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Review

Virtual Tasting in the Metaverse: Technological Advances and Consumer Behavior Impacts

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Abstract: Product tasting is a key element in improving customer satisfaction in the commercial environment. This study looks at the notion of traditional tasting and its effect on customer behavior and explores emerging tasting techniques, shedding light on the contribution of digital tasting. Indeed, the advent of the metaverse has made it possible to offer new virtual tasting experiences. However, this experience does not yet involve a sense of taste. Our manuscript highlights the potential of tasting in the metaverse through a descriptive study of various concrete cases of international brands that have included it in their marketing strategies. In light of the results, practical and theoretical recommendations are provided for professionals interested in leveraging virtual tools to improve consumer satisfaction.

Keywords: metaverse; virtual tasting; virtual reality; virtual sensory experience; consumer behavior

1. Introduction

Companies resort to product tasting to seek consumer satisfaction at the point of sale. Through this experience, the customer forms a perception of the product, which can influence their purchase decision. According to Peynaud [1], tasting consists of experimenting, analyzing, and assessing organoleptic characteristics, particularly the olfactory–gustatory attributes of a product. This definition highlights the consumer's interaction with their five senses to fully appreciate the product and facilitate their purchase decision. The tasting completes the promotion of the product by offering a concrete experience [2]. Marketers and wine managers agree that tasting experience rooms strongly influence customer satisfaction, repeat purchase intentions, tasting room sales, and profits [3].

Although widely used and appreciated by consumers, physical tasting has several limitations that could affect its effectiveness and scope. First, it is geographically limited, which may exclude consumers located in remote areas. Second, physical tasting generates transport and storage costs, as the products must be transported and kept at the tasting sites. In addition, the organization of the physical tasting requires significant human and financial resources, especially for purchasing products, renting spaces, and remuneration of staff. Training tasting staff can also be costly for businesses with limited financial resources.

Technological development has given rise to new forms of innovations exploited by business owners as a means of improved and advanced marketing to meet some of the challenges of physical tasting. Among these innovations, we find the appearance of the metaverse as a tool offering a virtual shopping experience to customers. In 1992, Neal Stephenson, a science fiction author, was the first to address the notion of the "metaverse" in his publication. He describes it as a three-dimensional digital environment providing a shared virtual reality (VR) experience to escape the physical world. According to Riva and Wiederhold [4], the high-tech industries will invest heavily in this technology over the next five years—up to tens of millions of dollars.

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The metaverse is mainly made up of VR, which is a simulation that faithfully reproduces real and imaginary environments in real time [5], and Augmented Reality (AR), which allows computer-generated elements to be superimposed on an actual image [6,7]. It attempts to predict the sensory consequences of users' movements by constructing the same scene (visible in the headset) and the same sensations (generated by sensors) that they would experience in the real world [4]. These technologies make it possible to carry out virtual tastings that do not require consumers to be present in the same place. Virtual or online tasting removes the barriers of geographical accessibility, allowing the consumer to participate in the event from anywhere [8]. It also reduces travel or space rental costs, which reduces expenses for the organizer and the consumer [8]. The metaverse has begun to attract the attention of major players and to be implemented by the big names in the business world to offer customers a new form of virtual tasting. For example, in 2021, Mark Zuckerberg, founder and owner of the most recognized social network, revealed a monumental change in the company's identity from Facebook to Meta [9]. Leading companies like Coca-Cola, Nike, and others actively engage their customers in immersive virtual interactions with their products [10]. Researchers have mentioned that about a third of global companies will implement the metaverse in their operations by 2026 [11]. Even in its early stages, the metaverse offers customers an experience that merges the physical and the virtual, which is impossible in traditional stores. Research shows that 76% of customers prefer to use various communication channels when interacting with businesses, tailoring their choices to specific needs or requests [12].

However, in a metaverse or VR environment, the sensory experience is mainly limited to the senses of sight and hearing. In addition, very little research has looked at the stimulation of smell and taste in the virtual world following the challenges it presents [13]. Like appearance, taste is a crucial element influencing food choice and eating behavior [14]. That is, the lack of a taste experience within the metaverse could impact product appreciation and consumer satisfaction. This article aims to explore integrating the sense of taste in the metaverse to recreate a virtual tasting experience.

Our article first discusses the notion of traditional tasting and its effect on consumer behavior. Then, it defines the metaverse concept and explores tasting in it by presenting the different technologies involved in this experience. The next part is dedicated to the study of integrating the metaverse into the tasting experience of four international brands. Finally, we present the limits and future avenues of research. Theoretically, this research will provide a clear insight into the relationship between the virtual tasting experience and customer behavior. From a practical perspective, it offers companies recommendations on how to use immersive technologies, including the metaverse, in virtual tasting experiences to achieve their marketing goals.

2. Literature Review

2.1. Traditional Tasting

2.1.1. Definition

Tasting is "an operation consisting of expressing, analyzing and assessing the organoleptic characteristics and, more particularly, the olfactory-gustatory characteristics of a product. It can be more or less analytical and detailed, i.e., it tends to break down its characteristics into simple elements to attach this or that taste to a particular substance or set of reference substances (analytical tasting). It can be more or less global, that is to say, it can tend to express the pleasure or displeasure felt (hedonic tasting)" [1], pp. 2–3. According to this definition, there are three fundamental criteria inherent to the tasting experience, namely, express, which refers to the active interaction of the consumer with the product using their different senses; analyze, which refers to the evaluation of the sensations felt concerning past experiences; and appreciate, which corresponds to the consumer's final assessment, whether positive or negative. By inference, these criteria can describe the process of engaging individuals' senses to understand their evaluations of virtual tasting experiences. If the tasting experience is satisfactory for the customer, it contributes to the

success of distributors, increased consumer loyalty, and realized sales. Many retailers in Canada offer point-of-sale tastings of their products for marketing purposes, such as the Costco warehouse.

On the other hand, Kinnamon [15] defines tasting as the sensory perception of ionic and complex compounds in the oral cavity, resulting in the perception of sweet, sour, salty, bitter, and umami flavors. This definition highlights the complex nature of the tasting experience, appealing to the consumer's senses to appreciate the product's quality. The consumer can thus have a positive or negative assessment depending on his previous experiences and preferences. Indeed, they sometimes base their purchase or loyalty decisions on their appreciation of the tasting, and it is not uncommon to see divergent opinions between two consumers tasting the same product. Although taste is the most complex sense, it is how the individual enjoys the product. Thus, tasting not only reveals the product's intrinsic quality, but other senses can also influence the perception of flavors, including smell, sight, texture, sound, or temperature [16].

To conclude, tasting involves multiple sensory and cognitive factors that shape consumers' subjective appreciation, which can condition their purchasing and loyalty toward a given product.

2.1.2. The Effects of Traditional Tasting on Consumer Behavior

Several studies have addressed the effect of tasting experiences on consumer behavior [17,18]. Nin Ho and Patrick Gallagher [18] carried out a study on the impact of wine tasting on purchase decisions by considering other situational and cognitive factors. These researchers found that groups of more than three tasters are more likely to buy wine than those tasting in groups of three or fewer. In addition, the consumer's confidence in their wine selection is essential in predicting their purchase. Another surprising confirmation is that the comfort of the wine-tasting room, while marginally significant, was negatively related to purchasing behavior. This seems to suggest that consumers don't pay as much attention to the atmosphere of the tasting room as they do to other important factors, such as the quality and selection of wines, self-confidence, and the impact of the group. In the same context, Li et al. [19] have shown that the internal atmosphere of the brewery, the execution of beer tastings, and the friendliness and knowledge of the waiters/waitresses have a direct effect on the satisfaction of customers in the tasting rooms and, consequently, on their likelihood of purchase.

Moreover, Rebollar et al. [20], who analyzed the impact of the level of the illuminance of a light source on the evaluation of the attributes of sweetened plain yogurt, as well as the willingness to buy when tasting the product, highlighted that the level of illumination affects tasting experiences. Indeed, men perceived yogurt as sweeter in low-light conditions, while women perceived it as sweeter in high-light conditions. In another context, Lidón et al. [21] showed that the visual appearance of the apple depicted in the packaging image (red vs. green apple) influenced women's rating of specific attributes. Similarly, the study of Banovic et al. [17] on the effect of product information and experience on the evaluation of healthy and sustainable plant-based products indicates the product information provided to the consumer significantly influences the evaluation of the product and helps to improve health perception compared to taste perception during purchase intent when presented before the first tasting. A recent study on the effect of service quality, taste, and price perceptions on consumer loyalty found that product taste positively and significantly influences customer satisfaction and loyalty [22]. The product's taste is also associated with trust in the brand [23]. The literature has also highlighted the relationship between brand image and consumers' taste preferences [24]. These researchers have shown that taste preferences can change when the brand's image changes.

2.2. Digital Tasting

2.2.1. The Origin of the Metaverse Concept

The metaverse concept originated in the 1950s through science fiction, notably with the novel Neuromancer by William Gibson and the 1982 film Tron [25,26]. In 1938, the French writer and poet Antonin Artaud used the concept of VR in his book of essays "le théâtre et son double" [27]. The year 1962 was marked by the first virtual reality simulation, the Sensorama, a machine that simulates an immersive experience [28]. After these virtual reality trials, Neal Stephenson used the expression "Metaverse" in his book "Snow Crush" in 1992, imagining a virtual multiverse in which people exchanged and experienced virtual worlds in a dystopian future [29,30]. Five years later, Richard Garriot, a famous video game developer, used the metaverse concept to describe an online role-playing game he was exploring called Ultima Online, released a year later and considered the first MMO (massively multiplayer) game [27,31]. In 2003, the 3D online virtual world called "Second Life" appeared, and it aimed to allow users to create virtual spaces, interact with them, and exchange virtual goods [27]. In 2008, Roblox was released, allowing users to create virtual worlds from the blocks (i.e., "Blox") or to play between users in virtual worlds, which has been successful [30]. Over the years, tech companies have begun to explore and design the world of VR. In 2012, Oculus released the first VR headset available to the general public, and two years later, it was acquired by Facebook [32]. With the advent of smartphones, internet connections, and more sophisticated devices, the emergence of gaming platforms such as Pokemon Go, which combines AR and virtual gaming in the real environment, and Fortnite, which hosts more than 250 million users in its virtual MMO gaming world, began [27,33]. Then, in 2021, the metaverse concept touched more people with the announcement of the change of Facebook's name to Meta [34] and the platform launch Mesh by Microsoft [35]. The advancements of the two tech giants in the metaverse world are starting to prompt companies to use VR in their daily business. This trend has continued with the appearance of new materials and software every year, making VR headsets lighter, with good quality and affordability [27].

2.2.2. Definition of the Metaverse

The term Metaverse is composed of two words, namely "Meta", which means beyond, and "Verse", which represents the universe. This reflects the transcendence of the physical world. Previously, the metaverse was defined as a future version of the internet that would make users feel like they were in a near-physical world. Individuals would be represented by articulated human figures or avatars whose body movements would be calculated automatically by the system [36]. Subsequently, since the experiment takes place in the virtual space, Allbeck and Badler [37] introduced the notion of VR and highlighted the immersive aspect of the metaverse in their definition: "it is a virtual reality world imagined as a vast cyber-planet. It contains houses, corporate headquarters, nightclubs, and virtually every other type of building found in reality, and some that don't exist. Individuals from all over the world materialize on this cyber-planet and are represented by avatars." [37], p. 19. Later, 3D became part of the metaverse design, defined as a vast, networked, and interconnected 3D virtual world capable of supporting a large number of people simultaneously for social interactions [38]. The metaverse is also considered a fully immersive, three-dimensional digital environment [39].

Recently, Lee et al. [40] proposed a more comprehensive and structured definition, describing the metaverse as a virtual environment combining physical and digital aspects made possible by the convergence of the internet, web technologies, and extended reality (XR). The latter corresponds to experiences integrating the real, virtual, and simulated worlds, offering immersion [41].

Each user has a personalized avatar representing a version of themselves [42], allowing him to live an alternate existence in VR that symbolizes the user's real-world [36]. Given the different proposals of the authors, we can identify the common attributes of the metaverse, which are the continuity of identity and objects, a shared environment, the use of avatars,

3D (or virtual) representation, immersion, and the social aspect. This broad and evolving definition may change as the metaverse continues to be developed and employed [43].

2.2.3. Tasting in the Metaverse

Compared to traditional tasting based on the sense of taste, sight, and smell, tasting in the metaverse aims to simulate these senses in the digital world. It may seem paradoxical to associate gastronomy with the metaverse because the senses involved in tasting cannot be harnessed in virtual worlds [44]. However, current technological advances demonstrate that this convergence is becoming plausible and that these two aspects can be indirectly associated with cultural, social, and territorial connections [44]. For example, virtual food festivals in the metaverse can be offered to establish a social link with other avatars, or virtual tours of farms can be organized to discover the production process of certain food products. Rejeb et al. [45] mention that consumers can taste and deepen their knowledge of the chosen wine. On the other hand, as mentioned by Boccia and Covino [46], agri-food companies have started to give importance to this topic by offering immersive virtual experiences that combine culture, gastronomy, and art in the metaverse. In addition, it is conceivable that the metaverse will involve all five senses in the future in order to offer the most immersive experience [47]. In other words, in the future, the metaverse will no longer be limited to hearing and vision but will stimulate the other senses through simulated smells and tastes and haptic body suiting, which helps users physically feel interactions in the virtual environment [48]. In fact, today, professionals are developing an artificial system to reproduce the biological taste system.

In addition, the engagement of all the senses, including taste, makes the immersive experience in the metaverse more complete and enriching [49]. Thus, the use of several senses, such as sight and hearing, makes it possible to feel taste in the virtual environment [50]. Spence [51] also points out that, just like in the real world, the appearance of food influences how it tastes and how it is consumed. That is, the visual aspect, such as lighting and colors, contributes to the increase in the perception of taste in virtual environments [52], highlighting the importance of appearance in the virtual taste experience. In a similar vein, Batat [50] found that high-quality images that enhance the visual appearance of foods can overcome the inability to taste products in the metaverse. On the other hand, the simulation of tastes in virtual environments offers customers various possibilities for culinary pleasures [53]. So, the metaverse has great potential to change our preferences by simulating all our senses. Korsgaard et al. [54] confirmed that older adults prefer to eat with their friends in the virtual world rather than eating alone. Thus, customers' evaluation of meals varies depending on the environment [55]. Overall, the metaverse improves the personalization of the tasting experience, thus increasing the degree of engagement and strengthening the connection of individuals with the product [56]. However, the simulation of this sense of taste could negatively influence the phygital experience of customers in the metaverse [49].

2.2.4. Technological Advances Implemented in Virtual Tasting

Although the metaverse is still in the early stages of development, and its adoption is still limited, several technologies have been deployed to enable virtual tasting despite the challenges it brings. First, VR allows for the virtual performance of an action while giving the impression of actually performing it [57]. To generate this sensation, technology must "trick the brain" into providing it with information that mimics what it would perceive in the real world [57]. For example, the idea of enjoying a coffee at the Eiffel Tower can be made possible by virtually simulating physical presence at the Eiffel Tower through a virtual experience. The images presented must be of a very high resolution so that the perception of the real world is relegated to the background, or even eliminated, in order to be replaced by that of the virtual world. This change in perception, known as immersion, is the very first foundation of VR [57]. VR media deliver a satisfactory immersion since the only visual information perceived is transmitted through them. It is also necessary to simulate not only the avatars of other customers in the café but also the avatars of the

servers in the café in order to stimulate real interaction between the customer and the staff. This interaction between the individual and the VR system represents the second foundation of VR [57].

Second, eye-tracking technologies and software allow the collection and processing of eye-tracking data consisting of individuals' eye movements and positions [58]. The headset will track the movements of the individual's pupils, so what they see in the virtual world will match where they are actually looking, not just the direction of the head [59]. Thanks to the possibility of eye tracking in the VR environment, professionals can specify where and how long individuals look in order to analyze their preferences and behaviors during the virtual tasting.

The third technology concerns holograms. These serve as an additional entry point into the metaverse. Three-dimensional holographic communication technology can enhance realism and immersion using various technologies [60]. Holograms in the metaverse rendered and displayed via HMDs (Head Mounted Displays) with additional parallax provide interactive and immersive experiences, promoting a better quality of perception and emotional engagement, such as making eye contact during meetings and generating a digital projection of the physical individual rather than a purely fictional representation [61]. They then make it possible to improve the quality of the products in virtual tasting.

Among them, display technologies like projectors, holography, and touch screens play an important role. These technologies are essential in creating immersive experiences in the metaverse [60]. For example, touch screens can improve the user's interaction with digital content and increase the level of immersion [62]. As for large screens, they allow for more immersive virtual tasting spaces, allowing users to see products and other related details in large format. Display technologies offer a variety of ways to display digital content, including expansive displays using large interactive projectors on the ceiling [63], portable and flexible displays via portable projectors [64], and the display of 3D images by holographic screens [65].

Fifth, we have haptic technology. In order to create immersive and engaging experiences in the metaverse, users need to feel physical sensations in virtual environments [60]. Indeed, telepresence technologies can create the feeling of being present in a distant place [66,67]. As for haptic technologies, they can offer users tactile feedback that contains a strong source of positive emotions [68], such as the sensation of touch and pressure, or kinesthetic feedback, such as movement or resistance [60]. Thus, haptic gloves can be used to feel feedback and vibrations in the virtual space. During a tasting experience in a virtual environment, these gloves simulate the sensation of touch of the virtual product as if it were the real world. This feature increases the user's immersion in the virtual world and enriches their tasting experience. In addition, thanks to the vibratory feedback, the user is able to perceive the texture of the different products available in the virtual space before proceeding with the actual tasting experience. Similarly, the snap functionality of haptic gloves [60] allows the user to feel the pressure exerted on the tongue when the gloves come into contact with the mouth. This feature adds an extra dimension to the sensory experience, enhancing the realism of the virtual tasting. In the context of virtual tasting, haptic gloves significantly enrich the experience by reproducing the feel of the product, its texture, and the pressure exerted on the tongue. These elements help to create a more authentic and immersive experience, bringing virtual tasting closer to its real-world counterpart.

It is possible to stimulate the sense of taste not only with the help of haptic technologies but also by combining an electronic language device, which allows users to have a conversion of real taste in the virtual space, with an electronic nose device, which offers a digital version of the smell of food, in order to incorporate the flavor of various types of food into the virtual world. In other words, the tongue and electronic nose devices would act on the tongue directly to simulate the sensation of food presented in the metaverse [47].

Finally, users create and customize avatars to represent them in the metaverse [59]. This includes appearances, costumes, face and body shapes, movements, and other props [59].

In the context of tasting, avatars are used to represent individuals in shared virtual tasting experiences.

All of these devices enhance digital sensory experiences by emulating biological senses. Thus, the metaverse is able to provide immersive experiences in the virtual world by integrating the senses of sight, hearing, and touch.

2.2.5. The Technical Functioning of Tasting in the Metaverse

The phenomenon of tasting in the metaverse is based on several technologies, including telecommunication (e.g., connectivity networks, an internet connection), IT infrastructure (e.g., software, powerful computers, cloud computing), and user interfaces and sensory devices (e.g., VR headset, haptic gloves), to create innovative immersive experiences to explore food. First, telecommunication infrastructure contributes to the improvement of virtual experiences in the metaverse. For example, the 5G connectivity network supports and facilitates the management of data-intensive applications, including sensory simulations. This network offers a high data rate, i.e., 20 Gigabits per second (Gbps) of theoretical peak throughput (the maximum speed) downlink—the speed at which data is transferred from the network to the device—and 10 Gbps uplink—the speed at which data is transferred from the device to the network—[69]. That is, the 5G network aims to offer a speed that is fast enough to download (downlink) or send (uplink) data. So, this network makes virtual experiences more immersive by reducing response time and facilitating the management of a large amount of data. Second, IT infrastructure makes it possible to properly manage and store data in the metaverse. Indeed, the metaverse is essentially based on cloud computing because, as a complex virtual world, it is crucial to have a high-performance and powerful tool for data processing and storage [70]. Finally, user interfaces and sensory devices contribute to the reproduction of sensory experiences. For example, the VR and AR headsets allow users to be immersed in the virtual environment. As for the taste and haptic devices, they are still in the development phase. Technological advances contributing to the implementation of virtual tasting are presented in Figure 1.

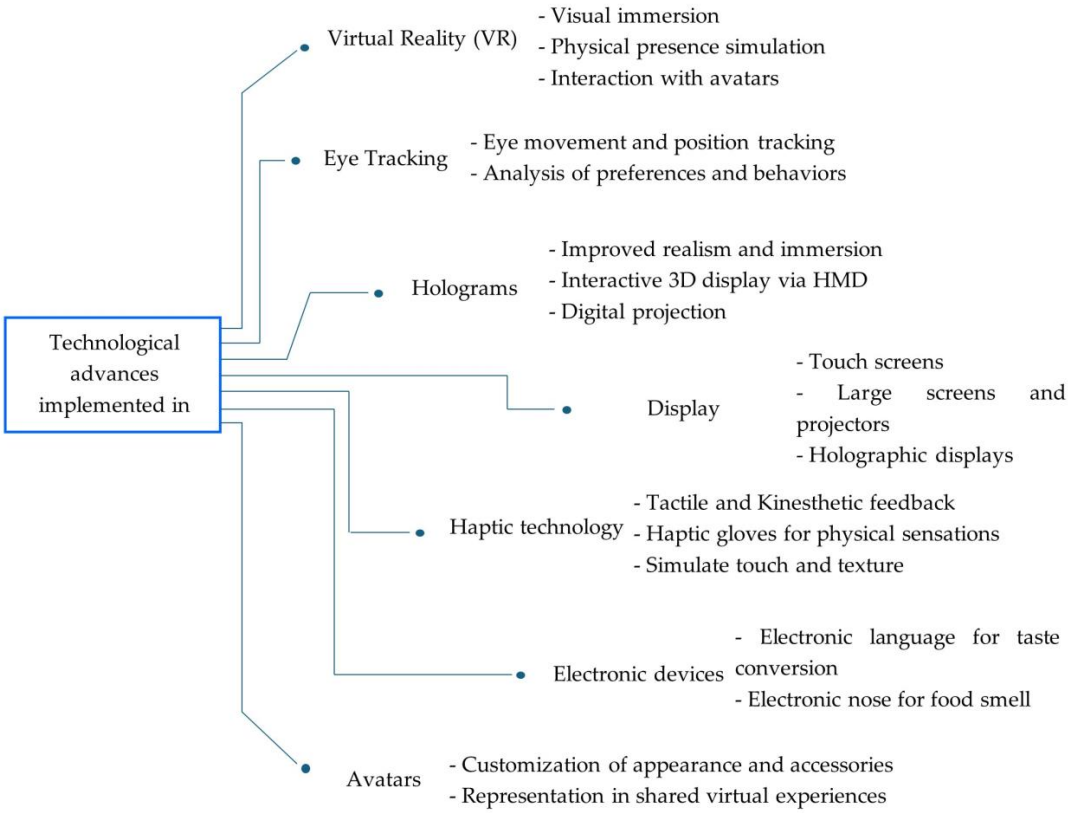


Figure 1. Technological advances implemented in virtual tasting. Source: The authors.

On the other hand, tasting in the metaverse is also based on electronic systems that promote sensory stimulation, namely electronic language (e-tongue) and electronic taste (e-taste) [47]. The first electronic device (e-Tongue) is considered to be an artificial language for specifying and processing different flavors [47]. The e-Tongue detects the taste molecules that exist in a solution using chemical sensors. It is responsible for converting chemical signals into electronic signals for analysis through data processing systems in order to transfer to users a digital representation of taste similar to biological interpretations of tastes [71]. While the e-Tongue aims to analyze existing tastes in solutions in a manner similar to how human taste receptors work, e-Taste makes it possible to generate taste sensations in users using thermal and electrical stimulation of taste receptors [47]. In other words, e-Taste devices use electrodes to stimulate the taste buds, sending electrical impulses. This approach allows users to enjoy the flavors electronically rather than organically. For a better integration of tasting in the metaverse, Atanasio et al. [47] proposed to use the e-Tongue, the e-Taste, and the e-Nose simultaneously. The latter technology converts the actual smells of food into digital data.

2.2.6. The Impact of Tasting Experiences in the Metaverse on Consumer Behavior

The study of the effect of the metaverse on consumer behavior is still an emerging phenomenon, and its application in the context of virtual tasting remains relatively rare. However, there is other research in related areas, such as the impact of virtual reality experiences on customer behavior, that offers relevant findings and interesting insights and could be extrapolated to explore potential effects in the context of the metaverse. In fact, applications using virtual reality and the number of practitioners are being developed [72].

Several studies have analyzed the impact of virtual reality on different marketing variables in different contexts and situations. Other research has instead focused on the effectiveness and usefulness of this technology. In addition, particular emphasis has been placed on examining virtual reality devices [73] to improve the navigation experience. Similarly, the role of this technology has been studied through tests of different products, such as the virtual driving test [74]. In fact, several brands offer customers a virtual try-on experience of their products using virtual reality, including Volvo, which allows people to test-drive one of its car models, and Merell, a U.S.-based footwear manufacturing and marketing company, which offers a Trailscape virtual reality experience to simulate a perilous hiking experience.

The literature has indicated that a lot of research has explored the impact of stores in virtual worlds on purchase intent for real and virtual products [75,76] based on the atmosphere of virtual points of sale [76]. Thus, virtual reality influences customers' attitudes towards the brand or product [77,78] because customers value immersion in the experience offered [79], as it allows them to escape into another world. These immersive experiences also help generate positive emotions in less than five minutes of immersion in the virtual environment [80]. Other research has explored the role of the virtual reality experience in reducing the negative effects of crowding at a physical point of sale [81]. These researchers found that the experience of a virtual walk in a shopping mall during the Christmas period provided a sense of relaxation and escape, which had a positive impact on people's satisfaction and attitude towards the mall. They also pointed out that, in a virtual environment, customer brand attitudes and purchase intentions are higher compared to 2D representations.

By inference, the use of virtual reality makes it possible to supplant traditional marketing techniques by creating a sensory navigation experience. Indeed, positive reactions from individuals to virtual reality improve the shopping experience [82]. Virtual reality experiences also make it possible to engage the customer on a cognitive level [83] through memorable virtual reality content; on an emotional level [84,85] by offering a pleasurable virtual experience that allows for establishing a relationship with the customer; and on a conative level [84] by giving customers the opportunity to test certain aspects of the product in order to increase the desire to buy. For example, Decathlon allows customers to

virtually test tents in different weather conditions. In summary, virtual reality is a powerful tool to improve the quality of services offered and facilitate consumer learning, i.e., the process of changing consumer behavior when processing information.

In the context of virtual tasting, Xu et al. [86] highlighted that the impact of the tasting experience in virtual reality environments could be a precursor of the metaverse on customer behavior. Other research has indicated that the virtual tasting environment influences the perception of wine taste [87] and allows for the analysis of customers' emotional responses to food products, such as chocolates [88]. Thus, the food stimuli present in virtual experiences can generate a desire to taste or eat the presented food [86] and influence eating behavior after the virtual reality experience [89]. On the other hand, the other senses could play an important role in the perception of food in virtual environments. Ammann et al. [90] found that individuals may express difficulty in identifying flavor if the food product is presented with a different color compared to the original one, while Wang et al. [91] showed that a simulated coffee color does not affect either sweetness or perceived taste. In the context of the metaverse, Cui and van Esch [56] examined how emerging multisensory technologies contribute to the enhancement of the wine-tasting experience through the simulation of taste sensation. These researchers claimed that virtual environments can influence the tasting experience.

3. Methodology

The aim of our study is to examine how tasting experiences in the metaverse influence consumer satisfaction. To do this, we have adopted a descriptive approach based on the study of multiple cases. This method makes it possible to explore and explain a specific phenomenon in a real context [92,93], such as the integration of the metaverse into tasting. That is to say, it makes it possible to analyze the initiatives implemented by the various companies. The relevance of this method lies in its ability to explain a phenomenon that is still emerging with theories that are still in development [94,95]. The case study is also helpful because it describes a complex phenomenon by understanding all aspects.

Our study focuses on brands recognized for their innovation in integrating the metaverse, namely Coca-Cola, McDonald's, Chipotle, and Wendy's. By analyzing these concrete cases, we aim to understand how they adopt the metaverse in the promotion of their products and to identify the key factors that contribute to customer satisfaction during the virtual tasting. This research seeks to offer a nuanced view of current strategies and shed light on emerging trends, paving the way for further future research.

Cases were selected based on several criteria to ensure data relevance. First, we chose companies actively engaged in the metaverse to understand how they leverage this technology in their strategy. Then, we considered those that deploy technological advances, such as VR technologies, to deliver immersive experiences to customers. Finally, we have favored companies with available and reliable documentation to analyze the data in depth. These criteria demonstrate that the selected cases offer a rich perspective on the use of the metaverse due to the diversity of approaches adopted by each brand. Data were collected through secondary data analysis to understand the strategies used. In addition, we addressed the interdisciplinary dimensions of metaverse technology adoption by exploring technological, behavioral, and marketing effects.

While this descriptive approach is not based on research proposals/hypotheses or a predefined conceptual framework, it helps to highlight the diversity of strategies implemented by brands and illustrate how these actions influence customer satisfaction. While this approach lacks generalizability due to its qualitative nature, it is particularly relevant for the description of complex and emerging phenomena, thus providing a general view to serve as a basis for future theoretical research.

4. Results

4.1. Coca-Cola

Coca-Cola has launched a virtual platform in the metaverse world called Coca-Cola World, in which users can interact with each other and learn about the company's history [96]. This virtual world aims to promote Coca-Cola products [97].

Coca-Cola offers several drinks for tasting. The first product launched on the platform is Starlight, a drink that evokes the taste of space and is available in an original and sugar-free version [98]. Consumers can use AR filters associated with the Coca-Cola starlight product and enjoy immersive ASMR (Autonomous Sensory Meridian Response) audio experiences [98]. These experiences are characterized by a pleasant bodily sensation of tingling or well-being in response to visual or auditory stimuli, called "triggers" [99]. Researchers pointed out that ASMR videos are similar to VR in offering immersive stimuli that induce bodily sensations and real-world feelings, giving the impression of being present in the virtual space. Through this virtual tasting experience, individuals can interact with the product, appreciate it, and enrich its discovery experience. The induced satisfaction can lead to purchase intent or brand loyalty.

4.2. McDonald's

McDonald's has inaugurated the virtual universe, Mr. Nuggets Land, on the platform The Sandbox [100]. This themed virtual space commemorates the 40th anniversary of Chicken McNuggets and allows users to interact with nugget-shaped avatars inspired by the characteristic atmosphere of McDonald's restaurants.

We note that this brand offers, on the platform, the same products that are already available in physical establishments (e.g., hamburgers, fries) [101]. Therefore, consumers could order both virtual and real products, with the option of physical delivery [102]. However, this brand does not offer virtual tasting in the strict sense of the term but offers immersive experiences of its products in the virtual environment. These experiences allow customers to either have the product delivered to them in the real world or to discover and interact with the product virtually. In conclusion, this approach has allowed McDonald's to promote its products and consolidate its image among its users.

4.3. Chipotle

The Mexican fast food chain Chipotle is positioning itself among the leaders in the metaverse. It launched a virtual restaurant in the metaverse via the Roblox platform during the Halloween celebration in 2021 [103]. This virtual space is intended to bring together the brand's users by offering them an immersive and interactive experience. Users can dress up their avatars in Chipotle-themed costumes, such as the burrito mom and the chip bag ghost [103]. According to the brand's official website, the products offered for tasting in the virtual restaurant include burritos, salads, and tacos [104]. As a result, thousands of users received codes for free burritos at Chipotle's virtual locations that could be redeemed at physical restaurants [103].

In order to taste the products in the virtual world, users must customize their avatars, enter the virtual restaurant to benefit from the promo codes, and finally choose their ingredients for virtual preparation. After this, they can enjoy the virtual tasting. In addition, this brand has set up activities on its virtual site to attract customers to its physical restaurants. These different services offer a new tasting experience to customers, allowing them to build a strong relationship with the brand to drive purchases and increase loyalty.

4.4. Wendy's

Wendy's, a fast-food chain brand that is a competitor of McDonald's, has entered the metaverse. It has established its presence in the virtual universe by creating a virtual space named Wendyverse on Facebook's Horizon World platform, where users can enjoy virtual food [105]. This brand allows users to choose from its menu in the virtual space from the

various products offered in its virtual space, such as burgers, fries, sausages, drinks, eggs, and cheese.

According to Meisenzahl [103], the design of the virtual restaurant does not differ significantly from that of the physical restaurant. For example, in a virtual restaurant, the user chooses from the menu and then goes to checkout to pay. They can also sit at the table to enjoy the virtual tasting experience. This immersive experience also allows users to learn about the process of preparing dishes and ordering real food [103]. As for the activities offered, individuals can participate in the basketball game on the brand's virtual platform to win burgers.

For all the cases presented, users must have several technologies, including a digital device, an internet connection, the metaverse platform made available by each brand, an avatar to represent the digital incarnation of users in the virtual environment [59], and augmented, mixed, and extended VR technologies in order to access the virtual world offered and experience virtual tasting.

As a result of the evolving needs of customers in the digital world, multinational companies, particularly those in the fast-food restaurant sector, have taken initiatives in the area of virtual tasting to promote branding further and drive increased customer engagement. However, it should be noted that the metaverse is still far from mass adoption due to the challenges of making this technology accessible at scale.

4.5. Synthesis of the Cases

To summarize, the selected international brands have integrated the metaverse into the virtual tasting experiences offered. However, they have adopted different approaches that are adapted to their objectives. According to the analysis carried out, Coca-Cola and Chipotle have proposed more immersive experiences. Coca-Cola launched a virtual platform, "Coca-Cola World Virtual Platform", to engage customers in the metaverse, while Chipotle offered a virtual restaurant in the metaverse to offer users a virtual dining experience. Both brands have, therefore, adopted an approach to immerse customers in the virtual world.

In contrast, McDonald's and Wendy's have focused on establishing a relationship between virtual experiences and the real world. In other words, these brands aim to convert virtual experiences into real purchases and consumption of products. This approach aims to convert virtual experiences into tangible results, such as increasing online orders.

To draw meaningful conclusions, it is important to assess how Coca-Cola and Chipotle's immersive approaches affect consumer engagement and perception compared to the transactional approaches of McDonald's and Wendy's. For example, examining how each approach influences actual sales, customer loyalty, and brand awareness provides insights into the effectiveness and contribution of metaverse strategies. On the other hand, exploring the challenges faced by brands helps identify the most effective practices. Future research can analyze these dynamics to provide more insights into the factors of failure and success in using the metaverse in the virtual tasting experience.

In the following table, we present a summary of the metaverse integration tools, objectives, and results for each brand studied (Table 1). This helps to clarify the different approaches adopted, as well as the effects observed.

The metaverse is known for its significant potential for innovation; however, it has several limitations. First, as mentioned in Section 2.2.4, virtual tasting is based on several complex technologies that are not sufficiently developed, which hinders their adoption by the general public. For example, the creation of virtual environments requires solid infrastructure [106]. The second limitation concerns the disconnection from the real world through immersion in the virtual environment. This phenomenon was addressed in the study by Ouerghemmi et al. [107]. The research pointed out that immersion—a psychological state that allows the individual to move away from his own physical state and to feel almost totally immersed in the virtual environment—makes it possible to detach from the real environment. This immersion can extend to the tasting experience in the

metaverse, causing confusion from the real world. This concern raises several critical avenues of reflection:

(1) By manipulating the senses through the metaverse, could immersion lead to a feeling of uprooting in users (moving away from usual experiences)?

(2) Could the experience of tasting in the metaverse slow down the distinction between the real and the virtual world?

(3) Will this experience be adapted to the traditional sensory needs and expectations of individuals?

(4) Today, are individuals interested in exploring more tasting experiences in the metaverse?

(5) Will the virtual tasting experience be real and accurate enough to replicate the sensation of taste? If not, will the absence of this precision affect the engagement of individuals in this kind of experience?

Table 1. The approach used by each brand.

Companies	Metaverse Integration Tools	Objectives	Results
Coca-Cola	Coca-Cola World Virtual Platform	- Promoting Coca-Cola products	- Interact with the product - Taste Coca-Cola products - Enrich the discovery experience - Customer satisfaction
McDonald's	Virtual Sandbox Platform	- Promote products - Control your image	- Interact with the product and avatars - Deliver the ordered product in the real world
Chipotle	Launch a virtual restaurant in the metaverse via the Roblox platform	- Merging the game and the dining experience to attract customers to its physical restaurants	- Participate in the proposed activities - Taste the chosen virtual dish - Consolidate the relationship between customers and the brand
Wendy's	Create a Wendyverse Virtual Space in the Horizon Worlds Platform		- Choose the menu in the virtual world - Taste virtual dishes - Participate in the various activities offered

Nevertheless, these criticisms are not insurmountable due to the continuous development of technologies. For example, gaming, which was once a niche leisure activity, is now ubiquitous and accepted in society. Pang and Cheng [108] confirmed this by stating that technological advances in virtual reality and video games have expanded the accessibility of immersive experiences, thereby influencing user acceptance of these technologies. So, improving the technologies responsible for taste accuracy can drive the adoption of virtual tasting experiences in the metaverse. In fact, other technological advances, including olfactory and haptic interfaces, are already in the experimental phase of integrating them into virtual sensory experiences [109]. This development could have an important role in the accuracy of tastes in tasting experiences in the metaverse.

As technology evolves, there is a need to keep up with changes in consumer behavior, including preferences and tastes, because there are several factors that can influence sensory experiences, such as tasting experiences. Rozin [110] has shown that food choice depends not only on biological factors but also on cultural, social, and environmental factors. Regarding virtual tasting, the metaverse presents other virtual factors that can change the way people interact with food, such as observing food products in an immersive and more realistic way, haptic interaction, and auditory stimuli. The latter contribute to improved food perception, for example, crispy and crunchy [111] and chewing and lip-smacking [112]. According to Mintz and Du Bois [113], culture influences food preferences, consumption and culinary habits. These researchers also pointed out that individuals' beliefs, norms, and values can alter their sensory perceptions of food. With the emergence of the metaverse, the latter could be the new world for cultural encounters. That is, the metaverse, as an

immersive virtual world, will allow individuals to change their taste preferences by having the opportunity to try several tastes from different cultures. Therefore, the preferences and tastes of individuals play an important role in creating a suitable virtual tasting experience based on food traditions and stimuli from other international cultures.

5. Limitations and Proposed Future Directions of Research

Although users have started to adopt VR and large international companies have incorporated this technology into their operations, VR still encounters some limits in its deployment of tasting in the metaverse.

First, 3D image quality sometimes lacks visual perception due to brightness and increased contrast, deviating from the realistic view [114]. Thus, it is challenging to offer a wide range of products to be enjoyed in the virtual world due to financial and time constraints. As a result, retailers only display a limited quantity of products in the virtual store [115]. In this case, it would be relevant to explore the various digital capabilities of companies in the metaverse to better understand their current capabilities and future needs in this area. This also makes it possible to meet customer expectations adequately.

Second, immersive technologies present challenges related to software, materials, and human factors [14]. Psychologists suggest that immersive environments could physiologically desensitize the user and make them addicted to the virtual environment [14], which could have a negative impact on mental health. To overcome this limitation, scientists should conduct studies with users to measure their degree of resistance to the metaverse. Thus, it would be helpful to explore the different methods of reducing the adverse effects of immersive technologies by proposing guidelines for the healthy use of these technologies.

The third limitation lies in the limited ability of immersive technologies to offer more developed and realistic virtual tasting experiences. In other words, current technologies do not provide complete virtual stimulation of olfaction and tasting [14]. One of the major obstacles is the user-friendliness of digital devices because individuals are reluctant to place electrodes in their language, as in the case of thermal snack machines [14]. In addition, these digital devices take longer to produce sensations than chemical-assisted sensations [116]. Future research can analyze alternative technologies that are more convenient, allow virtual tasting in more practical and real conditions, and are less restrictive.

Add to this the limitation related to the discomfort of immersive technologies (transport pain, head and neck fatigue, nausea, and dizziness) [117]. Although the visual appearance of the product can be changed using AR-HMDs, the use of this device causes discomfort for the user when eating, and, in addition, the unnatural focal length of the eye causes incorrect distance perception [118]. Moreover, these types of technologies certainly lead to addiction and social isolation [119]. It would, therefore, be beneficial to determine the existence of other alternatives; in other words, to clarify whether technologies can realistically reproduce flavors and to analyze how improving the sensory experience and comfort can influence customers' attitudes towards products presented in the virtual world. Another study could be done to identify the average time spent using immersive technologies and how companies could integrate them into their platforms. On a physical level, immersive technologies have led to distractions and severe physical consequences, such as the Pokémon Go app [120]. It is, therefore, necessary to examine how the metaverse could position itself in such a way as to minimize this negative effect on human beings.

In addition to the technical limitations mentioned, it is important to mention that the metaverse works by emerging technologies, which can affect the immersive experience. In other words, these technologies must ensure the responsiveness of virtual systems [121]. Indeed, the responsiveness of virtual environments increases the feeling of environmental presence [121]. Additionally, the technologies involved must ensure immersion in the virtual world without interruptions or bugs in order to provide a smooth and realistic tasting experience.

From a methodological point of view, the exploratory approach adopted in this study has limitations. Indeed, it did not test hypotheses or pursue specific objectives. Although

this approach allows studying an emergent phenomenon, such as tasting in the metaverse, it limits the generalizability of the results. Therefore, it would be relevant for future research to address this issue by presenting specific and clear objectives and developing research hypotheses in order to deepen the understanding of the phenomenon studied and thus strengthen the rigor of studies on the metaverse.

In terms of ethical considerations, tasting experiences in the metaverse could influence the psychological states of individuals after leaving the virtual environment [122]. In fact, virtual experiences recreate physical sensations and offer immersion in the virtual world by identifying with an avatar. This immersion can create an illusion in users by separating the real self from the virtual self. This phenomenon can also influence social interactions in the physical world [122]. These researchers also indicated that users must respect the immersion times and the frequency of use to avoid the risk of addiction, mental disorders, and isolation following distance from the physical environment. In addition, technologies that track the user's movements can penetrate their privacy through the recording of kinematic data [122]. Therefore, professionals need to make users aware of the ethical challenges and potential effects of using technological advances.

Furthermore, Barrera and Shah [123] propose in their article on marketing in the metaverse that this virtual space has changed the values it provides to customers. This space combines the virtual and the physical, and the values have shifted from hedonic and utilitarian to an immersive, real-world experience. As the concept of shopping experience values has taken on a new form, it would be necessary to look at the values of shopping experience and virtual tasting. Other research has focused on the information asymmetry between the user and the provider [124]. It is, therefore, necessary to study, in future research, how companies can transmit all the required information to the target.

Another significant limitation concerns the technological infrastructure. Indeed, connectivity requires substantial investments in infrastructure and technology [60]. In this case, it is necessary to study how companies could implement technologies that require less mobile connection to facilitate access to the virtual world on a large scale.

6. Conclusions

Tasting exerts a significant influence on customer behavior in the metaverse or VR. These different virtual technologies provide a new experience in the perception of the product, subsequently influencing the consumer's purchase decision. Some organizations have embraced the benefits that the metaverse brings to their businesses to satisfy their customers, which explains the significant investments in this area. These technologies have not only created a new virtual tasting experience but have also strengthened connections to their physical stores to attract customers and increase user loyalty to their brand.

From a theoretical point of view, this article shows the extent to which tasting significantly influences consumer behavior in the context of the metaverse. The deployment of immersive technologies has attracted consumers' attention and promoted their satisfaction with companies. From a practical point of view, our study offers companies an overview of the improvements to be made to benefit more from the metaverse in tasting. While the metaverse has been very successful, major challenges remain.

It is also crucial to acknowledge some limitations of this study. First, the conclusions are limited by the nature of the research, which is based on existing studies and secondary data rather than empirical evidence. Therefore, the results cannot be generalized. For example, future research should include empirical studies, such as experiments, to concretely explore the real impact of tasting on customer satisfaction in the metaverse. Researchers could also look at how interactions with avatars influence customer satisfaction. Companies could set up shared tasting environments where users interact with avatars. Motion-tracking technologies to animate avatars in real time could be used to explore this topic better. Finally, this study did not consider the personalization of tasting experiences on user satisfaction. Future studies could tailor the virtual space to the needs

of each user through the data captured in real-time and then explore the impact of tasting personalization on consumer decision-making behavior.

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