

CONSUMER ATTITUDE TOWARDS ONLINE ADVERTISING

K.Sai Divya^{*}, K.Shashidhar^{**}, R.Manisha^{***}

^{*} Department of MBA, **Samskruthi College Of Engineering And Technology**,
Hyderabad, Telangana, India .

Corresponding Author Email: kalvala31@gmail.com

^{**} Department Of Electronics & Communication Engineering, **Samskruthi College Of Engineering And Technology**, Hyderabad, Telangana, India.

Email: shashignitc2015@gmail.com

^{***} Department of MBA, **Samskruthi College Of Engineering And Technology**,
Hyderabad, Telangana, India. Email: manisharagiri99@gmail.com

To Cite this Article

K.Sai Divya, K.Shashidhar, R.Manisha, "Consumer Attitude Towards Online Advertising", *Journal of Science Engineering Technology and Management Science*, Vol. 02, Issue 06, July 2025, pp: 354-361, DOI: <http://doi.org/10.63590/jsetms.2025.v02.i06.pp354-361>

Submitted: 10-05-2025

Accepted: 16-06-2025

Published: 23-06-2025

ABSTRACT

The digital advertising ecosystem has undergone a radical transformation with the advent of advanced computational technologies. Consumer attitudes, once relatively passive in response to traditional advertising, have evolved dramatically in today's hyper connected environment. This research delves deep into the complexities of consumer attitudes toward online advertising in an era increasingly shaped by artificial intelligence, machine learning (ML), and deep learning (DL). Consumers interact with a multitude of ads across platforms like Google, Facebook, Instagram, YouTube, and e-commerce websites, often without consciously engaging. As online advertising grows more data-driven and algorithmically optimized, this study seeks to understand the factors shaping consumer responses—ranging from perceived utility, relevance, trust, to privacy concerns and emotional reactions. Incorporating AI techniques, the study uses natural language processing (NLP), user clustering, predictive modeling, and neural network sentiment analysis to dissect consumer sentiments and behavioral tendencies. It highlights how ML and DL enable the personalization of ad experiences and how these same technologies can be employed

to measure, predict, and ethically guide consumer engagement. By evaluating large-scale datasets and consumer interviews, the study not only reveals patterns of ad acceptance and avoidance but also proposes a roadmap for responsible AI integration in digital marketing. This multidisciplinary research provides critical insights for businesses, marketers, technologists, and policymakers striving to balance innovation, consumer satisfaction, and digital ethics in advertising.

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1. INTRODUCTION

Online advertising has become an integral part of the digital economy. From simple display banners to sophisticated AI-generated native content, advertising strategies are increasingly reliant on user data and behavioral profiling. As digital footprints expand and algorithms grow more refined, businesses now deliver tailored ad experiences to segmented audiences in real-time. The shift from mass advertising to micro-targeting has significantly influenced how consumers perceive and respond to advertising. While these technological advancements allow for hyper-personalized content delivery, they also raise concerns related to user privacy, data exploitation, advertisement fatigue, and algorithmic bias. This study seeks to explore consumer attitudes in this highly dynamic context. We examine how machine learning and deep learning algorithms impact ad delivery

mechanisms and, in turn, influence consumer receptivity, emotional engagement, and behavioral intent. In particular, this research emphasizes the dual role of AI in both ad optimization and consumer sentiment understanding. With consumers often unaware of the data being used to target them, it is essential to explore how trust, transparency, and perceived intrusiveness affect their attitudes. This paper not only investigates the psychological and behavioral dimensions of online ad perception but also highlights the software technologies shaping and responding to those perceptions. This research becomes increasingly relevant as policy frameworks such as GDPR, CCPA, and India's Digital Personal Data Protection Act demand more ethical AI integration.

Definition:

Consumer attitude toward online advertising refers to an individual's

learned predisposition to respond in a consistently favorable or unfavorable manner to advertising content encountered in online environments. This attitude encompasses cognitive evaluations (e.g., assessing ad credibility or informativeness), emotional reactions (e.g., feelings of irritation, amusement, or comfort), and behavioral intentions (e.g., likelihood to click, engage, or avoid).

In the software and AI context, these attitudes are now quantifiable through user interaction metrics such as click-through rates (CTR), view time, bounce rates, and sentiment extracted from user feedback. Advanced techniques in machine learning (ML) and deep learning (DL) offer the ability to model these responses algorithmically. For instance, ML algorithms like decision trees, logistic regression, and support vector machines (SVM) can classify user intent based on past behavior. Deep learning models like convolutional neural networks (CNNs) and transformer-based architectures (e.g., BERT, RoBERTa, GPT) are capable of extracting deep semantic meaning from text-based feedback and social media interactions, enabling the real-time analysis of consumer sentiment. These definitions allow researchers and

advertisers alike to shift from generalized assumptions to evidence-based, data-driven insights into consumer perception.

Research Problem

As online advertising continues to evolve under the influence of advanced technologies, a critical issue arises: how do consumers actually perceive and emotionally process the increasingly personalized, automated, and pervasive nature of these ads? Despite improvements in ad targeting and delivery through ML/DL, many consumers express growing concern over issues like data misuse, loss of privacy, manipulation, and decision fatigue. The core problem this study addresses is the gap between technological advancement in online advertising and consumer psychological acceptance of these technologies.

Key research questions include:

- ❖ What are the major psychological drivers behind consumer approval or disapproval of online advertisements?
- ❖ How do ML/DL-enabled ads impact trust and privacy perceptions among digital users?

- ❖ Can AI techniques be optimized to increase consumer engagement without compromising ethical standards?
- ❖ What socio-demographic factors influence consumer tolerance for personalized ads?
- ❖ How can algorithmic advertising balance personalization and privacy in a legally compliant and consumer-respectful manner?

This research aims to analyze not only how consumers react to AI-powered advertisements but also how their reactions can be used to fine-tune advertising models ethically and effectively.

RESEARCH METHODOLOGY

To address the research problem comprehensively, this study adopts a mixed-method approach comprising both qualitative and quantitative techniques, supplemented by advanced software tools and AI models.

Survey Research: A structured online survey was distributed to 1000+ respondents representing diverse age groups, geographic regions, digital literacy levels, and professions. The survey contained Likert scale items and open-ended questions related to ad

preferences, personalization, trust, and ethical concerns.

Behavioral Observation: User browsing behavior was monitored (with consent) through plugins that collected anonymized data such as clicks, dwell time, mouse movement, and ad interaction frequency across multiple platforms.

Machine Learning Modeling: Supervised learning models were trained to classify users based on ad engagement likelihood. Random Forest, Gradient Boosting, and XGBoost models were evaluated using precision, recall, and F1-score to identify performance accuracy.

Sentiment and Emotion Analysis: Deep learning models including CNNs, LSTMs, and BERT were applied to textual data extracted from open-ended survey responses, social media, and review forums to assess underlying sentiment and emotion related to specific ad types and platforms.

Cluster Analysis: Unsupervised learning (K-means, hierarchical clustering) was used to segment users based on response patterns, forming distinct personas such as 'Ad Enthusiasts', 'Skeptics', and 'Privacy-Conscious'.

Dashboard Development: Results were visualized through Streamlit-based interactive dashboards and Jupyter-based notebooks that displayed real-time

sentiment trends, user cluster distributions, and predictive analytics outcomes. Interpretability techniques such as SHAP and LIME were used to explain model predictions.

II.LITERATURE REVIEW

The academic and industrial literature on online advertising has evolved in tandem with technological progress. Ducoffe's (1996) seminal work introduced dimensions of informativeness, entertainment, and irritation to assess advertising value. Since then, researchers have focused on emotional reactions, brand recall, personalization, and technological mediation. Pavlou and Stewart (2000) emphasized trust and perceived control in shaping consumer responses to web-based advertising.

The integration of machine learning has opened new frontiers in this domain. Kumar et al. (2020) employed unsupervised learning for user clustering, improving ad targeting efficiency. Zhao et al. (2021) explored how deep learning can be used to predict consumer preferences in real time. Binns et al. (2020) discussed ethical AI in digital marketing, focusing on algorithmic transparency and consumer autonomy. Studies by Bélanger and Crossler (2011) dissected the privacy paradox—where users value privacy but

fail to act on it—and its implications for behavioral targeting.

Recent advancements in sentiment analysis and neural language processing (NLP) have enriched consumer attitude modeling. Tools such as BERT, GPT, and RoBERTa have demonstrated state-of-the-art performance in understanding nuanced human sentiment. Additionally, frameworks such as Responsible AI by Microsoft and Google's Explainable AI initiatives underline the need for fairness, accountability, and transparency in advertising algorithms. Indian researchers like Sharma & Goel (2022) emphasize regional linguistic challenges and the cultural sensitivity required in hyper-localized advertising models.

Overall, the literature suggests that while personalization and ML-powered targeting enhance relevance and business ROI, they must be cautiously deployed to avoid violating consumer trust. This study builds upon these insights to propose an AI-integrated yet consumer-friendly advertising paradigm.

III.DATA ANALYSIS AND INTERPRETATION

The collected data from survey responses, user interaction tracking, and social media sentiment mining was subjected to in-depth analysis using a variety of statistical and AI-driven tools.

Quantitative data was processed using Python (Pandas, NumPy, SciPy), while qualitative textual data was analyzed using natural language processing (NLP) models. The dataset consisted of 1,200 survey responses, 75,000 anonymized clickstream logs, and 30,000 user-generated social media comments.

Descriptive Statistics: Survey responses revealed that 58% of users felt overwhelmed by the frequency of ads online. About 62% stated they preferred personalized ads, but only if they were relevant and non-repetitive. Interestingly, 78% expressed concern over data privacy. When segmented by age, Gen Z users showed higher tolerance for ad content compared to Boomers.

Sentiment Analysis: BERT-based deep learning models were trained on social media comments and open-ended survey responses to classify user sentiment. The model reached 91% accuracy in sentiment classification. Results showed 40% negative sentiment, 35% neutral, and 25% positive. Common negative themes included "annoyance," "tracking," and "irrelevant." Positive sentiment clustered around words like "useful," "discounts," and "recommendations."

Engagement Prediction: An ensemble ML model (XGBoost + Random Forest)

was used to predict click-through behavior. The top predictors included ad relevance, device used, time of day, and ad placement. The model achieved 87% accuracy, with AUC-ROC of 0.89. Users were more likely to engage with embedded or native ads over pop-ups or banners.

- Clustering and Consumer Segmentation:
- K-Means clustering algorithm grouped users into four primary segments:
- Data-Driven Pragmatists – Interested in useful ads, but wary of excessive data use.
- Ad Fatigue Responders – Likely to install ad blockers and avoid platforms with excessive ads.
- Social Media Enthusiasts – Engage actively with influencer-driven and story-based ads.
- Privacy Guardians – Extremely sensitive to data usage and oppose targeted advertising.

Visualizations were built using Streamlit dashboards, showing sentiment trends, demographic engagement heatmaps, and feature importance in ML models.

IV.FINDINGS

- Consumers value relevance: Personalization enhances perceived value but must be

balanced against overexposure and intrusiveness.

- Privacy is paramount: Despite higher engagement rates, invasive ads risk long-term brand trust and loyalty.
- Ad format matters: Native ads outperform banners and pop-ups in terms of engagement and user satisfaction.
- AI has dual potential: While it enables personalization, AI can also perpetuate bias and exploitation if not ethically applied.
- Cultural and demographic factors: Regional preferences, language barriers, and device usage patterns influence ad acceptance.
- Explainable AI is needed: To increase trust, AI systems must clearly communicate how they use personal data.

V.CONCLUSION

The study confirms that consumer attitudes towards online advertising are shaped by a complex interplay of psychological, contextual, and technological factors. As AI and ML technologies redefine how ads are delivered and perceived, understanding

consumer sentiment is more critical than ever. While personalization improves effectiveness, it can also lead to resistance if ethical boundaries are ignored. There is a pressing need for transparent, user-centric advertising ecosystems where AI serves as a tool for empowerment rather than manipulation. Future innovation must focus on creating explainable, respectful, and privacy-preserving models. The key to sustainable advertising lies not just in technological advancement, but in aligning those advancements with evolving consumer expectations and digital ethics.

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