approach for a fuller user engagement or an immersive experience [13,43] using the five basic senses: touch, taste, hearing, sight, and smell. Velasco et al. [44] designed sonic systems with a multisensory framework to enhance food and drink experience, sharing the importance of congruency of senses in such an approach. Wearable olfactory interfaces to exude scents in daily spaces [45, 46] and a straw-like interface [47] that sends vibration signals for real-life eating sensations are noteworthy everyday multisensory integrations. Several researchers have proposed a multisensory integration in virtual reality. For example, Narumi [48] observed pleasure levels and augmented flavor mechanisms with VR techniques. Ranasinghe et al. [49] constructed a digital flavor device that simulates five different flavors. To some extent, many scholars are also looking into multisensory interventions assist human functioning and providing guidance. For instance, Kerdegari et al. [50] attempted to shape 'tactile language' by commanding navigation through tactile sensations, and Beker et al. [51] discovered the opportunity to use multisensory processing as a remediation strategy for early autism spectrum disorder [51].

In human–food interaction, as food is around every moment of people's lives and influences not only oneself but countless others [52], its design space and meaning need to be meticulously addressed. While the field is still in its early exploration stage, the central task is to reconcile interactive and innovative technologies with traditional food practices [14, 53]. Besides the evident technological limitations to fully represent human senses in digital interfaces, user acceptance of many evolving technologies is another issue to consider. Cattaneo et al. [54] posited that while food technologies are rapidly evolving, food technology neophobia has now arisen, and time may be needed to evoke positive attitudes from the public. This may also apply to new technologies related to trying unfamiliar foods, which is a vital theme to challenge if we are to successfully achieve a way for the public to handle future food sources and technologies, as mentioned earlier. Since food is certainly an integral and physical part of lives, technology should be carefully and affectively embraced with design, and studies should gradually explore their interactions with the public.

To date, no research on multisensory interface has been conducted with the public on an everyday device such as a self-ordering machine. The primary research question is whether it is possible to obtain sensory mappings through a sensory workshop, to integrate multiple sensory attributes to a day-to-day device, and to familiarize the public about a novel food item with the proposed interface. The central structure of this research consisted of two parts. First, an exploratory workshop was designed to formulate sensory attributes from which the results and requirements were gathered thereafter. Second, an experimental study on the public was conducted with the devised prototype. We then performed quantitative and qualitative analyses with the collected data. In later sections, we share both significant and insignificant results and suggest ponderable discussion points.

3 EXPLORATORY WORKSHOP

One of the commonly addressed challenges of multisensory design is how to determine the sensory modalities for the design. There is currently no concrete framework for the design of human senses and their incorporation into technologies; designing such a framework is akin to shaping the intangible. The purpose of this workshop was to generate a sensory framework based on the literature by extracting sensory requirements and exploring whether the transmitted sensory cues can be utilized for multisensorial interactions.

3.1 Procedure

In this workshop, a design framework and corresponding worksheet were produced through a specific literature review. In previous studies, some noteworthy attempts to frame sensory cues into design include the synesthesia-like mapping method Jeon [55] applied as a perceptual process to visualize different tastes, or the study that explored which sounds matched the taste of the wine in an attempt to capture hedonically pleasing sound attributes [56]. Further, efforts to constantly iterate and ask for the professionals' insights have been ubiquitous, such as in multisensory visual arts [57]. Collectively, we noticed that the sensory modalities were chosen by the consensus of a group of people, and they were instinctively understandable. Given this, a sensory worksheet was created by integrating the previously known theories regarding improving certain hedonic properties of a food, proposed factors for enhancing food familiarity, and basic notions on sensory exposure and education. Justifications used to create the worksheet and their properties are jointly provided in Table 1.

3.1.1 Choosing the Unfamiliar Item

An unfamiliar food item was to be selected from which the sensory attributes were designed at the workshop and used as the input variable in the subsequent experiment. It was important that the food item was novel and commonly perceived

as ‘unfamiliar’ to the public, and preferably even unappetizing at first glance. Recalling that food neophobic populations show classic dislike toward bitter or pungent tastes than adventurous people [58], a bitter, peppery, aromatic condiment called turmeric was selected as the main ingredient. Turmeric is often used in Asian cuisines [59] but rarely in Korean foods and drinks, despite its known antioxidant and anti-inflammatory activity and potential health benefits in heart and cancer [60]. Novel drinks, such as a ‘turmeric latte’ that is made out of turmeric, cinnamon, honey, ginger, and milk, make an excellent source of antioxidants and a great sugary drink replacement. Especially when sugary drinks are becoming a severe risk behavior factor in obese and non-obese individuals both in South Korea and other countries [61, 62, 63], it is worth exploring whether multiple sensory exposure can improve familiarity and willingness to try on this novel healthy food item.

3.1.2 Workshop Flow

Two design majors and two food and nutrition majors who have no food allergies to the item and its ingredients—turmeric, cinnamon, honey, ginger, and milk—were recruited for the workshop. They were engaged in one session each, two people at a time, and spent around 45 to 60 minutes completing the worksheet. As shown in Figure 1, participants filled out the worksheet after seeing, hearing, smelling, touching, and finally tasting the ingredient one by one. They were told to ‘heighten’ their senses and were asked to taste ingredients at least three times for an accurate representation. Between each tasting session, they were asked to drink a cup of plain water and proceed with successive ingredients. Although the worksheet mainly required textual representations, they were encouraged to draw diagrams and images and use colorings when needed.

Table 1: Workshop buildup framework

	Vision	Sound	Smell	Touch	Taste
Justification	Mere visual exposure, Shape-taste congruency, Color-taste congruency, Typography affectation	Mere sound exposure, sound-taste congruency (eating or food sound), music stimulation	Mere smell exposure, smell-taste congruency, semantic congruence, Learning the origin	Variety of food texture exposure, temperature, shape congruency	Taste description and recognition
References	[19, 22, 23, 64, 65]	[37, 66, 67, 68]	[69, 70, 71]	[35, 71]	[37, 72]
Modalities	Color, shape, typography, imagery	Food sound, origin sound, associative music	General smell, origin smell, imagery	Temperature, texture, shape-feel	General taste, pleasure, imagery

Figure 1: The sensory workshop conducted in the study.

3.2 Results

After the participants completed all workshop sessions, modalities were collected and organized according to the design requirements. Overlapping ideas were placed as the priority modalities, and the rest were referred at the last. Concerning the small scale of participant data, manual text and image analysis was conducted. Appropriate modalities were chosen as the visual, auditory, olfactory, and tactile stimuli, while the gustatory implication was only used as a referral point. The decided modalities and design requirements are shown in Table 2. These requirements were subsequently incorporated into the prototype interface and tested out on the public.

Table 2: Complete summarized modalities and design requirements

	Senses	Turmeric	Cinnamon	Honey	Ginger	Milk	Product
Design Requirements	Vision	Indian, forest-like background, dried flowers, cursive typeface	Woods background, old typeface, brittle, grainy, textured layer	Sparkly and hexagonal beehive, gooey syrup, sap dripping from beehive, dripping typeface	Asian-themed typeface, mountains and soil background, wind	Thick and liquid-like impression, bubbly and round typeface, green pasture with blue sky	Bright neon yellow, gluey popping image
	Sound	Native music, vibrations	Wooden sound, jazz, hollow sound, hard tree	Buzzing sound, sticky and dripping sound, warm sweet music	Oriental music, damp sound, windy and stompy	Splish splash, cow mooing, plump, liquid pouring	Splashing and boiling sound
	Smell	Turmeric smell	Cinnamon smell, cinnamon roll	Honey smell	Gingerbread smell, chopped ginger	Fresh milk smell	Sweet milk-like, aromatic smell
	Touch	Powdery, thin, and sandy	Rough and barky	Sticky and gooey	Damp, wet yet hard	Smooth and slimy	Round, hard, soft gushy

4 EXPERIMENTAL STUDY

Sensory attributes extracted from the workshop were incorporated into devising a multisensorial interface. The following study centralized in discovering and analyzing the emerging reactions from novel food encounters through a multisensorial interface, and to what extent of its effectiveness in familiarizing participants with the food. The primary goals of this experiment were to assess whether the multisensorial interface could be accepted by the public, to observe the general

perceptions of both the food and the interface design, and to analyze its effects in terms of participant food familiarity and willingness to try the novel item. After prototyping the interface on an appropriate device, the experiment was conducted on public participants with a questionnaire and subsequent interviews.

4.1 Apparatus

4.1.1 Self-ordering Kiosk

The multisensorial modalities of a novel food item were devised on a kiosk machine. An interactive kiosk can be incorporated into any service and industry to provide a convenient and easy-to-use service [73] without face-to-face, employee assistance. Ordering from kiosks is one of the rare moments when the food experience meets technology on a daily basis. Amid the COVID-19 pandemic, self-ordering kiosks have become even more ubiquitous in many restaurants and cafés to enhance social distancing [74], resulting in many customers using them almost daily. Thus, it was logical to leverage the interface in an experiment on how an unfamiliar food item can be commonly used and well-accustomed to daily life with the use of a novel technology. Therefore, a multisensorial interface was developed into a kiosk machine to emulate the casual scenario where a person encounters and picks a food item from the kiosk screen.

4.1.2 Three Interface Variations

On-screen interactions of the multisensorial kiosk consisted of the following: the menu name, the menu picture, and the purchase button. Another unique property was the item's ingredient exposure, complying with previous studies [33,75] that indicated food neophobics would respond better when they learned about the food ingredients and not only the product. Here, each ingredient could be selected and was accompanied by interactive sensory stimuli: touch, smell, vision, and sound. Although the study focused on the interactive behavior and the perceptions stemming from a multisensorial interface, it placed two additional independent variables for comparison: control and audio-visual interfaces. The control interface represented a typical menu ordering interface, displaying the menu name, menu picture, menu price, and a purchase button. It did not, however, reveal the ingredient list and contained non-visual sensory stimuli. Prior to comparing the results from the control and multisensorial groups, to investigate whether the two regularly used sensory attributes (auditory, visual) and ingredient exposure alone had familiarizing capacity on the users, an audio-visual interface was also created. The audio-visual interface had identical on-screen interactions as those of the multisensorial interface—ingredient exposure and corresponding visual and auditory stimuli—but it lacked olfactory and somatosensory stimulation.

4.2 Implementation and prototyping

The control, audio-visual, and multisensorial visual interfaces were all prototyped via Framer prototyping tool; examples are shown in Figure 2. Ingredient exposure was staged as the users from either the audio-visual or multisensorial group selected each presented ingredient, which then activated the designated sensory stimuli (audio-visual only, or all four stimuli). The audio stimulation was transmitted through embedded speakers. To implement olfactory modalities, fragrance oils from Nature In Flavor Co., Ltd. were utilized to match each ingredient's smell attributes, which were then diffused by planting an Arduino humidifier module (see Figure 3). Tactile stimulations were formulated through modeling clays, resin, and appropriate ornamental components, each fixed with a tact switch attached to the pertinent ingredient.

Figure 2: Examples of Visual Interactions of Interfaces: (a) Control (b) Audio-visual (c) Multisensorial.

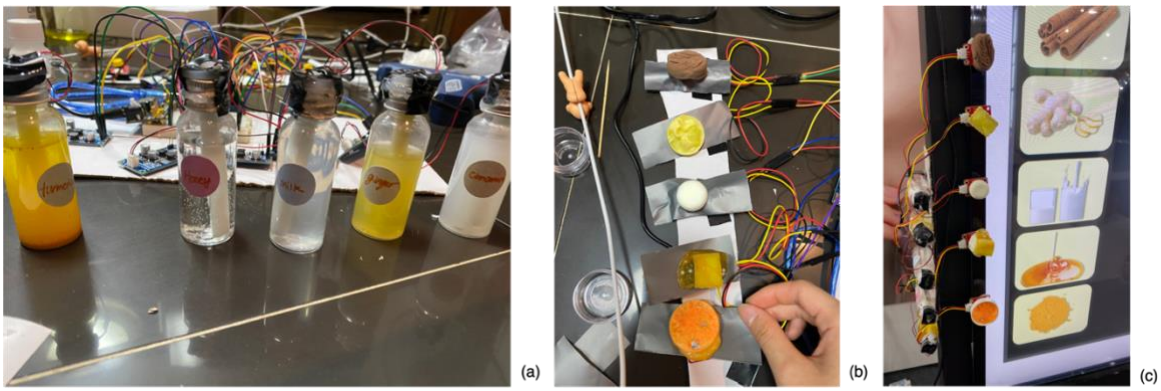

Figure 3: Multisensorial Composition: (a) Olfactory mechanism (b) Tactile mechanism (c) Interface implementation.

4.3 Study design

The experiment was a between-subject design, consisting of three experimental conditions according to the interface type (control, audio-visual, multisensorial). The experiment was situated in a local expo in South Korea, an open space with guests visiting the expo for sight-seeing. A kiosk machine was installed at a booth that permitted the conduction of the experiment. As all interfaces had distinct installation processes, only one type of interface was installed a day. The experiment was conducted for nine days, and each interface was tested three times at two-day intervals. All participants during the nine-day experiment had a common interest in visiting the expo and were unaware of the conduction of the experiment upon their arrival. Out of the visiting crowd, those who read the booth sign that asked them to evaluate a newly launched latte drink and wanted to participate were included in the experiment. These participants randomly joined one of the three experimentation conditions, according to the day they visited the booth. They were given rewards at a suitable price after the experiment. Figure 4 showcases some of the images from the experiment.

4.4 Study procedure

After entering the booth, participants were told that they were to evaluate a drink called ‘turmeric latte’. They were then asked to complete a three-question questionnaire on their baseline familiarity with the drink, liked tastes, and disliked tastes. The presented questions were “How much do you know about a turmeric latte? (6-point Likert scale)”, “What tastes do you normally prefer?” and “What tastes do you not prefer?” (both questions had choices of sweet, salty, bitter, sour, and spicy). After the experiment, participants were given out a post-experience questionnaire on the endline familiarity,

satisfaction level, and willingness to try the drink. The presented questions were: “How much do you know about a turmeric latte?”, “How satisfied are you with the experience? (5-point Likert scale)”, and “How much would you like to try the drink? (5 point-Likert scale). These questions were statistically analyzed. Participants were asked to complete emotional adjective assessments by choosing any of the 16 words describing the interface and 18 words describing the expected taste. They were also asked to rank the perceived senses (vision, sound, smell, and touch) by intensity. Last, they completed the FNS questionnaire (7-point scale, 10 items) and submitted their responses with their gender and age. Complete questionnaires are provided in Appendix A1. After signing a consent form, the respondents participated in a semi-structured interview that was mainly composed of three parts: general kiosk experience, interface impressions, and perceived drink impressions.

Figure 4. Some participants are trying the audio-visual and multisensorial interfaces of the turmeric latte.

4.5 Participants

There was a total of 91 participants (female = 58), of which 32 were the control, 26 were the audio-visual, and 33 were the multisensorial groups. The age of the participants varied between 4 and 70 years old, with a mean of 33±14.8 years, 34±15.9 years, and 31±16.7 years old in respective groups. Out of them, 47% (n = 43) exhibited food neophobia, knowing a score of 38.6 or above is considered neophobic. The mean FNS score was 37.6±9.9; 38.6±11.2 (FN = 16) in the control group, 37.4±8.4 (FN = 13) in the audio-visual group, and 36.7±9.8 (FN = 14) in the multisensorial group. Lastly, 66% (n = 61) of the total sample showed a preference for sweet taste, while 46% (n = 42) showed a dislike for bitter taste.

5 RESULTS

5.1 Quantitative analysis

Prior to conducting the statistical analysis, the Shapiro-Wilk test was used to verify the normality of distribution. Afterwards, two paired measurements on food familiarity were completed through paired t-tests, and group comparisons were conducted with one-way analysis of variance (ANOVA). Statistical significance was accepted at $\rho \leq 0.05$ and the analysis was performed using XLSTAT software (XLSTAT 23.4.1, Addinsoft, NY, USA).

5.1.1 Food Familiarity

The baseline results showed that most participants in all groups were unaccustomed to the food item, showing an overall mean of 1.5±1.0 out of 6. After conducting paired t-tests on food familiarity baseline and post-experiment endline data, statistical significance was achieved from audio-visual and multisensorial groups. While the control group had no statistical significance in the improvement of food familiarity (ρ = 0.091), the audio-visual group presented a significantly high improvement of food familiarity (ρ = 0.001), and the multisensorial group had a significantly high improvement of food familiarity (ρ <0.0001).

The food neophobic participants showed improved familiarity with the audio-visual (ρ = 0.010) and highly improved familiarity with the multisensorial interfaces (ρ <0.0001). Interestingly, non-food neophobic participants showed moderate familiarity improvements in the control interface (ρ = 0.034) and in the multisensorial interface (ρ = 0.011). However, given the relatively smaller size of the sample grouped by neophobic characteristics, the results may be less valid in terms of its degree of improved familiarity among these fragmented groups. The collective representation of food familiarity levels is shown in Table 3.

Table 3. Mean differences of food familiarity in control, audio-visual, and multisensorial groups among the entire sample, food neophobic, and non-neophobic participants

Category		Baseline	Endline	Difference	t-value	ρ-value [a]
Interface	Characteristic	Mean(±Std. D)	Mean(±Std. D)			
Control	FN [b] (n = 16)	1.5 (1.2)	1.8 (1.2)	-0.250	-0.620	0.544
	NFN [c] (n = 16)	1.5 (0.9)	2.1 (1.1)	-0.563	-2.334	**0.034***
	Total (n = 32)	1.5 (1.0)	1.9 (1.1)	-0.406	-1.746	0.091
Audio-visual	FN (n = 13)	1.2 (0.6)	2.7 (1.7)	-1.462	-3.075	**0.010***
	NFN (n = 13)	2.3 (1.5)	3.1 (1.6)	-0.769	-2.034	0.065
	Total (n = 26)	1.8 (1.3)	2.9 (1.6)	-1.115	-3.651	**0.001****
Multisensorial	FN (n = 19)	1.4 (0.7)	2.9 (1.7)	-1.571	-2.956	**0.011***
	NFN (n = 14)	1.5 (1.0)	3.4 (1.8)	-1.947	-5.628	**<0.0001****
	Total (n = 33)	1.4 (0.9)	3.2 (1.7)	-1.788	-6.008	**<0.0001****

[a] *$\rho < 0.05$, **$\rho \leq 0.001$

[b] Food neophobic participants

[c] Non-food neophobic participants

5.1.2 Willingness to try. Satisfaction Level. Post Food Familiarity

A one-way ANOVA was performed to compare the effect of each interface group on willingness to try, satisfaction level, and food familiarity (post-experiment). The results were then checked under post-hoc comparisons for the significant mean values. ANOVA showed that there was a statistically significant difference in the willingness to try the novel item between at least two groups (F(2,88) = [4.663], ρ = 0.012). Tukey's HSD test for multiple comparisons revealed that the multisensorial interface elicited a greater intent to try the food than did the control interface, with a significant difference (Tukey's post hoc test ρ = 0.009, 95% C.I. = [0.190,1.631]). We did not observe significant differences between the multisensorial and audio-visual interfaces (ρ = 0.597), or between the audio-visual and control interfaces (ρ = 0.154), supporting that the mean difference between the multisensorial and control interfaces was significant.

A significant difference was also recorded at the satisfaction level. The ANOVA results uncovered that there was a significant difference in the level of satisfaction between certain groups (F(2,88) = [4.409], ρ = 0.015). Tukey's HSD test showed that the mean value of the satisfaction level was significantly different between the multisensorial and control

interfaces (Tukey's post-hoc test ρ = 0.011, 95% C.I. = [0.172,1.571]), indicating that the participants from the multisensorial group had better experiences than those from the control group. However, there were no significant differences in the mean values of satisfaction between the multisensorial and audio-visual interfaces (ρ = 0.354), or between the audio-visual and control interfaces (ρ = 0.337).

Finally, significant differences in post-food familiarity were obtained between at least two groups (F(2,88 = 6.346, ρ = 0.003). Tukey's HSD test revealed that there were highly significant differences between the multisensorial and audio-visual interfaces, each compared to the control interface (Tukey's post hoc test ρ = 0.002, 95% C.I. = [0.403,2.208], ρ = 0.045, 95% C.I. = [0.018, 1.939], respectively). The multisensorial and audio-visual interfaces did not have a significant difference in terms of post-food familiarity (ρ = 0.693). The means and standard errors of the three dependent variables from each sensorial group are shown in Figure 5.

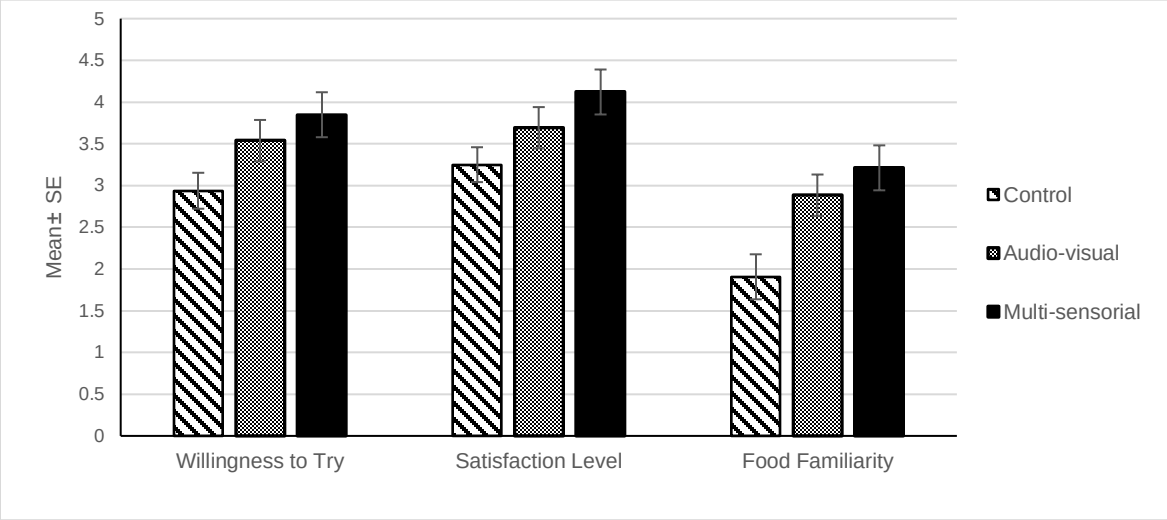

Figure 5. Overall Willingness to Try, Satisfactions Level, and Post-food Familiarity Means±SE

Separate one-way ANOVA analysis conducted among the food neophobic and non-neophobic groups revealed that the food neophobic participants presented a significant difference in willingness to try (F(2,40) = [6.546), ρ = 0.003), but not in satisfaction level (ρ = 0.150) or post-food familiarity (ρ = 0.101). By contrast, participants who were not neophobic exhibited significant differences in satisfaction level (F(2,45) = [4.082], ρ = 0.023) and post-food familiarity (F(2,45) = 3.608, ρ = 0.035), but not in willingness to try (ρ = 0.742). The ANOVA results on willingness to try, satisfaction level, and post-food familiarity according to the food neophobic, non-neophobic, and whole groups are summarized in Table 4.

Table 4. ANOVA results of willingness to try, satisfaction level, post-food familiarity per group

	Characteristic	N	Mean	Std D.	ANOVA F	ρ-value [a]	HSD contrast [b]
Willingness to Try	FN	43	3.2	1.34	6.546	**0.003***	MS vs Control
	NFN	48	3.6	1.18	0.300	0.742	MS vs Control
	Total	91	3.4	1.27	4.663	**0.012***	MS vs Control

Satisfaction Level	FN	43	3.6	1.30	1.989	0.150	AV vs Control
	NFN	48	3.8	1.16	4.862	**0.023***	MS vs Control
	Total	91	3.7	1.23	4.409	**0.015***	MS vs Control
Food Familiarity	FN	43	2.4	1.61	2.434	0.101	MS vs Control
	NFN	48	2.9	1.61	3.608	**0.035***	MS vs Control
	Total	91	2.7	1.61	6.346	**0.003***	MS vs Control / AV vs Control

a $*\rho < 0.05$

[b] Tukey (HSD) contrast between categories with a confidence interval of 95%

5.2 Qualitative results

Qualitative analysis was performed on the full interview data after transcription, emotional adjective assessment, and the ranked sensory intensity. The data were then sorted and coded through thematic grouping using Atlas.ti software (Atlas.ti Scientific Development GmbH, Berlin, Germany). The findings were first on the general impressions before the experiment, holistic findings on the reasons for trying or not trying the drink, and separate inquisition on each interface and perceptions on the experimental drink.

5.2.1 Initial Thoughts and Feelings

Overall, 72 out of 87 interviewed participants answered that they used the kiosk system frequently and that they were comfortable using it. With the turmeric latte, however, they were not so comfortable. As witnessed from the quantitative analysis, the mean baseline familiarity of the drink was 1.5 out of 6, regardless of the later-encountered interface. It showed that most participants equally agreed that the drink was simply unknown. Prevailing emotions toward the drink were discomfort, confusion, and unfamiliarity. Participants showed strong detest toward the fact that they simply did not know the drink (unfamiliarity) and the uncertainty and distrust emerging from it. They expressed that the drink and its name were not self-explanatory; it was hard to imagine the taste and identity of the drink. To the question 'What do you think of a drink called turmeric latte?', most responded, "I do not know." One participant commented:

> "Isn't latte supposed to be soft and sweet? With milk or coffee? It just seemed like turmeric will go nowhere in between, because it's probably some kind of herbal plant." (participant (p) 20, audio-visual)

Similarly, utter discomfort came from the unimaginable properties of the drink. The participants exhibited strong rejection toward the 'inconsistencies' of the ingredients; the word combination of turmeric and latte seemed to have repelled them from accepting it. Many pictured the food curry, as that is the only food that they were familiar with when they thought of turmeric, in a desperate need of picturing what it would taste like. The majority also perceived it as being somewhat healthy. Participants responded that the ingredients would not harmonize but instead conflict with each other; one answered:

> "Turmeric for me has a notion that is strong, with strong smell and everything. It will definitely not go with milk… and all I can think of is curry and just cannot imagine the taste at all." (p. 13, control)

Therefore, it seemed that later perceptions of each assigned interface significantly depended on how much their perception could shift to a more positive one. Since it was equally agreed that the drink was unfamiliar and had mostly negative connotations with clear reasons, it was important to determine how much the interface could transition their impressions and thoughts while improving familiarity.

5.2.2 Reasons to Try or Not to Try

After participants had experienced the interface, those who rated the willingness to try at two or one were asked about the reasons for not trying the drink, while those who rated it at three or more were asked about the reasons for trying. After coding the interview results, we found that a general tendency and reasons to try the drink were prevalent in the audio-visual and multisensorial groups after their experience, while reasons to dislike and not to try the drink proliferated in the control group. All groups had their own reasons for trying or not trying, but the frequency of the occurrence varied. It was clear that the core trigger and substance that promoted the willingness to try was the degree of familiarity. If the initial unfamiliarity remained and prolonged, participants were likely to be unwilling to try, whereas if the familiarity was eventually improved or if marginal familiarity existed from the beginning, they were more willing to try. Other key factors to determine the intent to try were the perceived sweetness, the coherency (of the drink and sensory experience), suitability to one's liking, and capacity to stir curiosity. Meanwhile, other factors for not trying were the perceived bitterness or strong tastes, the discordancy (between ingredients), unsuitability to one's liking, and raging discomfort. The reasons for not trying are consistent with those in the existing research by Pliner regarding reasons for disliking novel foods: appearance, dislike, idea, and unfamiliarity [76]. There were also reasons that contain duplicity, the double-sided factors that were both the reason for trying or not trying. Perceived healthiness and visual trigger of the drink are such factors.

Looking 'healthy' had duality; it was a negative indication when the participants ended up not liking the drink, and a positive connotation when the participants liked to try the drink. Most participants perceived the drink as healthy in their first encounters. Participants who did not like to try the drink had this initial perception maintained as the main characteristic of the drink and nothing else. For those who were not fond of the drink, healthy meant 'not tasty', especially for younger populations. By contrast, those who liked to try the drink had this perception switched to thinking the health benefit was actually a bonus factor, given they already acquired a general liking toward the drink. It is possible that if the initial unfamiliarity was not resolved, the healthiness would have remained a negative factor, whereas if it gave out a positive impression, it became an additional reason to justify their liking. A participant who did not perceive the drink as suiting his liking said:

> "It looks like a drink made to serve health benefits… you know those drinks with lots of herbal ingredients and are for older people to drink… it may be good for health, but that's it. You know it won't taste good." (p. 12, control, male age 30)

Meanwhile, participants who came to like to drink had different implications for its health benefits:

> "It would taste sweet and will suit my liking. And, on top of it, it's healthy, so I guess it's a bonus." (p. 8, multisensorial, female age 12)

> "I would taste it. I see all other ingredients are healthy too, and some will taste sweet. The taste? It will be sweet with a mix of other tastes..." (p.16, audio-visual, male age 61)

Another factor that presented duality was the visual trigger, but it primarily differed according to the characteristics of the people, not so much the interfaces themselves. The visual trigger included the color, shape, and picture of the turmeric latte that was used on all three interfaces. The picture contained turmeric latte in a glass, which is bright yellow and slightly bubbling up. Some perceived it as familiar by linking their knowledge with banana milk, imagining the taste to be soft and sweet assuming they have similar colors. Nonetheless, some perceived it as displeasing, thinking the color makes it taste curry-like and not harmonize with milk. Since most people only get to make visual assumptions about their encounter with novel foods, it was interesting to observe their initial impressions of the visual representation of the drink.

> "That picture doesn't quicken my appetite; it just looks… unpleasant and it reminds me of curry so I really can't imagine it in a drink." (p. 30, control, female age 24)

> "Well, I didn't expect the drink to have this color, which I think it's a lot prettier than imagined. It almost looks like a banana smoothie? Looks a lot more familiar to me now that I see the picture." (p. 18, control, female age 18)

5.2.3 Control Interface Item and Taste Perceptions

Participants in the control group agreed that there were barely any differences between the interface and previously used self-ordering kiosks and deemed them very similar. The participants did not have a significant increase in their food familiarity or statistical significance in their willingness to try or their satisfaction level. Witnessed from the interview results, most maintained their initial thoughts of uncertainty and unfamiliarity until after the experiment. Based on the control interface interaction (menu picture and menu name), the majority of participants answered that they would not purchase it if they were to encounter it at a café in real life. Only those who had answered they would order it and would like to try said the reason was that it was new, and that they liked to adventure most times. This was different from stirred curiosity, because it was the inherent audacity of the participant that drove them to want to try, and not because curiosity was sparked from the drink itself.

> "Reason I'd like to try? Well… because it's new. I like to take adventures so if it's new, I'd try it." (p. 11, control)

The participants also seemed to rely almost entirely on the visual image of the turmeric latte, since it was the only sensory stimulus provided, as with most of the kiosk interfaces at that moment. They made assumptions about the color yellow and its texture. Further, they tried to make connections with what they already knew about this food they had just encountered. For example, a participant took a guess that since it was made out of turmeric, it would be spicy and kind of bitter, and some made associations with familiar foods, such as banana and curry. Altogether, the visual assumption alone seemed to not have resolved their uncertainties, as most of them rated the drink unfamiliar after the encounter (familiarity mean score 1.9±1.1).

They also made assumptions based on their previous knowledge, trying to understand the qualities of turmeric. Most of them were acquainted with turmeric being a substance for making curry, and uneasiness was created from the apparent contradiction. Curry is usually a dish and eaten as a meal and not for dessert or a drink. Such an assumption caused a misunderstanding that the drink would taste like curry and therefore not perceived as attractive, when in fact turmeric and curry have very disparate tastes, and turmeric is only a part of many spices from which curry is made. They were greatly

repulsed by the inconsistencies between ingredients; with limited amount of information including that of sensory, to their understanding, turmeric and milk were incompatible:

> "I've heard about turmeric as an ingredient in curry… but I assume it's more for dinner and not for your drink? It could be spicy, but I really can't seem to imagine what it would taste like." (p. 4, control)

However, an interesting result was achieved when they were asked to rank the sensory stimulus by intensity; even though they were never exposed to any smell stimuli, they first ranked vision, smell, touch, and then sound. It was an implication that even when olfactory stimulation is not physically present, the brain acknowledges a food experience to be closely related to its smell, leaving it as second most intense after the visual stimuli. This implies that olfactory performance is instinctively in need when food is presented to humans.

According to the emotional adjective assessment, the most frequently used words to describe taste in the control group were indicated as 'unfamiliar (9),' 'new (9),' 'unpleasant (9),' and 'healthy (8)'.

5.2.4Audio-visual Interface Item and Taste Perceptions

The audio-visual interface enabled the exposure of ingredients through an interactive selection and exertion of corresponding visual and auditory stimuli. The interface consisted primarily of the menu image and name exposure, followed by the ingredients button, which allowed the participant to select and be exposed to its auditory and visual stimuli. Each assigned stimulation was designed according to the collected design requirements. Primarily, participants perceived the interface as simple, clear, and user-friendly, as it has a big interactive screen and ingredient specification only for one drink; however, this was an unexpected outcome of building an interface entirely for one drink and not for many, as in real-life cafés.

The ingredient exposure served great significance in moderating discomfort of not knowing. The participants said that when they noticed familiar ingredients from the ingredient list, they felt a stronger sense of comfort and perceived it as less familiar correspondingly. Such discovery resonates with the previous notion that familiar flavor principles increase willingness to try [29, 77]. Accordingly, the main difference noticed in this group was that a flavor description was enabled, unlike in the control, where participants had no choice but to assume from a very limited amount of information. Participants gave a more detailed thought on what the taste would be like and specific reasons they would try or not try the item. Meanwhile, a mixed set of feelings toward the drink was observed, as they could now understand the ingredient composition, yet were very confused on how they would synthesize into the latte. Participants showed uncertainties in that there were both 'strong and pungent' ingredients like ginger and turmeric, and 'appealing' ingredients like milk and honey, leaving a mixture of feelings reading from the screen. They could not get a grasp on whether the taste is more geared toward sweet, bitter, or in between, and some said it would be 'all kinds of tastes'.

> "Looking at the screen, I think the taste will be a lot stronger than I thought; it has ginger and then cinnamon… and has milk and honey to complement the tastes, but I think the others will be already too strong to be covered… so I expect the taste to be sweet at first, then bitter as it gets." (p. 21, audio-visual)

One of its key characteristics, auditory stimuli, was evaluated as unclear by most participants. Auditory modalities for each ingredient included the musical properties, food sounds, and origin sounds. However, it seemed that their impact on the perception of the ingredients was low. In fact, when asked to rank the senses by perceived intensity, they ranked sound at the very last, while smell and touch, which were not part of the presented stimuli, were ranked as second and third. Similar to the results of the control group, the ranking results indicate that the smell attribute is what is inherently in mind

during food decision-making. This may exemplify its relatively weaker impacts on the willingness to try and the satisfaction level than those of the multisensorial interface, as the participants were not given the 'right stimulation'. Participants commented that the sound served little assistance in understanding what the drink was, simply because the background noise at the expo was too loud for the sounds to be heard, but also because the visual stimuli alone were powerful and understandable to know what each ingredient was. In contrast to previous studies, where sonic stimulations were used to enhance the experience of tasting and improve hedonic experiences, such an attempt seemed to have a lower impact on improving familiarity. A participant responded:

> "Was there a sound? Oh, right. I think that the images alone convey the right information; the sounds were really supplementary than rudimentary." (p. 8, audio-visual)

Yet, some suggested further usage of the audio-visual self-ordering interface as a marketing tool to introduce new foods and to animate the menu selection procedure. The ingredient exposure certainly helped increase food familiarity, as shown by the mean post-familiarity (2.9±1.6). The distress for not knowing what the drink was seemed to have been alleviated through the ingredient exploration. Participants exhibited improved trust in the drink because of the increased familiarity:

> "Reason I'd like to try is because it looks sweet. It's not like I normally like sweet stuffs. But it's mainly because by at least knowing how it'll taste, my distrust toward this drink is lightened." (p. 9, audio-visual)

Nonetheless, despite the familiarity of other ingredients, some were still confounded by turmeric and its taste attributes and were repulsed even after using the interface. Some said it improved their understanding about the drink; however, since they were still very unaccustomed to the word turmeric, they would not want to try it. One participant also said he was even more confused after the experience, as he encountered other ingredients he did not expect. It seemed that they needed further trigger to want the drink other than mere ingredient exposure or be provided with other stimuli to synthesize the presented auditory and visual stimulations.

> "For me, the word 'turmeric' is really a put-off for a latte. After the experience, I now know what other ingredients are and what they do, but still don't like the color of the drink, and the name of the drink – wouldn't want to try it." (p. 10, audio-visual)

According to the emotional adjective assessment, the most frequently used words to describe taste in the audio-visual group were recorded as 'healthy (14),' 'sweet (11),' 'new (10),' and 'pleasant (8)'.

5.2.5 Multisensorial Interface Item and Taste Perceptions

The multisensorial interface was evaluated as mainly fun, interesting, easy to use, and able to 'heighten the level of understanding.' The interface was implemented with all four sensory stimuli: vision, smell, touch, and sound, of which smell seemed to have shown the strongest stimulation. One of the main takeaways was that the very idea of receiving all non-taste sensory information prior to tasting the food item was phenomenal. The group revealed that not only did it help make an objective decision, but it also had other items to be considered an option amid the market dominated by the popular and well-known items. Such an idea is even more relevant in the current pandemic situation; participants said being able to remotely smell, touch, and see the ingredients before ordering the menu tremendously helped make a decision while much of the sensory contacts were restricted. Even regardless of the specific situation, the need for non-face-to-face interactions is accelerating every day, and many technologies are only bourgeoning due to this demand, resulting in a serious need for pertinent explorations.

The distinctiveness of the multisensorial group was on the smell stimuli. In contrast to auditory and visual stimuli, complying with existing studies that taste is more intensely related to smell [68,78] than any other properties, the olfactory experience was indeed a powerful conveyance of information. In fact, most of the transitions of impressions from negative and unfamiliar to positive and wanting to try revolved around the smelling experience. Participants found the smell stimulation as coherent to the interface and not irregular, well-suited to the presented ingredients, and creating olfactory acquisition on the food. Some often used the word "I could taste the smell" (p. 4, p. 5, p. 22) instead of tasting the food, and deemed it helpful in knowing the food. Further, they generally commented that ingredients smelled good, and that when they were mixed, they harmonized well and provided synthesis to what they are shown, almost like a complete simulation scent of the drink.

> "Honestly, I had thought of turmeric latte as tasting kind of gross when I first heard it. This really does help get acquainted with the drink because a lot of the times at restaurants, you can only guess what's in it when they show you the menu. Even if I knew the term, I wouldn't be able to process what it would actually taste like, just like when I first heard the name. But after smelling it, hearing the sounds, and clicking on the textured buttons, I want to have it. It now kind of reminds of this latte I had the other day made out of sweet potato, of which I would have never linked the similarity with this if it weren't for the experience today. Because for me, the word turmeric was never an option to make a latte." (p.31, multisensorial)

Participants showed evident improvement of familiarity through interview responses, saying that their understanding is deeper now than before. Complying with the statistical analysis that the food familiarity levels significantly increased as a whole, among food neophobic and not food neophobic, multisensorial experience and integration can be extremely relevant means to educate, familiarize novel products, regardless of how neophobic they are.

> "What do I think of the interface… well, it's obvious that for unfamiliar items like this, it helps us have better idea about it and picture the taste without even knowing what it is…Now I actually wish this drink was out in the market for me to try." (p.33, multisensorial)

Their willingness to try was also very high; except for four out of 33 (scored two), all participants scored three or more on their willingness to try (n=29) and the mode number was five on a scale of five (n=11). Overall effects were larger than those of audio-visual and control interfaces, signifying that the four senses involved are better than one or two. The willingness to try was generally high that one neophobic participant answered that even though he does not normally like sour tastes, he perceives the taste to be sour and yet wanted to try it because the experience was satisfactory. Many also seemed to imagine the taste according to their usual taste preferences; for example, if they had normally liked spicy foods, they imagined the drink to be spicy and thus wanted to try it.

Some participants managed to notice the nudging capability of multisensorial exposure and addressed its potential benefits to the community. They mentioned that as humans, we are normally so prone to eating what we always eat, but the blame is partially on that we have no choice but to rely only on the name and picture of the menu at restaurants and cafés when ordering foods. One participant also lamented that most young populations tended to drink sugary, iced, cold drinks only and wished they could consume more healthy beverages, such as turmeric latte, with external help as this interface implementation. They mentioned that multisensorial experience can also help promote healthy foods and domestically grown crops to improve health and flourish their economy:

> "I personally sell herbal goods, so I am well-aware of what turmeric is. One thing that concerns me is that not many young people are consuming healthy products but instead are eating what they are already familiar with. It is of course important for people like me to develop healthy foods and beverages, but it is equally important to get help from the government, or to develop technologies like this to get young people to try these foods in the first place." (p. 23, multisensorial)

> "You know there are many kinds of beverages at a café these days… rather than ordering straight ahead, it will be great to have an exploratory option like this beforehand. Because I don't know if it's just me, but I struggle to understand what's in the drink just by reading their names." (p. 20, multisensorial)

Amid the many positive feedbacks, however, one participant questioned the authenticity of smell attributes, as they were after all synthetically flavored and not naturally smelling. Another participant was also not fond of one of the ingredient scents, alarming that not all users can be pleased with certain smells or even have allergies and so a safeguard is essential to make the stimulation completely optional.

> "The only thing was that it smelled too artificial for me. I also thought is it completely necessary to smell the food? I wished it smelled more natural because then it's not an accurate representation." (p. 25)

Finally, coherency was seen to be fundamental in a positive evaluation. Consistently designed olfactory and somatosensory stimuli seemed to have well-functioned on the participants, as they deemed them very appropriate and that they provided more knowledgeable ideas on the turmeric itself. They realized the buttons resembled each ingredient's texture in nature and were 'realistic' in that sense. They were interested in the buttons that were not just round and identical, but with relevant colors, shapes, and tactile stimulations. Younger populations (age < 18) were especially intrigued by these sensory stimulations. Encountering smells and touches, they responded that it was 'cool' and 'amazing' to see and feel the scent exertion, and that, as a whole, it was a fun 'activity'.

According to the emotional adjective assessment, the most frequently used words to describe taste in the multisensorial group were counted as 'sweet (15)', 'new (13)', 'healthy (11)' and 'soft (10)'. All interfaces and their characteristics are collectively shown in Table 5.

Table 5. Qualitative Summary on Three Interface Variations.

Properties	**Type of Interface**		
	Control	Audio-visual	Multisensorial
Interface Impression	Simple, familiar	Convenient, clear	Interesting, sensorial
Initial Familiarity	Very low	Very low	Very low
Improved Familiarity	False	True	True
Ingredient Exposure	False	True	True
Taste Impression	Unfamiliar; New; Unpleasant; Healthy;	Healthy; Sweet; New; Pleasant;	Sweet; New; Healthy; Soft;
Turmeric Latte Impression	Unimaginable; Unpalatable; Un-suiting to liking;	Heightened understanding; Mixed feelings; Health benefit;	Familiar; Trustworthy; Imaginable; Suiting to liking;
Reason for trigger	Adventurousness	Curiosity, health benefit	Will suit to preference, health benefit
Sensorial Stimuli	Visual	Visual, auditory	Visual, auditory, olfactory, somatosensory

Ranked Sensorial Stimulus by Intensity	Vision > Smell > Touch > Sound	Vision > Smell > Touch > Sound	Smell > touch > vision > sound

6 DISCUSSIONS

6.1 Food neophobic participants are more willing to try

As identified from a group of studies, food neophobia could occur or prolong into adulthood [24,28]. Similarly, this study observed that 43 out of 91 participants were food neophobic, of which 31 were adults (31 out of 72 adults). This signifies that almost half of the random sample (47%) typically showed reluctance to try novel foods. In summary, participants showed significant differences in their levels of food familiarity from audio-visual and multisensorial interfaces, whereas they remained insignificant in the control group. Further, a comparison of the audio-visual and multisensorial groups revealed that food neophobic participants displayed a significant difference in their willingness to try but not in satisfaction level and post-food familiarity. Opposite results were shown in those who are not food neophobic, showing no significance in willingness to try, but high significance in other two factors, post food familiarity and especially the satisfaction level. A few reasons can exemplify such a trend.

First, those who are not neophobic tend to focus more on their experience and experiential qualities, and second, they have a lower acceptance barrier to getting to know a food item. They placed weight on the quality of the experience, content, and interactions, and quickly gained knowledge through the provided sensory information. This also made them have significantly improved familiarity with the control interface through mere visual exposure. However, they were less influenced in terms of their preference (willingness to try), rather than being swayed by simple sensory modalities. By contrast, food neophobics have seemed to support the emerging theory that they respond more sensitively to sensory stimuli [79] than those who are not neophobic. This could indicate that since they were more sensitive to stimulations and that multisensorial stimuli expressly roused their sensorial input but in a positive way, leading to a higher willingness to try as a whole. However, all the above explanatory assumptions are only based on the observatory findings and should not be considered scientifically applicable, especially with the smaller sample size under the food neophobia categorization. Nonetheless, that the overall participants, as well as the neophobic population who is typically known to show extreme aversion toward novel foods, showed a significant level of willingness to try remains positive.

6.2 Possible usages of multisensorial interface

Most participants established that a multisensorial experience provided an opportunity for objective decision-making, better understanding of the novel food, and drastically improved familiarity. This sheds light on the possibility of using sensory stimulation and manipulation to restrict unhealthy foods and to evoke curiosity about healthy foods, substituting costly government or policy regulations. Some participants also hinted that such an interface will be practical when traveling; even if the language is incomprehensible, sensory acknowledgements will always be universal. They can choose the foods that are unfamiliar through such a self-ordering system through different sensory stimuli, omit or add the foods of certain smells or spices through olfactory information, and choose their own preferences, making a sound decision. Besides dining places, the olfactory interface could be utilized in perfume and cosmetic shops or implemented in vending machines. Further, multisensorial assistance can be useful for the sensorially impaired, with complementary sensory stimuli, and for a better conveyance of information. Lastly, some suggested that it could be simply used for sensory activities and education during the sensory development stage of young children. Concerning that most sensory programs and the different strategies to tackle food neophobia have mainly been focused on children, this study also suggests an alternative approach for adult food neophobia.

6.3 Efficacy of sensory exposure

Non-taste element exposure has been a rising theory for effectively managing food neophobia for years, but it has yet to be tested. Especially since mere sensory exposure without taste stimuli meant that people cannot have mouth contact with food, there existed suspicion as to the degree of its effectiveness. However, this study has shown that multisensorial exposure through vision, sound, smell, and touch can elicit higher willingness to try and considerably improve food familiarity with certain novel items. Given that most participants were more strongly influenced by olfactory exposure than other stimuli and the least by auditory stimulation, active investigation on devising olfactory cues is a promising topic. Audio-visual exposure also induced improved familiarity; however, both the audio-visual and multisensorial groups revealed that olfactory stimulation is vital in food acquisitions.

Despite the focus of the experiment on only one novel item, the chosen item (turmeric latte) was proven to be novel to most participants, and multisensorial exposure induced significantly increased post-familiarity and willingness to try, and enhanced satisfactory experience, supporting the theory of sensory exposure. Finally, we also showed that food familiarity was positively related to food preference, consistent with previous studies [4,30]. This suggests that the long-term nature of all previous tactics to tackle food neophobia could be shortened considerably, and that mere multiple sensory exposure itself has a great impact on their temporary change in perception. Considering that the biggest challenge for food neophobia is to elicit curiosity and willingness to try prior to the actual ingestion [38,39], our findings shed light on the fact that multisensorial exposure incorporated into everyday technology and interface can be a practical solution for all. Further, given that the multisensorial exposure was an effective means to increase food familiarity in both non-neophobic and neophobic participants emphasizes that such an approach can be extended to have the public consume alternative food sources and healthy items.

6.4 Multisensorial exposure is a gentle way to try new foods

After the construction of the sensory framework, we consulted with a professional through an online forum. A nutrition and education professional assessed the workshop and theme as rational and informative education-wise. She had commented that exposing foods through a multisensorial interface can simultaneously be an education on technology uses for younger audiences, and not just a food education. She added that in children's developmental stages, sensory education and exposure are integral, and a variety of food exposure alone could be a powerful delivery of information. She also predicted that more food-related educational forums would be expanded to digital and remote platforms due to the current restriction of mid-air interactions. Since a remote ordering system is what everyone encounters so frequently nowadays, this study may set a milestone in a feasible and practical implementation in everyday lives. The professional remarked:

> "Of course, a physical sensory education is what has the most impact on children and their behavioral development, but as less and less face-to-face interactions are required these days, such an attempt to design remote multisensorial education could be a renovative approach to reduce costs and risks of physical contacts among children. And not just for children, limited contacts and exposures to physical properties is no stranger for everyone these days. Such a way to describe shape, taste, scent of a food, especially on unfamiliar foods, will be sufficiently educational even if it was contacted for once, as it is that one time that is the most difficult to be experienced by people."

7 LIMITATIONS

Although the study mainly focused on exploring the feasibility of multisensorial experience implemented on a kiosk interface and its acceptance and efficacy, it lacked the holistic interactions between the sensory stimuli themselves. While flavor is a synthesized outcome of all sensory inputs, complex interactions in between are key when the flavor is recognized by the brain. Similarly, when designing a multisensorial experience, the interactiveness with all sensory modalities must be considered. This study lacked such an observation and had not found an appropriate measure to assess it than to check for coherency. Further, the interface had prototyping mechanisms exposed to the public without additional processing of the design, such as the cables and mechanics. The experience could have been less immersive than it ought to have been. Finally, while the study carefully designed ingredient exposure, its workshop framework is yet to be justified as viable in other novel food items. A subsequent study on verifying the sensory workshop as a qualified multisensorial design guideline is needed.

8 CONCLUSION

This study implemented a multisensorial interface into everyday encounters, analyzed surrounding results when presenting a novel food item to the public, and explored the arousing perceptions by comparing it with two other variables. While it primarily aimed to see the extent to which a multisensorial kiosk interface can influence user acceptance and familiarity of a novel food item, it also proposed an empirical methodology for multisensorial designs. A self-ordering kiosk, now used almost daily in most restaurants and cafés, is the chosen medium for multisensorial integration. With two other independent variables, control interface and audio-visual interface, this research observed that a multisensorial interface significantly improved food familiarity with a novel beverage, enhanced the intent to try the food, and its experience was rated as satisfactory. Willingness to try was also shown to be significant among the food neophobic participants. As a primary insight, it showcases that olfactory stimulation is tremendously important in terms of a food experience, consolidating that flavor is a close network, especially of taste and smell. It also postulates that multisensorial interfaces can be an example of short-term, effective sensory exposure that can alleviate food neophobia in a wide age range, when possibly incorporated in day-to-day interfaces. Finally, it posits that multisensorial integrations can set guidelines for a stimulative and informative strategy to arouse curiosity to try new food sources in the future or assist those in need of sensory complementation. Continuous proliferation of sensory management can start to a closer collaboration between technologies and everyday food practices and integrate affective multisensorial experience in vast fields of study.

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APPENDICES

A.1 Questionnaire

A.1.1 Pre-experiment questionnaire

Questions (1- don't know at all, 6- know it very well)	1	2	3	4	5	6
1. How much do you know about the turmeric latte?						

Please select any of the following:	Sweet	Bitter	Sour	Salty	Spicy	None
Tastes you normally like						
Tastes you normally don't like						

A.1.2 Post-experiment questionnaire

Questions (1- don't know at all, 6- know it very well)	1	2	3	4	5	6
1. How much do you know about the turmeric latte?						

Questions (1- not at all, 5- extremely	1	2	3	4	5
2. How much would you like to try the drink?					
3. How satisfied were you with the kiosk?					

Please choose any of the words best described the experience.							
Familiar	Sensational	Static	Simple	Unfamiliar	Dynamic	Unclear	Complicated
Interesting	Clear	Unpleasant	Easy	Plain	Confusing	Appealing	Flat

Please choose any of the words that will best describe the taste of a turmeric latte.							
Sweet	Bitter	Pleasant	Unfamiliar	Spicy	Soft	Stale	New
Pungent	Cold	Warm	Savory	Unpleasant	Healthy	Familiar	Salty
Sour	Addictive						

Please rank the senses according to the perceived intensity.				
Rank	Sight (what I see)	Smell (what I smell)	Sound (what I hear)	Touch (what I touch)
1st				
2nd				
3rd				
4th				

A.1.3 Food Neophobia Scale

Questions (1-not at all, 7 extremely)	1	2	3	4	5	6	7
1. I am constantly sampling new and different foods.							
2. I don't trust new foods.							
3. If I don't know what is in a food, I won't try it.							
4. I like foods from different countries.							
5. Ethnic food looks too weird to eat.							
6. At dinner parties, I will try a new food.							
7. I am afraid to eat things I have never had before.							

8. I am very particular about the foods I will eat.							
9. I will eat almost anything.							
10. I like to try new ethnic restaurant.							