

A Marketing Perspective on the Roles of AI and ML in Shaping Contemporary Programmatic Advertising

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ABSTRACT

Artificial intelligence (AI) and machine learning (ML) have revolutionized programmatic advertising by enhancing precision targeting, operational efficiency, and consumer engagement. This systematic literature review uses the PRISMA framework to synthesize recent advancements, emphasizing personalization and real-time optimization while addressing challenges such as algorithmic bias, privacy concerns, and ethical considerations. Findings reveal that AI-driven advertising significantly improves campaign effectiveness, though its implementation requires careful management to mitigate cultural and data biases. The study identifies key ethical frameworks and consumer transparency gaps, proposing future research directions in AI-integrated creativity, privacy, ethics, and consumer trust dynamics. These insights contribute to developing sustainable and responsible programmatic advertising ecosystems, aligning technological innovation with ethical and cultural sensitivity.

KEYWORDS

Artificial Intelligence, Machine Learning, AI-Driven Marketing, Programmatic Advertising, Personalized Advertising, Contextual Advertising, Digital Marketing

1. INTRODUCTION

Programmatic advertising is integral to digital marketing and has revolutionized how businesses connect with their audiences. It automates ad space purchasing through algorithms and real-time bidding (RTB) platforms, allowing for precise targeting within milliseconds. This automated process contrasts sharply with traditional advertising, which relies on manual negotiations, predefined schedules, and fixed placements, often limiting flexibility and responsiveness (Chen et al., 2019; Ford et al., 2023; Yuan et al., 2013). These real-time platforms significantly improve key advertising metrics, such as click-through rates and conversions (Shan et al., 2018). Within this evolving industry, Artificial Intelligence (AI) and Machine Learning (ML) applications have steadily advanced the precision of audience analysis, predictive modeling, and ad placement optimization. These technologies allow advertisers to explore psychographic and contextual elements, enabling them to design tailored advertising experiences (Bakpayev et al., 2020; Meirezaldi, 2023).

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Programmatic advertising stands out from traditional methods by using automation, real-time data analysis, and dynamic optimization, while traditional advertising relies on manual negotiations and fixed placements. (Taylor, 2019). Real-time bidding platforms underpin programmatic advertising, facilitating campaign adjustments in response to live data. This enhances targeting precision by incorporating psychographic insights and contextual factors, surpassing the broad demographic segmentation typical of traditional methods (Ciuchita et al., 2022). Furthermore, programmatic systems improve cost efficiency, minimizing wasted impressions and maximizing return on investment in ways that static campaigns cannot achieve (Bakpayev et al., 2020; Yuan et al., 2013).

Applying AI and ML within programmatic advertising has transformed consumer engagement possibilities. AI-driven algorithms facilitate real-time adjustments to advertising strategies based on behavioral patterns, accurately predicting user intent (Meirezaldi, 2023; Shan et al., 2018). Meanwhile, ML processes vast datasets to uncover patterns that drive strategic decision-making (Nishant et al., 2023). Techniques such as reinforcement learning refine bidding strategies in live auctions, while natural language processing (NLP) improves contextual targeting by evaluating content sentiment and relevance (Bakpayev et al., 2020; Häglund & Björklund, 2022). These developments illustrate the expanding capabilities of AI and ML in shaping advanced advertising ecosystems.

Despite these innovations, programmatic advertising is not without challenges. Concerns related to privacy, data security, and ethical considerations of personalized targeting demand continued attention (Malthouse & Copulsky, 2022). The increasing complexity of AI and ML algorithms also raises risks, including algorithmic bias that can perpetuate systemic inequities or produce suboptimal results for underrepresented groups (Meirezaldi, 2023; Nishant et al., 2023). Addressing these issues requires a nuanced understanding of the balance between technological innovation and regulatory oversight, coupled with transparent and accountable system design (Yuan et al., 2013).

This study examines less-explored dimensions of AI and ML in programmatic advertising. While prior research has concentrated on technological innovations and efficiency improvements, limited attention has been given to their adoption's strategic and ethical aspects (Bakpayev et al., 2020). By employing a systematic literature review following the PRISMA protocol, this study seeks to

This study addresses critical gaps identified in prior research across ethical, strategic, and operational dimensions. While earlier studies emphasize the technological innovations of AI and ML in programmatic advertising (Chen et al., 2019; Häglund & Björklund, 2024), limited attention has been paid to the ethical concerns surrounding algorithmic transparency and consumer trust (Bakpayev et al., 2020; Ford et al., 2023; Sjøvaag & Owren, 2021). As Kerr et al. (2023) highlighted, strategic gaps include a lack of frameworks integrating AI capabilities with organizational performance and decision-making processes. On the operational side, challenges such as algorithmic bias and cultural variability in ad personalization remain underexplored (Kuang, 2022; Xie & Huang, 2023). This study uniquely synthesizes these dimensions by providing a systematic analysis that bridges technological advancements with their ethical, strategic, and operational implications in the programmatic advertising ecosystem. It analyzes opportunities and challenges for integrating AI and ML into programmatic advertising systems (Shan et al., 2018).

The relevance of this research stems from the growing academic and industry emphasis on leveraging AI and ML to refine marketing strategies (Ford et al., 2023). This work contributes valuable insights into how these technologies reshape programmatic advertising, offering practical and theoretical perspectives for researchers, practitioners, and policymakers (Ford et al., 2023; Häglund & Björklund, 2022; Malthouse & Copulsky, 2022). This paper uniquely synthesizes findings from recent studies to explore underexamined dimensions such as ethical considerations, algorithmic transparency, and consumer perceptions. This review bridges the gap between technical innovations and their practical applications in advertising strategy by combining empirical insights with thematic analysis. Furthermore, this study aligns with calls for interdisciplinary approaches to evaluating AI and ML marketing applications, as Malthouse and Copulsky (2022) highlighted. By addressing critical gaps in the literature, this research underscores the far-reaching implications of technological advancement

for the future of advertising. Furthermore, the dynamics and complexity of programmatic advertising highlight the need to make marketing decisions based on data evidence instead of the professional's instinct or intuition, as seen through the growth in the application of analysis-based approaches in marketing academia and practice (Borges et al., 2021; Jabbar et al., 2020).

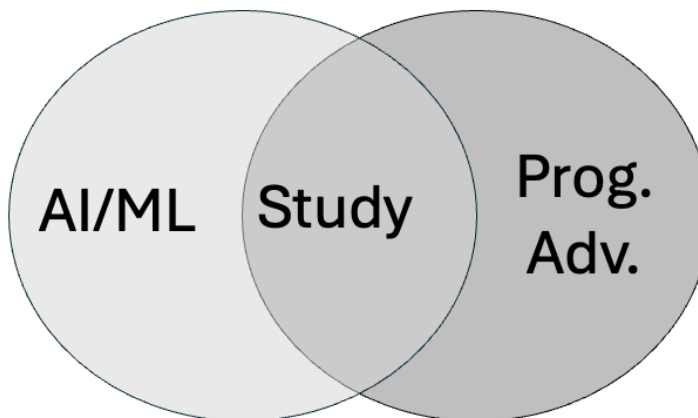
2. METHODOLOGY

This systematic literature review explores the impact of AI and ML on influencing contemporary programmatic advertising. This review's central research question is: *How do AI and ML enhance targeting and efficiency in programmatic advertising?* A structured methodology was employed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Page et al., 2021). This protocol ensures rigor in identifying, analyzing, and synthesizing relevant studies that address the research objectives (Page et al., 2021).

Scopus was chosen as the sole database for this systematic literature review due to its extensive coverage of high-quality, peer-reviewed literature in this field and advanced search functionalities. For the selected search string, Scopus returned more than twice the number of results compared to Web of Science, ensuring a broader and comprehensive dataset. Potential limitations are acknowledged, such as missing studies not indexed in Scopus.

The search was conducted on November 20, 2024, and was filtered to include only papers published between 2019 and 2024. The advanced search mode was used for the following Boolean operator: (“program* advert*” OR “Context* advert*” OR “person* advert*”) AND (“artificial intelligence” OR “machine learning”) as shown in Figure 1. Pilot searches were conducted to refine term relevance, ensuring exhaustive coverage of relevant literature.

Figure 1. Database search strategy



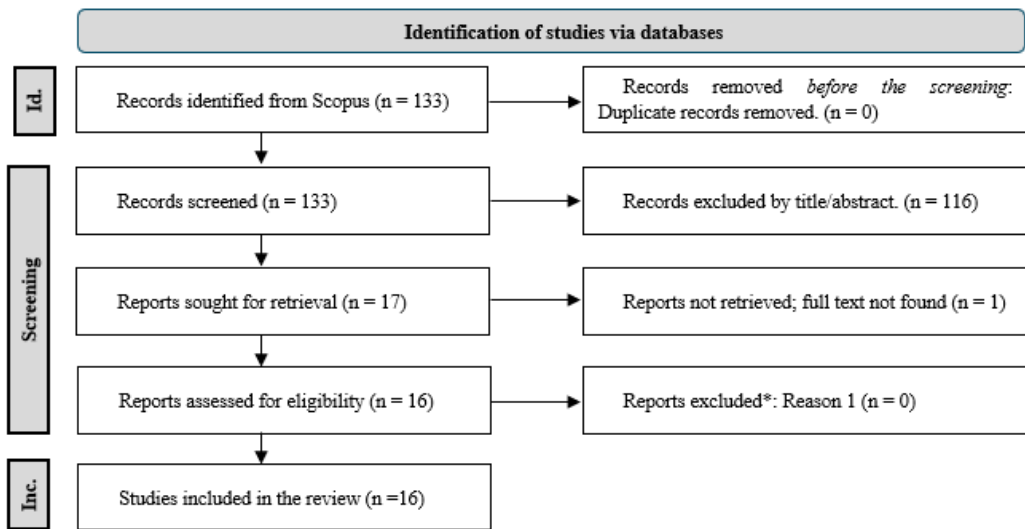
Source: *Self-elaboration.*

Studies that were theoretical or lacked primary keywords were excluded. Further exclusions were applied to non-English publications, books, and studies that did not directly address the research question. To mitigate potential selection bias, two reviewers cross-validated the inclusion criteria. Initial results were screened by the title and abstract, followed by a full-text review to ensure eligibility. EndNote was used for reference management, and VOSViewer for data visualization.

3. RESULTS

Following the PRISMA protocol, 133 records were identified from Scopus search, as shown in Figure 2. After confirming there were no duplicates, titles and abstracts were evaluated, excluding 116 records that did not contribute to the research question. Out of 17 reports sought for retrieval, one was excluded due to the lack of full text. The remaining 16 reports were thoroughly assessed and found relevant, resulting in a final sample of 16 studies included for analysis.

Figure 2. PRISMA flow diagram for the systematic review process to identify relevant studies



Source: Adapted from Page et al. (2021).

The final set of studies covered diverse aspects, including automation, personalization, ethical considerations, and advanced predictive systems. Table 1 presents a detailed breakdown of the studies and their objectives.

Table 1. Description of key characteristics and the studies included in the review

Study no.	Authors	Journal/Proceeding	Study Objective
1	Chen et al. (2019)	Journal of Advertising	Explore the integration of AI in automating programmatic creative and addressing challenges in the advertising industry in China.
2	Chen and Feng (2021)	Advances in AI Software and Systems Engineering	Explore AI's transformative potential in programmatic advertising.
3	Ciuchita et al. (2022)	Journal of Service Management	Investigate consumer perceptions of programmatic advertising in retail.
4	Deng et al. (2019)	Journal of Advertising	Develop a smart generation system for personalized advertising content.
5	Diwanji et al. (2022)	Journal of Strategic Marketing	Examine AI's role in programmatic advertising, focusing on automation and transparency.

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Table 1. Continued

Study no.	Authors	Journal/Proceeding	Study Objective
6	Ford et al. (2023)	Journal of Business Research	Provide an overview and guidelines for AI's role in modern advertising.
7	Guo and Jiang (2023)	Electronic Commerce Research	Compare AI-generated personalized ads with the traditional copy in consumer engagement.
8	Häglund and Björklund (2024)	Journal of Current Issues and Research in Advertising	Analyze the influence of media context and AI techniques on optimizing ad placement in programmatic advertising.
9	Jing et al. (2024)	Applied Artificial Intelligence	Design a blockchain-enhanced platform for secure generative AI advertising.
10	Kerr et al. (2023)	European Journal of Marketing	Develop a framework linking programmatic advertising to organizational integration and performance.
11	Kuang (2022)	International Conference on Artificial Intelligence and Autonomous Robot Systems	Enhance personalized advertising accuracy using AI technologies.
12	Mogan et al. (2023)	IEEE 8th International Conference On Software Engineering and Computer Systems	Develop deep learning techniques for product recommendation in advertising.
13	Seyghaly et al. (2024)	Sensors	Introduce a federated learning architecture for privacy-preserving smart advertising.
14	Shamieh et al. (2024)	IEEE Canadian Conference on Electrical and Computer Engineering	Propose memorability-based ad insertion in OTT content using machine learning.
15	Sjøvaag and Owren (2021)	Nordicom Review	Analyze the challenges of digital advertising and its impact on local news markets.
16	Xie and Huang (2023)	IEEE Access	Propose a personalized recommendation model addressing efficiency and ethical risks in computing advertising.

Source: Self-elaboration based on sample articles.

Table 1 provides an overview of the selected studies, including their sources and key objectives. The sample contains studies with diverse methodological approaches, encompassing conceptual frameworks, computational models, and qualitative research. The results clearly understand AI and ML solutions in programmatic advertising and show how AI and ML can improve targeting and personalization capabilities and productivity.

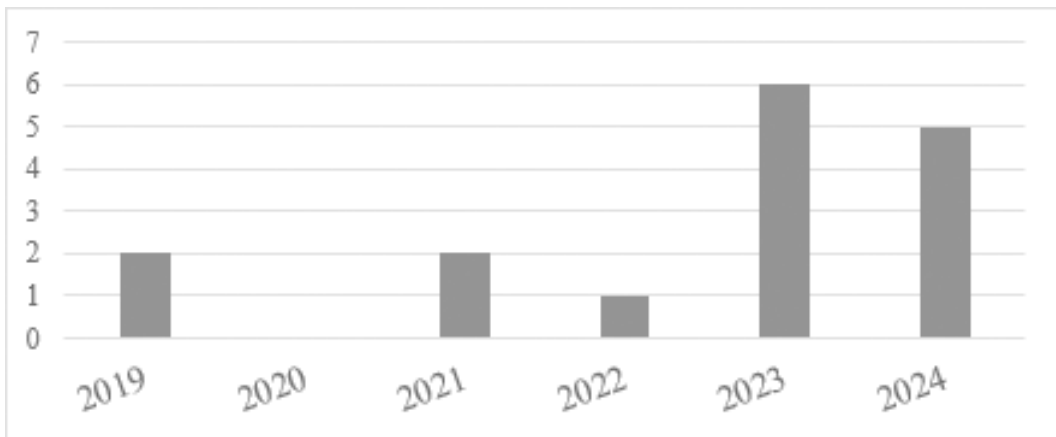
Several studies focus on AI-driven personalization and creative processes, emphasizing the role of creativity in programmatic advertising (Chen et al., 2019; Deng et al., 2019). Other research delves into integrating programmatic advertising with organizational activities, proposing frameworks linking programmatic capabilities to improved organizational performance (Ciuchita et al., 2022; Kerr et al., 2023).

Empirical studies address real-world challenges, including privacy-preserving mechanisms in intelligent advertising systems (Seyghaly et al., 2024) and federated learning architectures to enhance data security (Jing et al., 2024). Innovative AI models have been introduced, such as deep learning techniques for product recommendations (Mogan et al., 2023) and collaborative filtering methods for personalized ad placement (Xie & Huang, 2023).

Key themes emerging from the sample include exploring ethical considerations surrounding AI-driven advertising, operationalizing advanced analytics for real-time bidding, and enhancing customer engagement through machine learning algorithms (Guo & Jiang, 2023; Häglund & Björklund, 2024). Together, these studies emphasize the revolutionary possibilities of AI and ML in influencing the future of programmatic advertising. While the selected studies demonstrate the potential of AI and ML, several exhibited limitations. For example, Chen et al. (2019) it relied heavily on theoretical assumptions without empirical validation and employed robust field experiments. Furthermore, biases in training data Ford et al. (2023) and limited cultural adaptability Xie and Huang (2023) were frequently noted, suggesting the need for more comprehensive and inclusive study designs.

The studies in the sample are predominantly recent, with most published between 2023 and 2024, as shown in Figure 3. Notably, 2023 accounts for 38% of the sample, followed by 31% in 2024, despite the year being incomplete. Earlier years, such as 2019 and 2021, represent a smaller portion, highlighting the growing academic interest in this topic.

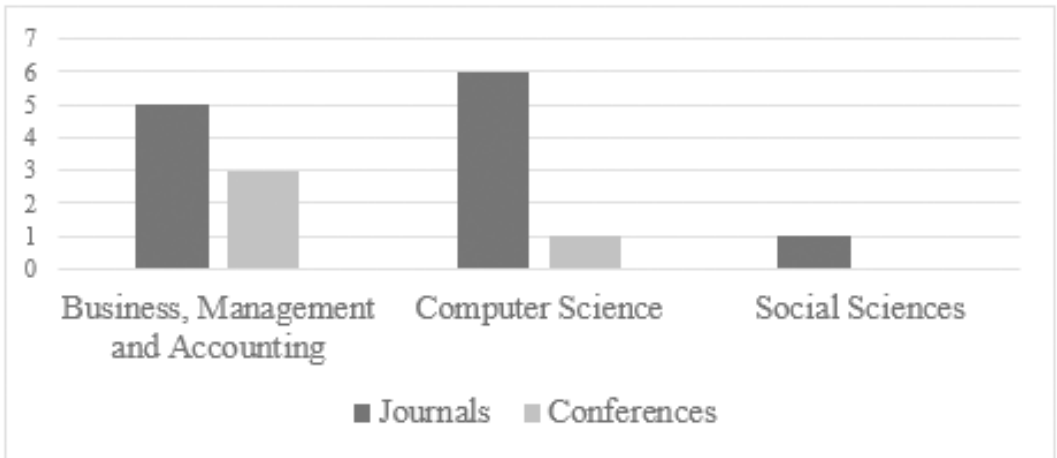
Figure 3. Temporal distribution of the studies included in the review



Source: Self-elaboration.

The sample spans three areas: seven articles from Computer Science, eight from Business, Management, and Accounting, and one from Social Sciences (Figure 4). Computer Science publications focus on algorithms and AI-driven advancements, while Business and Management emphasize practical applications and strategic implications. Most articles were published in journals (12) rather than conference proceedings (4), reflecting the topic's academic rigor.

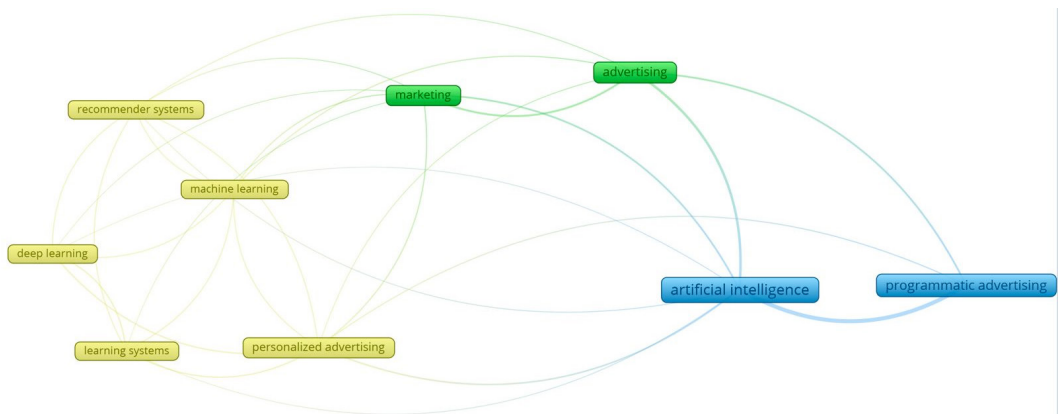
Figure 4. Distribution between scientific areas and paper types



Source: Self-elaboration.

Figure 5 illustrates the keyword co-occurrence network generated by VOSViewer, highlighting key terms' interconnections in AI and ML for programmatic advertising. Significant clusters center around “artificial intelligence” and “programmatic advertising,” emphasizing their foundational role. Linked terms like “machine learning,” “personalized advertising,” and “recommender systems” highlight the technological backbone of data-driven targeting. Another cluster includes “deep learning” and “learning systems,” showcasing contributions to ad placement precision. Additionally, “advertising” and “marketing” bridge clusters, reflecting their broader strategic relevance.

Figure 5. Network of cooccurrence of keywords



Source: Self-elaboration with VOSViewer.

Table 2 offers a comprehensive summary of several key aspects pertinent to this research's objectives to facilitate a clearer understanding of the studies incorporated within the sample. By presenting these critical points, these highlights aim to illuminate the findings of the included studies, thereby contributing to a deeper analysis and interpretation of the overall research context.

Table 2. Key highlights from the studies in the review

Study no.	Authors	Key Highlights
1	Chen et al. (2019)	Programmatic systems using machine learning optimize ad placement based on user preferences, improving engagement and ROI.
2	Chen and Feng (2021)	Human oversight in AI-driven advertising enhances the quality of AI-generated ad content.
3	Ciuchita et al. (2022)	Consumer perceptions of programmatic advertising emphasize the need for greater transparency and ethical considerations.
4	Deng et al. (2019)	Personalized advertising systems, such as SGS-PAC, increase consumer engagement and click-through rates through NLP.
5	Diwanji et al. (2022)	Sponsorship transparency in programmatic advertising remains inconsistent, requiring regulatory attention.
6	Ford et al. (2023)	Bibliometric reviews of AI in advertising reveal gaps in ethical AI implementation and cultural adaptability.
7	Guo and Jiang (2023)	Field experiments show that AI-generated ads outperform human-crafted ads in terms of relevance and consumer appeal.
8	Häglund and Björklund (2024)	AI-driven programmatic advertising enhances precision and efficiency in targeting, enabling real-time personalized content delivery.
9	Jing et al. (2024)	Blockchain-enhanced AI platforms improve transparency and security in programmatic advertising.
10	Kerr et al. (2023)	IMC technologies supported by AI act as integrators, aligning organizational functions for greater efficiency.
11	Kuang (2022)	AI models for advertising personalization require enhancements in accuracy and adaptability.
12	Mogan et al. (2023)	Hybrid approaches combining human creativity with AI yield superior advertising outcomes.
13	Seyghaly et al. (2024)	Federated learning architectures enable privacy-preserving data analysis for personalized advertising.
14	Shamieh et al. (2024)	Cultural adaptability remains challenging for AI models, which need localization for effectiveness in diverse markets.
15	Sjøvaag and Owren (2021)	AI-driven IMC technologies streamline advertising, promoting efficiency and cohesive campaign strategies.
16	Xie and Huang (2023)	AI facilitates automated decision-making in advertising, reducing human error and enhancing scalability.

Source: Self-elaboration based on sample articles.

4. DISCUSSION

The increasing adoption of AI and ML in programmatic advertising has introduced significant advancements, shaping the landscape of digital marketing by enhancing personalization, efficiency, and engagement. AI-driven technologies, such as ML algorithms, natural language processing, and automated bidding systems, reshape how advertisements are tailored and delivered to audiences. Across the reviewed studies, recurring themes emerged, emphasizing the interplay between technological capabilities, ethical considerations, and the evolving expectations of consumers and advertisers.

4.1. Technological Advancements in AI-Driven Programmatic Advertising

AI technologies have substantially improved the precision and efficiency of programmatic advertising systems by automating key functions such as audience segmentation, real-time bidding,

or content optimization. For instance, using integrated marketing communication (IMC) technologies supported by AI significantly enhanced organizational performance through real-time adaptability and cost-efficient personalization (Kerr et al., 2023). These advancements extend to sophisticated behavioral targeting, where AI systems leverage consumer data to predict preferences and deliver highly relevant advertisements (Guo & Jiang, 2023). This predictive capability aligns with the broader trend of programmatic advertising evolving into a data-driven ecosystem, as Chen and Feng (2021) highlighted. Similarly, AI applications in programmatic creative have demonstrated their capacity to improve engagement rates and advertising campaigns' effectiveness by optimizing content dynamically based on real-time audience feedback (Chen et al., 2019).

Federated learning architectures have emerged as innovative solutions for privacy-preserving data utilization, with frameworks prioritizing data integrity while ensuring compliance with privacy regulations, such as the General Data Protection Regulation (GDPR) in Europe (Seyghaly et al., 2024). The seamless integration of AI into advertising workflows also facilitates scalable solutions, enabling advertisers to produce high-quality and audience-specific content across multiple platforms with minimal human intervention (Häglund & Björklund, 2024). Such scalability ensures businesses can engage with diverse demographic segments without compromising personalization or engagement quality (Ciuchita et al., 2022).

4.2. Impact on Consumer Engagement and Advertising Effectiveness

AI's ability to process large volumes of consumer data has profoundly impacted engagement metrics by enabling highly personalized and contextually relevant advertisements: AI-powered recommender systems have been found to significantly enhance click-through rates and conversion rates by aligning ad content with individual user preferences (Mogan et al., 2023). Real-time feedback mechanisms embedded within AI systems allow for dynamic content adjustments, improving the resonance of advertisements with target audiences (Xie & Huang, 2023). This level of personalization allows for deeper consumer trust and brand loyalty, as demonstrated in studies emphasizing the importance of delivering emotionally resonant content through AI (Shamieh et al., 2024). However, AI's reliance on consumer data challenges transparency and ethical responsibility. While effective, consumer insights for ad customization raise concerns about consent and data ownership, necessitating the development of frameworks to mitigate these issues (Jing et al., 2024). Despite these concerns, studies consistently show that consumers tend to favor AI-generated advertisements when they perceive them as more relevant and timelier, as evidenced in field experiments comparing AI-generated copy with traditional advertisements (Deng et al., 2019).

4.3. Challenges in Implementing AI in Programmatic Advertising

While the potential of AI in programmatic advertising is evident, its implementation is not without challenges. Algorithmic bias remains a persistent issue, with several studies highlighting the risk of skewed ad targeting stemming from biased training data (Ford et al., 2023). This bias affects the effectiveness of advertising campaigns and has broader implications for equity and inclusivity in digital marketing (Kuang, 2022). The cultural and linguistic variability inherent in global advertising markets often requires AI systems to be adapted to local contexts. For example, AI frameworks designed in specific cultural or linguistic environments may not perform optimally when applied to diverse populations, as noted by Xie and Huang (2023). Another critical challenge is the ethical dilemma posed by AI's capabilities in deep personalization since studies indicate that while consumers appreciate the relevance of highly targeted advertisements, excessive personalization can lead to perceptions of intrusion, potentially undermining brand trust (Guo & Jiang, 2023). Addressing these concerns requires advertisers to balance leveraging AI for engagement and respecting consumer boundaries, as Diwanji et al. (2022) emphasize.

4.4. Ethical and Privacy Considerations

Using consumer data for ad targeting while enabling unmatched precision poses significant privacy risks. For instance, studies have underscored the necessity of aligning AI-driven advertising practices with regulatory frameworks to ensure compliance and consumer trust (Sjøvaag & Owren, 2021). Privacy-preserving techniques, such as federated learning and data anonymization, have been proposed to address these concerns without compromising advertising effectiveness (Seyghaly et al., 2024). Nevertheless, implementing these solutions often involves trade-offs between data utility and privacy, requiring careful consideration by advertisers and policymakers alike (Chen et al., 2019).

The ethical implications of AI in programmatic advertising extend beyond compliance with data privacy regulations to include broader concerns about consumer autonomy and societal trust in AI systems. The capability of AI to hyper-personalize advertising, while effective, raises the potential for manipulative practices that exploit behavioral vulnerabilities, as highlighted in prior studies (Ford et al., 2023; Guo & Jiang, 2023). These practices could erode consumer trust and foster perceptions of intrusion, particularly when ads are tailored using sensitive or implicit data without clear consent (Jing et al., 2024). Addressing these concerns requires advertisers to implement transparency mechanisms, such as explainable AI frameworks, which provide consumers with understandable insights into how their data is being used (Chen & Feng, 2021).

On a practical level, companies must integrate ethical decision-making processes within AI governance structures to align technological advancements with societal values. These initiatives mitigate reputational risks and enhance consumer engagement by promoting a sense of security and fairness (Sjøvaag & Owren, 2021). The rapid advancement of AI technologies calls for establishing comprehensive ethical guidelines to govern their use in advertising contexts (Jing et al., 2024). Such guidelines would help mitigate risks associated with bias, manipulation, and privacy breaches while fostering trust in AI systems among consumers and advertisers (Chen & Feng, 2021).

4.5. Future Research and Implications

Future research should explore the long-term implications of AI and ML in programmatic advertising, mainly focusing on consumer perceptions and behavior towards AI-driven advertising, ethical frameworks, privacy considerations, performance, and the integration of creativity and AI. Table 3 provides future research questions based on analyzing the sample articles and their integrated analysis to promote a further expansion of this field and provide valuable insights for academic and practical applications.

Table 3. Future research directions

Theme	Research Question	
Consumer Behavior and AI	What are the psychological impacts of AI-driven personalization on consumer trust and purchasing behavior?	Sjøvaag and Owren (2021); Guo and Jiang (2023)
	How do consumers perceive the ethical risks of algorithmic personalization in programmatic advertising?	Diwanji et al. (2022); Kerr et al. (2023)
	How do consumer attitudes toward AI-driven advertising differ across cultural and demographic contexts?	Xie and Huang (2023)

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Table 3. Continued

Theme	Research Question	
Ethics and Privacy	How can advertisers ensure privacy-compliant utilization of hyper-personalized data in programmatic campaigns?	Seyghaly et al. (2024); Chen and Feng (2021)
	What ethical frameworks can mitigate concerns regarding the manipulative potential of AI in personalized advertising?	Ford et al. (2023); Jing et al. (2024)
	How does transparency in AI algorithms influence consumer acceptance of programmatic advertising?	Häglund and Björklund (2024); Chen et al. (2019)
Algorithmic Performance	How can the performance of AI models in programmatic advertising be improved to balance efficiency and personalization?	Shamieh et al. (2024)
	What strategies can minimize algorithmic bias while delivering programmatic advertisements to diverse audiences?	Deng et al. (2019); Kuang (2022)
Creativity in Programmatic Ads	What is the role of human-AI collaboration in enhancing the creative aspects of AI-driven advertisements?	Mogan et al. (2023); Ford et al. (2023)
AI Integration with Marketing	How can AI-generated insights be seamlessly integrated into existing marketing strategies for programmatic advertising?	Kerr et al. (2023)
	What role does blockchain play in improving transparency and accountability in programmatic advertising?	Jing et al. (2024)
Measurement and Evaluation	What metrics can effectively measure the success of AI-generated advertisements in programmatic campaigns?	Ford et al. (2023); Mogan et al. (2023)

Source: Self-elaboration based on sample articles.

Although these future research questions present several directions for researchers, we must also consider that such technology-enabled subjects are prone to integrating innovative or different perspectives and implementations, which may provide new paths to explore AI and ML usage in programmatic advertising.

The use of AI and machine learning in programmatic advertising offers great opportunities but also presents challenges that need targeted solutions from all stakeholders. Advertisers should harness AI for real-time bidding and content optimization to improve campaign effectiveness and ensure transparency to gain consumer trust. Policymakers are instrumental in mitigating algorithmic bias and ensuring compliance with data protection regulations in AI applications by establishing adequate regulatory frameworks. Technologists should focus on developing inclusive and unbiased training datasets to address disparities in ad targeting. To safeguard consumer data, they must also implement privacy-preserving technologies, such as federated learning. Collaboration among stakeholders is crucial to balancing innovation with ethical responsibility in the advertising ecosystem.

5. CONCLUSION

This study systematically reviewed the role of AI and ML in shaping contemporary programmatic advertising. In summary, the integrated analysis of these articles reveals that AI and ML have become an indispensable tool in advancing the capabilities and reach of programmatic advertising. Adopting AI technologies has consistently demonstrated their ability to enhance personalization, efficiency, and scalability, allowing advertisers to achieve unprecedented engagement and campaign effectiveness (Kerr et al., 2023; Häglund & Björklund, 2024). By leveraging vast consumer datasets, AI-driven systems have transformed the advertising ecosystem into a dynamic, real-time, and data-centric domain where relevance and timeliness dictate success (Chen et al., 2019). However, the ethical

and operational challenges, including algorithmic bias, cultural variability, and privacy concerns, underline the need for advertisers to approach AI integration with caution and responsibility (Ford et al., 2023; Jing et al., 2024; Seyghaly et al., 2024). Despite these hurdles, the potential for AI to drive innovative advertising solutions and allow for deeper consumer connections remains a pivotal strength, as evidenced by studies emphasizing the strategic value of personalized content and adaptive frameworks (Mogan et al., 2023; Guo & Jiang, 2023). Collectively, these findings illustrate that while AI has reshaped programmatic advertising with remarkable benefits, its implementation requires deliberate attention to ethical practices and cultural adaptability to ensure sustainable and equitable advancements in the field (Ciuchita et al., 2022; Sjøvaag & Owren, 2021).

The study's limitations, including its reliance on a single database and English-language publications, suggest the need for broader, multilingual, and interdisciplinary investigations. These constraints may limit the generalizability of the findings to broader contexts. Future research could explore different databases like Web of Science or IEEE Xplore. Also, since this study was made from a marketing viewpoint, future research could focus specifically on the technological side of programmatic advertising, exploring new pathways for AI and ML integration and ad performance enhancement.

COMPETING INTERESTS

The authors of this publication declare there are no competing interests.

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