International Journal of Hospitality Management 132 (2026) 104340

Contents lists available at ScienceDirect

International Journal of Hospitality Management

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

Can Augmented Reality (AR) enhance how restaurants present Farm-to-Table information? The role of cognitive absorption, learning gains, and brand image congruence

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ARTICLE INFO

Keywords:
Farm-to-Table (FTT) Information
Ingredient disclosure
Augmented Reality
Augmented Reality menus
Cognitive absorption
Learning gains
Brand image congruence

ABSTRACT

This study examines whether disclosing Farm-to-Table (FTT) information through an Augmented Reality (AR) menu increases customers' information sharing intentions and visit intentions. Study 1, using a single-factor, three-group experiment in a local restaurant setting, demonstrated that AR was more effective at disclosing FTT information and enhancing customers' behavioral intentions. This effect was mediated by cognitive absorption and perceived learning gains. Study 2, using a 2 × 2 experimental design in a chain restaurant setting, found that AR FTT disclosure significantly improved the perceived healthiness of the brands. The results also showed that AR was more effective in enhancing FTT disclosure for brands with a high level of healthy image congruency, highlighting the moderating role of brand image. These findings offer valuable theoretical and practical insights into the restaurant industry.

1. Introduction

As consumers' health concerns and interest in food safety and security grow, they increasingly seek transparency in their restaurant menu choices (Pozelli Sabio and Spers, 2022). The National Restaurant Association has declared that sustainability and health will be the key macro trends shaping the restaurant industry in 2025, while also forecasting that local sourcing will continue to receive attention through 2030 (National Restaurant Association, 2025a). In line with this, consumers are becoming more discerning - not just regarding nutritional or allergen information but also concerning food sources and the origins of ingredients (Byrd et al., 2021). Moreover, such information shapes people's perceptions of a restaurant's healthiness (Plasek et al., 2020). Additionally, detailed information about food sources can help build trust, differentiate a business from its competitors (Shafieizadeh and Tao, 2020), and increase restaurant sales (Brewer and Sebby, 2021).

Farm-to-Table (FTT) represents a specific form of food source disclosure that reflects a growing demand for transparency, health, and sustainability in dining (National Restaurant Association, 2025a). Restaurants aware of these needs have been providing such information to consumers, indicating the source of ingredients and the supply chain process of the produce from the farm. While consumers often base food decisions on labels like local, organic, or fair trade, few realize that only 14.9 % of every dollar spent goes to the producers or farms (U.S. Department of Agriculture USDA and Economic Research Service, n.d.). Despite the importance, disclosing relevant information is voluntary; however, the growing consumer interest in understanding where their food comes from is reshaping the restaurant industry. With the upcoming FDA Food Traceability Rule taking effect in 2026, restaurants will be required to track and disclose the origins of certain food items, reinforcing stronger shifts to source disclosure (National Restaurant Association, 2025b). Further, social media platforms (e.g., Instagram, YouTube Shorts, and reels) have become key sources for sharing food literacy and sourcing details, further amplifying the demand for transparency and healthy consumption. Thus, offering FTT information is crucial as it appeals to health-conscious consumers while informing them about the ethics and processes behind food production (Onozaka et al., 2010).

FTT information conveys ingredient origins, sustainability, and ethics - complex factors that require immersive storytelling to be fully appreciated. Traditional FTT disclosures rely on static, text-heavy formats, limiting engagement and comprehension. Augmented Reality (AR) menus, which realistically depict 3D menus on customers' phones

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https://doi.org/10.1016/j.ijhm.2025.104340
Received 19 September 2024; Received in revised form 31 May 2025; Accepted 10 June 2025
Available online 8 July 2025
0278-4319/Published by Elsevier Ltd.

or tablets, offer an innovative solution. By scanning a marker or label, users can engage with dynamic content such as videos and auditory elements, enhancing their understanding beyond written narratives (Ali, 2022). For instance, Le Petit Chef by Skullmapping exemplifies AR in dining, using 3D projection to animate a chef character preparing dishes on diners' tables showing where the ingredients are coming from - a concept gaining traction in fine dining at upscale hotels (Le Petit Chef, n. d.). Similarly, Jack Daniel's uses AR to illustrate its whiskey-making process, enhancing trust and transparency (Jack Daniel's, 2021). These examples showcase AR's potential in restaurants, particularly in visually tracing ingredient journeys from raw materials to the final dish. Because of its ability to create immersive and engaging experiences, AR is particularly well-suited for delivering FTT information effectively.

According to the media richness theory, more interactive communication channels can effectively and efficiently convey abundant information (Carlson and Zmud, 1999; Maity et al., 2018). AR, as part of Extended Reality, is highly effective in allowing consumers to experience products or locations visually and interactively without the need for physical presence (Rauschnabel et al., 2022). AR enhances decision-making and heightens cognitive and emotional responses, in line with the cognitive absorption theory (de Amorim et al., 2022; Agarwal and Karahanna, 2000). In the early stages of a consumer's decision-making process, when they cannot physically interact with a product or visit a place, AR helps mitigate risk, enhance entertainment value and product awareness, and increase engagement (Haile and Kang, 2020; Von der Au et al., 2023). When consumers engage with highly immersive media channels like AR, their cognitive load will likely decrease, leading to higher chances of absorbing relevant information and enhancing individual learning gains (Zhao et al., 2023). Therefore, interactive features within AR menus may empower customers to acquire detailed information about the food, or FTT information.

Adopting AR menus with FTT information could differ by the restaurant context. Smaller scale individually owned local restaurants, or FTT-themed restaurants, advocating sustainable procurement processes are particularly likely to provide more information about their food sourcing and supply chains and benefit from them (Nguyen et al., 2022; Yang et al., 2022). Yet, chain restaurants struggle more to convey their commitment to healthy ingredients. For instance, McDonald's attempts to highlight local farm sources for their ingredients have not dispelled their unhealthy image (Vieregge et al., 2007; Choi and Reid, 2018). Furthermore, information disclosure in menus significantly impacts brand image and evaluations (Choi and Reid, 2018). Consistency between a restaurant's brand image regarding healthfulness and promoted menu items is crucial for enhancing customer perceptions of information credibility and fostering positive attitudes towards menu items (Jeong and Jang, 2017).

In sum, our research questions are as follows: how do different menu platforms affect the disclosure of FTT information and influence individuals' intentions to visit local and chain restaurants, and how does brand image interact with these effects? Consequently, this research investigates how AR, compared to other menu platforms, effectively conveys FTT information and influences individuals' intentions to visit local and chain restaurants. Specifically, it examines AR's role in disclosing ingredient sources (i.e., FTT information) through the following studies. Study 1 compares AR's effectiveness against QR codes and traditional menus in a local restaurant setting, drawing on media richness theory. Study 2 extends study 1 by exploring the moderating effect of a chain restaurant's healthy brand image, using image congruency theory, while replicating study 1's findings. It further examines how brand image congruency, menu presentation (high vs. low), and disclosure mediums influence post-brand image perceptions and customers' intentions to visit chain restaurants.

This research holds several theoretical and practical significances. First, this study addresses a gap in AR research within the hospitality industry. Despite growing interest in AR across various service domains, there remains a significant gap in understanding how AR can be effectively utilized for diverse types of information delivery, including FTT information, as prior research has primarily focused on entertainment and customer engagement rather than informational depth and utility (Lim et al., 2024; Wei, 2019). Second, this study extends media richness theory by incorporating cognitive absorption and perceived learning gains as mediators to explain the effectiveness of different media platforms, particularly AR. These mechanisms highlight the crucial role of immersive and interactive technologies in shaping customer engagement and decision-making. Third, this paper is significant as it integrates media richness theory with image congruency theory to further explore the impact of brand image on this mechanism. Examining how contextual factors, such as the type of restaurant (local vs. chain) and individual perceptions (e.g., perceived healthy image of a brand), interact with the emerging technology effects like AR are important to explore, as restaurant type and brand perceptions influence consumer responses to marketing, menu design, and food choices (Choi and Reid, 2018). Restaurants' healthy perception influences stakeholders' perceptions, affecting their investment intentions (Kim and Zapata Ramos, 2018). Customers may react differently to health claims or branding based on the restaurant type, making it essential to understand these dynamics, especially with AR-integrated menus. This research examines the moderating role of brand image providing new insights indicating that AR-driven FTT information is more impactful when aligned with existing brand's healthy perceptions. Overall, this research introduces cognitive mechanisms and contextual factors that could influence customer responses to AR menu effects and ingredient information.

Finally, this research offers practical insights for restaurants, managers, marketers, policymakers, and technology stakeholders by exploring the adoption of AR in diverse restaurant settings. Our findings demonstrate how AR can enhance food source transparency, address space limitations of traditional menus, and improve consumer food literacy. It also shows policy implications by encouraging stronger farm-to-restaurant connections. Furthermore, restaurant managers can leverage AR as a marketing tool, while larger franchises may use AR menus to disclose ingredient details and promote local sourcing, supporting their sustainability branding. These contributions also align with broader Sustainable Development Goals (SDGs).

2. Literature review

2.1. Media richness theory

Media richness theory (MRT) examines the effectiveness of various communication channels in conveying information (Daft and Lengel, 1986). The theory categorizes communication channels along a continuum of "richness" or "lean," depending on the effectiveness of transmitting information. Rich communication channels offer more interactive components, such as immediate feedback, multiple cues, and personalization, allowing for the nuanced conversation of information with emotions and context. Here, face-to-face conversations are at the end of the spectrum. In contrast, lean communication channels lack interactivity and engagement, as shown in examples such as written memos, formal reports, and text messages. Thus, aligning the choice of communication medium with the information's nature and the desired level of richness is crucial (Daft and Lengel, 1986). For instance, simple messages may suit lean media like written formats, while complex ones may require richer mediums. When the concept of media richness is applied for restaurant menus, it is essential to give thought to the appropriate medium to deliver the value more effectively. Restaurant menus still utilize paper and ink, but nowadays more moving on to tablet menus with improved interactivity (Yim and Yoo, 2022). However, AR menus bring this experience to another level, by visualizing the menu realistically, allowing consumers to get immersed into the menu itself (Ali, 2022).

As such, AR fits into the interactive end of the media richness spectrum. We adopt the concept of AR from the XReality (XR) framework, which encompasses a range of immersive technologies (e.g., AR, Virtual Reality, Mixed Reality) that blend physical and virtual environments to

create immersive and interactive experiences for customers (Rauschnabel et al., 2022). The framework sets conceptual and technological foundation for developing AR menu experiences for restaurants, as it enables the integration of digital elements into the customers' real-world environment. Not only interacting with the 3D featured virtual menus, but users can also click on icons or wordings in their AR environment, which could lead them to audiovisual contents or video archives. Thus, AR features a rich communicative channel to effectively deliver contents by offering immersive experiences to individuals.

2.2. Farm-to-table (FTT) information disclosure and augmented reality (AR)

Research shows that people are increasingly interested in the origin of their food and the distance it has traveled before reaching their plate, thus local food with shorter food miles is often perceived as healthier (Frash et al., 2015). This is also evidenced by the increasing trend of local sourcing (National Restaurant Association, 2025a). As a relevant concept, FTT focuses on the mileage of the ingredient traveling within its supply chain process (Buck et al., 1997). The term FTT originates from the culinary movement has evolved into a global phenomenon since the 1960s and emphasizes the direct connection between consumers, restaurants, or/and local agriculture while promoting sustainability, transparency, and freshness (Buck et al., 1997; Pesci and Brinkley, 2022). Providing information on food origin or hyper locally sourced ingredients attracts their customers and impacts restaurant patronage (Shin et al., 2018), as well as their trust and perceived transparency (Shafieizadeh and Tao, 2020; Brewer and Sebby, 2021)

Despite the importance, challenges remain in effectively disclosing and communicating sourcing information. It is often complex in explaining the ethics, sustainability, sourcing, and ingredient processing, often requiring extensive detail. This complexity can increase cognitive load for consumers. Lu and Chi (2018) noted that excessive information can be overwhelming, especially given the limited space on traditional menus for detailed descriptions. Traditional mediums like printed posters or menus typically present FTT information in static, text-heavy formats, which can limit consumer engagement and understanding, calling for a new platform of conveying information.

The advancement of technology, intertwined with the COVID-19 pandemic, has accelerated the development of new menu formats, including electronic menus (Yim and Yoo, 2022; Lin et al., 2023). Many restaurants are transforming their menus through digital formats such as tablets, kiosks, and QR codes, offering improved presentation and better visualization of how dishes will appear (Batat, 2021). Although prior studies have identified the positive effects of digital or alternative format menus compared to traditional written menus, limited research has compared AR menus with other menu types, a significant gap that should be explored (Table 1). Assisting with food portion size estimation, AR can enhance both accuracy and consistency in estimating standard serving sizes compared to traditional methods (Sharma et al., 2024; Rollo et al., 2017). Since AR menus offer high-quality visual representations of menu items, they are likely to reduce cognitive dissonance among customers (Ali, 2022).

Transformations like AR impact customers' behavioral intentions (Lee and Kim, 2020). In hospitality and tourism, prior research has examined the relationship between AR usage and behavioral intentions. The interactivity of AR and its ability to enhance higher levels of learning demonstrate that this cutting-edge technology improves visitors' overall experience, fosters positive word-of-mouth, and motivates them to visit (Ali, 2022; Rauschnabel, 2021). In the context of dining, Lee and Kim (2020) found that menus presented in video clips generated the highest levels of mental imagery, thereby influencing people's desire to eat. Similarly, Petit et al. (2022) discovered that AR-enhanced visualized packaging increased the mental simulation of the eating process, leading to greater purchase intentions. More specifically, AR in restaurants and menus has the potential to generate positive customer responses (Batat, 2021; Brewer and Sebby, 2021). In a qualitative study, Batat (2021) interviewed customers who had experienced AR dining and found that AR influenced their sensory perceptions (e.g., senses, pleasantness) as well as their behavioral, social, and intellectual experiences. Furthermore, Ali (2022) developed a scale to measure AR-enhanced experiences in restaurant settings, revealing potential relationships with usage, intention to reuse, and recommendation intentions. Bae and Kim (2024) discovered how the AR's usefulness, innovativeness, subjective norm, enjoyment, and benefits influenced customer intentions. Despite being in its developmental stage, the design and implementation of menu systems using 3D objects and their integration with the physical world highlight AR's potential for innovative menu presentations and platforms that disclose food-related information in hospitality settings, increasing the positive responses and intentions from consumers.

Consequently, we suggest that compared to traditional menu mediums, such as digital menus using QR codes or written menus, disclosing FTT information through AR menus with more media richness and interactivity is likely to increase individuals' intentions to visit restaurants and share information about them. Therefore, we suggest our first hypothesis:

H_1. *Disclosing FTT information through an AR medium (vs. QR or written) will have a stronger positive effect on behavioral intentions.*

2.3. Cognitive absorption

Cognitive absorption is grounded in the interconnected concepts of

Table 1
Research on digital menu effects.

Authors	Year	Type of Menu Explored	Context	Key Findings
Lin et al.	2023	Digital menus (Text and Images vs. Text and Videos)	Restaurant	• Video-based digital menu was most effective in enhancing customers' behavioral intentions
Yim & Yoo	2022	Digital menus vs. Traditional menus (Web-based digital menu, tablet-based menu)	Restaurant	• Tablet-based digital menus were effective in greater enjoyment and increased behavioral intentions, especially for less-experienced foods
Lee & Kim	2020	Conventional vs. narration vs. picture vs. video menu	Restaurant	• Video menus evoke the most mental imagery and appetite, followed by picture, narration, and traditional menus
Suarez et al.	2019	Tablet-based menu	Quick service, midscale, upscale restaurants	• Tablet menu adoptions were strongly predicted by compatibility and perceived benefits
Lu & Chi.	2018	Visual vs. verbal menus	Local food dining decisions	• Tourists respond more positively to visual and interactive menus compared to verbal ones • Local residents prefer when additional information from the producer is provided rather than the control version
Hartwell et al.	2016	E-menu (Touchscreen)	Hospital foodservice	• E-menus effectively convey food-related information and generally lead to higher satisfaction among users
Beldona et al.	2014	E-tablet restaurant menu vs. traditional paper-based menu	Restaurant	• Electronic menus improve order accuracy, enhance customer service, and drive sales. • The interactivity of e-tablet menus allows for better information transfer, strengthening their role in restaurant menu merchandising

absorption, flow, and cognitive engagement, all which center on the idea that "time flies when people are having fun" (Agarwal and Karahanna, 2000). Absorption, a personality trait defined by Tellegen and Atkinson (1974), involves periods of undivided attention when a person focuses all their attention on a particular interest. Additionally, Csikszentmihalyi (1988) described flow as complete involvement in an activity, characterized by the merging of action and awareness, focused attention, loss of self-consciousness, a sense of control, consistent demands, and intrinsic enjoyment. Recent studies have further expanded on this concept, emphasizing its role in user trust and experience in the services context (Balakrishnan and Dwivedi, 2021). Furthermore, prior research has refined the connection between cognitive engagement and absorption, emphasizing immersion as a key factor closely associated with enjoyment (Leveau and Camus, 2023). In sum, cognitive absorption essentially examines how individuals can become deeply engrossed in a specific activity or content, particularly when engaging with technology or immersive environments (Agarwal and Karahanna, 2000). When people are fully absorbed in an enjoyable experience, they tend to exhibit a heightened level of concentration and focus, leading to a more profound and engaging experience. In the marketing and hospitality context, high levels of cognitive absorption are likely to result in stronger desired behavioral intentions (Zhu and Morosan, 2014; Shevchuk et al., 2019).

Building on the fundamental conceptual background, Agarwal and Karahanna (2000) describe cognitive absorption through five key dimensions: 1) Temporal Dissociation: the sensation of losing track of time during an interaction, 2) Focused Immersion: the state of being completely engrossed in an activity without any distractions, 3) Heightened Enjoyment: the pleasurable feelings derived from the interaction., 4) Control: the individual's perception of having authority over the interaction, and 5) Curiosity: the extent to which the experience stimulates an individual's sensory and cognitive interest.

AR significantly influences cognitive absorption, playing a crucial role in enhancing customer experiences, behaviors, and literacy in marketing (Massa and Ladhari, 2023). Based on the theory of situated cognition, Chylinski et al. (2020) identified AR attributes or features that could impact individuals' cognition, experiences, and behaviors. These AR affordances are known to reduce individuals' cognitive overload and ease their decision-making process, especially when comparing alternatives and making choices (Massa and Ladhari, 2023).

2.4. Perceived learning gains

Understanding consumers' perceived learning gains is crucial for enabling informed food choices and enhancing food literacy. Perceived learning gains refer to individuals' perceived improvements in learning outcomes following a specific intervention or educational experience (Georgiou and Kyza, 2021). AR has significant potential in enhancing this for individuals; studies have highlighted that narrative-based AR interventions lead to increased immersion and conceptual learning gains (Georgiou and Kyza, 2021). AR triggers cognitive flow, making users more immersed and cognitively attached to the augmented environment, which effectively delivers information and facilitates learning (Agarwal and Karahanna, 2000). Cheng (2017) also found that individuals engaged with AR environments learn and absorb content more effectively while reducing their cognitive load. In a similar line, interactive features within AR may impact customers' cognitive factors (Ali, 2022), and empower them to effectively acquire more detailed information about the food they are ordering.

2.5. Mediating role of cognitive absorption and perceived learning gains

Prior research has documented the mediating roles of cognitive absorption and perceived learning gains in the human-technology interaction literature (Reychav and Wu, 2015; Salimon et al., 2021; Lui and Goel, 2022). Cognitive absorption has been shown to significantly influence individuals' behavioral intentions through user perceptions, with perceived learning being one such outcome (Balakrishnan and Dwivedi, 2021). This effect is particularly evident in human-machine interactions, where it enhances users' intention to continue engaging with technology. Salimon et al. (2021) also found that cognitive absorption indirectly affects e-satisfaction and e-retention in learning contexts. Similarly, Goel et al. (2013) demonstrated that in virtual environments, cognitive absorption mediates the relationship between virtual cues and consumer learning. In a 3D virtual training setting, cognitive absorption positively influenced learning outcomes (Lui and Goel, 2022). These results were replicated in mobile technology contexts, where cognitive absorption significantly impacted individuals' perceived learning (Reychav and Wu, 2015). Understanding how AR fosters cognitive absorption and its effect on individual learning can help marketers create more engaging and effective communication strategies, enhance consumer decision-making, and promote greater food literacy.

The serial mediating role of cognitive absorption and perceived learning gains can be drawn from existing theories in education literature, especially in the topic of user engagement and learning. Cognitive absorption, which reflects deep engagement and immersion in an experience (Agarwal and Karahanna, 2000), enhances perceived learning gains by facilitating information processing and retention (Webster and Ho, 1997). In turn, greater perceived learning gains can positively influence behavioral intentions, as individuals who feel they have acquired valuable knowledge are more likely to act upon it (Fishbein and Ajzen, 1977). Therefore, based on the literature, we expect that the flow experience (i.e. cognitive absorption) and the learning experience gained from the AR medium are likely to increase individual's behavioral intentions. In other words, customers presented with FTT information using AR menus are expected to experience higher cognitive absorption, or flow, and perceive greater learning gains, which ultimately lead to their restaurant behavioral intentions. Therefore, we propose the following:

H_2. *The type of FTT information disclosure medium (AR vs. QR vs. written) influences behavioral intentions through cognitive absorption (H_{2a}) and perceived learning gains (H_{2b}). In addition, the effect of the FTT disclosure medium (AR vs. QR vs. written) on behavioral intentions is sequentially mediated by cognitive absorption and perceived learning gains (H_{2c}).*

2.6. Moderating role of brand's healthy image congruency

Addressing contextual differences, our research examines the role of brand's healthy image congruency (Fig. 1) in chain restaurant settings. Brand image congruency refers to the alignment between a brand's identity and consumers' perceptions or expectations, positively influencing customers' attitudes and behavioral intentions (Jeong and Jang, 2017; Hilken et al., 2021). According to self-congruency theory, or the image-congruency, a brand that aligns with consumers' self-image creates a positive effect, explaining how consumers evaluate such brands (Sirgy, 1982). Prior literature documents the significant moderating role of brand image in the relationship between individual perceptions and attitudes/behavior (Hsieh and Li, 2008; Jeong and Jang, 2017). Furthermore, brand logos influence individuals' cognitive processing, as incongruent logos can significantly disrupt cognitive processes and affect consumer behavior (Dini et al., 2022). Furthermore, the alignment between a brand and its sponsoring firm enhances brand equity, fostering more favorable perceptions and reducing cognitive strain (Groza et al., 2012). Similarly, when brand identity aligns with consumer perception, it bridges gaps in understanding and improves cognitive engagement and learning (Sotiriadou et al., 2025). We apply this logic to understand consumers' cognitive psychology when interacting with extended reality menus. Higher brand congruency is expected to reduce cognitive disruption, thereby enhancing cognitive engagement and learning gains, ultimately strengthening behavioral intentions.

More specifically, perceived congruity between a restaurant's

healthy brand image and its healthy menu items influences customers' perceptions of nutritional information credibility and attitudes towards menu healthiness (Jeong and Jang, 2017). Since FTT information is closely tied to building a healthy and transparent restaurant image (Buck et al., 1997), congruency with a healthy brand image may affect customers' cognition regarding FTT disclosure when interacting with AR menus. We particularly employ this concept within the chain restaurant setting, as prior research has evidenced the impact of brand image on chain restaurant performance (Hyun and Kim, 2011). Consequently, we expect that when AR experiences align with the chain restaurant's healthy brand image, they can enhance cognitive absorption, and further impact learning gains, leading to stronger behavioral intentions. Therefore, we propose the following H3:

H3a. *The positive effect of the FTT disclosure medium on behavioral intentions is stronger when the restaurant's healthy brand image is congruent with the FTT information delivered via AR. H3b: The positive indirect effect of the FTT disclosure medium on behavioral intentions through cognitive absorption and perceived learning gains is positively stronger when the restaurant's healthy brand image is congruent with the FTT information delivered via AR.*

Taken together, we propose our conceptual model as illustrated in Fig. 1.

This study combines media richness theory (MRT) and image congruency theory (ICT) to explore how AR influences customer behavioral intentions in restaurant settings. MRT suggests that richer media, which offer interactivity and sensory engagement, are more effective at conveying complex information (Daft and Lengel, 1986). In Study 1, as a richer medium, AR is expected to better engage customers by providing dynamic, immersive content on ingredient sources, influencing their intention to visit local restaurants, compared to QR or traditional menus. Study 2 extends this by applying ICT to examine the moderating role of a chain restaurant's healthy brand image. ICT posits that consumers engage more with brands when there is congruence between the brand's image and their expectations (Sirgy, 1982). This study explores how AR's FTT disclosures resonate with customers who perceive the restaurant's brand as aligned with health and sustainability values, thus influencing their likelihood to visit and share about the restaurant. Together, these theories offer a comprehensive framework for understanding how AR's media richness and brand image impact customers' behavioral intentions.

3. Study 1

3.1. Methods (Local Farm-to-table Restaurant Setting)

Study 1 was a single-factor three-group between-subjects experiment (FTT disclosure medium type: AR vs. QR code vs. written). According to the media richness, we compared QR codes and written menus to the AR menus. QR code menus typically include photos and more detailed descriptions compared to conventional written menus, positioning them between traditional menus and AR menus in terms of interactivity (Ozturkcan and Kitapci, 2023). A total of 243 participants from United States were recruited through MTurk for an online experiment. As there is substantial scientific evidence supporting the validity and representativeness of using MTurk for consumer research data (Chmielewski and Kucker, 2020), we adhered strictly to recommended guidelines to ensure high-quality responses for the data collection (Aguinis et al., 2021). The survey was developed using Qualtrics and received approval from the Institutional Review Board. Measures were taken to assure participants of anonymity and confidentiality (Kock et al., 2021). Attention-check questions were strategically placed throughout the questionnaire to further ensure response quality and responses that failed to answer the questions were removed, leaving 193 responses. Respondents aged from 20 to 68 had an average age of 33.14 years. Among them, 65.1 % were male, 75.1 % had a college degree, and 56.7 % had an annual income level over $40,000.

Respondents were randomly assigned to one of three experimental conditions (See Appendix 1). Descriptive scenarios based on a fictitious farm-to-table themed local restaurant were given to all participants, with the same menu designs and wordings, but only manipulating the mediums. The mediums were presented as menus customers would use to order their food in restaurants. Scenario-based surveys are widely used in hospitality research to explore technological innovation, as they are considered valid and cost-effective alternatives to real-world experiments (Ye and Mattila, 2022). The exposure time of the stimuli for each group was checked to ensure participants experienced them. The participants were asked to imagine that they were in a local restaurant trying to order its signature burger dish. We controlled the menu item, as burgers are one of the most popular dishes to the U.S. population (Finmore, 2024). Next, each group experienced the FTT information disclosure process through their respective medium (AR, QR code, or written). FTT information included statements such as "From our own farm, we are receiving lettuce, herbs, and cucumbers," "Tomato and peppers from Kott Farms, mushrooms from Miki Fungi…" "In addition

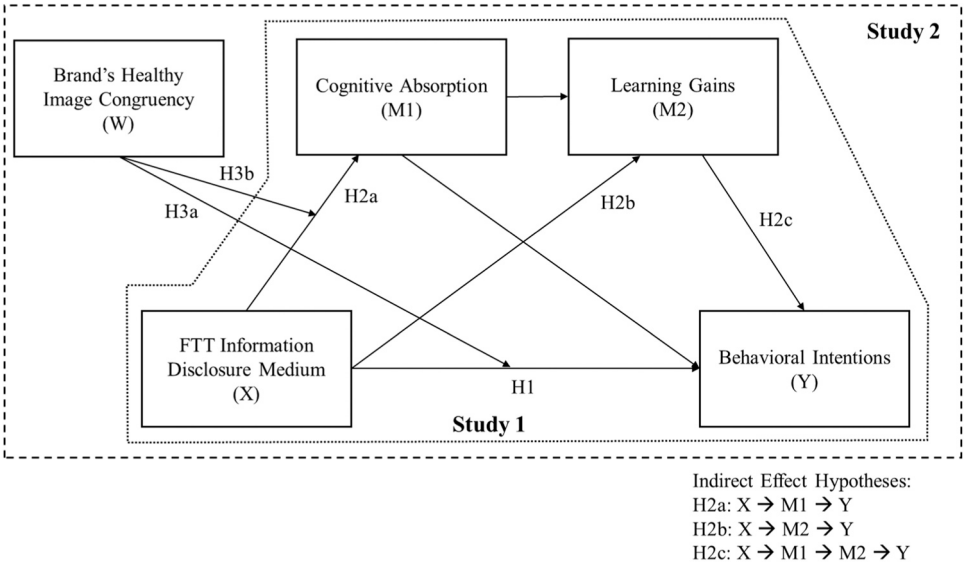


Fig. 1. Proposed conceptual model.

to our partnership with Native American ranchers in our state, we are butchering our own farm-raised beef." For the AR menu group, participants received an AR code with specific instructions, enabling them to view a 3D AR burger menu on their devices, such as phones or tablets with a camera. To ensure full exposure to the stimulus and mitigate potential buffering issues, we also provided a short video demonstrating how the AR menu functions. They were also shown an example of the interactive features of the AR burger to explore further information about the ingredient sources (e.g., Find out how we take care of our greens, Find out more about our Rancher partnerships). To prevent technical difficulties, an additional video of the AR experience was provided at the end. For the QR menu condition, participants scanned a QR code that displayed the burger menu and FTT information on separate static, digital pages. While both QR and AR formats involve scanning, we deliberately selected these conditions to reflect realistic and increasingly common restaurant technologies. The QR format serves as a meaningful intermediary between static written menus and fully immersive AR menus, offering limited interactivity and linear information access, whereas AR delivers a more engaging experience through 3D visuals and interactive features that enhance cognitive engagement (Poushneh and Vasquez-Parraga, 2017; Rauschnabel, 2021; Yim et al., 2017). The last group received a conventional written menu.

Respondents were asked to evaluate the realism of the food menu and the difficulty of imagining the actual food they would receive (1 = extremely unrealistic, 7 = extremely realistic). They were also asked about the interactivity of the menu (1 = not interactive at all, 7 = fully interactive) and questions regarding the trust and transparency of the FTT information (1 = strongly disagree, 7 = strongly agree). Additionally, we included questions using 7-point Likert scales to assess cognitive absorption based on five dimensions adapted from Agarwal and Karahanna (2000) (α =.92). We also measured perceived learning gains adapted from Barzilai and Blau (2014) (α =.70) and behavioral intentions adapted from Ryu et al. (2010), including visit intentions (α =.70) and information-sharing intentions (α =.81). Prior literature suggests that previous experience with technology, AR familiarity, and personal innovativeness influence AR acceptance (Wu et al., 2021); therefore, these factors were controlled. Additionally, food literacy (i.e., interest in ingredient sources) was controlled, as it could impact the experiment testing FTT information (Benjamin and Virkler, 2016). The final section of the survey collected demographic data, such as gender, age, ethnicity, income, and educational level. Demographics did not show any significant differences among the groups.

3.2. Results

Data was analyzed using the Statistical Package for Social Sciences (SPSS) 27 and Mplus 8. First, we confirmed that the randomization was effective; randomization check results showed a high level of awareness of the menu manipulations with over 90 % of reporting the cues for all three manipulations (AR 98.9 %, QR 95.5 %, and Written 90.0 %) (AR=66, QR=65. Written=62). Realism questions indicated that participants perceived the menu as highly realistic (M = 6.01, SD = 1.03). Ensuring realism and incorporating a manipulation check help validate the authenticity of the experiment and confirm that participants meaningfully engaged with the conditions, thereby strengthening the validity of the findings (Leung et al., 2024). When asked about the difficulty of imagining the actual food they would receive, participants mentioned it was highly imaginable (M = 5.74, SD = 0.93). For the manipulation check, we used a one-way ANOVA to test the manipulation of the medium. Our manipulation was successful, showing that the AR group experienced higher menu interactivity compared to both the QR group and the written group (M_{AR} = 5.97, M_{QR} = 4.86, $M_{written}$ = 4.71; F = 20.10, p = .00).

To understand the effect of mediums on consumers' cognitive factors and behavioral intentions, we utilized Univariate one-way analysis of variance (ANOVA). Results indicated that participants who were engaged with AR menus as a FTT disclosure medium had higher cognitive absorption (F=11.88, p < .001) and perceived learning gains (F=4.29, p < .001). As expected, they showed significant differences in their behavioral intentions: AR group had the highest intentions to visit the restaurants (F=8.57, p < .001) and share the menu experience (F=10.26, p < .001) than the other two groups. The written and QR group did not show significant differences (Fig. 2).

A mediation analysis was conducted using Hayes PROCESS Model 6 and 5000 bootstrap samples to examine the serial mediation effects of the FTT disclosure medium (multicategorical indicators: AR, QR, written) on behavioral intentions, with cognitive absorption and learning gains as mediators (Hayes, 2012; Hayes and Preacher, 2014). AR medium served as the reference category. The overall model predicting behavioral intentions was significant (R^2 = 0.54, $F(4)$ = 52.6807, p < .001). Both cognitive absorption (β = 0.62, SE = 0.12, p < .001) and learning gains (β = 0.28, SE = 0.10, p < .01) were significant predictors of behavioral intentions. However, the direct effects of QR (β = −0.10, SE = 0.08, p = .24) and written (β = −0.11, SE = 0.09, p = .19) mediums on behavioral intentions were not significant, indicating that the FTT disclosure medium itself did not directly influence behavioral intentions.

The indirect effects through cognitive absorption showed AR significantly leads to higher cognitive absorption and thus higher behavioral intentions compared to QR (Effect = −0.22, BootSE = 0.08, 95 % CI = [-0.41, −0.09]) and written (Effect = −0.22, BootSE = 0.09, 95 % CI = [-0.42, −0.08]) mediums (H2a accepted). However, the indirect effects of the medium through learning gains did not have a significant effect for AR when compared to both QR (Effect=.03, BootSE = 0.03, 95 % CI [-0.01 0.09]) and written (Effect=0.02, BootSE = 0.02, 95 % CI [-0.02 0.06]) (H2b rejected). Additionally, the serial mediation results indicated that disclosing FTT information through AR had a significant and stronger effect compared to the QR (Effect = −0.10, BootSE = 0.05, 95 % CI = [-0.21, −0.01]) and written (Effect = −0.10, BootSE = 0.05, 95 % CI = [-0.19, −0.01]) mediums, which showed negative indirect effects (H2c accepted).

In summary, results from study 1 indicate that customers engaged with AR menus had a greater intention to visit the restaurant and were more inclined to share their menu experience than those in the other two groups (written and QR). Cognitive absorption played a significant role in understanding the relationship between the type of menu mediums and behavioral intentions, while learning gains only showed a significant impact within serial mediation. In other words, although perceived learning gains did not solely impact intentions, when individuals were cognitively absorbed in the FTT information about the restaurant via AR, it increased their perceived learning gains, which ultimately impacted their behavioral intentions towards the restaurant.

Next, we aimed to generalize the AR effect in disclosing FTT information in chain restaurants. Synchronization between a restaurant's healthful brand image and promoted menu enhances consumers' perceived credibility and positive attitude (Jeong and Jang, 2017), having potential to affect their cognitive factors and behavioral intentions. Therefore, based on the congruency theory (Sirgy, 1982), we tested whether the congruency between a company's healthy brand image and customer perceptions interacted with the media platforms and impact their cognitive factors and behavioral intentions.

4. Study 2

4.1. Methods

Based on the results of study 1, we aimed to test the moderating effect of brand's healthy image congruency (H3). Study 2 was designed as a 2 (FTT disclosure medium: AR vs. QR) x 2 (brand's healthy image congruence: low - Mcdonald's vs. high - Panera Bread) between-subjects factorial design. To add further insights about the AR effects, we also explore the pre and post brand image perception after being exposed to

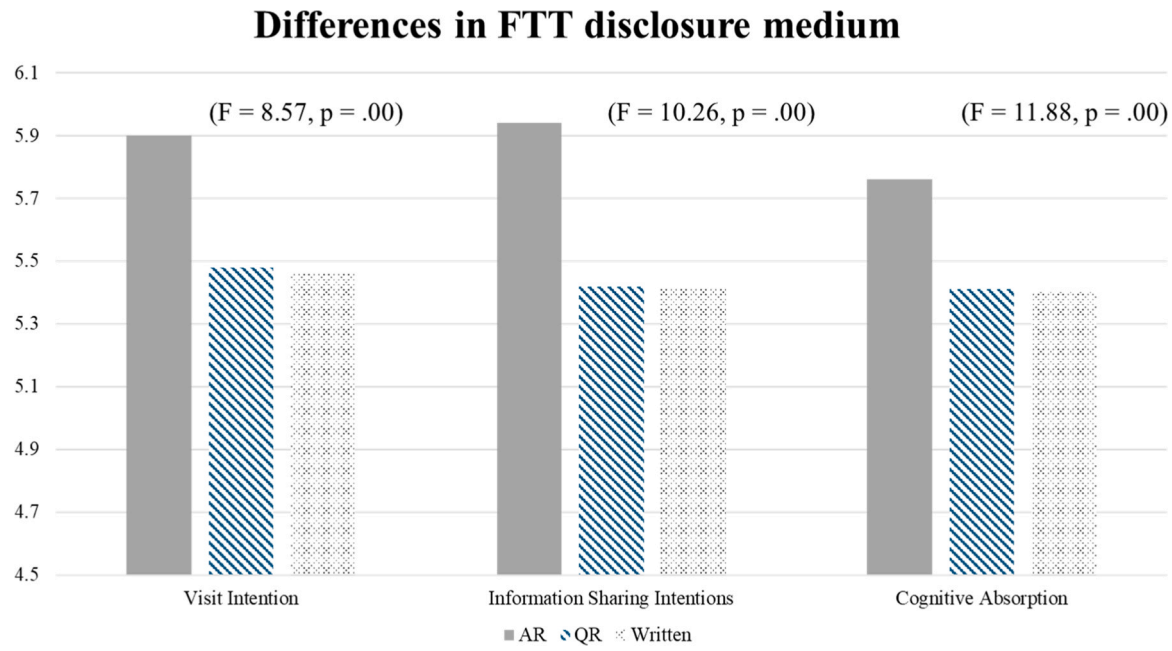


Fig. 2. ANOVA results for study 1.

the mediums. Since no significant difference was detected between the QR and written in study 1, we only compared the AR and QR groups.

We first conducted a pretest to ensure the validity of the stimuli and the congruence levels of the brand images. To increase realism, we utilized the real-world franchise brands (Burger King, Chipotle, McDonald's, Panera Bread, Subway, Taco Bell, etc.) listed from prior literature that determined the perceived healthiness of the restaurant brand (Choi and Reid, 2018; Kim and Zapata Ramos, 2018). A pre-test was conducted with Amazon Mturk. To perform a pre-test, we recruited participants (n = 30) and asked them to evaluate the perceived healthiness of the given brands. Example questions were *"How would you describe the brand's image?" "Rate the healthiness image of the brand."* The results showed that McDonald's had the lowest perceived healthiness ($M_{McDonald's}$=4.80), and Panera Bread had the highest ($M_{Panera\ Bread}$=5.87) (7-point Likert scale). While the low congruency group exhibited relatively high healthiness ratings, prior online experimental studies have demonstrated that manipulations commonly produce elevated mid-range scores but with successful manipulation (Ye and Mattila, 2022). The group differences of simple contrast analysis were significant ($t = 2.73$, $p = .01$). Therefore, we selected McDonald's brand to represent low congruence and Panera Bread to represent high congruence in terms of a healthy brand image.

In terms of FTT disclosure, McDonald's has established connections with local suppliers and farms, demonstrating efforts to source ingredients responsibly (McDonald's, n.d.). However, as a quick-service restaurant, its primary communication channels - such as kiosks and online menus - limit the effective conveyance of these practices (McDonald's Korea, n.d.). Similarly, Panera Bread emphasizes partnerships with local farms and suppliers, as outlined in its responsibility report, yet these efforts are mainly shared through written materials that may not fully engage consumers (Panera Bread, 2021). Further, the FDA rules effective in 2026 is expected to significantly impact large-scale companies. Thus, AR presents an opportunity to bridge this communication gap by integrating sourcing transparency directly into restaurant menus, making such information more accessible and immersive. Given these considerations, testing the brands related to FTT is a reasonable and relevant approach for this research.

We collected 243 U.S. participants via Mturk. After the data cleaning process identical to study 1, 219 responses were used for the analysis. Respondents aged from 20 to 67 with an average age of 34.34 years. 40 % was female, over 74.1 % had a bachelor's degree or higher education, and 63 % had an annual income level over $40,000. Respondents were randomly allocated to one of the four experimental conditions (See Appendix 2). Like Study 1, respondents were asked to imagine themselves ordering food at a chain restaurant. Scenarios and brief descriptions about the restaurant brand were provided. The design of the AR and QR menus was manipulated using real menus from McDonald's and Panera Bread. For both AR and QR menus, scannable codes were provided, and FTT information was disclosed. Specific instructions for the experience were clearly explained. Before being exposed to the medium, respondents provided their initial perceptions related to the perceived healthiness of the brand. After the experience, they answered a set of questions about their perceptions of the brand, cognitive absorption, learning gains, and behavioral intentions (visit and sharing intentions). 7-point Likert scale measurement items for pre- and post-brand image were adapted from Jeong and Jang (2017) (e.g., "The image of the chain restaurant brand is healthy."). Items for other constructs were identical to those used in Study 1. Similar to study 1, study 2 included control variables including personal innovativeness, AR familiarity, prior AR usage experience, and food literacy. Additionally, we controlled for brand familiarity and prior perceptions of the brand regarding its innovativeness, transparency, and environmental commitment, particularly in relation to ingredient source disclosure.

4.2. Results

Based on the randomization results, over 90 % of participants in the QR-McDonald's group (n = 53) saw the AR menu pop-up, 94.8 % in the AR-McDonald's group (n = 55), 94.8 % in the QR-Panera group (n = 55), and 96.6 % in the AR-Panera group (n = 56). Manipulation check results showed that McDonald's was relatively unhealthy ($M_{McDonald's}$=5.06) and Panera as healthy (M_{Panera}=5.95) ($t = 6.03$, $p = .00$). The perceived interactivity of the medium also showed significant differences (MAR=6.19, M_{QR}=5.42, $t = 6.47$, $p = .00$), thus showing successful manipulation.

Our paired sample statistics revealed pre- and post-differences in chain brand image when FTT information was disclosed via each medium (Fig. 3). The effect was particularly strong for the low congruent group (McDonald's), with significant changes observed before and after exposure to AR and QR stimuli. No significant differences were detected

for the high congruent group (Panera) using the QR menu, but significant differences were found for this group using the AR menu. In summary, while disclosing FTT information via both mediums effectively enhanced a franchise's healthy brand image, the effects were stronger for the AR group and significantly differed before and after the exposure.

The MANOVA analysis shows the FTT disclosure medium (AR vs. QR) has significant differences in predicting information sharing intentions ($F=14.97$, $p < .001$) and visit intentions ($F=33.07$, $p < .001$) (Fig. 4). The interaction effect of brand's healthy image congruency and mediums was also significant for both sharing intentions ($F=4.92$, $p < .05$) and visit intentions ($F=4.42$, $p < .05$), indicating the significant moderating role of brand's healthy image congruency (H3a accepted).

Additionally, Hayes PROCESS Model 83 was performed to test the serial mediation and moderated mediation. Results of the indirect effects successfully replicated results from study 1, showing cognitive absorption and learning gains played as important role as mediators, while learning gains did not solely impact customer's visit intentions (H2a: Effect=-.28, BootSE =.07, 95 % CI [-.44 −.16]; H2b: Effect=-.04, BootSE=.03, 95 % CI [-.10.00]; H2c: Effect=-.06, BootSE=.02, 95 % CI [-.09 −.02]) and sharing intentions (H2a: Effect=-.16, BootSE =.08, 95 % CI [-.33 −.01]; H2b: Effect=-.02, BootSE=.01, 95 % CI [-.05.01]; H2c: Effect=-.02, BootSE=.01, 95 % CI [-.04 −.00]). However, there were no signs of moderated mediation, rejecting H3b.

In summary, study 2 results showed that AR effectively disclosed FTT information for both high congruence (Panera) and low congruence (McDonald's) brands. Providing FTT information increased perceived healthiness for both, with McDonald's showing stronger pre- and post-exposure differences. AR had a greater overall effect, particularly on sharing and visit intentions, with stronger results for Panera than McDonald's, suggesting that high congruence with a healthy brand image naturally enhances cognitive processing, leading to higher behavioral intentions. However, providing FTT information remained valuable for predicting behavioral intentions for low-congruence brands, regardless of the medium.

5. General discussion

Our overall results reveal the differential impact of the AR menu medium for FTT information disclosure on individuals' behavioral intentions concerning local and franchise restaurants. Our findings support the media richness theory (Daft and Lengel, 1986), which posits that the ideal medium should be used to convey specific types of information by showing that AR medium is more effective due to its high level of media richness. Given that FTT information is often expansive, many food establishments have resorted to using extra boards or condensing the information into their menus. However, this study demonstrates that AR technology offers an alternative platform for conveying such information, catering to individuals who seek detailed insights into how their restaurant dishes are prepared. The interactive features of AR enable consumers to access information more efficiently and conveniently compared to the limited content presented by conventional menus. As anticipated, the heightened interactivity provided by AR was more influential than other mediums in promoting FTT information.

Moreover, our findings uncover the cognitive mechanisms through which AR mediums influence customers' behavioral intentions. This relationship was mediated by the flow experience (i.e., cognitive absorption) and learning gains, supporting cognitive absorption theory (Agarwal and Karahanna, 2000). This indicates that customers who engage with AR menus within a restaurant are more likely to be cognitively absorbed, which enhances their perceived learning gains related to the ingredient sourcing of their ordered dish, thereby influencing their behavioral intentions. This is consistent with previous studies suggesting that AR reduces cognitive overload and facilitates decision-making (Massa and Ladhari, 2023). Additionally, it aligns with the notion that AR's interactivity in menus can enhance an individual's learning process, allowing them to absorb more detailed information about their food (Lee et al., 2018). Lee et al. (2018) explored written, image, and video formats, while our research focused on more recent emerging trends in menu mediums, such as AR. An interesting finding of our study was that cognitive absorption emerged as a critical factor in explaining the overall mechanism. This is also in line with the results from Petit et al. (2022), indicating that immersion plays an important role as a mediator. Across both our study 1 and study 2, we found that perceived learning gains alone did not fully account for behavioral intentions; rather, our significant serial mediation revealed that cognitive absorption enhanced perceived learning gains, highlighting the role of AR as cognitive absorption is one of its key strengths. Therefore, cognitive absorption lays the ground for predicting other important factors such as perceived learning gains and behavioral intentions.

Following Ali's (2022) suggestion to cross-validate the effects of AR in different restaurant settings, we conducted further analysis in a franchise restaurant context, revealing the moderating role of healthy brand congruency. Consistent with prior research (Jeong and Jang, 2017), our findings show that the level of congruity (high vs. low) between the healthy brand image of the franchise and FTT information impacts customers' perceptions of the brand's healthiness and their

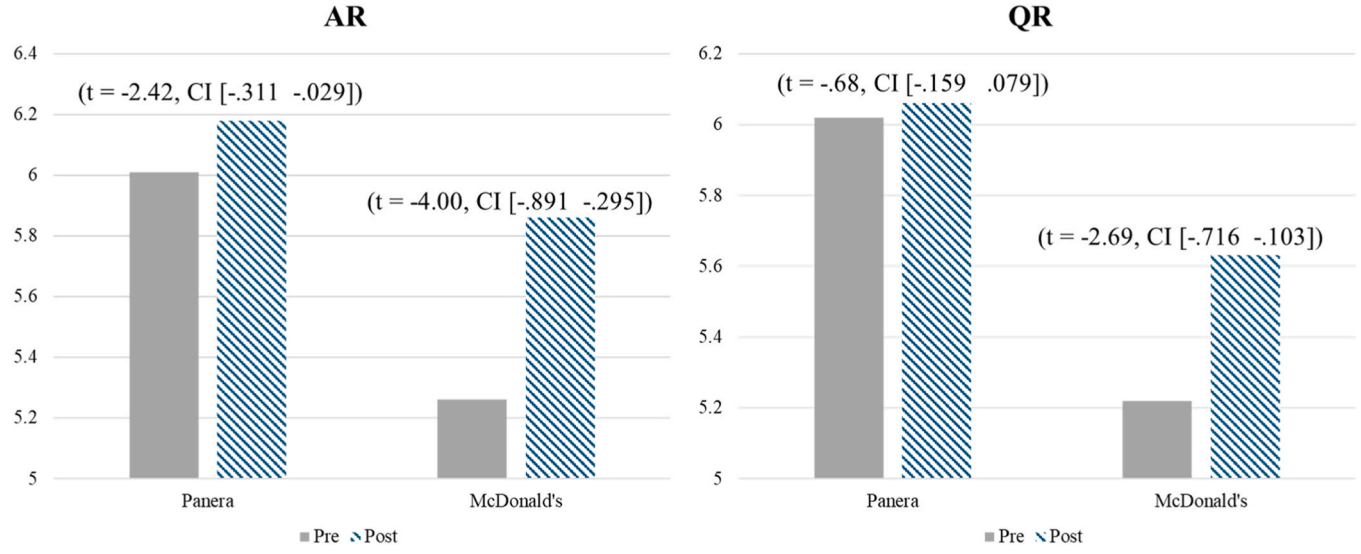


Fig. 3. Pre and post differences in healthy brand image.

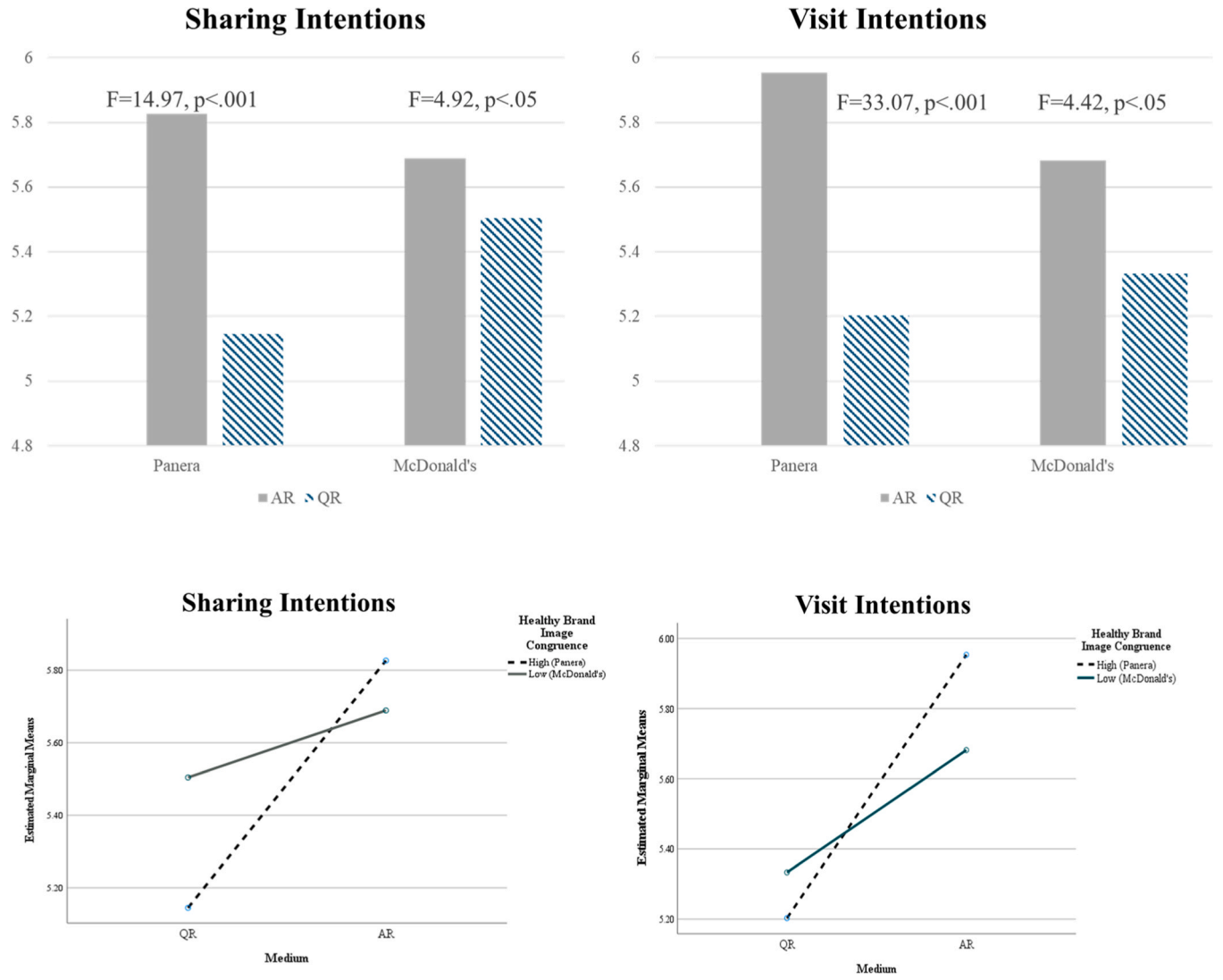


Fig. 4. Interaction effect between FTT medium and brand image on behavioral intentions.

behavioral intentions. Specifically, the pre- and post-exposure differences after interacting with AR and QR menus containing FTT information indicated that exposing this information to the low-congruent group (McDonald's) resulted in stronger differences in perceived brand healthiness. This underscores the importance of disclosing FTT information, especially for franchises with low congruency between the brand image and the information. Additionally, while subtle, AR menus were more effective for both high and low congruency groups.

The interaction effect between the mediums and brand congruency also yielded interesting results. For high congruity brands (Panera), AR effects were stronger than QR effects. When FTT information was presented via QR, the effects on behavioral intentions were similar to those in the low congruent group (McDonald's). However, when interactive AR features were used to convey FTT information, the high-congruity group showed a rapid increase in predicting both sharing and visit intentions. In other words, for McDonald's, providing FTT information through any medium was effective in enhancing customer behavioral intentions. This suggests that providing FTT information overall enhances individuals' knowledge of healthy foods and strengthens behavioral intentions, as evidenced by Lee et al. (2018). However, for Panera Bread, AR produced more pronounced differences compared to QR. We hypothesize that for brands perceived as healthy, customers may expect to see FTT or related health information more frequently than for brands perceived as less healthy. Such expectations may lead customers to take the information for granted or not notice it distinctly, but the effectiveness of information delivery is amplified when AR technology is employed, leading to higher intentions. Cognitively, when consumers' brand image regarding healthiness aligns with the FTT information, AR strengthens the decision-making process, thereby enhancing customers' behavioral intentions. This again aligns with the findings of Jeong and Jang (2017), which show that the alignment between a restaurant's healthy brand image and its menu enhances customers' favorable attitudes. Finally, our results expand on this by highlighting the role of different menu mediums interacting with brand image congruency.

6. Conclusion

6.1. Theoretical contributions

This research has several theoretical contributions. First, this research lies in its advancement of the literature on AR menu applications by examining the underexplored domain of food sourcing disclosure, particularly FTT information. While prior AR menu studies have primarily focused on enhancing menu visualization or promoting indulgent consumption (e.g., Batat, 2021; Ali, 2022; Bae and Kim, 2024), our study shifts the focus toward the cognitive and behavioral impact of AR-facilitated transparency in food sourcing, which is a critical and timely issue in hospitality. By experimentally investigating how

AR affects consumer responses to FTT disclosures, we go beyond viewing AR solely as an experiential enhancement tool and demonstrate its potential as a persuasive medium for conveying complex, value-driven information like FTT. This discovery also opens new possibilities for sourcing disclosure mediums, advancing beyond prior research that focused on conventional menus or visual components (Lu and Chi, 2018; Lee and Kim, 2020).

Second, while cognitive mechanisms have been widely explored in human-computer interaction research, the specific cognitive processes involved in engaging with AR menus for ethical or informational content, such as food origin, have not been examined in hospitality contexts. Our findings reveal that AR can mitigate information fatigue and enhance engagement through reduced cognitive load, offering a new lens on how AR supports information processing in value-oriented decision-making. Additionally, by linking cognitive absorption to perceived learning gains, our study identifies a mechanism connecting AR media to customer behavioral intentions, thus extending theoretical understandings of how immersive technology can influence not just experience, but the learning process and future behavior in restaurant settings.

Last but not least, by integrating the image congruency theory with the media richness theory, our study provides empirical evidence that a brand's healthy image congruency can serve as a potential moderator in AR-based research within the hospitality industry. Based on this, our research extends the theoretical boundaries to the underexplored context of AR menu environments. It demonstrates how congruency and interactivity function in experiential consumption settings like restaurants and offers a framework for future AR studies focused on restaurant branding. This integration also refines brand–consumer congruency theories by highlighting that congruence operates not only at the product–brand level but also at the brand–technology interface. In doing so, it adds nuance to existing theory by introducing technology-mediated menu experiences as a meaningful moderating factor. Furthermore, our findings suggest that customer responses to healthy branding may differ based on restaurant type, underscoring the importance of understanding these dynamics, particularly in AR-integrated dining contexts.

6.2. Practical implications

This study offers several practical implications. First, restaurants are encouraged to leverage effective mediums like AR for disclosing FTT information. Our findings show that AR enhanced menus for FTT disclosure is more effective and appealing to customers, enhancing their intentions to share and visit the restaurant. Managers and marketers in both local and chain restaurants can use this tool to transform customer engagement through interactive and immersive experiences, fostering stronger reliability and transparency, which could lead to higher customer loyalty. However, it is important to consider the potential ethical considerations of using AR menus for FTT information disclosure, such as ensuring transparency, preventing misleading information, and protecting consumer privacy when collecting data through interactive technologies.

Second, our study addresses real-world challenges restaurants face in communicating food source (i.e., FTT) and sustainability values. A primary issue is the limited space available on menu displays, whether printed, on digital kiosks, mobile apps, overhead boards, or drive-thrus, which constrains the delivery of detailed information. Additionally, FTT-related content is often accessed through websites or company reports, requiring proactive individual searches. In this context, AR-enhanced menus offer a practical solution by enabling interactive, layered information delivery without overwhelming the primary interface. Furthermore, with the FDA's Food Traceability Rule taking effect in 2026, restaurants will be required to maintain and potentially share more transparent sourcing records, making consumer-facing solutions like AR increasingly relevant.

Third, understanding the cognitive mechanisms that predict customer behavioral intentions when using AR allows restaurants to tailor their menu and FTT disclosure strategies to attract health-conscious customers. The more interactive and immersive the FTT disclosure, the more likely customers are to be cognitively engaged. Menu designers can use AR to reduce cognitive overload by providing detailed FTT information in an engaging, easy-to-navigate format, helping customers make informed decisions without feeling overwhelmed. Since cognitive engagement is strongly tied to individual learning gains, restaurants can use AR to meet the needs of consumers increasingly concerned about procurement process and souring of their food. This strengthens the restaurant's market position as a leader in transparency and health consciousness, contributing to food literacy, healthy eating habits, and appealing to the growing health-conscious population post-pandemic.

Fourth, for franchises with established brand names, tailoring FTT information delivery based on brand health image congruency is a key strategy. Franchise restaurants often struggle with brand health perception, and AR can help improve customer attitudes and intentions. For example, brands with a high healthy image, like Panera, can use AR to reinforce their health-focused reputation. Conversely, brands with a lower health image, such as McDonald's, can utilize AR to enhance perceived healthiness, though any means of providing FTT information should be advanced to build trust and a healthier brand image. Likely, Stakeholders of fast-food companies are likely influenced by their healthy corporate image (Kim and Zapata Ramos, 2018), and our research offers a practical solution to mitigate the negative health-related perception of a fast-food franchise.

Finally, this study's findings align with key Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production). By showing that AR can effectively communicate FTT information and influence consumers' perceptions of brand healthiness, the study supports informed decision-making and healthier food choices (SDG 3). It also encourages restaurants, both local and chain, to engage in farm-to-table and hyper-local sourcing, strengthening ties with local farms and promoting urban agriculture (SDG 11). Additionally, the study highlights how transparency through AR could foster responsible consumption, as consumers are more likely to engage with and act on food source information when delivered interactively, supporting SDG 12. Overall, the research underscores the role of technology in advancing sustainable and health-conscious food systems.

6.3. Limitations and future research

This study is not free from limitations. First, as the study was conducted as an online experiment, it may have lacked realism. Although we provided actual AR experiences, the use of fictional restaurants, limited menus, and the absence of environmental or spatial cues may likely reduce the realism of the AR experience. Future studies could benefit from field studies or lab experiments that control environmental conditions and enhance realism. Additionally, our sample's gender distribution and income level may limit its representativeness of the broader dining population, a limitation that future studies could address through more accurate sampling. Moreover, AR experiences could be enhanced, by including the real interactive features. Further, although controlled to our best extent, we acknowledge that other factors such as menu items, price, personality traits, or demographic variables could influence the AR experience, which could be explored in future studies. Additionally, our study focused on two brands with different levels of brand's healthy image congruency. We recognize that a wider range of brands could be explored within this context. Therefore, future research is encouraged to cross-validate or contrast these findings using other franchise brands. Third, our research is based on U.S. customers and U.S. franchise brands. Future studies could conduct cross-cultural research to explore potential cultural differences in the adoption of AR mediums for FTT disclosure. Finally, while our study concentrated on cognitive absorption and learning gains, future research could expand the mechanisms related to FTT disclosure and AR mediums. Identifying new

moderators and exploring contextual differences could provide valuable insights into the role of AR in information disclosure.

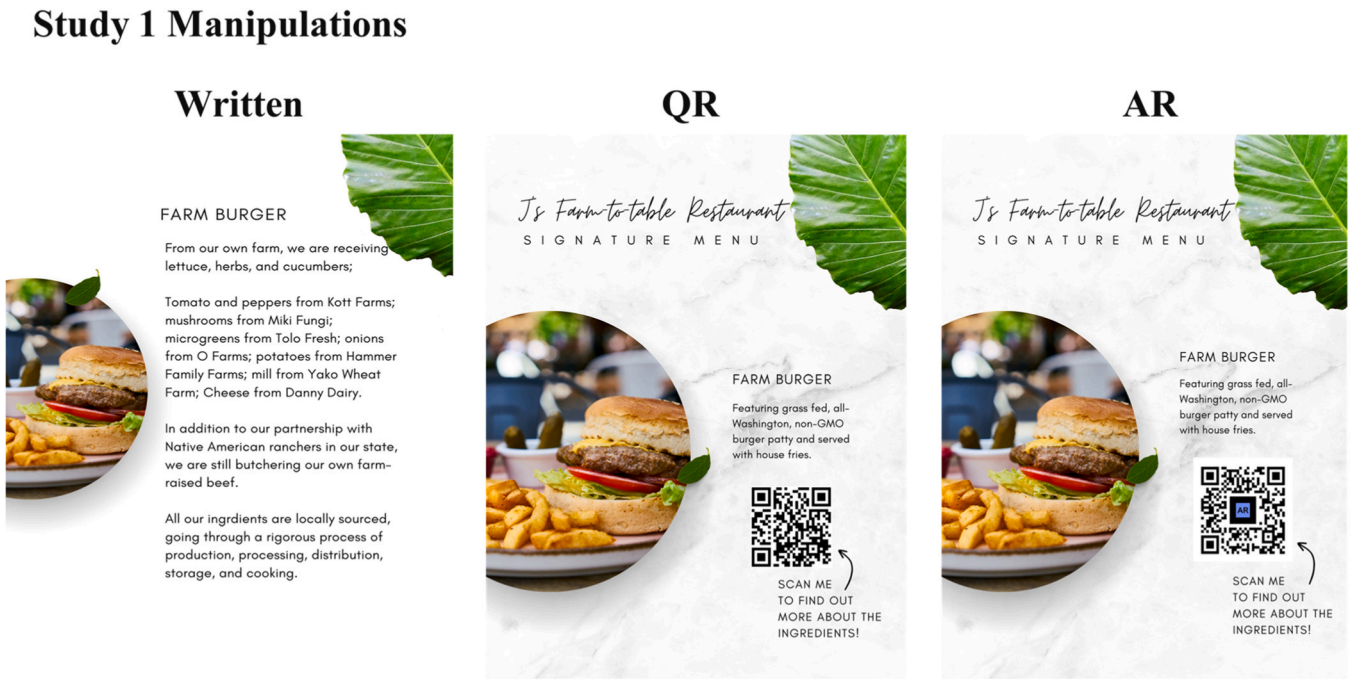
CRediT authorship contribution statement

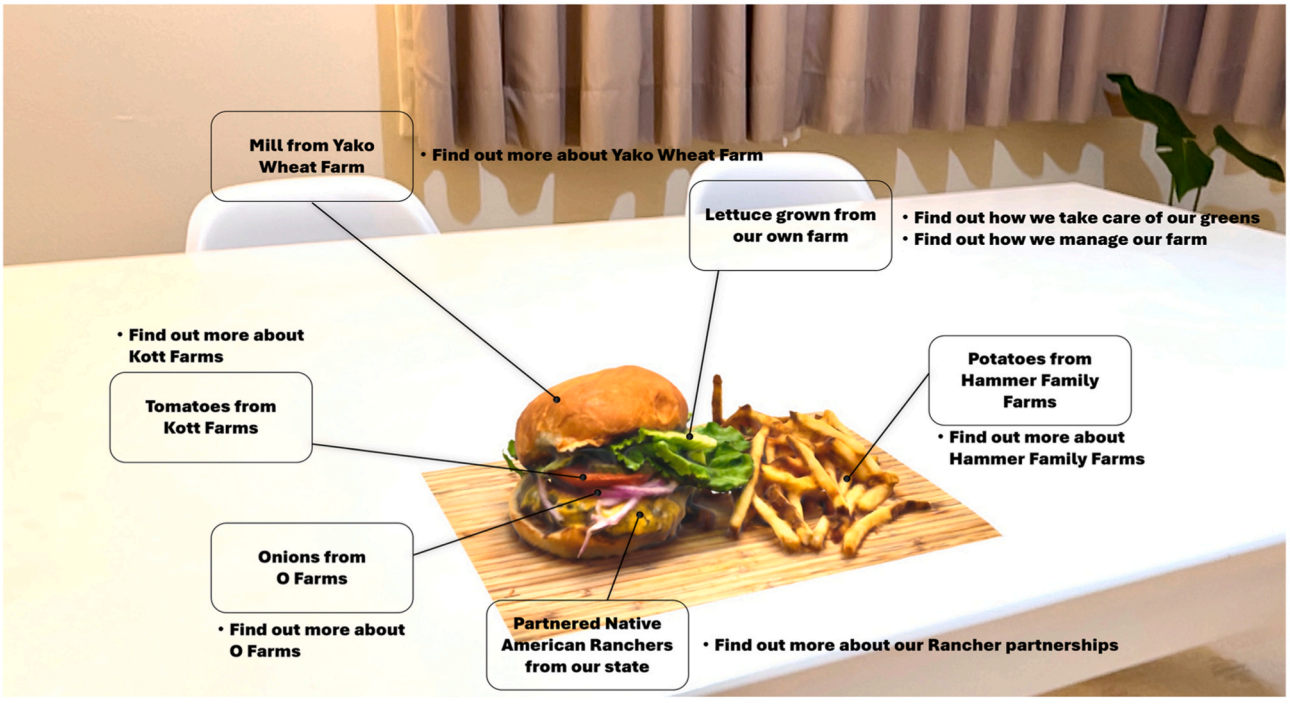
Soobin Seo: Writing – review & editing, Supervision, Resources, Project administration, Methodology, Investigation, Conceptualization. **Jiyoon (Jennifer) Han:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Elizabeth A. Howlett:** Writing – review & editing, Supervision, Investigation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1





Appendix 2

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