A Review of Neuromarketing Applications in Gastronomy

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***Abstract*— This review explores the burgeoning field of neuromarketing within the context of gastronomy, examining how neuroscience-based insights are revolutionizing the way food is perceived, marketed, and consumed. By analyzing key sensory elements such as flavor, aroma, texture, and visual presentation, neuromarketing provides a deeper understanding of how these factors influence consumer preferences and emotional responses. Techniques such as EEG, eye-tracking, and facial expression analysis offer valuable data on how sensory inputs interact with the brain's processing mechanisms, optimizing culinary experiences and restaurant environments.**

The review highlights the multifaceted applications of neuromarketing in gastronomy, from enhancing the aesthetic appeal of dishes to improving the overall ambiance of dining spaces. It also discusses the potential of neuromarketing to guide healthier eating habits and more sustainable food choices by aligning culinary offerings with consumers' subconscious preferences. Ultimately, the integration of neuromarketing into gastronomy not only enriches the sensory experience of dining but also offers innovative strategies for food design, presentation, and marketing, paving the way for a more consumer-centered approach in the food industry.

Keywords*— *Neurogastronomy; Neuromarketing; Gastronomy

I. INTRODUCTION

Gastronomy, the art and science of good eating, plays a significant role in cultures around the world. It encompasses not only the preparation and consumption of food but also the experience and enjoyment derived from it. Neuromarketing, which combines neuroscience and marketing principles, provides a deeper understanding of how consumers perceive and respond to various gastronomic experiences. This review explores the intersection of gastronomy and neuromarketing, highlighting how the latter can enhance culinary experiences and marketing strategies in the food industry.

II. UNDERSTANDING OF NEUROMARLKEING

Neuromarketing involves using neuroscientific tools and techniques to study consumers' brain responses to marketing stimuli. Methods such as functional magnetic resonance imaging (fMRI), electroencephalography (EEG), eye tracking, and biometric measurements help marketers gain insights into the subconscious preferences and emotional reactions of consumers. These insights enable the creation of more effective marketing strategies that resonate deeply with consumers. [1]

III. KEY ASPECTS OF GASTRONOMY ANALYZED IN NEUROMARKETING

1. **Flavor and Taste Perception**: Taste is one of the most direct and influential senses in the gastronomic experience. Neuromarketing research helps understand how different flavors and tastes are perceived by the brain, revealing preferences and aversions that can guide recipe development and menu design.
2. **Visual Presentation**: The visual appeal of food significantly impacts its perceived taste and overall enjoyment. Eye-tracking studies can identify which aspects of a dish's presentation draw the most attention, allowing chefs to optimize plating and presentation techniques.
3. **Aroma and Smell**: The sense of smell is closely linked to taste and memory. Neuromarketing techniques can analyze how different aromas affect consumer perceptions and emotional responses, helping in the creation of more aromatic and appealing dishes.

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4. **Texture and Mouthfeel**: The texture of food contributes to the overall eating experience. Neuromarketing can evaluate how the brain processes different textures and how they influence consumer satisfaction.
5. **Ambiance and Environment**: The dining environment, including lighting, music, and decor, plays a crucial role in the gastronomic experience. Neuromarketing research can assess how these elements impact mood and perception, guiding the design of restaurant spaces [2].

IV. APPLICATION OF NEUROMAREKETING IN GASTRONOMY

1. **Menu Design and Development**:
   - **Flavor Combinations**: Understanding the neural responses to different flavor combinations can help chefs create dishes that are more appealing and satisfying. This can lead to innovative culinary creations that enhance the dining experience.
   - **Descriptive Language**: Neuromarketing can identify which types of descriptive language on menus evoke the most positive responses. Using vivid and sensory-rich descriptions can make dishes more enticing and increase sales.
2. **Food and Beverage Pairings**:
   - **Complementary Flavors**: By analyzing brain responses to different food and beverage pairings, neuromarketing can help identify combinations that enhance the overall dining experience. This is particularly valuable for wine pairings, cocktail creations, and multi-course meals.
   - **Sensory Harmony**: Ensuring that all sensory aspects of a meal (taste, smell, sight, texture) are in harmony can create a more cohesive and enjoyable experience. Neuromarketing insights can guide the development of balanced and complementary dishes.
3. **Restaurant Design and Ambiance**:
   - **Lighting and Decor**: Neuromarketing research can reveal how different lighting schemes and decor styles affect mood and perception. This information helps restaurateurs design spaces that enhance the dining experience and encourage longer stays.
   - **Sound and Music**: The type and volume of music can influence dining behavior and perception. Neuromarketing can determine which types of music create the desired atmosphere and complement the gastronomic experience.
4. **Marketing and Advertising**:
   - **Visual and Emotional Appeal**: Neuromarketing can help create more effective food advertisements by identifying which visuals and emotional triggers resonate most with consumers. High-quality images and videos showcasing dishes' sensory and emotional aspects can drive engagement and sales.
   - **Storytelling**: Crafting compelling narratives around food and dining experiences can create a deeper connection with consumers. Neuromarketing insights can guide the development of stories that evoke positive emotions and memories, enhancing brand loyalty [3].

One of the studies about menu design conducted by Sahin and Yazicioglu employed eye-tracking and electroencephalogram (EEG) technology to analyze how customers interact with different menu designs. Some of findings of this study are as below:

- **Eye-Tracking Results**: Eye-tracking technology helped identify which areas of the menu attract the most attention. High-traffic areas were found to be prime spots for placing high-margin items to increase profitability.
- **EEG Analysis**: EEG technology measured brain activity to determine the emotional engagement and cognitive load of customers while viewing the menu. Menus that were cluttered or poorly organized resulted in higher cognitive load and lower engagement.
- **Menu Layout**: The study found that placing visually appealing images and using larger fonts for popular or high-profit items drew more attention and made these items more likely to be chosen.
- **Color and Design Elements**: Colors and design elements that are congruent with the restaurant's theme and ambiance can positively influence customers' perceptions and choices [4].

Another study conducted by A.Mengual-Recuerda et al investigates the comparative emotional impacts of dishes and wines on restaurant diners, particularly in the context of haute cuisine. It aims to understand how these elements individually and collectively influence the dining experience and customer satisfaction. In this reseacrh, the data collection was carried out using Pupil Capture Software, 1.23 version. To record the electrodermal activity in the same phase, the galvanic skin response equipment Shimmer3 GSR+ was used, using, for data collection, the ConsensysPRO software, v.1.6. Changes in brain wave electrical currents recording was carried out using the EEG "EPOC+" model equipment with 14 channels (manufacturer Emotiv-saline-based electrodes). Data collection was carried out using the EmotivPRO v.2.0 software. Finally,

the data statistical analysis used R software, v.3.6.3. Key findings of this research are as below:

- **Emotional Response to Dishes**: The study highlights that dishes in haute cuisine often evoke strong emotional responses due to their complexity, presentation, and the sensory experiences they provide. The creativity and innovation in dish preparation significantly contribute to the diners' overall satisfaction and emotional engagement.
- **Emotional Response to Wines**: Wines also play a crucial role in shaping the dining experience. The selection of wines, their pairing with dishes, and the overall wine service can evoke various emotional reactions, enhancing the overall dining pleasure.
- **Interaction Between Dishes and Wines**: The research underscores the synergistic effect of dishes and wines when paired thoughtfully. The combination of a well-prepared dish with a complementary wine can elevate the emotional experience far beyond what either element could achieve alone.
- **Customer Preferences and Satisfaction**: Understanding customer preferences regarding dishes and wines allows restaurants to tailor their offerings more precisely. This personalization can lead to higher customer satisfaction and loyalty [5].

Regarding to restaurant design and its ambience there are a lot of studies, one of them conducted by Liwei Hsu and Yen-jung Chen. This study investigates the impact of background music on the wine-tasting experience, using neuromarketing techniques to analyze how different types of music influence consumers' perceptions and preferences. Researchers conducted experiments where participants tasted wines while listening to various music genres. **Electroencephalography (EEG)** was used to measure the neural responses of participants as they tasted wine paired with different types of music. Here are the key findings:

1. **Altered Taste Perception:** The study found that different types of music can alter the perceived taste of wine. For example, certain genres of music might enhance the sweetness, bitterness, or acidity of the wine, influencing how participants experience its flavor profile.
2. **Emotional Impact:** Music was shown to evoke specific emotional responses that were linked to the sensory experience of the wine. These emotional responses could lead to a more enjoyable or less enjoyable tasting experience depending on the music played.
3. **Enhanced Wine Enjoyment:** The study suggests that certain music genres can increase the overall enjoyment of the wine, making it taste better or more pleasant to the participants.
4. **Consumer Behavior Influence:** The research indicates that music can be a powerful tool in influencing consumer preferences and behaviors, particularly in settings like wine tasting, where sensory experiences are key to enjoyment and satisfaction [6].

In one study about Neurogastronomy, Berčík, J., Paluchová, J., & Neomániová, K. investigated how the visual presentation of waffles, made from the same ingredients but served in three different ways (on a stone plate, street food style, and a classic white plate), influences consumer preferences. Techniques like EEG, eye-tracking, and facial expression analysis are used to measure participants' emotional and cognitive responses to various food presentations. These methods provide insights into which visual elements enhance or diminish the attractiveness and perceived quality of the food. The research reveals that specific plating styles and color combinations evoke stronger positive emotions, leading to a preference for those presentations. For example, more elaborate or aesthetically pleasing arrangements tend to generate greater enjoyment and desire to consume the food. The findings suggest that chefs and food marketers can use neurogastronomy to optimize food presentation, enhancing the dining experience and influencing consumer behavior. By understanding how visual cues impact emotions, the food industry can create more appealing dishes that cater to consumers' preferences [7].

One study regarding to advertsiment in Gastronomy which conducted by Hernandez-Santaolalla, V. Et al, aimed to determine the most effective strategies by analyzing the cognitive, emotional, and behavioral responses evoked by visual communication elements used by two companies (Foster's Hollywood and VICIO). An experiment was conducted using various neurophysiological techniques such as electroencephalogram (EEG), eye tracking, and galvanic skin response (GSR). After analyzing the images on Instagram, it was determined that there were significant differences in valence and memory in favor of VICIO. Furthermore, although not statistically significant, VICIO's website architecture resulted in more engagement and likes, and VICIO's outdoor advertising elements performed better in all metrics. VICIO's brand style appears to have a greater impact on users' emotional responses. This study advances our understanding of the effects of communication strategies by determining which tools are most effective in creating a strong brand image. The scope and results of this study apply to many different fields. It is seen how important the impact of visuals is in online sales in the food industry after the pandemic period. Additionally, for success in brand recognition and sales, it is important to establish an emotional connection with the target audience and benefit from the contribution of digital media to the brand experience [8].

The study conducted by Julca-Infants, S. et al. investigates how different types of potato chips (native vs. classic) affect consumer emotions and visual preferences. Using neurogastronomy and neuromarketing techniques, the study

provides insights into how these factors influence consumer choice and Two types of fried flakes were used, classic potato and native potato, with a cost of S/ 6.60 (1.79 USD) and S/ 7.00 (1.90 USD), respectively. Eye Tracking technology and Emotion Analysis were used in the first stage using a mobile phone application. In the second stage, each participant answered a cognitive survey. The research highlights that visual and emotional preferences play a critical role in consumer choice. Native chips with unique or appealing visual attributes tend to be favored, suggesting that aesthetics can enhance perceived quality and desirability. The findings suggest that food marketers can use these insights to tailor product presentation and marketing strategies, focusing on visual appeal and emotional engagement to boost consumer satisfaction and preference [9].

In 2020, Mengual-Recuerda et al. conducted a study to explore how specific elements of a high-level dining experience in a Michelin-starred restaurant affect the brain activity of the diner. The study examined variables such as the presentation of the waiter or chef, the plate design, the food served, the taste of the food, the interaction, and the timing of food service. The researchers used neuromarketing techniques in combination with qualitative research methods, including in-depth interviews with consumers, to assess the emotional impact of these variables relative to the actual taste of the food. The findings indicated that seeing the chef present the food had a positive effect on emotions. Additionally, specially presented dishes generated more interest than traditional ones. However, as the dining experience progressed, levels of emotion and attention decreased, possibly due to the duration of the experience. Furthermore, the study noted that while special dishes had an emotional impact at the beginning of the experience, this impact diminished as the experience continued [10].

CONCLUSION

The intersection of gastronomy and neuromarketing offers valuable insights into the sensory and emotional aspects of the dining experience. The application of neuromarketing in gastronomy represents a significant advancement in understanding and optimizing the dining experience. By leveraging insights from neuroscience, this approach allows for a deeper comprehension of how various sensory inputs—such as flavor, aroma, texture, and visual presentation—affect consumer preferences and emotional responses. Neuromarketing techniques, including EEG, eye-tracking, and facial expression analysis, provide valuable data that can guide chefs, restaurateurs, and food marketers in creating more appealing and satisfying culinary experiences.

Moreover, by analyzing the impact of ambiance and environment on mood and perception, neuromarketing offers strategies to enhance the overall atmosphere of dining establishments, leading to improved customer satisfaction and loyalty. As the food industry continues to evolve, the integration of neuromarketing into gastronomy will play a crucial role in developing innovative, consumer-centered approaches to food design, presentation, and marketing. This convergence of science and culinary art not only enriches the dining experience but also holds the potential to influence healthier eating habits and more sustainable food choices.

By understanding how consumers perceive and respond to different flavors, presentations, aromas, textures, and environments, culinary professionals and marketers can create more engaging and satisfying experiences. As neuromarketing continues to evolve, its application in gastronomy will play an increasingly important role in enhancing culinary creativity and marketing effectiveness.

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