

Virtual journeys into terroir: Assessing the effect of immersive contexts on consumer evaluations of artisanal honey

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ABSTRACT

Terroir, the unique interplay of geography, climate, and agricultural practices, shapes the identity of local foods, yet consumer appreciation of terroir may depend on personal experience. This study examines how providing consumers with “the sense of being there” influences sensory perception and attitudes toward terroir-specific products. Honey was selected as the focus as its flavour profile is directly shaped by the fields visited by bees.

To create an immersive experience, VR footage was recorded at three beehive locations on an artisanal honey farm in South Ostrobothnia, Finland. A consumer study ($N = 266$) was then conducted at a regional food fair in South Ostrobothnia and the University of Turku. Participants were randomly assigned to one of three contextual conditions: a VR tour on hive locations, still images of the same locations, or abstract images (control). They then evaluated two honey samples, one from the featured farm and one commercial alternative from Central America, and completed sensory evaluations and purchase intention assessments.

Contrary to expectations, there was no direct effect of exposure condition on product evaluations. Across conditions, the local honey was rated higher than the foreign honey in liking, purchase intention, and willingness to pay. Although sense of presence did not differ between VR and image conditions, both presence and enjoyment were positively associated with liking and purchase intention. Mediation analyses indicated that enjoyment, rather than technological immersion per se, accounted for small indirect effects on evaluations. These findings suggest that emotional engagement and narrative framing may play a greater role in shaping consumer responses to local foods than the use of immersive technology alone.

1. Introduction

Food choices are shaped not only by sensory characteristics, but also by the meanings consumers attach to products through emotional and cognitive associations. Attributes such as origin, labelling, and packaging act as significant extrinsic cues that shape expectations, guide perception, and influence hedonic evaluations (Piqueras-Fiszman and Spence, 2015). Recent research further highlights that such cognitive links between product attributes and perceived quality or identity can be as influential as direct sensory input itself (Fernqvist et al., 2024). This is particularly relevant for artisanal and terroir-driven foods, whose value is often constructed through associations with place, production practices, tradition, and authenticity. In such products, consumers are not only evaluating a flavour profile, but also interpreting where and how the food was produced. For example, Leipämaa-Leskinen's (2021) study

of the Finnish REKO local food system shows that local food choices are shaped by meanings attached to producers, material cues, consumer values, and alternatives to “faceless” mass food production. Similarly, research with Italian residents in Marche shows that perceptions of food localness are closely intertwined with rural space, authenticity, and place-based belonging (Graciotti and McEachern, 2024). A central challenge for gastronomy and food communication is therefore how to convey these place-based meanings when consumers encounter products away from their place of origin.

Luomala (2007) examined food origin as a determinant of consumer food choice and proposed a framework consisting of three psychological routes through which extrinsic cues such as product origin are processed: cognitive, affective, and normative. The cognitive route addresses the question “What is this product like?” and involves beliefs, expectations, and knowledge about product attributes. The affective

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route focuses on “How does this product make me feel?”, activating emotions, moods, and experiential feelings elicited by the product. The normative route addresses “What is the right thing to do?” and draws on social norms, moral values, and identity-related considerations that guide appropriate consumption behaviour. Although these three routes can be analytically distinguished, Luomala (2007) also emphasises that in real consumption contexts extrinsic cues rarely trigger purely cognitive, affective, or normative responses, but rather initiate cascading processes in which, for example, cognitive beliefs about origin evoke emotional reactions, which may subsequently activate normative considerations related to ethics, identity, or social belonging. From this perspective, terroir and origin cues may shape consumer evaluations not only by providing information about product provenance, but also by activating memories, emotions, and identity-related associations. These mechanisms are especially relevant in informed tasting contexts, where consumers know something about the origin of the product before evaluating it.

Advances in immersive technologies - particularly Virtual Reality (VR) and Augmented Reality (AR) - provide a new type of affective messaging and offer new opportunities to communicate these multisensory and place-based attributes. Collectively described under the concept of digital gastronomy (Çöl et al., 2023), these technologies can extend beyond information delivery to simulate environments and experiences that foster emotional engagement, authenticity, and even perceived taste enhancement (see Wang et al., 2021; Wang and Barbosa Escobar, 2026, for reviews). In recent years, experimental research in multisensory environments has shown that contextual immersion in Virtual Reality can modify taste perception (Cornelio et al., 2022; Dawes et al., 2023), influence portion estimation (Long et al., 2023; Mellos and Probst, 2022), and shift food choices and preferences (Gouton et al., 2023; Plechatá et al., 2022, 2024; Schouteten et al., 2024). For example, congruency of the eating environment with the food tasted can influence food liking, with watermelon being more liked in a summer context and chocolate truffles more liked in a winter context (Schouteten et al., 2024). Beyond food liking, modifying the virtual environment can influence sensory perception, with blue lighting reducing perceived sweetness of jelly samples (Cornelio et al., 2022) while red ambient lighting increased perceived sweetness of similar samples (Dawes et al., 2023). Other studies have used VR to examine pro-environmental food choices and dietary behaviour change by allowing consumers to experience the consequences of food choices in immersive future scenarios (Plechatá et al., 2022, 2024). In parallel, AR research has examined how digital overlays on menus, packaging, and food products can influence mental simulation, purchase intention, consumer trust, and taste perception (Fritz et al., 2023; Gu et al., 2023; Nakano et al., 2021; Petit et al., 2022; Ueda et al., 2020). For example, introducing AR on takeaway packaging has the potential to increase consumer trust in the restaurant and the food itself in young urban Chinese consumers (Gu et al., 2023). The type of product also matters depending on the precise technology used; presenting menu items with AR visualisation (where the food is visualised in the user's current environment) increases purchase intention for served/plated products, whereas presenting 3D visualisation (where the user can digitally manipulate a 3D model of the food) improves purchase intention for packaged products (Petit et al., 2022). In summary, the effects of immersive technologies on consumer responses appear to depend strongly on product category, content design, and the type of experience created.

In food marketing and tourism, VR has been applied to create embodied experiences that strengthen the connection between products and their provenance. Studies in wine, coffee, and food tourism suggest that virtual tours can enhance perceived authenticity, enjoyment, satisfaction, purchase intention, and intention to visit by creating a sense of “being there” (Wen and Leung, 2021; De Canio et al., 2022; Sousa et al., 2026). For example, Wen and Leung (2021) found that experiencing a vineyard and winery tour in VR, compared to watching it on a

computer screen, resulted in higher purchase intentions and willingness to pay for a wine from the winery. De Canio et al. (2022) showed that presence and immersion during a 360° virtual tour of a Parmigiano Reggiano production site increased enjoyment, which indirectly influenced satisfaction with the tour and intention to visit the site. Similarly, Sousa et al. (2026) found that enjoyment during a VR grape-treading experience enhanced perceived quality of experience, satisfaction, and intention to visit a wine tourism destination. These effects are commonly explained through mechanisms such as presence, understood as the subjective feeling of being in a mediated environment (Slater and Wilbur, 1997), and enjoyment, which may support positive affective transfer toward the product or destination (Lawless and Heymann, 1997). Taken together, this literature suggests that the effectiveness of VR in food and wine tourism depends not only on technological immersion, but also on whether the experience is enjoyable, realistic, and meaningful. However, existing studies have primarily focused on tourism-related outcomes, such as satisfaction, destination image, visit intention, or purchase intention. Less is known about whether VR-based exposure to a production landscape influences consumer evaluation of the food product itself during tasting, or whether VR provides added value beyond simpler visual formats such as static images. This distinction is important because restaurants, producers, food festivals, and tourism settings may not require advanced technologies if simpler visual or narrative tools can evoke similar emotional engagement.

A related body of work on nature exposure suggests that natural landscapes and nature-related sensory cues can influence food perception and consumer choice even when they are not part of the product itself (Rim et al., 2025). A recent review by Spence and Pillay (2025) concludes that exposure to nature-related stimuli, whether real, artificial, or digital, can affect food and drink experiences as well as food choice behaviour. Such effects may occur through several mechanisms, including improved mood, affective engagement, reduced stress, and increased associations with naturalness, sustainability, or authenticity. In a retail field experiment, Spendrup et al. (2016) showed that playing nature sounds (i.e., birdsong) in the background increased willingness to buy organic foods among consumers with higher levels of connectedness to nature, suggesting that even subtle nature-related cues can influence food-related decisions.

Studies comparing immersive and non-immersive formats further suggest that the added value of VR is context-dependent. In an environmental valuation study, Meyer (2020) found no detectable difference in willingness to pay between participants exposed to immersive VR footage and those exposed to static images of the same lake environment. Similarly, Barbosa Escobar et al. (2021) showed that VR atmospheres depicting coffee farms did not enhance purchase intention or enjoyment compared to a city scene, although it did enhance coffee premiumness perception. More directly relevant to the present study, Uldemolins et al. (2025) showed that the format used to present honey-production landscapes, including pictures, 2D video, and immersive 3D video shown before a discrete choice experiment, can influence consumer preferences and willingness to pay (WTP) for honey origin and botanical variety. More specifically, 3D video resulted in higher WTP compared to all other conditions for honeys with regional labels. Going one step further, Fantechi et al. (2025) compared real forest immersion, static forest images, VR forest video, and memory-based recall before a choice experiment involving organic honey. They found that real forest immersion had the strongest effect on willingness to pay for honey, with VR taking an intermediate position between real forest exposure and static images. Together, these studies suggest that nature-based contextualisation may influence food evaluation, but that its effects depend on the type, fidelity, and product relevance of the exposure.

As a food product, honey provides a particularly relevant case for studying these effects because its sensory and symbolic value is closely tied to the place of production. Honey's sensory characteristics are directly shaped by the floral landscape, climate, and beekeeping

practices surrounding the hives (Stolzenbach et al., 2011). Unlike many processed foods, honey can therefore retain a close and interpretable link to the environments visited by bees, making it a useful product for investigating how consumers respond to terroir-related cues. Previous research on honey preferences shows that geographical origin and landscape cues can shape both product evaluation and willingness to pay. Cosmina et al. (2016), for example, found that Italian consumers preferred local Italian honey over foreign honey and showed a higher willingness to pay for country-of-origin attributes. Similarly, Cela et al. (2020) found that origin and production landscape were among the most important attributes for Albanian honey consumers, who preferred honey produced in mountainous forests and pastures. More recently, López-Galán and de-Magistris (2025) showed in a field experiment that geographical origin influences both hedonic evaluation and willingness to pay for honey, and that willingness to pay was more strongly influenced by origin than by taste. These findings support the notion that honey is not evaluated only as a sensory product, but also as a landscape-linked food whose perceived value may be shaped by how origin and production environment are communicated.

Despite these advances, important questions remain about whether immersive production-site exposure influences consumer evaluation during actual tasting, and whether, in a tasting setting, VR provides added value beyond simpler visual formats such as static images. Existing studies have often focused on tourism-related outcomes, hypothetical choice tasks, or willingness to pay without tasting the product itself. The present study addresses this gap by examining VR, static image, and abstract control conditions in an informed tasting of local and foreign honey. The Finnish context is relevant given documented consumer acceptance of local food and local food systems (Ehrnström-Fuentes et al., 2019; Leipämaa-Leskinen, 2021). Within this context, South Ostrobothnia provides a meaningful regional setting because of its strong agricultural and food production identity, with approximately 15% of the employed labor force working in agriculture and food production (Niemi and Väre, 2018). Moreover, Finnish honey production is largely characterised by relatively small-scale beekeeping and direct sales practices (Finnish Beekeepers' Association, 2025), which may reinforce associations between honey, landscape, and regional origin.

Building on this literature, the present study investigates whether a VR-based farm visit can enhance consumer evaluations of a local food product by increasing sensory liking, purchase intention, and willingness to pay. More specifically, the study asks whether immersive visual contextualisation of a terroir-linked product influences informed consumer evaluations, and whether VR provides added value beyond static 2D imagery. We compared three contextual conditions: (1) an immersive 360° VR tour of a Finnish honey farm, (2) static images of the same locations, and (3) a control condition with abstract visuals. Beyond assessing the direct effects of immersion, we examined the mediating roles of sense of presence and experiencing enjoyment in shaping product evaluations.

This study contributes to existing research in three ways. First, it compares VR with static images and an abstract visual control in an informed tasting context, allowing us to assess whether technological immersion offers additional value beyond visual contextualisation. Second, it examines presence and enjoyment as potential psychological mechanisms through which contextual exposure may influence consumer evaluations. Third, it extends research on immersive food experiences and terroir communication to artisanal honey, a product whose sensory characteristic and symbolic identity is closely linked to a specific region, but has received limited attention in this literature. Specifically, we hypothesized that:

(H1). Based on affective transfer theory and prior findings that immersive environments enhance perceived authenticity and engagement (Wen and Leung, 2021), we expected VR exposure to increase liking and purchase intention compared to the image condition, and that

both VR and image conditions would outperform the control condition;

(H2). Based on previous findings that presence is a psychological mechanism underlying affective engagement in immersive environments (Slater and Wilbur, 1997), we expected that the effects of contextual condition on sensory liking, purchase intention, and WTP would be mediated by the sense of presence;

(H3). Based on prior research demonstrating that local food preferences are driven by trust and identity-related motives (Carfora and Catellani, 2023; Graciotti and McEachern, 2024), we expected that local honey would be rated higher than the foreign honey across all conditions in terms of sensory liking, purchase intention, and WTP.

2. Methods

2.1. Ethics statement

The study protocol was approved by the Ethics Committee for Human Sciences at the University of Turku, Humanities and Social Sciences Division (Approval number: TY/422/06.01.01/2024). The study adhered to the European Union's General Data Protection Regulation (GDPR). Written informed consent was obtained from all participants before participation, and informed that they could withdraw at any time without providing a reason. This study is pre-registered on OSF (<https://osf.io/tcd6y>).

A total of 266 volunteers, aged 17-79 years, participated in the study (Table 1). The broad age range was considered appropriate because the study was designed as a consumer evaluation, and recruiting consumers across a wide age range allowed us to capture responses from people likely to encounter local honey in food fair, retail, or specialty food contexts. 115 participants were recruited at the Kauhajoki Food Fair, and 150 participants at the University of Turku. The gender distribution was as follows: 72 males, 192 females, 1 non-binary participant, and 1 participant who preferred not to disclose their gender. The target sample size was determined by practical feasibility of recruiting approximately 150 participants per location during the available data-collection period, resulting in 90-100 participants per contextual condition. Recruitment was guided by a power calculation to determine small to

Table 1
Comparison of socio-demographic and food attitude variables between participants in the 3 conditions.

Variable	Condition 1 VR N = 87	Condition 2 Image N = 89	Condition 3 Control N = 90	Total N = 266
Age	45 (SD = 17)	45 (SD = 16)	46 (SD = 17)	45 (SD = 17)
Sex				
Female	65 (75%)	63 (71%)	64 (71%)	192 (72%)
Male	21 (24%)	28 (28%)	26 (29%)	72 (27%)
Other	1 (1%)			1 (.4%)
South Ostrobothnia identity				
Yes	45 (52%)	39 (44%)	43 (48%)	127 (48%)
No	42 (48%)	49 (55%)	47 (52%)	138 (52%)
Local food attitude (1–7 scale)	5.03 (SD = 1.11)	5.08 (SD = .99)	5.18 (SD = 1.09)	5.10 (SD = 1.06)
Honey knowledge check (passed)	56 (64%)	57 (64%)	62 (69%)	175 (66%)
Honey consumption frequency				
A few times a week	32 (37%)	48 (54%)	32 (36%)	112 (42%)
A few times a month	30 (34%)	29 (33%)	33 (37%)	92 (35%)
A few times a year	23 (26%)	11 (12%)	20 (22%)	54 (29%)
Never	2 (2%)		5 (6%)	7 (3%)

medium effect size in a between-subjects ANOVA between three conditions ($\alpha = .05$, power = .8, and $f = .2$, G*Power 3.1).

2.2. Materials

Two honey samples were used for the study, one local and one foreign. The local honey was a fresh non-pasteurised honey from Lakeuden Hunaja Ltd honey farm in Lapua, South Ostrobothnia. The foreign honey was a commercial organic flower honey sourced from South and Central America (imported by SAM Fair trade honey, Finland). Both honey samples were liquid honey, served from a dropper bottle. The foreign honey was selected in a pilot study to match the colour and texture of the Lakeuden Hunaja honey. The inclusion of a foreign honey served two purposes. First, it allowed examination of whether contextual immersion would selectively enhance evaluations of the product linked to the depicted environment (local honey). Second, it enabled comparison of origin-based preferences independent of contextual exposure.

2.3. Procedure

The experimental design is shown in Fig. 1. The study took place in two settings: a 12 m² enclosed area at the Kauhajoki Food Fair and a sensory laboratory at the University of Turku. Participants were not trained as expert sensory assessors, as the study was designed as a consumer evaluation. Instead, research staff provided standardized instructions before the task. Participants assigned to the VR condition were assisted in using the VR headset and instructed to watch the 360° video for 1 min, whereas participants in the image and control conditions were guided to view the image displays for the same duration. After familiarising themselves with the information sheet and providing consent, participants were randomly assigned to one of three contextual conditions, each lasting 1 min:

Condition 1: A 1-min virtual reality (VR) tour of the three beehive locations in Lakeuden Hunaja honey farm (Lapua, Finland), viewed via a 360° video in a VR headset (Meta Quest 2). The locations were selected to showcase typical areas in South Ostrobothnia where the bees visited to gather honey – a forest, a meadow, and the area close to the hives. The video can be viewed at this link: <https://www.youtube.com/watch?v=QzSqEDVPxMk>.

Condition 2: A 1-min viewing of three high-resolution photographs from the beehive locations in Lakeuden Hunaja honey farm, presented as 40 × 60 cm² colour wall displays (printed by Ifolor, Finland), placed on easels. The easels were placed in a semi-circle around the viewer and resembled a miniature art gallery.

Condition 3: An exposure to three images based on the same photographs from condition 2. These control images were generated by computationally rearranging the pixels of the original farm photographs (2160 × 3840) while preserving their overall colour tones and brightness distribution, thereby removing recognizable semantic content while maintaining comparable low-level visual properties. The images were printed and presented in the same miniature art gallery manner as in Condition 2. The photos of conditions 2 and 3 are shown in Fig. 2.

Before the exposure session, participants in Conditions 1 and 2 were informed that they would view visual material depicting the beehive locations of the local honey farm (Lakeuden Hunaja, Lapua, Finland). No additional narrative or descriptive storytelling was provided beyond indicating that the images/VR footage showed the environments where the bees collected nectar. The foreign honey was not visually contextualized; participants were only informed of its geographic origin prior to tasting. The abstract control images were described neutrally as visual material unrelated to specific food production sites.

After the exposure condition, the participants evaluated the two honey samples (~5 g) on white plastic teaspoons placed on a white paper plate. The samples were served in random order to control for order effects. Before the sensory evaluation, participants were verbally informed that they would taste two different honey samples and that the origin of each sample would be indicated in the questionnaire. A glass of water was provided to each participant during the sensory evaluation. Before tasting, participants were instructed in the Compusense questionnaire to drink water to neutralize their palate. Water was used for palate cleansing also between the two honey samples. In Kauhajoki, evaluations took place in portable cabins, while in Turku, sensory laboratory tasting cabins were used. Before tasting each sample, participants were informed whether the honey was from Lakeuden Hunaja or from Central and Southern America.

After tasting each of the two honey samples, participants responded to a sensory evaluation questionnaire on sensory liking (overall and for each modality of vision, smell, taste, and aftertaste, on scales from 1 to 9), purchase intention (3 items on scales from 1 to 5), willingness to pay (WTP, given in euros). After each honey evaluation, participants also responded to the open-ended question: “Please describe the total taste experience of this honey in your own words, what does the honey taste like, and how does it make you feel?” Responses consisted of unrestricted free text. Those who experienced VR and Image conditions also answered presence-related questions based on Schubert et al. (2001). Finally, participants answered additional questions regarding their honey consumption habits, attitudes and knowledge about honey as well as demographics and regional identity. A more detailed description of the questionnaire with accompanying scales and measures can be found

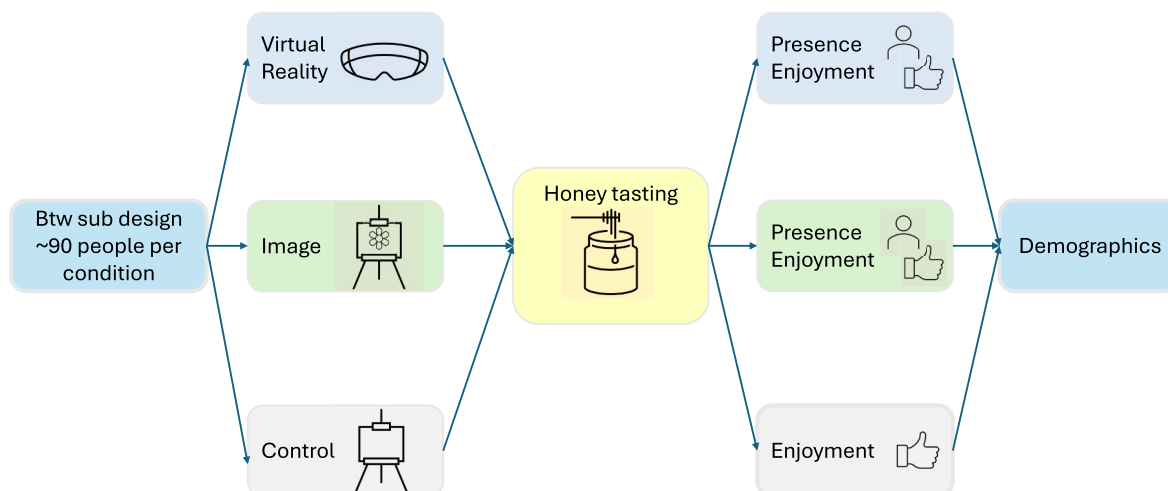


Fig. 1. Experiment design.

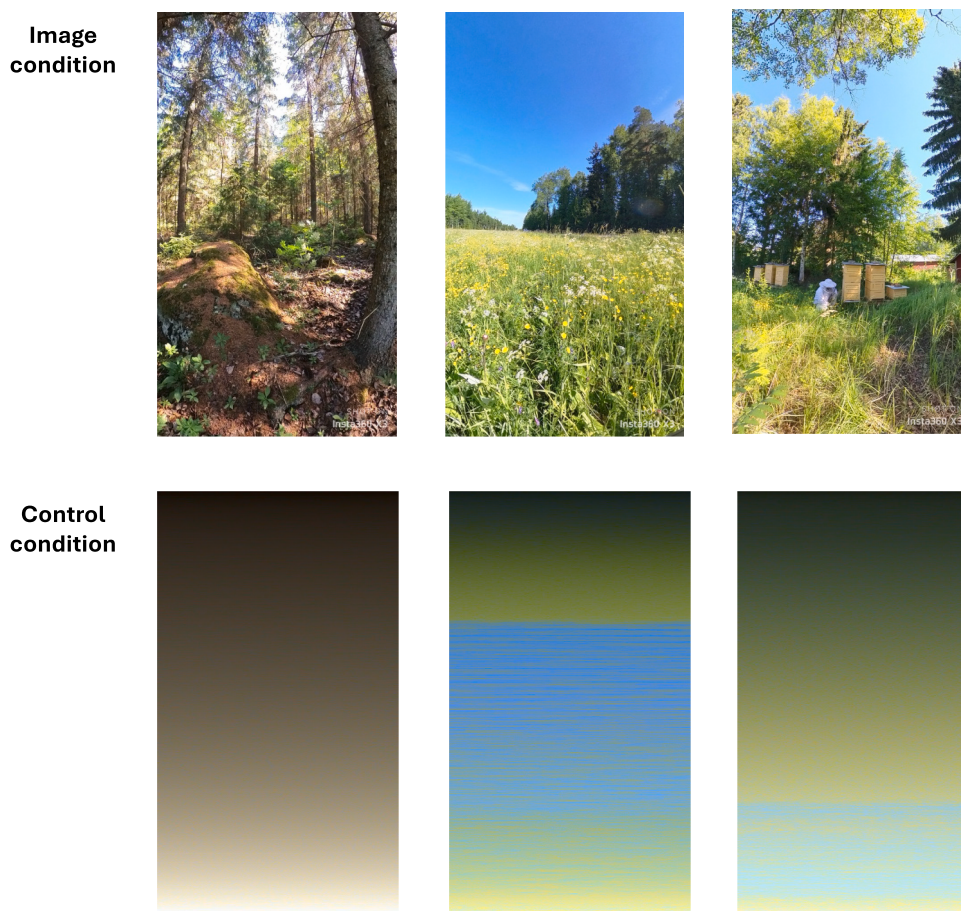


Fig. 2. Pictures displayed during the image and control conditions.

in [Appendix A](#).

The entire study took 10-15 min. The survey was administered via an online platform on tablets or personal smartphones. Paper versions of the questionnaire were available for participants unwilling to use digital platforms or in case of technical issues. Nine participants at the Kauhajokki Food Fair completed paper questionnaires.

2.4. Data analysis

Data was collected using Compusense® Cloud software (Compusense Inc., Guelph, ON, Canada). The survey results were analyzed using SPSS 28 (IBM SPSS Statistics, IBM Corporation, Armonk, NY, USA) and R (version 4.2.3).

To test Hypothesis 1, we conducted a repeated measures multivariate analysis of variance (RM-MANOVA) with contextual condition as a between-subjects factor (VR, image, control) and honey type (local, foreign) as a within-subjects factor, and overall liking, WTP, and purchase intention as measures. To account for the presence of multiple correlated dependent variables, a multivariate approach was used rather than conducting separate ANOVAs, thereby reducing the risk of inflated Type I error associated with multiple comparisons. For Hypothesis 2 A, we conducted a series of mediation analyses with contextual condition as the independent variable (only VR vs. image, as it did not make sense to rate presence in the control condition), sense of presence as the mediator, and the local honey's overall sensory liking, purchase intention, and willingness to pay as dependent variables. To evaluate Hypothesis 2 B, the mediation analyses were conducted with contextual condition again as independent variable (VR, image, control), enjoyment of the contextual condition as mediator, and the same dependent variables as before. This was conducted with the PROCESS macro in

SPSS, applying linear regression-based mediation models. Hypothesis 3 was assessed using the RM-MANOVA analysis from Hypothesis 1, based on the main effect of honey type.

Moreover, exploratory analyses were performed to understand the impact of honey type (local vs. foreign) on sensory liking, and to decipher regional differences between participants in South Ostrobothnia (where the local honey sample is also from) and in Turku. For the first analysis, a repeated measures ANOVA (RM-ANOVA) was conducted with honey type and sensory modality (vision, smell, taste, aftertaste) as independent variables and liking as the dependent variable. For the second analysis, the RM-MANOVA from Hypothesis 1 were conducted with an additional between-subjects factor of Location (South Ostrobothnia, Turku) to better understand the relationship between location, contextual condition, and honey type.

In terms of qualitative analysis, open-ended responses were analyzed using thematic content analysis coded by two independent researchers. The coding steps included initial familiarisation with the responses, inductive coding of recurring themes and grouping them to higher-level categories. Each researcher conducted an initial classification separately, and any discrepancies were resolved through discussion to reach a consensus. The details of the analyses are described in [Appendix B](#). The analysis then combined thematic coding with frequency counts of coded references across conditions. The categories identified were dominant sensory patterns describing sensory perceptions, dominant hedonic and emotional valence describing liking and emotional responses, and associative meaning patterns describing symbolic associations of the samples under different contextual conditions.

3. Results

3.1. Quantitative analysis

Table 1 presents a comparison of participants in the three conditions based on age, sex, South Ostrobothnia identity, attitude towards local food, honey knowledge, and honey consumption frequency.

3.1.1. Hypothesis 1

The mean values of the participants' overall liking, purchase intention, and willingness to pay (WTP) evaluations for both honey types (local, foreign) in all three contextual conditions (VR, images, control) are shown in Fig. 3. A RM-MANOVA revealed a significant main effect of honey type ($F(3,261) = 45.63$, $p < .001$, Wilk's Lambda = .66) when considered over all three measurement types (liking, purchase intention, WTP). There was no significant effect of condition ($F(6, 524) = .89$, $p = .502$), and no significant interaction effect between condition and honey type ($F(6,524) = .69$, $p = .657$). In other words, Hypothesis 1 was not confirmed since the VR condition did not lead to greater liking, purchase intentions, or WTP compared to the other contextual conditions.

3.1.2. Hypothesis 2

The sense of presence was measured in the VR and image conditions (Table 2) and assessed as a mediator in the relationship between condition and liking, willingness to buy, and willingness to pay. For local honey, mediation effects revealed no significant indirect effect in any of the three models, but there was a significant correlation between sense of presence and liking ($b = .25$, 95% CI [.12, .38]), and between presence and purchase intention ($b = .24$, 95% CI [.13, .34]). In other words, Hypothesis 2 was partially confirmed, in that the sense of presence was significantly correlated with honey liking and purchase intention. See Table 3 for full mediation results.

As an additional exploratory analysis, participant enjoyment of the contextual condition was measured in all three conditions (Table 2), and assessed as a mediator in the relationship between condition and liking, willingness to buy, and willingness to pay. The indirect effect of enjoyment was significant for contextual condition's effect on liking (indirect effect = $-.046$, 95% CI $[-.093, -.0096]$) and on purchase intention (indirect effect = $-.030$, 95% CI $[-.068, -.0036]$). There was no significant mediation effect of enjoyment in the relationship between condition and willingness to pay. See Table 3 for full mediation results.

To summarise, the effect of contextual condition on overall honey liking and purchase intention was in fact mediated by experience enjoyment, even though it was not mediated by the sense of presence.

3.1.3. Hypothesis 3

RM-MANOVA results from Hypothesis 1 testing also revealed a significant effect of honey type on liking, purchase intention and WTP for honeys. More specifically, the local honey was preferred to foreign honey (Liking_foreign = 4.82, SE = .07, Liking_local = 7.29, SE = .06, $p < .001$), and participants had higher purchase intentions (WTB_foreign = 2.77, SE = .06, WTB_local = 3.67, SE = .05, $p < .001$) and were willing to pay more for it (WTP_foreign = 5.74, SE = .14, WTP_local = 7.31, SE = .13, $p < .001$). Hypothesis 3 is thus confirmed, showing that local honey is preferred over foreign honey.

3.1.4. Exploratory analyses: the role of sensory modality and testing location

Fig. 4 shows the average liking values across different sensory modalities and honey types. RM-ANOVA revealed a significant interaction effect between sensory modalities and honey type ($F(3,263) = 23.34$, $p < .001$, Wilk's Lambda = .79). More specifically, there was a significant difference between honey type for each sensory modality, where the foreign honey was liked more than local honey in terms of looks ($p = .015$), but the local honey was liked more in terms of smell, taste,

and aftertaste ($p < .001$ for all comparisons).

Looking at the difference between South Ostrobothnia and Turku populations, a RM-MANOVA revealed a significant main effect of location ($F(3,258) = 3.04$, $p = .030$, Wilk's Lambda = .97) when considered over all three measurement types (liking, purchase intention, WTP). More specifically, participants from Turku had higher purchase intentions compared to those from South Ostrobothnia (WTB_Turku = 3.31, SE = .05, WTB_SO = 3.10, SE = .06, $p = .007$).

There was also a significant interaction effect between location and honey type ($F(3, 258) = 3.77$, $p = .011$, Wilk's Lambda = .96). This was driven by a significant interaction effect when it comes to purchase intention ($F(1, 260) = 10.30$, $p = .001$). While in all locations, local honey was preferred to foreign honey; when comparing the evaluation honey across locations, the foreign honey was rated with higher purchase intentions by Turku participants compared to those from South Ostrobothnia (WTB_Turku = 2.97, SE = .08, WTB_SO = 2.50, SE = .09, $p < .001$).

3.2. Qualitative analysis

The qualitative analysis was structured into three sequential levels: sensory perception, hedonic evaluation, and emotional-associative meaning-making.

Sensory descriptors aim to capture what participants perceived. They were identified from the qualitative responses and were grouped by sensory modality. In this grouping, the repeated mentions have been counted once under the same descriptor, and intensity modifiers such as *very*, *really* and *quite* have been ignored for uniqueness. Compound comments have been split into separate descriptors when they refer to different sensory qualities. For example, the description "*sweet but bitter aftertaste*" has been grouped to sweetness, bitterness and aftertaste. The most common types of sensory descriptors within each condition were counted (Appendix D), and the sensory descriptor patterns by honey type and contextual condition are presented in Table 4.

The second step of the analysis was to identify the dominant hedonic patterns from the qualitative responses. These are positive, negative, ambivalent or neutral responses and are considered to indicate the main reasons for liking or disliking honey samples as expressed by participants (Table 5). The raw data is shown in Appendix table (column "liking").

Finally the emotional valence and associations were classified from the raw data (Appendix C, column "Emotions and associations"). Table 6 lists the emotions and associations of the qualitative responses. It aims to capture how the different contextual conditions evoked meanings, emotions, and associations beyond sensory perception and liking. Here the term "dominant" refers to the most characteristic emotional and associative patterns within each cell.

4. Discussion

While the contextual conditions (VR, images) had limited direct impact on consumer evaluations of honey, the findings suggest that immersive and visual contexts may still shape the cognitive and affective framing of local food products. The most robust effect was linked to honey type: across all conditions, the local Finnish honey was consistently preferred over the foreign honey and received higher ratings for liking, purchase intention, and willingness to pay. At the same time, the mediation analyses indicate that affective dimensions of the experience were relevant. Enjoyment mediated small indirect effects on liking and purchase intention, while presence was positively associated with these outcomes. Thus, although the visual context did not directly shift average product evaluations, the results suggest that the experience surrounding the product can still contribute to how consumers engage with and interpret a place-based food.

These findings should be interpreted in relation to recent work on nature exposure, landscape presentation, and food-related consumer

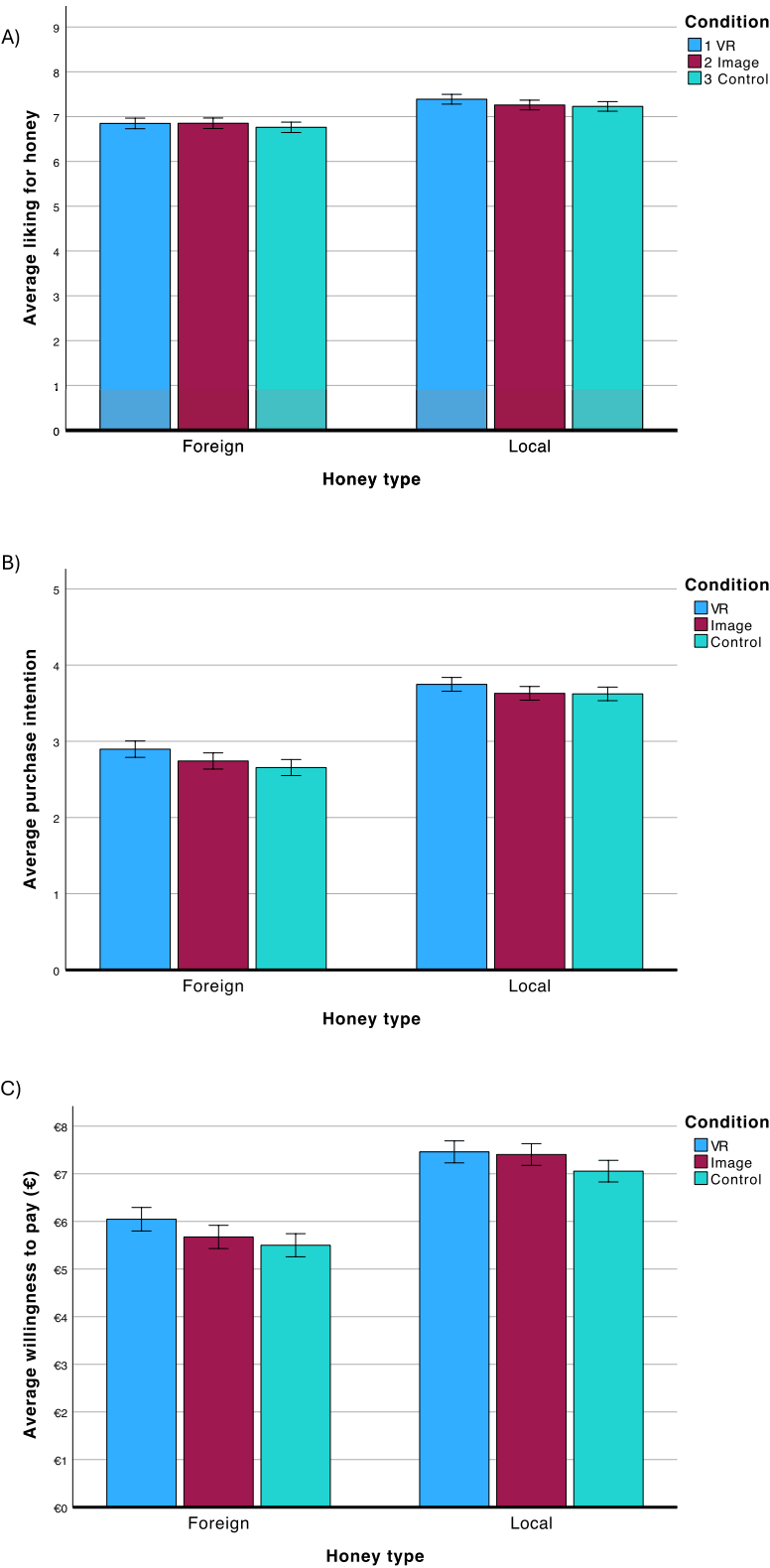


Fig. 3. Average values of A) overall honey liking, B) willingness to purchase, and C) willingness to pay for both types of honey (foreign vs local) across the three contextual conditions (VR, image, control). Error bars indicate standard error.

Table 2

Average ratings of sense of presence and enjoyment, the two mediators used in this analysis.

Variable	Condition 1 VR	Condition 2 Image	Condition 3 Control
Sense of presence (1–7)	4.19 (SD = .93)	4.01 (SD = 1.32)	Not measured
Enjoyment of experience (1–9)	7.26 (SD = 1.36)	7.53 (SD = 1.19)	6.72 (SD = 1.33)

responses. Prior research suggests that natural landscapes and nature-related cues can shape food choice and willingness to pay, particularly for products associated with sustainability, origin, or naturalness (Spendrup et al., 2016; Spence and Pillay, 2025). More directly, Fantechi et al. (2025) found that real forest immersion increased willingness to pay for organic honey, while VR produced effects that were not statistically different from either the picture or memory-recall conditions. In comparison, Uldemolins et al. (2025) showed that presentation formats of honey-production landscapes, including pictures, 2D video, and immersive 3D video, influenced willingness to pay for honey origin and botanical variety, with immersive 3D video producing particularly strong effects for regional labels. Compared with these studies, the present study did not show a direct effect of VR versus

images. However, one difference is that, in the present study, willingness to pay was elicited as an open euro amount rather than through pre-selected price tiers (e.g., €7, €11, €14 in the Fantechi et al., 2025 study), which may have introduced greater individual variation and reduced sensitivity to contextual effects. Another important difference is that the present study involved actual tasting evaluations of honey rather than a hypothetical choice task or valuation scenario. Participants therefore evaluated products that they had just tasted, which may have anchored their responses more strongly in direct sensory experience and reduced the influence of the visual contextualisation. This interpretation is further supported by Barbosa Escobar et al. (2021), where immersion in a VR coffee farm while actually smelling coffee did not result in increased intent to purchase or experience enjoyment compared to an incongruent city VR environment.

The absence of a direct VR effect should therefore be interpreted cautiously. It does not imply that VR or nature-based contextualisation is ineffective in general. Rather, it suggests that, in this specific informed tasting context, VR did not add measurable value beyond a coherent and visually engaging static-image condition. This interpretation is consistent with Meyer (2020), who found no detectable difference in willingness to pay between immersive VR footage and static images in an environmental valuation study. In the present study, the static image condition may have been more immersive than intended because the

Table 3

Mediation results for Hypothesis 2.

Models	b (X to M)	b (M to Y)	Direct effect c'	Indirect effect	Total effect c
X = Condition M=Presence Y=Liking	−.17 [−.51,.17]	.25 [.12,.38]	−.10 [−.40,.19]	−.042 [−.14,.041]	−.15 [−.45,.16]
X = Condition M=Presence Y=Purchase intention	−.17 [−.51,.17]	.24 [.13,.34]	−.081 [−.32,.16]	−.041 [−.13,.04]	−.12 [−.38,.13]
X = Condition M=Presence Y=WTP	−.17 [−.51,.17]	.17 [−.12,.46]	−.0096 [−.67,.65]	−.030 [−.15,.044]	−.039 [−.69,.62]
X = Condition M=Enjoyment Y=Liking	−.27 [−.47, −.078]	.17 [.076,.26]	−.034 [−.18,.11]	−.046 [−.093, −.0096]	−.080, [−.23,.070]
X = Condition M=Enjoyment Y=Purchase intention	−.27 [−.47, −.078]	.11 [.032,.19]	−.032 [−.16,.093]	−.030 [−.068, −.0036]	−.062 [−.19,.063]
X = Condition M=Enjoyment Y=WTP	−.27 [−.47, −.078]	.15 [−.042,.35]	−.16 [−.48,.16]	−.042 [−.12,.011]	−.20 [−.52,.12]

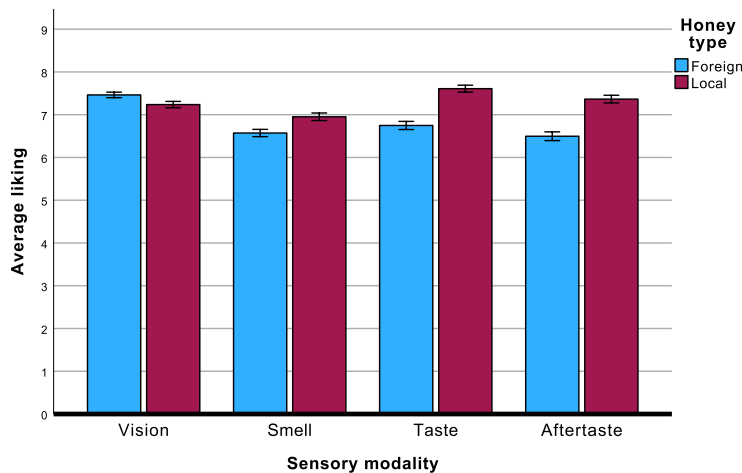


Fig. 4. Average liking rates across four assessments (vision, smell, taste, and aftertaste) for both types of honey (foreign vs local). Error bars indicate standard error.

Table 4
Dominant (most common) sensory descriptor patterns by honey type and contextual condition.

Honey/Condition	Dominant sensory pattern identified
Foreign honey/VR	Sweetness, bitterness and pungency; natural but also industrial/artificial flavors; smooth/runny texture; both strong and weak notes for aroma and aftertaste
Foreign honey/Image	Intensive sweetness but also bitterness and pungency; diverse description of flavors; natural but also industrial/artificial flavors; diverse description of aftertaste
Foreign honey/Control	Intensive sweetness but also bitterness and sharpness and sourness; limited spectrum of flavors
Local honey/VR	Sweetness mild-to-rich; natural and candy flavors; both strong and weak notes for flavor strength; soft/creamy texture; diverse descriptions of aftertaste length and intensity
Local honey/Image	Sweetness moderate-to-strong, tangy, bitter and pungent notes; aroma descriptions nature-origin but include also woody and beeswax-notes; soft/creamy texture; variable descriptions of aftertaste and its length
Local honey/Control	Sweetness moderate-to-strong, bitter, tart and pungent notes; natural and caramel-like but also earthy and some off-flavor notes identified; weak or bitter/tart aftertaste

Table 5
Dominant hedonic (liking) patterns by honey type and contextual condition, with summary terms presented in blue.

Honey/Condition	Dominant liking patterns
Foreign/VR	Mixed but slightly positive liking ; sweetness and smooth texture often liked; frequent ambivalence (“good but nothing special”); some rejection based on excessive sweetness or unfamiliar taste
Foreign/Image	Polarized liking ; strong positives (“very good”, “pleasant”, “would buy”) alongside strong negatives (“too sweet”, “not natural”, “not to my taste”); liking closely tied to flavor intensity and aftertaste
Foreign/Control	Moderate, cautious liking ; frequent “okay”, “basic”, “average” evaluations; liking driven by familiarity and acceptable sweetness; rejection mainly due to excessive sweetness or bitterness
Local/VR	Strongly positive liking ; descriptors emphasize pleasantness, softness, balance, and “good taste”; Occasional negative evaluations, typically related to texture or sweetness
Local/Image	Generally positive liking with some ambivalence; many “good”, “very tasty”, “pleasant”, “like honey should taste” evaluations; dislikes mainly related to lame flavor, sweetness level or graininess rather than overall rejection
Local/Control	Mild to moderate liking ; frequent neutral-positive evaluations (“good”, “ok”, “basic honey”); liking driven by familiarity rather than excitement; some boredom or disappointment expressed

large photographs surrounded participants in a gallery-like arrangement, reducing the experiential contrast between the image and VR conditions. This may also explain why our findings contrast with [Wen and Leung \(2021\)](#), who found that a VR vineyard and winery tour increased wine purchase intention and willingness to pay compared with a traditional video. Whereas Wen and Leung compared VR with a less immersive video format, the present study compared VR with large-scale static images presented in a physically engaging format. The null VR effect may therefore reflect the relative strength of the comparison conditions rather than the weakness of VR itself.

Several further explanations may account for the lack of an overall VR effect. First, the origin information provided before tasting may have been a stronger cue than the visual exposure itself. This is plausible given recent evidence that geographical origin can influence both hedonic evaluation and willingness to pay for honey, sometimes more strongly than taste itself ([López-Galán and de-Magistris, 2025](#)). Second, the VR experience was short and relatively passive, which may have limited the extent to which technological immersion translated into stronger product evaluations. Studies reporting stronger effects of immersive formats often involve richer or more differentiated experiential contrasts, such as real forest immersion compared with VR, static

Table 6
Dominant emotional valence and associative meaning patterns by honey type and contextual condition, with summary terms presented in blue.

Honey/Condition	Dominant emotional valence and associations
Foreign/VR	Mixed and ambivalent emotional responses referring to both nature and practical use; curiosity and mild surprise; occasional positive moods (summery, light), but also distancing associations (industrial, unfamiliar); origin-related doubts sometimes explicitly mentioned
Foreign/Image	Polarized emotional reactions ; surprise, intrigue, confusion, and sometimes discomfort; rich associative imagery (medicinal, exotic, mountains, herbs); frequent reflection on unfamiliarity and “difference” from expected honey
Foreign/Control	Weak emotional engagement ; neutral or absent feelings common; occasional curiosity or exotic associations; origin and foreignness sometimes mentioned, often as a mild barrier rather than a strong emotional response; only a few associations to nature
Local/VR	Strong positive affect ; feelings of comfort, warmth, well-being, and happiness; vivid associations with summer, meadows, childhood, home, bees, and nature; explicit pride and positive bias linked to domestic origin, even patriotic feelings
Local/Image	Mostly positive affect ; nostalgia and familiarity common; associations with childhood, home cooking, tea, and summer; fewer identity-related expressions than VR but still clearly domestic and comforting
Local/Control	Familiarity-based, mostly low-arousal emotions ; calmness, neutrality, or mild comfort; associations with everyday use (tea, bread); domestic origin noted but less emotionally amplified

images, or recall ([Fantechi et al., 2025](#)). Third, the product itself may have provided strong sensory and symbolic cues, especially because participants tasted both a local and a foreign honey under informed conditions. In this context, VR may have contributed less as a direct enhancer of liking or willingness to pay, and more as one possible way of supporting affective engagement with the product's origin. Overall, these findings support recent arguments that immersive technologies should be evaluated in terms of the experiential value they add beyond simpler alternatives, rather than assumed to be more effective because they are technologically advanced ([De Canio et al., 2022](#); [Chang and Suh, 2025](#)).

Regional variation further suggests that contextualisation may have context-dependent benefits. In South Ostrobothnia, where the honey originated, local participants likely already held strong place-based associations and therefore evaluated the local honey positively in all conditions. In contrast, participants in Turku had higher purchase intentions for the foreign honey compared to those from South Ostrobothnia. Although this pattern should be interpreted cautiously, it suggests that the effects of immersive or visual contextualisation may depend partly on consumers' prior familiarity with, or attachment to, the product's region of origin.

4.1. Presence and enjoyment as mediators of product evaluation

The mediation analyses partially supported Hypothesis 2 and highlighted two key takeaway points. First, although the sense of presence was not significantly higher in VR than in the image condition, it was positively correlated with liking and purchase intention for local honey. This reinforces the idea that presence supports affective engagement: when participants felt more immersed in the honey farm environment, they were more likely to appreciate the product and express intent to buy it. This is consistent with the notion of presence as a psychological mechanism through which immersive environments can make distant or absent places feel experientially available ([Slater and Wilbur, 1997](#)). That said, the similarity in presence ratings between VR and static images indicates that immersive perception may depend as much on content design as on technology. The large-scale photographs arranged around participants like a miniature art gallery possibly created a “surround” effect that fostered an unanticipated level of immersion,

reducing the contrast between the two conditions.

Secondly, participants' enjoyment of the exposure conditions, across all three conditions (VR, image, control) emerged as a consistent mediator of liking and purchase intentions. It should be noted here that the control condition was not affectively neutral, but rather liked. Although the control condition lacked recognizable production-related content, the abstract images still offered a pleasant, gallery-like visual experience. This may help explain why enjoyment, rather than technological immersion or production-related visual content per se, emerged as a relevant mediator of liking and purchase intention. Overall, our finding suggests that the pleasure derived from the contextual and informational experience, whether through engaging visuals, atmosphere, or novelty, plays an important role in shaping product evaluations. This is broadly consistent with [De Canio et al. \(2022\)](#), who found that presence and immersion in a 360° virtual tour of a Parmigiano Reggiano production site enhanced enjoyment, which subsequently influenced satisfaction with the virtual tour and intention to visit the production site. It also aligns with results from [Sousa et al. \(2026\)](#), where the effectiveness of VR in wine tourism depends on the quality and enjoyment of the experience, not simply on the presence of immersive technology.

From the perspective of [Luomala's \(2007\)](#) framework, these findings suggest that the affective route may be particularly important in origin-based food evaluation: the contextual cue does not simply provide information about provenance but may create an affective state that transfers to the product. The control condition in the present study, though being less informative, was perceived as equally pleasant as the honey farm images and VR experience, possibly due to its abstract, art-like visuals and presentation format. This further supports the importance of affective pleasure rather than technical immersion alone. Recent VR research on content design and digital storytelling in tourism and museum design offers a similar interpretation, where interest and emotion can shape perceived value, presence, immersion, and enjoyment ([Choudhary et al., 2025](#); [Chang and Suh, 2025](#)).

From a practical perspective, our findings suggest that effective product storytelling in immersive contexts may not require full technological immersion; rather, it should prioritise emotional engagement and storytelling. A positive, enjoyable experience can foster favourable consumer responses even without high levels of sensory realism or interactivity. Interestingly, the mediation effects did not extend to willingness to pay, indicating that experiential enjoyment may influence affective and behavioural intentions more readily than price perception, which may be rooted in market norms, personal habits, and prior expectations. This distinction is important for artisanal products, where perceived value may be shaped by both emotional meaning and more stable expectations about price, quality, and product category.

4.2. Perceived locality and emotional associations

The local honey's dominance over the foreign honey in overall liking, purchase intention, and willingness to pay (WTP), even in the control condition, confirmed Hypothesis 3. This finding suggests that simple origin cues such as "local" or "from Finland" can be persuasive in themselves, reflecting the well-documented preference for local foods based on trust, authenticity, and regional identity ([Graciotti and McEachern, 2024](#); [Ikerd, 2011](#); [Leipämaa-Leskinen, 2021](#)). This pattern aligns with recent honey-specific research showing that origin and landscape cues can strongly shape consumer preferences. [Cosmina et al. \(2016\)](#) found that Italian consumers preferred local Italian honey over foreign honey and showed higher willingness to pay for country-of-origin attributes, while [Cela et al. \(2020\)](#) found that origin and production landscape were among the most important attributes for Albanian honey consumers. More recently, [López-Galán and de-Magistris \(2025\)](#) showed that geographical origin influenced both hedonic evaluation and willingness to pay for honey, with willingness to pay being more strongly influenced by origin than by taste. In line with

these findings, the strong preference for local honey in the present study likely reflects not only sensory differences, but also the affective and symbolic meanings attached to local origin.

Interestingly, the only sensory attribute for which the foreign honey was rated higher than the local honey was appearance. The imported sample had a clear amber colour, while the local honey appeared lighter and slightly cloudy due to natural crystallisation. A practical implication of this finding is that foreign honey may appear more attractive in retail contexts where visual evaluation dominates. Providing tasting opportunities and origin-based storytelling for local honey at points of sale could therefore help consumers appreciate its sensory quality and make up for its less polished appearance.

This interpretation is supported by the qualitative data. The local honey consistently evoked nature-related, homely, and nostalgic associations across all conditions, including references to childhood, summer, home, meadows, bees, and Finnish landscapes. Foreign honey, by contrast, was more frequently described in terms of artificiality, industrial processing, and cultural distance ([Table 6](#)). These findings align with research showing that honey evaluation can be associated with emotions and memories, not only sensory descriptors ([Ramón-Canul et al., 2023](#)).

Although the quantitative analyses did not show a significant condition $\times$ honey interaction, the qualitative data suggest that the VR and image conditions may have sharpened the associative contrast between the local and foreign honey, especially in nature-related and home-related meanings. This can be seen in the hedonic rating patterns ([Table 5](#)) and in the increased number of nature and coziness associations for the local honey compared to foreign honey ([Table 6](#)). Future research could examine whether such contextualisation is especially effective for consumers with weaker prior familiarity with the production region. Practically, this suggests that immersive experiences may be most beneficial for marketing local products to non-local consumers, where immersion and storytelling can help simulate the associative context that supports perceptions of quality and familiarity. Overall, these findings suggest that contextual experiences may act less directly to enhance liking, but more to amplify meaning associated with a product; in other words, contextual experiences can make product origin, landscape, and production practices more emotionally available to consumers, even when they do not directly change average product ratings.

4.3. Limitations

Several limitations should be considered when interpreting these findings. First, although the visual materials were designed to differ clearly in their level of immersion, the static image condition may have been more engaging than intended. The photographs were displayed at large scale and arranged in a semi-circular format that physically surrounded participants—effectively creating an inadvertently immersive "mini-exhibition." This reduced the experiential contrast between the VR and image conditions and may partly explain the similar ratings of presence and liking across both groups.

Secondly, the sense of presence was measured only among participants in the VR and image conditions, preventing direct comparison with the abstract control group. Future studies should include comparable measures across all conditions to better capture the full gradient of experiential immersion.

From a sampling perspective, individual differences in familiarity and comfort with VR technology likely influenced both presence and enjoyment ratings. The average participant age (mid-forties) suggests limited prior exposure to immersive media, which may have constrained the psychological sense of "being there." Collecting explicit measures of prior VR experience, or offering a short familiarisation session, could help control for this source of variance in future research.

Another limitation is that the study did not include a blind tasting baseline. Thus, since participants were informed of product origin prior

to tasting, the design does not allow separation of pure sensory (blind) liking from origin-based expectations. The study therefore examines evaluations under informed conditions, which resembles real-world tasting contexts such as food fairs and specialty shops, rather than isolating sensory perception from extrinsic cues. After all, in real life, foods are rarely encountered as anonymous sensory stimuli, but are typically eaten and evaluated together with prior knowledge, expectations, labels, origin cues, memories, and social meanings.

Finally, the study was conducted entirely in Finland and focused on a single artisanal product (local honey) whose cultural associations and sensory expectations may differ from those of other foods or national contexts. Thus, the observed interplay between presence, enjoyment, and perceived locality should be interpreted as context-specific rather than universal. Extending the design to other product categories and countries, as well as varying the form of virtual storytelling, would help determine the generalisability of these effects.

5. Conclusions

This study examined how immersive and visual contextual environments shape consumer responses to local versus foreign honey. The absence of differences between VR and static images suggests that technological immersion alone did not enhance consumer evaluations in the present study. Instead, consumers' product evaluations are driven by the *quality* of the experience. Enjoyment mediated small indirect effects on liking and purchase intentions, while presence was positively associated with these outcomes. This suggests that emotional and experiential engagement, rather than the mere use of advanced technology, shapes how people value local products. Importantly, even static images can evoke positive associations and enhance evaluations when the experience is well designed and thematically coherent.

The present findings suggest that while immersive contexts can enrich the experiential framing of local food products, the affective and cognitive meanings attached to origin cues may outweigh sensory influences. Overall, this highlights the role of narrative framing in the communication of product origin and locality. Future research should explore how virtual experiences can be optimised to convey authenticity and trust, and how such technologies may complement, rather than substitute, direct sensory contact with place and product.

Implications for gastronomy

The findings highlight the importance of narrative and experiential framing in shaping how diners perceive terroir-driven foods. Although Virtual Reality did not enhance product evaluations beyond static visual images in this study, both forms of contextual exposure helped evoke emotional engagement with the honey's place of origin. For gastronomy practitioners, this suggests that communicating the landscape, ecology, and production environment behind ingredients can meaningfully influence how foods are experienced. Visual cues, storytelling, and atmospheric design can evoke associations with nature and authenticity, potentially enriching diners' perception of artisanal products even before tasting begins.

More broadly, the results reinforce the idea that gastronomic experiences are constructed not only through flavour, but also through the meanings and emotions attached to ingredients. In restaurants, food festivals, and culinary tourism settings, chefs and producers may therefore benefit from integrating place-based narratives into the presentation of local ingredients. Whether through imagery, descriptions, or curated environments, conveying the story of origin can strengthen the perceived identity of regional foods and help diners form a deeper connection with landscapes, traditions, and producers.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this manuscript, generative artificial intelligence tools were used in a limited and supportive role to assist with language editing, text clarity, and structural refinement of the manuscript. In addition, AI-based tools were used to support the organization and summarization of qualitative data during the early stages of analysis.

All qualitative coding, interpretation, and analytical decisions were conducted by the authors. The authors critically reviewed, edited, and verified all content generated or assisted by AI tools and take full responsibility for the accuracy, integrity, and originality of the work.

CRediT authorship contribution statement

Qian Janice Wang: Conceptualization, Data curation, Formal analysis, Methodology, Software, Visualization, Writing – original draft. **Hannele Suvanto:** Conceptualization, Investigation, Resources, Writing – original draft, Writing – review & editing. **Anu Hopia:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: One of the authors (Hannele Suvanto) is a co-owner of the Lakeuden Hunaja honey farm, which provided the local honey sample used in the study. The visual materials used in the virtual reality and image conditions were recorded at the same honey farm. This involvement did not influence the study design, data collection, data analysis, interpretation of the results, or the decision to publish the findings. All other authors declare no competing interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijgfs.2026.101587>.

Data availability

Data will be made available on request.

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