



From Arousal to Acceptance: A Review of EDA/GSR and BVP Applications in Food Consumer Research

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Abstract— Gastronomic experiences extend beyond taste and presentation, engaging multiple senses, emotions, and physiological responses. While traditional methods such as surveys and Interviews rely on subjective self-reports, recent research has demonstrated the value of psychophysiological measures—particularly electrodermal activity (EDA/GSR) and blood volume pulse (BVP/PPG)—as objective, time-resolved indicators of consumer arousal and engagement. This paper reviews the application of GSR in food consumer science, highlighting its role in assessing emotions and motivations, product and sensory evaluations, consumer behavior, and food packaging design. Evidence from recent studies indicates that GSR effectively captures implicit affective states in various contexts, including taste perception, beverage testing, pricing strategies, branding, and packaging, often revealing subconscious responses that diverge from explicit self-reports. These findings highlight the methodological advantages of integrating GSR with complementary tools, such as EEG, heart rate, and facial electromyography, to gain a comprehensive understanding of the consumer experience. Despite challenges related to signal interpretation and valence detection, standardized protocols and multimodal approaches strengthen the validity and predictive power of GSR in consumer research. Overall, the literature supports GSR as a robust tool for advancing sensory science and marketing, providing actionable insights into how emotions and physiological arousal shape consumer decision-making in food-related contexts.

Keywords:—Gastronomy; GSR; EDA; Neuromarketing; Consumer Behaviour; Food Packaging; Consumer Emotion

I. INTRODUCTION

Gastronomy is no longer just about taste and presentation—it is a multisensory experience that engages emotions, memory, and physiological reactions [1, 2]. Traditional methods like surveys and interviews rely on subjective self-reports, which can be biased or imprecise [2]. In contrast, physiological measures such as Galvanic Skin Response (GSR) and Blood Volume Pulse (BVP/PPG) offer time-resolved, objective indicators of arousal and affect that can be aligned with dining events [3-6] and have begun to show feasibility in food and beverage contexts [7].

Galvanic Skin Response (GSR), also known as electrodermal activity (EDA), is a physiological measure of emotional and sympathetic nervous system arousal [3, 8]. It

detects changes in the skin's electrical conductivity caused by sweat gland activity, which is innervated by the autonomic nervous system. When a person experiences emotional stimulation—such as tasting an unexpectedly flavorful dish or reacting to a displeasing texture—their sweat glands secrete minute amounts of moisture, altering skin conductance. This makes GSR a powerful tool for objectively quantifying emotional engagement in gastronomy, thereby bypassing the biases inherent in self-reported surveys [1, 3].

GSR Data Processing GSR signals are categorized into two components:

1. **SCL (Skin Conductance Level)** or Tonic – Represents the slow-changing, background level of skin conductance influenced by long-term factors like stress, ambient temperature, or an individual's general arousal state. In a dining context, tonic levels might reflect a guest's overall comfort (e.g., relaxed vs. stressed) before eating.

2. **SCR (Skin Conductance Response)** or Phasic – Rapid, short-term spikes triggered by immediate stimuli, such as the first bite of a dish, a surprising flavor combination, or an aromatic garnish. These transient responses are key to identifying specific moments of pleasure, surprise, or aversion during a meal [3, 8].

The tonic Skin Conductance Level (SCL) was obtained by low-pass filtering the SC signal at ~ 0.05 Hz (very slow trends). The phasic Skin Conductance Response (SCR) was computed as the fast component of SC, either as the residual $SCR(t) = SC(t) - SCL(t)$ or via a band-pass filter ($\approx 0.05 - 1.0$ Hz) that preserves stimulus-locked fluctuations [664, 9]. SCL change (ΔSCL) was quantified as the mean SCL in the response window minus the baseline SCL averaged over a pre-stimulus interval (e.g., 5 s immediately before the cue) [8]. In event-related SCR analysis, a post-stimulus window—typically 1–10 s after the cue (longer for olfaction)—is examined. Peaks in the phasic signal are detected with a refractory period of at least 1 s and a minimum-prominence threshold.

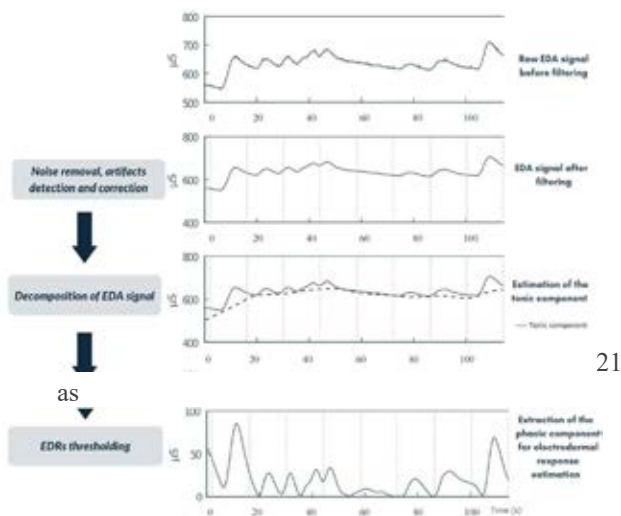


Fig 1. Schematic representation of EDA signal processing. Adapted from Zangróniz et al. (2017).

Amplitude is defined as the peak height above the preceding trough (μS), and latency as the time from stimulus to peak [8,10]. Researchers can use a range of GSR processing software—Ledalab (a MATLAB-based toolbox) among the most common.

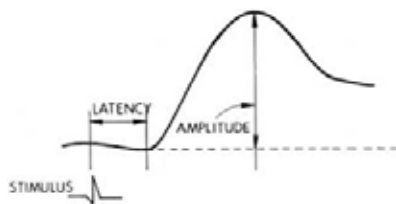


Fig. 2. Example of a typical SCR. Following stimulus onset. Adopted from Dawson, M. E., Schell, A. M., & Courtney, C. G. (2011)

Blood Volume Pulse (BVP)

BVP, often measured via photoplethysmography (PPG), tracks changes in blood flow near the skin's surface, reflecting heart rate and vascular responses. A sensor (usually on the finger or earlobe) emits light into the skin and detects reflected light to measure blood volume changes. Increased heart rate or vasoconstriction/vasodilation can indicate stress, excitement, or relaxation. By segmenting the BVP signal into epochs aligned to the stimulus (e.g., ± 5 s around the ad), researchers can directly compare ad-period BVP to pre-stimulus baseline. For noise reduction of the BVP signal, a 0.5–5 Hz band-pass filter is applied; this range is chosen to retain heart-rate frequencies [5, 6].

II. APPLICATIONS OF EDA IN FOOD CONSUMER SCIENCE RESEARCH

Electrodermal activity (EDA) measurements in consumer research require careful interpretation, as skin conductance fluctuations may reflect not only emotional arousal but also responses to environmental stimuli (e.g., ambient noise, odors) or cognitive states (e.g., task concentration, spontaneous thoughts) [11]. Standardized protocols are essential to control confounding variables and ensure valid inferences from EDA data [12]. In food consumer science, EDA has emerged as a

valuable tool to complement self-reports, capturing implicit emotional and motivational responses that traditional methods may miss, particularly non-conscious affective states [13]. EDA has been used in conjunction with explicit consumer emotions and motivations, product/experience evaluation, consumer behavior and food packaging research.

A. EDA in Assessing Consumer Emotions and Motivations

Caruelle et al. [13] review the use of electrodermal activity (EDA) in consumer research, highlighting its value as a psychophysiological measure of emotional arousal. They emphasize that EDA captures only arousal, not valence, and note methodological issues such as inconsistent reporting, latency, and attentional influences. The authors call for greater transparency and standardization, suggesting EDA is most effective when combined with complementary measures of emotion. Spinelli et al. [14] examine skin-conductance responses (SCR) to oral food stimuli, illuminating how taste quality and intensity, as well as individual personality traits, modulate emotional engagement during consumption. Their findings indicate that SCR reliably reflect arousal triggered by sensory characteristics such as novelty, perceived quality, and flavor intensity, underscoring that these physiological responses originate from multiple emotional drivers. This study highlights the value of assessing consumer reactions to food at the implicit, autonomic level, suggesting that SCR can uncover deeper layers of emotional experience—especially those not captured by traditional self-report—thus offering a more nuanced understanding of consumer sensory and affective experience. Larrañaga-Ayastuy et al. [7] explore the interplay between electrodermal activity (EDA) and conscious liking in the context of beer tasting, revealing critical insights into how implicit emotional arousal aligns—or diverges—from explicit evaluation. Their findings demonstrate that EDA, as a marker of autonomic emotional responses, does not always mirror self-reported liking, suggesting that consumers' immediate physiological reactions during tasting can be distinct from their reflective judgments. This divergence underscores the value of integrating implicit measures like EDA alongside explicit assessments in sensory research to capture the full spectrum of consumer experience. The study positions EDA as a powerful tool for uncovering underlying emotional engagement that may inform product development and marketing strategies in the beverage sector. Rita et al [15] investigate the autonomic emotional responses elicited by private label versus national food brands using electrodermal activity (EDA) measurements. Their experimental study reveals that national brands consistently generate stronger physiological arousal responses compared to private label alternatives, suggesting deeper emotional engagement with established brand identities. Notably, these implicit physiological reactions often diverged from participants' explicit brand attitude reports, revealing subconscious preferences undetectable through traditional surveys. The study demonstrates how autonomic nervous system responses provide unique insights into brand perception, particularly for low-involvement food products where consumers may lack strong conscious brand preferences. These findings advance our understanding of how different brand types unconsciously influence consumer emotions, with important implications for brand positioning strategies and private label marketing approaches in the food sector.

B. Product/Experience Evaluation

GSR has been employed in studies that measure consumers' perceived quality and perceived value, providing implicit insights into their underlying emotional responses. Álvarez-Pato et al. [16] developed an innovative multimodal framework for predicting food acceptance by integrating facial emotion recognition (FER), galvanic skin response (GSR), cardiac pulse measurements, and traditional self-reported liking scores during evaluations of both pleasant and unpleasant food samples. Their results revealed important limitations and opportunities in sensory evaluation methods: while FER alone proved insufficient for reliable acceptance prediction, the combination of physiological measures - particularly GSR as a robust indicator of emotional arousal - significantly improved predictive accuracy when analyzed through machine learning models (neural networks and decision trees). The study demonstrated that GSR measurements captured crucial aspects of consumer engagement that were not evident in either facial expressions or self-reports alone, with cardiac pulse providing additional, though less pronounced, predictive value. These findings challenge conventional reliance on subjective ratings in sensory science, instead advocating for a data fusion approach that combines multiple physiological signals with traditional measures. The research establishes GSR as particularly valuable for objectively assessing emotional responses to food stimuli, while also highlighting the potential of machine learning to automate and enhance acceptance predictions in both research and product development settings. This multimodal framework offers food scientists and marketers a more comprehensive, objective tool for understanding consumer preferences that accounts for both conscious evaluations and subconscious physiological responses. Martínez-Levy et al. [17] conducted a multimodal study examining consumer responses to chocolate pudding with varying sucrose concentrations (38, 83, 119, and 233 g/kg), combining both explicit self-reports (liking, sweetness, bitterness, and astringency ratings) and implicit physiological measures (heart rate/HR and galvanic skin response/GSR). Their findings revealed that increasing sucrose concentration enhanced self-reported liking and sweetness perception while reducing bitterness and astringency. Notably, HR - but not GSR - showed significant variation across sucrose levels, with the intermediate concentration (119 g/kg) eliciting peak HR responses that positively correlated with hedonic ratings, suggesting an optimal "sweet spot" for consumer preference. The study also found that adult participants exhibited stronger physiological responses than younger adults, and that HR patterns at lower sucrose levels reflected bitterness/astringency perception. These results demonstrate the value of integrating physiological and self-report measures in sensory science, providing actionable insights for product optimization (particularly suggesting ~120 g/kg sucrose as an ideal formulation target) while highlighting age-related differences in consumer responses. The research underscores how implicit physiological measures can reveal important consumer preferences that may not be captured through traditional self-report methods alone.

C. Consumer Behavior

Multiple studies demonstrate significant correlations between electrodermal activity (EDA) and key consumer

behavior metrics, including purchase intention, willingness to pay premiums and brand loyalty formation suggesting EDA's predictive value in consumer research. Somervuori and Ravaja [18] employ psychophysiological measures (facial EMG, skin conductance) to reveal that price levels differentially modulate emotional and behavioral responses: lower-priced brands elicit stronger positive affect and approach tendencies (SC increase: $1.2 \pm 0.3 \mu S$), while premium pricing triggers negative affect despite higher perceived quality ratings. This dissociation between conscious evaluations (self-reported) and implicit reactions (physiological) demonstrates that pricing strategies activate distinct affective processes, with physiological measures uncovering latent emotional conflicts (e.g., desire for quality vs. price aversion) that traditional surveys fail to capture. Smith et al. [19] demonstrate how branded food packaging physiologically engages children through skin conductance response (SCR) measurements. Their experimental study with school-aged children found significantly stronger physiological arousal when children viewed their favorite branded food and beverage products compared to unbranded alternatives, even for products with identical nutritional content. These elevated SCR patterns correlated with both increased self-reported desire to consume and improved brand recognition, suggesting that food branding triggers subconscious physiological responses that may influence consumption behavior. The effect was particularly notable for energy-dense, nutrient-poor products, highlighting how marketing may unconsciously promote less healthy food choices. By combining psychophysiological measures with behavioral and self-report data, this study provides compelling evidence that children's physiological responses to food branding precede and potentially shape their conscious preferences, with important implications for policies regulating food marketing to children.

D. Food Packaging

Moya et al [20] examine how neuromarketing methods such as EEG, galvanic skin response (GSR), and eye-tracking have been applied to the study of food packaging, with the aim of understanding consumer attention, emotional arousal, and memory. Their review highlights that while these techniques are increasingly used in both academic and commercial contexts, concerns remain about the validity, reliability, and standardization of measures in industry practice. The authors argue that neuromarketing can meaningfully complement traditional self-report approaches, offering deeper insights into unconscious and automatic consumer reactions to packaging design. At the same time, they stress the need for a stronger scientific framework to ensure methodological rigor and to translate physiological data into actionable strategies for food marketers. Vila-López et al [21] investigated consumer responses to low-fat food packaging by comparing reactions in virtual and physical shopping environments. Using both physiological measures (electrodermal activity, heart rate, and facial muscle activity) and self-report evaluations, they tested six packaging designs that varied in color and messaging. Their findings showed that low-order emotional responses captured through physiological indicators were consistent across both contexts and strongly predicted actual product choice, whereas high-order cognitive evaluations did not align with purchase behavior. This suggests that implicit physiological measures provide a more reliable reflection of

consumer decision-making processes in packaging research than conscious, self-reported judgments.

III. CONCLUSION

Overall, the reviewed literature demonstrates that electrodermal activity (EDA/GSR) and related physiological measures provide a valuable complement to traditional self-report methods in food consumer science, offering time-sensitive and objective insights into emotional arousal and motivation. Across applications ranging from taste evaluation [14, 17] and beverage testing [7] to brand perception [15, 19], pricing strategies [18], and packaging design [20-22], GSR consistently captures implicit reactions that often diverge from explicit evaluations. These divergences highlight its capacity to uncover subconscious affective processes—whether positive arousal in response to branding, negative tension in relation to price, or nuanced reactions to flavor intensity—that self-reports alone may overlook. At the same time, methodological challenges such as signal variability, latency, and the inability to capture valence underscore the need to combine GSR with complementary measures such as EEG, heart rate, or facial EMG, and to employ standardized protocols for data collection and analysis. Taken together, this body of work positions GSR as a robust tool for advancing sensory and consumer research, enabling a richer understanding of how emotions, motivations, and physiological arousal interact to shape food-related experiences and decision-making.

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