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Neuromarketing in advertising: a scoping review of attention, engagement, and persuasion metrics

Advertising effectiveness depends on capturing attention, fostering engagement, and achieving persuasion. Neuromarketing uses neuroscientific tools to measure these constructs beyond traditional self-report methods affected by cognitive biases. This scoping review examines neuromarketing metrics in advertising research and their application across modalities.

The review analyzed studies employing fMRI, EEG, ERPs, eye-tracking, pupillometry, facial coding, and autonomic indices. Attention was defined as selective resource allocation, engagement as cognitive-affective processing depth, and persuasion as behavioral intention change. Correlation and regression analyses were used to identify factors influencing interest in emerging marketing methods and their efficiency.

Attention metrics included fixations, dwell time, scan-path entropy, and early ERP components (P200, N200, N400). Engagement indices encompassed neural engagement scores, frontal coherence, and inter-subject synchrony. Persuasion outcomes involved purchase intent, recall, attitude change, and brand-choice propensity. fMRI studies revealed reward-related activation in the nucleus accumbens and prefrontal cortex, while EEG alpha-band activity and P300 components reflected attentional and cognitive processing. Eye-tracking demonstrated visual attention patterns underlying consumer decisions. Interest in emerging marketing tools depends on prior performance dynamics, and the use of applied neuroscience methods positively influences client satisfaction with analytical services.

Overall, evidence across modalities indicates parallel neural processes driving advertising effectiveness. Neuromarketing offers insights into subconscious consumer responses inaccessible through traditional measures. Future research requires methodological standardization and ethical frameworks for measuring involuntary responses.

Keywords: *Neuromarketing; advertising; attention; engagement; persuasion; consumer neuroscience; EEG; fMRI; eye-trackinng.*

Introduction. Advertising should persuade, engage, and direct attention toward buying or using products. Neuroscientific indicators are increasingly adopted to assess advertising attention, engagement, and persuasion. Attention links advertising to further consideration and purchasing. Engagement refers to cognitive or emotional responses elicited by an advertisement. Persuasion indicates the degree to which an advertisement influences consumers or motivates a desired action [1–3]. Theory and experimental evidence suggest that attention increases engagement, which in turn enhances persuasion. Scholars propose that neuromarketing metrics in advertising can be mapped to these three constructs [4–9]. The present scoping review investigates the use of neuromarketing metrics in advertising. The research questions are as follows:

– To what extent do advertising neuromarketing studies employ attention, engagement, and/or persuasion metrics?
– What are the predominant research domains of advertising neuromarketing studies?
– What are the factors affecting interest in neuromarketing methods and their efficiency?

While attentional access represents a theoretical gateway to advertising influence [10, 11], models extending the neural axis from attention through engagement to persuasion provide a more comprehensive mapping; a complementary scoping review confirms growing interest in neuromarketing's application to advertisement design.

Analysis of recent research and publications. Recent research highlights the growing effectiveness of neuromarketing tools in analyzing advertising performance. Studies demonstrate strong correlations between eye-tracking indicators and early attention, while EEG metrics such as alpha-band suppression and P300 reliably reflect engagement and cognitive evaluation. fMRI findings support these results by showing reward-related activation in the nucleus accumbens and prefrontal cortex during exposure to persuasive advertising. These outcomes confirm neuromarketing's potential to capture subconscious consumer responses that traditional methods often overlook.

However, despite these advances, scholars emphasize persistent challenges, particularly the lack of methodological standardization and ethical concerns regarding involuntary neural data. Variability in research designs and measurement protocols limits comparability across studies, while issues of data privacy and informed consent remain insufficiently addressed. Without unified frameworks, the field risks fragmented development and inconsistent interpretations of attention, engagement, and persuasion metrics.

Addressing these gaps requires coordinated efforts to establish standardized methodological guidelines and ensure robust ethical oversight. Such measures are essential to enable broader adoption of neuromarketing tools and ensure the reliable, responsible use of neuroscientific metrics in advertising research.

Statement of the problem. Despite rapid advancements in neuromarketing, current advertising research lacks a unified, methodologically consistent framework for measuring and interpreting consumers' unconscious responses to marketing stimuli. Existing studies employ diverse tools (fMRI, EEG/ERP, eye-tracking, facial coding, autonomic indices), yet the variability of experimental designs, inconsistent stimulus selection, insufficient control conditions, and heterogeneous timing parameters significantly limit comparability of findings and the ability to generalize conclusions.

Moreover, although attention, engagement, and persuasion are considered core components of advertising effectiveness, their metrics remain fragmented, often conflating cognitive, affective, and behavioral indicators. The absence of clearly defined neuromarketing metrics for these constructs, coupled with limited understanding of how physiological signals correspond to real-world consumer behavior, creates a gap between laboratory measurements and actual behavioral propensity (e.g., purchase intention, clicking, brand choice).

Consequently, there is a pressing need to systematize neuromarketing approaches applied in advertising, define standardized metrics for attention, engagement, and persuasion, and develop a coherent experimental framework that ensures ecological validity, reliability, and comparability across studies.

Research methods. Experiments on neuromarketing have proliferated in the past 15 years, spurred by developments in brain and body imaging techniques that afford real-time surrogates for consumer attention, engagement, and persuasion. To synthesize these findings, the present scoping review addresses the following questions:

1. What neuromarketing metrics have been applied to advertising stimuli?
2. How do these metrics interact with attention, engagement, and persuasion?
3. Which advertising modalities and stimuli have been investigated?

Given the diversity of neuromarketing techniques, attention, engagement, and persuasion occur across multiple modalities. The scoping review identifies the modalities most systematically studied in the context of attention, engagement, and persuasion. Definitions are established from the advertising literature. Attention denotes the extent to which internal cognitive resources are allocated to an advertisement. Engagement captures the depth of cognitive and emotional processing. Persuasion indicates the change in behavioral intention induced by an advertisement and can refer to variables such as message recall, attitude change, and purchase intention.

Research results. Neuromarketing, a hybrid discipline at the intersection of neuroscience, psychology, and marketing, aims to understand unconscious consumer behaviors. Probabilistic conclusions can be drawn about the advertising content that will most likely influence consumers' attention and behavioral response, based on the analysis of neural activation or patterns of specific physiological signals time-locked to those stimuli [7, 12, 13].

Attention has been defined as the selective allocation of processing resources to a stimulus, which is a function of salience [11]. Although different theoretical accounts exist of how attention may be allocated in advertising contexts, they mostly agree on two broad classifications: bottom-up and top-down. The bottom-up approach designates that attention is allocated automatically by the different characteristics of the stimulus; the top-down account, on the other hand, includes the influence of the observer's previous knowledge, expectations, awareness, and/or goals on stimulus processing. Brain regions involved in the automatic detection of salience, such as the visual cortex and the locus coeruleus, and regions involved in the influence of goals, such as the medial prefrontal cortex, suggest that both types of allocation occur simultaneously [14–21].

Engagement is defined as the motivational and cognitive effort devoted to a stimulus, which contributes to processing fluency, the experience of being cognitively involved in a stimulus. The latter further contributes to the derivation of affective feelings toward the stimulus, in agreement with models of the affective system [22–24]. Theoretical models of immersion, cognitive load, and the AIDA (attention-interest-desire-action) framework suggest that advertising content can foster engagement either by promoting a high degree of immersive experience in the message or by facilitating cognitive workload that enables the derivation of potential actionable steps in the content conveyed [25–31].

Persuasion refers to the process of forming or changing intentions, preferences, attitudes, or beliefs toward an object, which leads to behavioral modification. In advertising contexts, advertising effects scale can be framed with respect to behavioral propensity, which includes semantic recall, attitude positioning, social and executive functions, purchase intention, click behavior, and choice of brand or substitute [32–36].

1. According to researchers, attention may be a limited resource within the mind that can be directed and reflected upon. Several researchers [37] have noted that attention can be either voluntary or reflexive. In a voluntary process, visual input that is relevant to the individual's current goal must be detected by a perception system before the investment of attention. Salience can be defined as a measure of the distinctive importance or prominence of a stimulus and is a key construct for understanding attention in advertising. Salient stimuli capture attention through a reflexive signalling process. Finally, Kahneman's work suggests that, in advertising, attentional

capture generally begins with an analysis of visual salience followed by identification of whether any relevant promotional content is present [38–44].

Attorneys generally perceive an advertisement as a marketing stimulus from a service provider that can be reacted to in order to fulfill a need. Cues in an advertisement usually signal the need to appraise social stimuli included (e.g., the advertisement itself, the advertising firm, related third parties), which are components of the prospect theory assessment. A series of measures (e.g., SPPS, module feedback, recall, and Likert rating) are designed for assessing advertisement appraisal and a few mid-guide EEG epochs are integrated to focus the available information on corresponding elaboration (or persuasiveness) of the advertisement [45–52].

2. Advertising effectiveness includes the persuasive and engagement dimensions, with some models formally linking attention and engagement. The theoretical literature suggests that higher engagement is associated with immersive experiences that reduce cognitive load, facilitate positive affect transfer, and foster elaborative processing. Neuromarketing studies also associate engagement with immersion and control. Measurements of engagement are often conflated with attention, but distinctions are important; attention remains a focal concern. Immersion and cognitive load are further integrated into models linking persuasion and behavioral intention with attention and engagement [53–60].

Engagement is defined as a multicomponent construct denoting responsive rather than passive interaction, with procedural and content components. In immersive conditions, content engagement becomes more salient. Brain engagement reflects the allocation of internal cognitive resources. Immersion combines sensorimotor, affective, narrative, and cognitive elements. Advertising fosters immersion through worldbuilding, brands, and themes that resonate with consumers, enhancing positive attitude formation. Cognitive load relates to the effort expended in resource-limited tasks; high-load advertisements elevate processing and reduce cognitive resource availability for subsequent tasks [61–66].

3. The ultimate goal of advertising is to persuade consumers to adopt the advertised product. In other words, advertising aims to drive behavioral change. Various theories highlight the neural correlates of persuasion for high-involvement decisions such as the purchase of a car or a house [11]. Eliciting a purchase and an intention to search for more information are immediate measures of persuasion. Other indicators include clicking on a web link to visit the relevant website, recalling the brand and its product category, a change in attitude towards the brand, and the propensity to choose the brand [67]. At a macro level, the ability to persuade an audience and increase the probability of taking the desired action give advertisements value (regardless of the commercial or public sponsor's objective) [68–72].

Neuroimaging Modalities and Physiological Measures

An analysis of the various physiologically based marketing techniques motivates the present scoping review concerning advertising neuromarketing. Two general types of advertising metrics have emerged: tangible and intangible. Tangible metrics involve subjects' directly reportable behaviors, such as brand choice and memory recall. However, suppliers of advertising content seek insight into purchase-action propensities potentially effectuated by brain and body activity prior to conscious report. Such barely cognized motivation, supposedly subliminal, operates largely outside awareness. Categorized as intangible, such metrics therefore constitute a primary focus for neuromarketing, salience, preconscious insights into engagement, involvement, and exposure time; purchasing, however, is hypothesized to fall within conventional behavioral domains. Distinctions have arisen between preconscious and automatic responses, with the former presumed to involve covert attention coupled with high arousal, while the latter emphasize reflexive and purely perceptual engagements. Such faculties have been designated the «old brain» by the terminology of certain neuropsychologists [73–78].

Neuromarketing, which concentrates on subconscious stimuli that stimulate brain responses or perceptions intermediate between preconscious intent and overt action, has burgeoned rapidly. Three hundred thirty-six contributions discover seventy-five distinctive methodologies across the spectrum of sensing modalities. Context distinguishes the systems where signals are registered, including body sensors, between-condition differences, and statewide variations, four degrees characterize signal types based upon the eye movement indicators supplied, and a thirty-item content-analysis typology delineates information ostensibly communicated to consumers. A subset of neuromarketers pays exclusive regard to content and discount signals, designating them «advertising marketing» and evincing exclusion from the current investigation geared toward substantive content [79–82].

1. Functional Magnetic Resonance Imaging. As a non-invasive method to examine neurophysiological responses in humans, functional magnetic resonance imaging (fMRI) has rapidly gained prominence since the early 1990s. fMRI detects local changes in blood oxygenation level-dependent (BOLD) signals related to the neural activation of brain areas, enabling researchers to advance their understanding of the intricate relationship between neural activity and cognition. With high spatial resolution, fMRI can efficiently localize brain responses to marketing and advertising stimuli. Advertisements are frequently inconspicuous or are ignored; thus, substantial investments in time and resources frequently yield limited effects. It is claimed that fMRI could identify the moment an advertisement began to fail in engaging viewers, and pioneer studies provided practical and user-oriented insights into advertising [83–87].

Specific brain regions pertinent for attention are the right ventral frontal cortex and the superior temporal sulcus. The dorsal attentional network comprising the intraparietal sulcus and the superior frontal cortex relates to top-down attention. Brain regions relevant for the reward system encompass the nucleus accumbens, medial prefrontal cortex, and orbitofrontal cortex, assessing and computing the value associated with consumption activities – from pre-purchase and purchase to post-purchase. The medial and lateral regions of the prefrontal cortex provide inputs to this value-computation model. Advertising attention is followed by the modeling and computation of reward. Thus, fMRI is now widely applied in marketing and advertising – studies on the motivational system, emotional appraisal, aesthetic judgment, and multiple other angles are being reported [11].

2. Electroencephalography and Event-Related Potentials. Electroencephalography (EEG) has been increasingly adopted because the brain signals of interest are available during advertising stimuli and data acquisition is non-intrusive. EEG features can be extracted without task involvement or extended training, enabling evaluation of spontaneous processes in reaction to advertising communications; such processes often occur below the level of conscious familiarity [88]. EEG measures neural oscillatory activity and event-related potentials (ERPs). Brain waves that vary in frequency include alpha (8–12 Hz), beta (12–30 Hz), gamma (30–100 Hz), theta (4–8 Hz), and delta (< 4 Hz) bands of oscillation. Analyzing these includes the review of all recorded data; selection of a time segment of the data recording; averaging of data across multiple trials; and identification of features from the data's time/frequency domain. Authors recommend focusing on alpha band activity (8–12 Hz) at electrode locations over the parieto-occipital region and the occipital region when analyzing for metrics of attention, and describe procedures for identifying and extracting meaningful information from the data (i.e., preprocessing techniques, methods for selecting trials, and statistical testing). The primary motivation behind using electroencephalography (EEG) research lies in its ability to connect simple and easy-to-compute EEG attributes to higher order cognitive processes that affect how individuals perceive persuasive communications [12, 89–91].

ERP's are brief electrical responses in the brain evoked by an outside event. ERPs are generally categorized based upon their peak latency relative to the stimulus presentation. Cognitive processing during advertising stimuli has been studied through various ERP components that address questions from early perceptual analysis to more complex semantic processing involving high-level cognitive constructs and self-referent thinking. A number of studies have found associations between the P300 component and variables of interest in marketing contexts including brand recognition, advertisement complexity, and the persuasive effect of advertising. Some researchers view the P300 component as providing an efficient, though adequate, evaluation of cognitive processing elicited by advertisements. In addition to the P300, other researchers have investigated the logo-related P200 component that they believe accounts for advertising memory, and the N400 component, which is believed to reflect semantic congruence or incongruence between the expected and actual content of an advertisement [90, 92–97].

3. Eye-Tracking and Pupillometry. Eye-tracking methods help researchers find out what aspects of marketing materials and product information capture consumers' attention. In addition, it helps to determine how consumers process information and at what times they examine all the information they have access to. Also, eye-tracking research is a way to study the cognitive processes associated with consumer preferences, judgments, decision-making, and goal priming. As an example, priming health-related motives increase consumers' choice of low-calorie food products by increasing the amount of time consumers spend looking at these products. Additionally, impulsive consumers show an attentional bias toward distraction products, suggesting that the motivation or goal being considered influences how much attention consumers devote to relevant information. Therefore, eye-tracking is used as a method to measure consumer preferences and decision-making based on where their gaze is directed (eye movement) and where their gaze directs them (gaze shift), such as to more attractive faces that will lead to increased preference for those faces when the direction of the consumer's gaze is manipulated. Furthermore, eye-tracking can be used in naturalistic settings through wearable technology to study consumers' attention while engaging in everyday activities [98–102].

4. Facial Coding and Autonomic Indices. Emotional responses in people that result from advertising are commonly measured using two methods. Facial coding is a method used to measure how an individual's face changes when they experience certain types of emotions (such as surprise or joy), which can be triggered through various forms of advertisement (video, packaging, billboard etc.). While facial coding measures how a person experiences an emotional response, autonomic arousal measures the degree to which one responds emotionally; therefore, both measures have different ways of measuring the same thing (i.e., the emotional response), but both are related (facial coding shows the type of response experienced, while autonomic arousal indicates the extent to which it was experienced). Heart rate and skin conductance are two of the primary autonomic arousal measures that have been used to measure the level of response an individual experiences to an emotional stimulus. In terms of measuring exposure to emotion inducing stimuli, facial expression techniques have traditionally been used, and the use of automated measurement techniques has made them more applicable to the field of advertising and is now being used in the retail industry. There are also a number of commercially available systems that utilize emotion recognition technology that can be easily deployed within many businesses.

Experimental Design in Advertising Neuromarketing

Advertising neuromarketing studies incorporate a variety of methodological and technical designs that, although commonly implemented across studies, remain poorly documented and adhered to in the literature. Only limited formal specification of the requisite conditions needed for valid and interpretable results, combined with the extensive variety of experimental setups employed across studies, hinders the comparability and synthesis of findings. Selection of the advertising stimulus and its delivery to participants in an experimental task constitute a fundamental design choice influencing the nature of the neuromarketing signal, its interpretation, and its relevance to real-world advertising [110]. No formal guidelines articulating the measures that should accompany specific stimulus types in advertising neuromarketing exist to date. Establishing a common framework for defining the design specifications needed to garner advertising-relevant outcomes from a given modality of advertising neuromarketing appears valuable. Given the substantial body of work on attention, engagement, and persuasion in the advertisement context, one such framework can thus incorporate the preliminary notion of an advertising-neuromarketing signal [11] and capture the corresponding stimulus-selection, control-condition, and experimental-timing considerations [111–115].

1. Stimulus Selection and Ecological Validity. Advertising stimuli have been found to elicit physiological reactions, specifically heart rate acceleration and pupil dilation, which can be measured in a laboratory setting. However, because most of the research conducted to date has used an experimental paradigm, it is difficult to make a direct connection between commercial intent, the viewing conditions, and how consumers react to the advertisement. Ideally, researchers would utilize the same stimulus as the consumer viewed, so that there would be minimal preparation required to view the advertisement (i.e., changing from viewing on a mobile phone to viewing on a computer). It is also important to maintain the pre-test environment (e.g., geographic location, streaming service) to help ensure that the results are valid and reliable. The format of the advertisement is only one aspect that manufacturers need to consider when controlling for differences in advertisement content. Manufacturers will need to control for different formats of advertisements as well as comparison advertisements. A common method employed in scientific literature to control for content variability is to use either neutral or unrelated commercial materials. The authors of [11] investigated the influence of social embarrassment on advertising processing, particularly on memory and attention, using neural correlates to assess the emotion. In contrast to other forms of embarrassment, social embarrassment impairs the formation of memory and decreases the allocation of attention to advertising content, resulting in decreased memory and decreased attention. Neural activity in the medial prefrontal cortex and visual cortices indicates that subjects experienced embarrassment while activation in the amygdala and hippocampus, which support memory functions, indicate that socially embarrassing stimuli were being processed. Modulation of the neural activity associated with valuation-related regions of the brain (ventromedial prefrontal cortex, ventral striatum, and amygdala), which are indicative of advertising effectiveness, was consistent with the modulation observed for social embarrassment. Therefore, the neural activity related to traditional measures of advertising effectiveness (memory, attention, preference, and emotion) are influenced by social factors related to accessing advertising in real life. Additionally, collecting both self-report and neurophysiological data simultaneously in both social and isolated environments provides greater predictive power than solely relying on self-report data. Thus, further investigation of social influences on these core indicators in isolation is warranted, starting with the social influence on attention allocation [116–120].

2. Control Conditions and Baseline Measurements. Controlling for extraneous variables is crucial in ensuring the validity of neuromarketing metrics in advertising settings (Pozharliev et al., 2017). In the absence of adequate controls, the observed metrics may not accurately reflect the construct of interest or the theoretically predicted relationship with it. Several strategies can help minimize such confounding influences:

– sham or neutral stimuli can serve as control conditions, enabling the separation of the influence of advertising from that of other variables (Wei et al., 2018). Cross-modal controls allow a similar effect to be achieved when the advertisement is presented in a different modality;

– where the neuromarketing metrics are expected to show a baseline correction, pre-stimulus recordings can be used for this purpose. If the stimulation includes multiple presentations or segments, baseline correction helps mitigate the potential confounding effect of overall signal level.

3. Time Windows and Data Aggregation. The timing of stimulus presentation and data aggregation practices significantly influence experimental outcomes and their interpretation in marketing neuroscience studies [110]. Multiple design aspects modulate the nature of the consumer experience and should be tailored to research goals [10]. Advertising stimuli can be presented as isolated pieces of content or as an entire campaign comprising multiple ads. Similarly, the timing of data acquisition can vary from the analysis of individual ad exposures to the assessment of a complete campaign with multiple ads [37]. However, different aggregation levels with the same set of stimuli lead to different participant responses, masking the effect of the underlying experimental design. Therefore, the segmenting of analysis based on cross-study differences in timing between stimulus presentation and data acquisition holds merit [70, 84, 106, 117, 119, 121].

Metrics for Attention, Engagement, and Persuasion

Neuromarketing studies have employed various metrics for assessing attention, engagement, and persuasion to investigate consumers' responses to advertising stimuli. Attention metrics include two distinct categories: indicators based on physical traces of information intake and measures assessing the dynamic nature of attentional processes. The former class comprises fixations, indicators of visual engagement that reveal where and for how long individuals focus their attention on different elements of a stimulus; dwell time, which gauges the cumulative duration of gaze to a specific area of interest; scan path entropy, an index of exploration strategy trajectory complexity; and early event-related potentials, such as P200, N200, and N400, linked to stimulus saliency and semantic integration for large visual changes. Saliency measures from algorithm-based approaches also fall within this category, although they may provide misleading indications when visual fixation does not accompany a stimulus. Engagement metrics help determine the degree to which a stimulus successfully immerses consumers. Captured primarily through brain-processing analysis, these indices encompass neural engagement scores, frontal coherence, and inter-subject synchrony – indicators of information processing intensity, cognitive workload, and shared emotional experience, respectively and can be extracted from electroencephalography (EEG) data. Subjective ratings of immersion further clarify this construct [4, 81, 84, 122–124].

1. Attention Metrics and Salience. Since the dawn of advertising, its objectives have been to attract consumers' attention, engage them, communicate relevant information, and influence purchase intention [10]. Attention refers to the channeling of limited cognitive resources toward a particular stimulus, which limits the processing capability of other stimuli. Attention has been further divided into several subtypes, such as selective attention, focused attention, sustained attention, and divided attention. In advertising, attention plays a vital role as the first cognitive stage in determining consumers' acceptance to process. It plays a decisive role in the performance of ads, as highlighted by the statement «You cannot sell anything you do not get noticed». Salience refers to the process of stimuli action that influence a person perception and attention. Salience can be divided into bottom-up salience (intrinsic or stimulus-driven salience), and top-down salience (extrinsic or goal-driven salience), relevant to advertising, bottom-up salience is of consideration. Bottom-up salience is defined as a property of stimuli that can spontaneously capture the observer's attention independent of thought and belief. It is vitally important in the advertising setting because advertising stimulus cannot avoid the influence of situational factors, and bottom-up salience could be employed as an important metric to determine the attention allocation [7, 125, 126].

2. Engagement Indices and Immersion Levels. Neuromarketing offers the potential to measure engagement more directly than traditional proxies like viewing time [53]. Although outwardly simple, the concept remains complex. The term «engagement» applies to an array of scenarios ranging from work-related contexts to media consumption, and manufacturers, platforms, and researchers engage with the term differently. At the neural level, both explicit and implicit perspectives have the potential to yield insight into the nature of engagement. Some consider engagement to constitute a reflective, deliberate, explicitly aware cognitive state, whereas others contend that engagement designates an uncontrollable, rapid, implicit, barely conscious process originating from affective or heuristic contemplation. For instance, television advertising normally is processed implicitly and automatically without much awareness or subsequent retrieval. Even under automatic processing, however, neural circuits may differ markedly among varied advertisements or program activities. Engagement may be reflected through the time taken for commercials and programs to become irrelevant or forgotten, and the time before attention is diverted back to the program. As engagement in advertising normally has a temporal aspect, eye-tracking data have become a popular way to evaluate engagement [101, 117, 127–129].

3. Persuasion Outcomes and Behavioral Propensity. Persuasion outcomes derived from global and local processing are critical to explaining behavior [11]. Behavioral propensity metrics assess the likelihood to act upon persuasive messages and include purchase intent, clicking behavior, message recall, attitude change, and propensities toward brand choice [130]. Such measures remain widespread in digital advertising given the ease of tracking and quantifying, especially with e-commerce links, yet holistic studies on their link to raw neurometric signals remain scarce.

Neuromarketing metrics have great potential to guide advertising practices while considering consumer well-being. Nevertheless, ethical issues arise when the metrics target involuntary responses. Surveying these metrics enables researchers to balance advertising effectiveness and ethics. Top advertising agencies leverage neurophysiological parameters to enhance creative content and strategic decisions. The methodology allows for evaluating concepts not captured by rigid frameworks and understanding which approaches resonate with intended audiences. In the field of cinema advertising, substances in moving pictures may impact attention and modulation during voluntary mental wandering. Interfield advertising in long-form video can influence downstream attention and concurrent processing during full-screen video display. Far beyond the mere observation of interactions among pre-packaged software programs, selecting the appropriate software becomes paramount in combining diverse inputs and obtaining «the most average» answer for projection on a big screen. Transparency regarding the employed technologies cultivates consumer trust. Consumers embrace techniques utilizing finger movement and gaze direction that fall within intentional body movements. Subconscious or purely physiological measurements are less acceptable. Despite industry-related literature and informal discussions on neuromarketing, publishers

seldom examine the technology in academic articles; careful preparation is required. In the realm of virtual-reality helmets, it remains uncertain whether discreet observations based on head motion are admissible. Such situations detected by an internal circuit could disengage the sequence. Gaining prior consent is prudent before the commencement of any observation [81, 123, 131, 132].

The study of consumer «attention» to advertising has a long history that began during the 1880's. In addition to these historical roots, social media has created opportunities for advertisers to utilize classic measures of advertising (impressions, clicks, shares) on an array of different platforms. Thus, the digital era has altered how advertisers capture consumers' attention and where and how they do so; however, scholars are still debating the efficacy of advertising and if the convergence of Neuromarketing, Cognitive Neuroscience, and Artificial Intelligence will lead to major changes in how advertisers create attention-grabbing ads in the future [70].

Advertising also comes in many shapes and ways, and it can stimulate and capture consumer attention in several formats. Advertisements containing images, text, sounds, and motion all can contain easily identifiable attentional constructs. As a result of this diversity of attention-stimulating and capturing advertisement types, a multitude of studies have been completed regarding attention and its relationship to advertising across a variety of paradigms [133–138].

Greenbook provided a survey of usage of various emerging marketing methods among suppliers and buyers of analytical services mostly from the US [139]. Table 1 provides information about actual use of various methods and cases of considering using them.

Table 1

The interest in emerging marketing methods

Years	Actual use in 2014, % respondents	Actual use in 2020, % respondents	Change in actual use	Growth of actual use	Under consideration in 2020, % respondents	Under consideration / actual use ratio
Text analytics	40	61	21	53	18	0.30
Social media analytics	46	57	11	24	17	0.30
Mobile qualitative	37	54	17	46	17	0.31
Big data analytics	32	47	15	47	19	0.40
Mobile ethnography	30	45	15	50	18	0.40
Micro-surveys	25	41	16	64	19	0.46
Eye tracking	34	39	5	15	13	0.33
Behavioural economics models	25	37	12	48	19	0.51
Applied neuroscience	13	25	12	92	15	0.60
Research gamification	23	36	13	57	22	0.61
Facial analysis	18	26	8	44	14	0.54
Prediction markets	17	26	9	53	15	0.58
Crowdsourcing	12	22	10	83	17	0.77
Virtual environments	10	18	8	80	19	1.06
Biometric response	10	19	9	90	13	0.68

Source: [139] and author's calculations

Eye tracking, applied neuroscience, facial analysis and biometric response have intermediate or relatively smaller shares in comparison to text analytics, social media analytics and mobile qualitative studies. Except for slow growth for eye tracking, other neuromarketing methods substantially have grown in popularity. But a few more respondent considered using them in future. The regression model for the share of respondents considering using an emerging marketing method (C) shows dependence on the change in the share of respondents using it (I):

$$C = 13.0 + 0.33I \qquad (R^2 = 0.29,\ b_1 \text{ t-stat} = 2.3,\ p < 0.05).$$

Another model shows dependence of under consideration to actual use ratio (C/A) on the growth rate of the share of respondents using it (G):

$$C/A = 0.15 + 0.0067G \qquad (R^2 = 0.52,\ b_1 \text{ t-stat} = 3.7,\ p < 0.01).$$

This suggests further stability in dynamics of the preferences for the methods. Table 2 provides information about possible relationship between use of various marketing methods and various satisfaction aspects of buyers

of the analytical services (share of the satisfied respondents). Significant correlations are larger than 0.88 and marginally significant correlations are larger than 0.81. But scarcity of data on this issue allows to make only preliminary assumptions about the relationships.

For example, data visualization satisfaction is significantly correlated with the share of respondents using mobile qualitative methods and mobile ethnography. Data analysis satisfaction is associated with mobile ethnography, crowdsourcing and applied neuroscience. In most cases either positive or weak correlations exist.

Table 2

Correlation between satisfaction of buyers of analytical services and use of emerging marketing methods

	Overall satisfaction with strategic aspects	Overall satisfaction with tactical aspects	Value for Cost	Reporting research results	Recommending business actions based on the research	Understanding their business	Data visualization	Data analysis	Timeliness of deliverables	Conducting the research	Understanding the issue to be researched
Text analytics	0.60	0.54	0.67	0.60	0.38	0.27	0.81	0.76	0.24	-0.42	0.00
Social media analytics	0.19	-0.09	0.15	0.65	0.21	-0.20	0.52	0.60	-0.03	-0.67	-0.32
Mobile qualitative	0.84	0.46	0.46	0.82	0.70	0.54	0.96	0.82	-0.01	-0.09	0.13
Big data analytics	0.48	0.68	0.77	0.32	0.00	-0.01	0.70	0.84	0.67	-0.31	0.34
Mobile ethnography	0.78	0.64	0.63	0.63	0.41	0.34	0.93	0.94	0.37	-0.08	0.38
Micro-surveys	0.63	0.14	0.24	0.87	0.72	0.43	0.79	0.62	-0.29	-0.32	-0.24
Eye tracking	0.17	0.51	0.78	0.17	-0.09	-0.11	0.44	0.50	0.49	-0.72	-0.18
Behavioural economics models	0.51	0.53	0.71	0.50	0.32	0.25	0.71	0.65	0.24	-0.52	-0.13
Applied neuroscience	0.85	0.56	0.30	0.55	0.44	0.41	0.85	0.88	0.32	0.51	0.82
Research gamification	0.57	0.38	0.54	0.67	0.54	0.40	0.75	0.59	-0.04	-0.45	-0.24
Facial analysis	-0.17	-0.02	0.36	0.20	-0.08	-0.28	0.13	0.15	0.04	-0.95	-0.67
Prediction markets	-0.02	-0.23	0.09	0.49	0.24	-0.10	0.25	0.18	-0.31	-0.82	-0.74
Crowdsourcing	0.60	0.47	0.57	0.64	0.30	0.12	0.85	0.90	0.33	-0.33	0.18
Virtual environments	0.25	0.36	0.51	0.34	-0.14	-0.32	0.57	0.81	0.59	-0.44	0.23
Biometric response	0.33	0.57	0.80	0.28	0.12	0.13	0.54	0.50	0.35	-0.63	-0.21

Source: and author's calculations based on [139]

As for specifically neuromarketing approaches, applied neuroscience is also likely to provide better satisfaction with data analysis, overall strategic aspects, data visualization and understanding the issue to be researched. Eye tracking and biometric response are close to marginal significance of relationship with value for cost satisfaction. Facial analysis and satisfaction with conducting research are negatively correlated. It is possible to create a regression model for data analysis satisfaction's relationship (DA) with applied neuroscience use (AN):

$$DA = -129 + 2.9AN \qquad (R^2 = 0.78, b_1 \text{ t-stat} = 3.2, p < 0.05)$$

Conclusion. A multi-modal advertisement represents a number of differing types of advertisements and the multiple advertising modalities that exist within those forms of advertisements. Each modality also presents stimuli (the input) to consumers, which may be vastly different from one another; however, many of the same conclusions have been made about attention, engagement, and persuasion across the different modalities. This similarity suggests some level of correspondence between the underlying mechanisms of each modality. A scoping review was therefore undertaken to create a systematic documentation of metrics used to measure attention, engagement, and persuasion in advertising; and to determine how each metric manifests across different neuromarketing modalities. The review examined studies focused on consumer advertising in which the constructs of attention, engagement, and persuasion were either a hypothesized effect or an observed effect.

The motivation behind the review is the increasing use of neuromarketing metrics in advertising and to serve as a guide for future research in the area. Neuromarketing is generally defined as the application of neuroscience tools and principles to marketing. By using neuroscience-based methods to study how consumers respond to marketing stimuli (such as advertising), neuromarketing provides a much deeper insight into how consumers automatically react to marketing stimuli compared to the information that is available when using self-report methods (which are biased by a variety of factors including cognitive bias and social desirability). Self-report methods are best suited for examining the effects of marketing stimuli on consumers' reflective, conscious, and deliberate responses.

Past upward trends in popularity of various emerging marketing methods positively affect further interest in using them in analytical services demonstrating sustainability of the trends in future. Several aspects of satisfaction of buyers of data analytical services depend on how widespread is use of applied neuroscience methods in marketing. There is also preliminary conclusion on a positive link of value for cost satisfaction and eye tracking or biometric response methods.

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Дарвіду К.

Нейромаркетинг у рекламі: огляд показників уваги, залучення та переконання

Ефективність реклами залежить від привернення уваги, залучення та переконання. Нейромаркетинг використовує нейронаукові інструменти для вимірювання цих показників, що виходять за межі традиційних методів самооцінки, на які впливають когнітивні упередження. Цей огляд досліджує показники нейромаркетингу в рекламних дослідженнях та їх застосування в різних модальностях.

В огляді проаналізовано дослідження, в яких використовувалися fMRI, EEG, ERPs, відстеження руху очей, пупілометрія, кодування міміки та вегетативні показники. Увага була визначена як вибіркове розподілення ресурсів, залученість – як глибина когнітивно-афективної обробки, а переконання – як зміна поведінкових намірів. Для виявлення факторів, що впливають на інтерес до нових методів маркетингу та їх ефективність, було використано кореляційний та регресійний аналізи.

Показники уваги включали фіксації, час затримки, ентропію сканування та ранні компоненти ERP (P200, N200, N400). Індекси залучення охоплювали показники нейронного залучення, фронтальну когерентність та міжсуб'єктну синхронізацію. Результати переконання включали намір покупки, запам'ятовування, зміну ставлення та схильність до вибору бренду. Дослідження fMRI виявили активацію, пов'язану з винагородою, в прилеглому ядрі та префронтальній корі, тоді як активність альфа-діапазону EEG та компоненти P300 відображали увагу та когнітивну обробку. Відстеження руху очей продемонструвало візуальні патерни уваги, що лежать в основі рішень споживачів.

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