



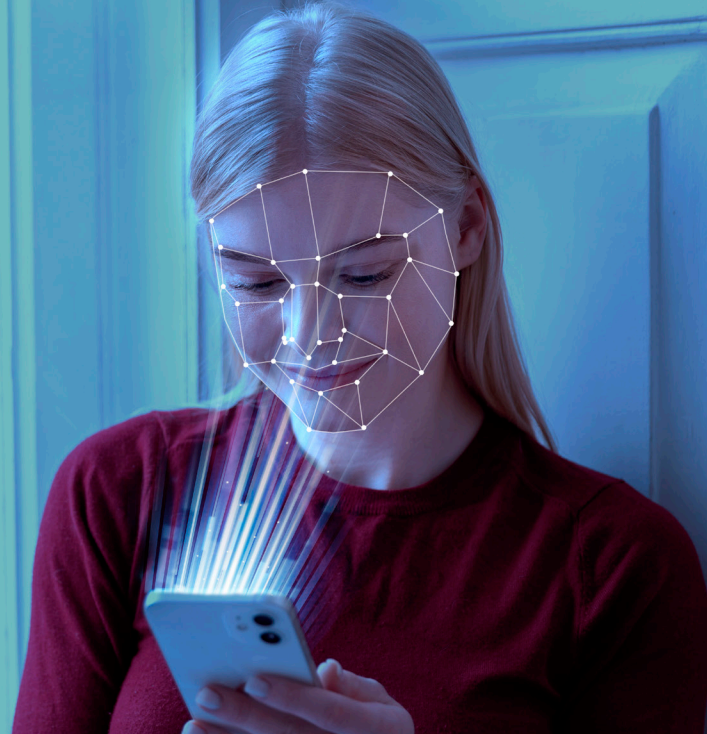
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PREDICTING CONSUMER AD PREFERENCES USING PHYSIOLOGICAL MONITORING AND AI

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What is Emotions' Role in Advertising?

Predicting consumer ad preferences is a significant challenge in marketing research. Traditional methods rely heavily on conscious assessments like questionnaires, but unconscious choices, often driven by brain activity, are harder to measure (Venkatraman et al., 2015). Advertising greatly influences consumer decisions, and understanding its impact involves both cognitive and emotional responses. As such, neurophysiological tools assist in monitoring and gauging emotions, therefore minimizing cognitive bias (Casado-Aranda et al., 2023). Conventional marketing research usually only permits the examination of customer responses to marketing stimuli after they occur (Wang & Minor, 2008). Furthermore, because participants may misremember their experiences or give into social desirability bias, self-report methods may produce data that is inadequate or biased (Wang & Minor, 2008). This limitation is exacerbated by the fact that many processes occur subconsciously (Camerer & Yoon, 2015). As a result, alternative techniques, such as neuroscientific tools, are becoming increasingly popular (see Casado et al., 2023).

Emotions have long been regarded as robust predictors of advertising effectiveness, given their profound influence on an individual's response to incoming messages. Ekman's (1992) emotional scale is a standard

reference model for categorizing emotions; a well-established categorical framework that posits the existence of a limited number of fundamental and discernible emotions. This model delineates seven fundamental emotions suitable for classifying facial expressions: Joy, Anger, Fear, Surprise, Sadness, Disgust, and Contempt. The assessment of emotions predominantly revolves around comprehending the seven fundamental emotions. Emotions often operate unconsciously, making it difficult for consumers to express their feelings, especially when directly asked (Harris et al., 2018). This underscores the importance of emotions in the effectiveness of marketing strategies. Since emotions significantly influence attention, memory, and decision-making, advertisers should consider them more carefully (Poels & Dewitte, 2019) and many firms are indeed trying to take it in consideration.

How Can Neurophysiological Tools Measure Emotions?

Researchers can capture real-time emotional responses using neurophysiological tools like Electrodermal Activity (EDA) and Facial Expression Analysis (FEA). EDA measures skin conductance linked to emotional arousal, while FEA decodes facial expressions to identify emotions. These tools are cost-effective, easy to use and have the capacity to offer real-time assessment of neurophysiological activity, provide valuable insights into how consumers react to advertisements, offering a more objective measure than traditional questionnaires. While eye tracking and EEG dominate the integrations with other tools, the exclusive use of autonomous nervous system tools is uncommon. Specifically, using tools such as EDA and emotions detected via facial expressions offer a cost-effective alternative for analyzing real-time responses to advertising stimuli. However, their combined analysis remains insufficiently explored in clinical research (Zheng et al., 2024).

What is EDA?	What is FEA?
<p>EDA measures skin conductance or electric resistance, which changes in response to sweat gland activity. Changes in sweat secretion are a standard physical marker for sympathetic activation and have been linked to Attention, arousal, cognition, and emotional responses. The high sensitivity of the electrodermal system to detect even slight variations in skin conductance explains why EDA is a valuable tool for assessing consumers' emotional arousal. Its significance lies in the fact that EDA is only affected by the sympathetic branch of the autonomous nervous system and is not affected by the peripheral parasympathetic system, unlike many other physiological tools. On the other hand, positive and negative emotions can increase arousal levels, so heightened skin conductance levels reflect the intensity of the stimuli rather than their emotional type.</p>	<p>Facial expression refers to the movement and muscle placement of the face. Decoding facial expressions is particularly important in various fields, including consumer neurosciences, as it can reveal emotions and provide insights into reactions to different perceptual stimuli. The methodology for automatic decoding technology plays a fundamental role in this field, and the primary techniques used are facial EMG (fEMG) and computer-aided decoding technology. Computer vision-based approaches take advantage of image processing algorithms and camera technology advances. While image processing algorithms used in this context are much more complex than those used in fEMG research, they have yielded significant results in recognizing emotional facial expressions near real-time without requiring sensors attached to the participant.</p>

How can Machine Learning Techniques and Explainable AI be used in Advertising?




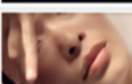
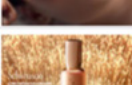

Machine learning (ML) techniques, such as Random Forest (RF), Support Vector Machine (SVM), and k-Nearest Neighbors (kNN), have been applied to predict consumer preferences. These techniques analyze data from

EDA and FEA to identify patterns and make predictions. Among them, RF has emerged as the top performer, achieving high accuracy and precision. In addition to predictive accuracy, it's essential to understand which features are most influential. Explainable AI (XAI) helps identify key factors that drive consumer preferences, such as attention, engagement, joy, and disgust. This transparency enhances trust in AI systems and provides actionable insights for marketers.

How did we conduct the study?

The study focused on cosmetics advertising for Chinese female consumers, using a sample of 37 participants who watched 6 advertisements while their EDA and FEA responses were recorded. The ads varied in tone (emotional vs. rational) and origin (Brazil, France, South Korea). After viewing, participants ranked their ad preferences. Neurophysiological data included EDA, measuring skin's electrical conductance, and FEA, analyzing facial muscle movements to decode emotions. The integration of these tools provided a comprehensive view of participants' emotional responses to advertisements.

TABLE 2 Experiment design with the sequence of six cosmetic product advertisements, their duration, tone, and origin.

Steps	Product	Brand	Tone of Ad	Link	Country	Advertisement
1	Skin Ritual Face Serum (duration: 55 s)	Costa Brazil	Emotional	https://www.youtube.com/watch?v=oQmEHXpnrQ (Accessed on February 4, 2023)	Brazil	
2	Bum Bum Body Scrub (duration: 93 s)	Sol de Janeiro	Rational	https://www.youtube.com/watch?v=y79s9VBSBOY (Accessed on February 4, 2023)	Brazil	
3	Orchidée Impériale High Regeneration Cream (duration: 47 s)	Guerlain	Rational	https://www.youtube.com/watch?v=uEGvI31ewjg (Accessed on February 4, 2023)	France	
4	Orchidée Impériale High Regeneration Cream (duration: 79 s)	Guerlain	Emotional	https://www.youtube.com/watch?v=0IGXR1WeXuM (Accessed on February 4, 2023)	France	
5	Concentrated Ginseng Renewing Serum (duration: 30 s)	Sulwhasoo	Rational	https://www.youtube.com/watch?v=jh7rx14c5P4 (Accessed on February 4, 2023)	Korea	
6	Timetreasure Renovating EX (duration: 83 s)	Sulwhasoo	Emotional	https://www.youtube.com/watch?v=erUdWktpncg (Accessed on February 4, 2023)	Korea	
7	Survey—Participant's Ad Preferences					

What did we conclude?

The study found that joy and disgust were key predictors of ad preferences, with joy positively linked to consumer engagement. The RF technique proved more effective than other ML methods for predicting preferences. Adding behavioural data, like buying habits, could further enhance understanding and validate AI performance across industries. This research highlights how combining neurophysiological tools with AI can predict consumer ad preferences more effectively. By focusing on key emotional drivers, marketers can craft better campaigns. The addition of explainable AI (XAI) makes these insights actionable and transparent. Integrating techniques like EDA, FEA, and ML improves prediction accuracy and offers a deeper understanding of the emotions that influence consumer behaviour, supporting more informed marketing strategies.

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