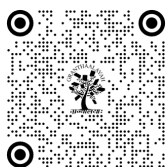


IMPACT OF PERSONALIZED ADVERTISING ON CONSUMER ORDERING DECISIONS: A STUDY OF FOOD DELIVERY APPS IN DELHI-NCR

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DOI
[10.29121/shodhkosh.v5.i4.2024.1177](https://doi.org/10.29121/shodhkosh.v5.i4.2024.1177)

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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ABSTRACT

Leveraging the advancements in digital technologies, marketers are increasingly relying on personalized ads to reach their target customers. In the realm of food delivery apps, targeted ads are being used to tempt users into ordering more and more meals. According to Statista, the food delivery market in India was valued at USD 7.4 billion in 2023 and is expected to reach approximately USD 24 billion by 2026.

This study aims to understand the impact of personalized advertisements by food delivery apps on the purchase decisions of consumers in Delhi-NCR, which is the second-largest regional market in India for this sector. Employing a mixed-methods approach, the research methodology integrates surveys and focus group discussions to identify the specific elements influencing the food ordering decisions of the respondents. The study's primary objective is to discern the extent to which personalized advertisements wield influence on user behaviour, including preferences, decision-making processes, and ordering tendencies. Elaboration Likelihood Model will provide the theoretical framework for this study to understand how individuals process persuasive information. The findings of the research can potentially offer actionable recommendations for the stakeholders in their efforts towards optimization of marketing strategies and elevate the effectiveness of advertising endeavours in this digital realm.

Keywords: Personalized Advertising, Consumer Purchase Decisions, Elaboration Likelihood Model, Online Food Delivery Applications, Targeted Advertising

1. INTRODUCTION

In the contemporary landscape of marketing, digital technologies have revolutionized the way businesses engage with their target audiences. One notable strategy that has gained significant traction among marketers is the use of personalized advertising. Personalized advertising refers to advertisements tailored to individuals on the basis of their personal information, including details like name, email address, and physical address, as well as consumption patterns such as shopping history, websites visited, and preferred products (Yuan & Tsao, 2003).

Personal information of users is readily accessible on the internet due to our engagement in various online activities such as browsing websites, using social media platforms, and conducting online searches through search engines (Acquisti, Brandimarte, & Loewenstein, 2015). The tracking and sharing of such information across platforms allow marketers to reach their audiences with more relevant advertising messages. The benefit is direct engagement, increased organic reach, enhanced responsiveness, simplified data gathering, and more precision in consumer targeting (Mehta & Kulkarni, 2020).

Amidst the plethora of industries leveraging personalized advertising, the food delivery sector stands out as a prominent domain where such strategies are extensively employed. In 2023, the Indian food delivery industry had a market worth of USD 7.4 Billion, with projections indicating a potential surge to around USD 24 Billion by the year 2026 (Statista, 2024). With the rapid proliferation of food delivery apps and the rising consumer demand for convenience and variety, personalized ads have become a cornerstone of marketing tactics within this sector. These apps utilize a myriad of data points, ranging from user demographics and location to past ordering history and preferences, to customize the entire customer experience according to individual preferences. (Saleh, 2023).

Delhi-NCR emerges as a focal point for examining the impact of personalized advertising within the food delivery ecosystem. As one of the largest metropolitan areas in India, Delhi-NCR represents a diverse and dynamic market characterized by a burgeoning middle class, rapid urbanization, and a thriving food culture. Moreover, the region's robust digital infrastructure and widespread smartphone penetration make it an ideal setting for studying consumer behaviour in the context of digital marketing interventions (Statista, 2024).

The efficacy of personalized advertising hinges on its ability to resonate with consumers on a personal level, leveraging data analytics and algorithms to deliver relevant content based on user behaviour, demographics, and past interactions. However, the extent to which these targeted ads influence consumer behaviour remains a subject of debate and empirical inquiry. This study aims to fill this gap by examining the mechanisms through which personalized advertisements impact the food ordering decisions of consumers in Delhi-NCR, one of the largest and most diverse markets in India.

Central to this investigation is the application of the Elaboration Likelihood Model (ELM), a theoretical framework proposed by Petty and Cacioppo, which elucidates the processes underlying persuasion and attitude change. ELM posits two distinct routes to persuasion: the central route, which involves thoughtful consideration and elaboration of message content, and the peripheral route, which relies on heuristics and peripheral cues. By employing ELM as a guiding framework, this study seeks to understand how individuals process persuasive information encountered through personalized advertisements on food delivery apps.

2. LITERATURE REVIEW

2.1. PERSONALIZED ADVERTISING

Defined as a strategic endeavour, personalized advertising refers to the creation, modification, and adaptation of content and distribution methods to optimize alignment with individual characteristics, interests, preferences, communication styles, and behaviours (Bol et al., 2018).

Personalized ads have become increasingly prevalent in the digital marketing landscape, with scholars exploring their impact on consumer behaviour, satisfaction levels, and purchase intentions across various platforms and contexts.

Mehta and Kulkarni (2020) investigated the impact of personalized social media advertisements on consumer purchase intentions. Their study found that personalized ads have a positive bearing on consumer purchase intentions if the ads are relevant to the users and informative. Similarly, Dodoo (2019) explored the antecedent impact of personalized social media advertising on online impulse buying tendencies, revealing a positive correlation between personalized ads and impulse purchasing behaviour. The findings from Mehta and Kulkarni (2020) and Dodoo (2019) reinforce the notion that personalized advertisements can have a significant impact on consumer behaviour and purchase intentions. However, it is important to note that the effectiveness of personalized ads depends on factors such as relevance, informativeness, and alignment with consumer preferences.

Furthermore, Gevyo (2023) sheds light on the broader implications of personalized advertising beyond social media platforms, particularly in the context of e-commerce applications. The study indicated that users who are exposed to personalized ads exhibit higher levels of satisfaction with their usage of e-commerce applications in contrast to those who are not exposed to personalized ads. Citing a survey conducted by Adlucent, Kirkpatrick (2016) highlights that consumers prefer ads tailored to their interests which reduces exposure to irrelevant ads. This highlights the growing demand for personalized content and the need for marketers to adopt data-driven approaches to deliver targeted advertising messages that resonate with individual consumers.

2.2. ONLINE FOOD DELIVERY APPLICATIONS

The food delivery market in India, according to Statista, stood at USD 7.4 Billion last year with a projected value of approximately USD 24 Billion by 2026. Apps for food delivery registered significant success in India due to the ease and genuineness of digital orders (Ramesh et al., 2023).

The popularity of food delivery apps is also highlighted by Gupta et. al, (2019), suggesting that many contemporary businesses are transitioning from traditional business models to online marketing in response to consumer demands and market trends. Research indicates a growing preference among consumers for food delivery applications, prioritizing convenient access to delivery services and competitive pricing and promotional offers.

Furthermore, Katoch and Siddhu (2021) studied the consumer satisfaction dynamics with respect to online food deliveries. Their study attributed the popularity of food delivery to the shift in the lifestyle of urban Indians, marked by longer work hours, increased commute times, and a growing number of working women and couples.

When it comes to the marketing of food delivery apps, a study conducted by Mythily and Vishnuvarnan (2023) highlights that most people see ads of food delivery apps on their social media. Another common strategy for personalized advertising is the use of push notifications. Shastri (2023) writes about Zomato's use of this strategy. "Once a user downloads the Zomato App, Zomato keeps nudging them via quirky push notifications to order something. The reason why their push notifications stand out from the rest is because they use related and Gen-Z language in their copy."

2.3. ELABORATION LIKELIHOOD MODEL IN PERSONALIZED ADVERTISING

The Elaboration Likelihood Model (ELM), proposed by Petty and Cacioppo (1986), offers a theoretical framework for understanding how individuals process persuasive stimuli and make decisions. Since, one of the key functions of advertising is to persuade the consumers in favour of the given product or service (Durmaz et. al. 2015), the most effective model to study this communication process is ELM (O'Keefe 2002). advertising as a communication process involves the occurrence of cognitive, behavioural and emotional elements in the mind of the consumers.

According to Petty and Cacioppo (1986), elaboration in persuasion refers to how much a person considers the arguments related to the issue presented in a message. ELM posits two distinct routes to persuasion: the central route and the peripheral route. According to the model, the routes are essentially the ways in which a person processes information. While the central route involves deep and systematic thinking, the peripheral route involves automatic and superficial reasoning. One way people are persuaded is by carefully considering the information presented, like weighing the pros and cons of an argument (central route). The other way is when something simple, like seeing an attractive person endorsing a product, convinces them without really thinking deeply about the information (peripheral route).

In the case of personalized advertising, Mehta and Kulkarni's (2020) study on personalized social media advertisements found that ads perceived as relevant and informative positively influenced consumer purchase intention, indicating the efficacy of central route processing. On the other hand, Dodoo (2019) highlighted the antecedent impact of personalized social media advertising on online impulse buying tendencies, suggesting the role of peripheral routes in affecting consumer behaviours.

Reviewing the literature in the above contexts, it can be said that a gap exists in researches pertaining to personalized advertising and its influence on purchase decisions and in finding out if the tenets of elaboration likelihood model can be a guiding force for the marketers in drafting central and peripheral routes of messaging suited for individual consumers.

3. METHODOLOGY

This study employs a mixed-methods approach, integrating both quantitative and qualitative techniques to comprehensively understand the impact of personalized advertising by food delivery apps on consumer ordering decisions.

3.1. SAMPLING STRATEGY

The target population comprises individuals above the age of 18, residing in Delhi-NCR who have experience using food delivery apps. Given the diverse demographics of app users, the respondents were selected from varying age groups, income groups, and educational backgrounds through simple random sampling.

3.2. SURVEY DESIGN

A structured questionnaire was developed to gather quantitative data regarding respondents' demographics, frequency of app usage, attitudes towards

personalized ads, and ordering behaviours. The survey includes Likert scale questions to measure the level of agreement or disagreement with statements related to personalized advertising effectiveness and influence on ordering decisions.

3.3. DATA COLLECTION

The survey was administered online through posts on open forums, through which 84 responses were received. Respondents were assured of confidentiality and anonymity to encourage honest answers.

3.4. FOCUS GROUP DISCUSSIONS

In order to obtain qualitative insights, three focus group discussions were conducted with subsets of respondents from the survey sample. Purposive sampling was used to select participants representing different income groups. The discussion explored in-depth the factors influencing ordering decisions, perceptions of personalized ads, and concerns about data privacy.

3.5. DATA ANALYSIS

Responses collected from the survey and the focus group discussion has been interpreted using descriptive analysis to examine patterns, themes, and insights into the behaviour of online food ordering consumers.

3.6. THEORETICAL FRAMEWORK

The Elaboration Likelihood Model (ELM) has served as the theoretical framework to understand the cognitive processes underlying the reception and processing of persuasive information conveyed through personalized ads.

4. DATA INTERPRETATION

4.1. DEMOGRAPHIC PROFILE OF RESPONDENTS

Table 1

Table 1 Demographic Distribution of Respondents			
Age Groups	Category	Count	Percentage
	18-21	10	12
	22-25	24	29
	26-30	22	26
	31-35	22	26
	Above 35	6	7
Education Levels	Category	Count	Percentage
	Undergraduate	4	5
	Graduate	32	38
	Post Graduate	44	52
	PhD and Above	4	5
Income Groups	Category	Count	Percentage
	Below INR 2,00,000	17	20
	INR 2,00,000-4,00,000	7	8
	INR 4,00,001-7,00,000	13	15
	INR 7,00,001-10,00,000	17	20
	INR 10,00,001-15,00,000	16	19
	Above INR 15,00,000	14	17

4.2. USAGE PATTERNS OF FOOD DELIVERY APPS

According to the survey, a significant 85.7% users reported using Zomato for online food deliveries, followed by Swiggy which is used by 67.9% respondents. 55.9% of respondents utilize both these apps. Other applications such as Dunzo and Magicpin have a very negligible number of users. When it comes to the frequency of use, the chart below shows that only 11.9% of respondents are rare users of the app.

Figure 1

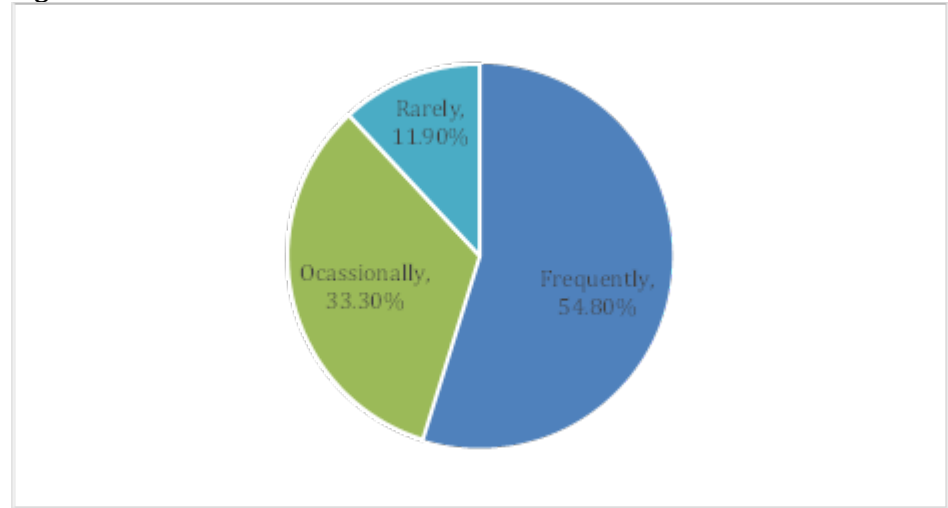


Figure 1 Frequency of ordering from food delivery apps

4.3. PERSONALIZED ADVERTISING ON SOCIAL MEDIA PLATFORMS

Figure 2

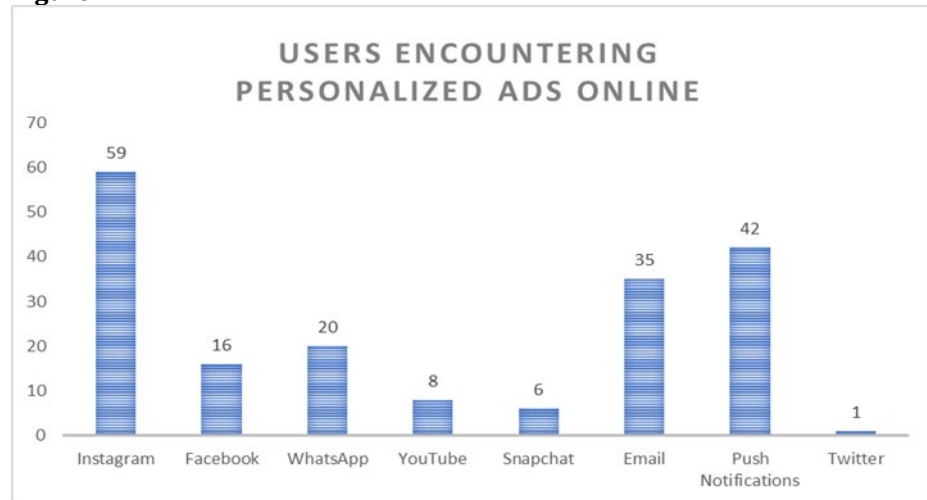


Figure 2 Users Encountering Personalized Ads Online

The analysis below presents the frequency distribution and percentage distribution of various social media platforms encountered in personalized ads of food apps based on the provided data.

Instagram Occurrences: 64 (70.2%)

Instagram emerges as the predominant platform for encountering personalized advertisements of food apps, constituting nearly half of all occurrences in the dataset. Its visually driven nature and user engagement make it a preferred choice for food app promotions.

Push Notifications: Occurrences: 42 (50%)

Push notifications rank as the second most prevalent channel, representing close to one-third of the occurrences. The direct and immediate nature of push notifications allows food apps to reach users with time-bound relevant messages.

Email Occurrences: 35 (41.7%)

Email campaigns constitute a significant portion of the advertisements encountered, comprising almost one-fifth of the total occurrences. Despite being a more traditional marketing channel, emails remain effective in targeting users with personalized promotions and offers.

WhatsApp Occurrences: 20 (23.8%)

WhatsApp, although less prevalent compared to Instagram and push notifications, still serves as a platform for food app advertisements. Its popularity for personal communication makes it an effective medium for targeted promotions. It further creates a facade of personalization.

Facebook Occurrences: 16 (19%)

Facebook ranks lower in frequency compared to Instagram but still maintains a presence in food app advertisements. With its large user base and diverse advertising options, Facebook offers opportunities for targeted campaigns.

YouTube Occurrences: 7 (8.3%)

YouTube appears less frequently compared to other platforms but still contributes to the advertising landscape for food apps. Video content on YouTube allows for engaging promotional strategies, although it may require different approaches compared to image-centric platforms like Instagram. Further, ads on YouTube can be skipped because of which the conversion rate is low.

Snapchat Occurrences: 5 (5.9%)

Snapchat features relatively fewer occurrences but still serves as a platform for food app advertisements, particularly targeting younger demographics. Its ephemeral nature and interactive features provide unique marketing opportunities.

Twitter Occurrences: 1 (1.1%)

Twitter accounts for the least number of occurrences in the dataset. While it may not be as prevalent for food app advertisements, its real-time engagement and trending topics could still be leveraged for targeted campaigns.

Overall, the analysis highlights the dominance of visually-driven platforms like Instagram, along with the importance of direct channels such as push notifications and emails in personalized advertising strategies for food delivery apps. Understanding the diverse preferences and behaviours of users across various platforms is crucial for effective targeting and engagement in the competitive landscape of digital marketing.

4.4. ELABORATION LIKELIHOOD MODEL (ELM) PROCESSING ROUTES

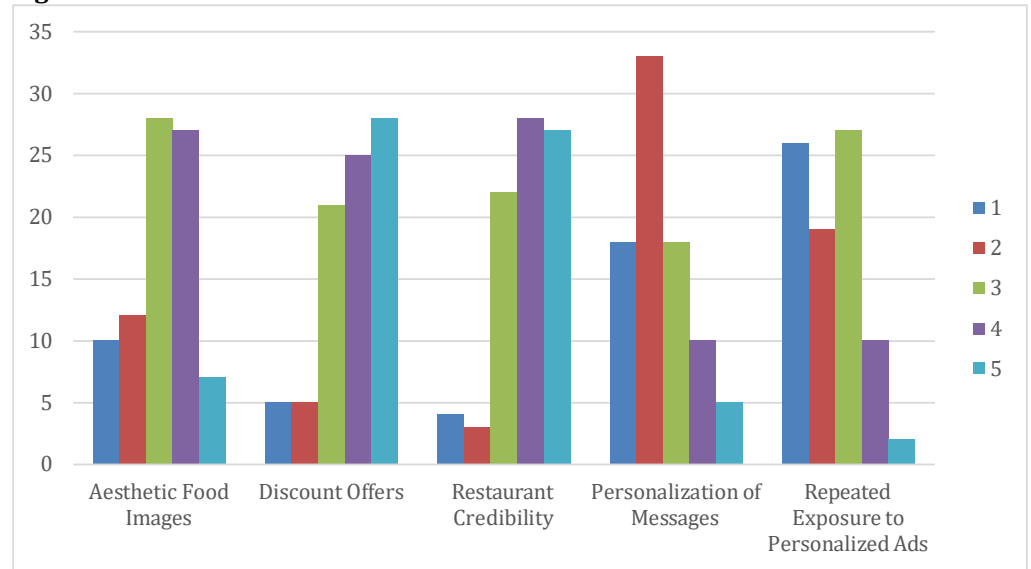
To understand the routes of processing information, respondents were asked different questions to understand their levels of elaboration while viewing a personalized ad.

Table 2

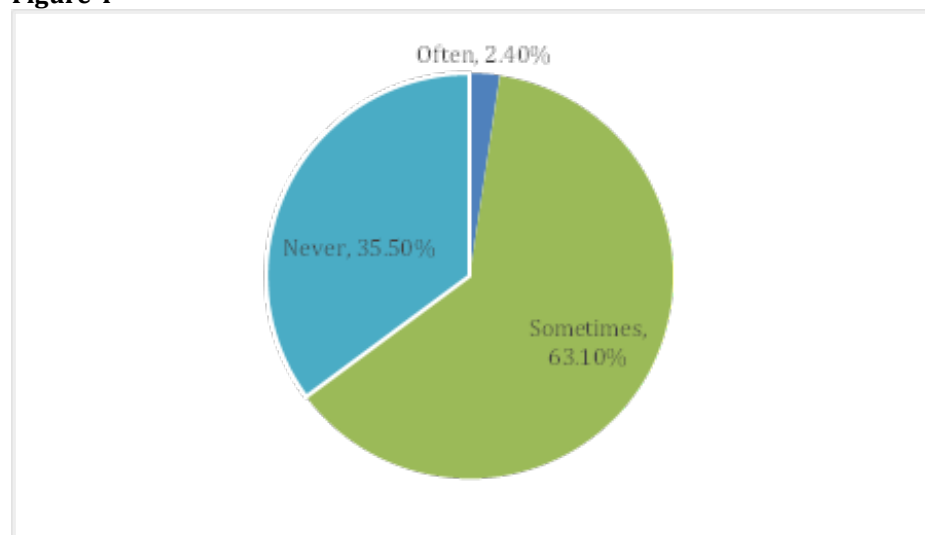
Table 2 Responses for elaboration of persuasive messages

Questions	Ratings	Score 1 (Least)	Score 2	Score 3	Score 4	Score 5 (Most)
How much thought do you put into the details of products or services in personalized ads?		17.9%	17.9%	35.7%	23.8%	4.8%
To what extent do you critically analyze the information provided in personalized ads before making a food ordering decision?		15.5%	23.8%	28.6%	25%	7.1%
To what extent do personalized ads of food delivery apps influence your decision to order food online?		21.4%	22.6%	25%	28.6%	2.4%

- According to ELM, putting thought into information and its critical analysis corresponds to central route processing. In this case, respondents who indicated higher levels of thought put into details and critical analysis (scores of 4 or 5) are likely to be processing the information through the central route.
- Conversely, respondents who reported lower levels of critical analysis and thoughts put into details (scores of 1 or 2) are more likely to be engaging in peripheral route processing, where they rely on superficial cues or heuristics to form judgments about the ads.
- A significant number of responses, however, point to a moderate extent of thoughts put into details and a moderate degree of critical analysis of information (score 3) in personalized advertisements, suggesting a more centred positioning in the likelihood continuum.
- 44% of respondents claimed that personalized ads have none to low levels of influence over their decisions to order food online. It is interesting to note that out of these, 43.2% claim to sometimes place online orders for food delivery due to the targeted advertisements in the subsequent questions of the survey. This points to the use of peripheral route of processing information while engaging with a persuasive message.

Figure 3**Figure 3** Components of Personalized Ads Influencing Online Food Ordering Decisions

- The chart above highlights that discount offers and credibility of restaurants are more influential factors when it comes to making a food ordering decision. Whereas, personalization of messages and repeated exposure to them is regarded as one of the least influential factors.
- The attitudes of respondents towards personalization are not favourable, leading to decreased amount of elaboration of messages in targeted advertisements.
- 27 respondents highlighted that peripheral factors such as aesthetic images of food are positive influencers on their purchase decisions.
- The motivations for elaboration of a persuasive message for most respondents are found to be taking the central route process.

Figure 4**Figure 4** Influence of Personalized Ads on Food Ordering Decisions

Despite the tepid attitude towards the impact of personalized advertising, a significant portion of respondents (63.1%) agree to have 'sometimes' made food ordering decisions based on them.

4.5. CONCERNS FOR PERSONAL DATA PRIVACY

Figure 5

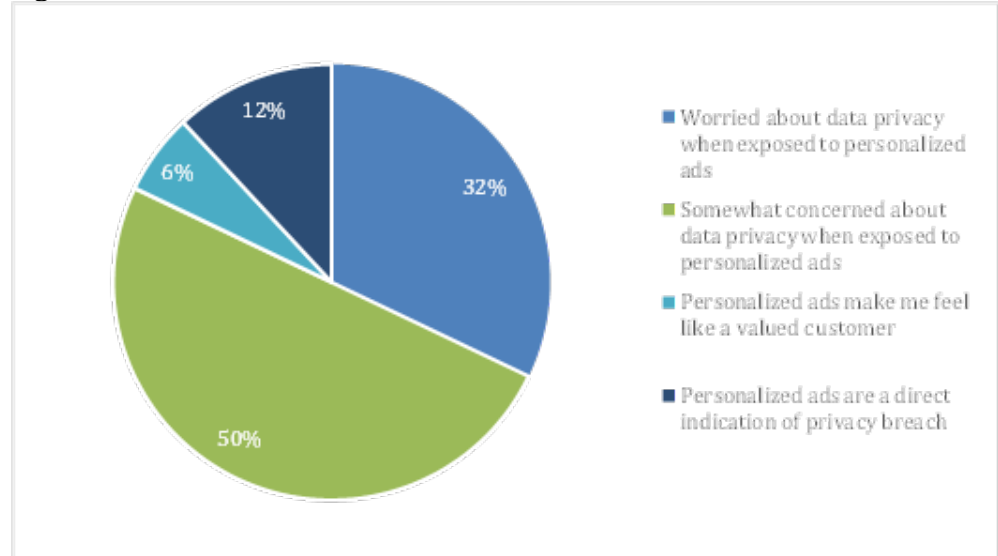


Figure 5 Attitudes towards data privacy

- Majority of respondents (50%) are only somewhat concerned about data privacy when they look at personalized ads.
- In contrast, only 6% of respondents cite no concerns for data privacy and say that personalized ads make them feel like a valued customer.
- 32% respondents are strongly worried about their data privacy when exposed to personalized ads and 12% cite it as a direct sign of privacy breach.

4.6. FINDINGS FROM FOCUS GROUP DISCUSSIONS

The following is a summary of outcomes from conducting focus group discussions with three subsets of survey respondents.

- A majority of respondents across all focus groups found repetition of personalized messages “annoying” and “disturbing”.
- Two distinct opinions emerged about the repetitive nature of personalized advertising. While one segment found the tendency for personalized advertisements to arouse sensations of hunger, another segment was of the opinion that the “constant barrage of personalized ads” made the content redundant and diminished their impact and relevance.
- While participants acknowledged and appreciated the creative aspects of personalized advertisements, such as innovative and quirky messaging, they noted that they were not consistently persuaded to make ordering decisions based solely on the creative aspects of the messages.

- Participants across the focus groups agreed that hyper personalized messages are a sign of data privacy breaches and often “creep out” the users with the immense accuracy and immediacy of targeted messages.

5. CONCLUSION

In summation, this study reveals the complex interplay between personalized advertising and consumer behaviour in the food delivery app ecosystem of Delhi-NCR. It can be inferred that personalized advertising, while prevalent across various social media platforms and communication channels, does not uniformly sway consumer behaviour. Despite their prevalence, a significant portion of respondents expressed minimal influence on their ordering decisions, with concerns about data privacy looming large.

The research uncovered nuanced processing routes employed by consumers when exposed to personalized ads. Findings from the survey and focus group discussion, when combined, suggest that individuals are less motivated to elaborately consume the messages of personalized ads due to the repetitive and bothersome nature of the ads. Breach of data privacy also factors in while understanding the unfavourable attitudes towards personalization.

It can be concluded that while personalized advertising holds immense potential for marketers to enhance engagement and drive sales in the online food delivery market, its effectiveness hinges on striking a delicate balance between relevance and privacy considerations. Marketers must be cautious not to overuse personalized advertisements to avoid making the users immune to their persuasion efforts. Food delivery apps like Zomato and Swiggy are quite popular across different demographics and a large section of users are frequent in terms of placing their order. However, the strategies of personalized advertising need to be reworked to tap their full potential.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

- Acquisti A, Brandimarte L, Loewenstein G. Privacy and human behavior in the age of information. *Science*. 2015 Jan 30;347(6221):509-14. doi: 10.1126/science.aaa1465. PMID: 25635091.
- Bol, N., T. Dienlin, S. Kruekemeier, M. Sax, S. C. Boerman, J. Strycharz, N. Helberger, and C. H. de Vreese. 2018. “Understanding the Effects of Personalization as a Privacy Calculus: Analyzing Self-Disclosure across Health, News, and Commerce Contexts.” *Journal of Computer-Mediated Communication* 23 (6): 370–388.
- Chu, C-J., Chiang, I-P., Tsai, K-H., & Tung, Y-H. (2022). Exploring the Effects of Personalized Advertising on Social Network Sites. *Journal of Social Media Marketing*, 1(2): 38-54. <https://doi.org/10.33422/jsmm.v1i2.1051>

- Dodoo N.a. Exploring the antecedent impact of personalised social media advertising on online impulse buying tendency. *Int. J. Internet Market Advert.* 2019;13(1):73–95.
- Durmaz, Gulbin & Suher, Kemal & Bir, Cibil. (2015). Elaboration Likelihood Model (ELM) In Print Advertisements: A Content Analysis of Advertisements Which Is Positioned In Special and General Interest Magazines. *Journal of Yaşar University.* 11. 45. 10.19168/jyu.00944.
- Evergage. (2019). Personalization trends: 2019 survey results. available at: <https://www.evergage.com/blog/personalization-trends-2019-survey-results/>
- India: online food delivery market size 2026. (2024, January 22). Statista. Retrieved March 6, 2024, from <https://www.statista.com/statistics/744350/online-food-delivery-market-size-india/>
- Irene, Gevyo. (2023). The Influence of Personalized Ads On E-Commerce Applications In Indonesia On User Satisfaction. *Journal Research of Social Science, Economics, and Management.* 3. 79-92. 10.59141/jrssem.v3i1.524.
- Katoch, R., & Sidhu, A. (2021). Online Food Delivery Industry In India: A Case Of Customer Satisfaction Dynamics.
- Kirkpatrick, D. (2016, May 9). Study: 71% of consumers prefer personalized ads. *Marketing Dive.* Retrieved February 27, 2024, from <https://www.marketingdive.com/news/study-71-of-consumers-prefer-personalized-ads/418831/>
- Mehta, Reena & Udit, Kulkarni. (2020). Impact of Personalized Social Media Advertisements on Consumer Purchase Intention. *Annals of Dunarea de Jos University of Galati. Fascicle I. Economics and Applied Informatics.* 26. 15-24. 10.35219/eai15840409101.
- Mythily, R., & Vishnuvarnan, B. (2023, May). A Study on Effectiveness of the Marketing Strategy of Food Delivery Apps through Zomato and Swiggy. *International Journal of Research Publication and Reviews,* 4(5), 938-957. <https://ijrpr.com/uploads/V4ISSUE5/IJRPR12760.pdf>
- Nguyen, Cuong & Nguyễn, Như & Duong, An. (2020). The Relationships of Social Media Marketing, Consumer Engagement and Purchase Intention. *Test Engineering and Management.* 83. 24653– 24666.
- O’Keefe, Daniel J. 2002. *Persuasion Theory & Research* CA: Sage Publications.
- Petty, Richard & Cacioppo, John. (1986). Elaboration Likelihood Model of Persuasion. *Advances in Experimental Social Psychology.* 19. 123-205. 10.1016/S0065-2601(08)60214-2.
- Ramesh, R. & Prabhu S, Venkatesa & Sasikumar, Bashyam & Devi, B.S. & Prasath, P. & Kamala, S.. (2021). An empirical study of online food delivery services from applications perspective. *Materials Today: Proceedings.* 80. 10.1016/j.matpr.2021.05.500.
- Saleh, R. (2023, December 14). The role of hyper-personalization in food delivery. *Infobip.* Retrieved February 25, 2024, from <https://www.infobip.com/blog/the-role-of-hyper-personalization-in-food-delivery>
- Shastri, A. (2023, August 28). Everything about Zomato Marketing Strategy {2024 Updated}. IIDE. Retrieved February 29, 2024, from <https://iide.co/case-studies/zomato-digital-marketing-strategy/>
- Sriram K V, Namitha KP & Giridhar B Kamath | (2021) Social media advertisements and their influence on consumer purchase intention, *Cogent Business & Management,* 8:1, 2000697, DOI: 10.1080/23311975.2021.2000697

- Statista. (2024, January 22). India: online food delivery market size 2026. Statista. Retrieved February 25, 2024, from <https://www.statista.com/statistics/744350/online-food-delivery-market-size-india/>
- Yuan, Soe-Tsyr & Tsao, Y.W.. (2003). A recommendation mechanism for contextualized mobile advertising. *Expert Systems with Applications*. 24. 399-414. 10.1016/S0957-4174(02)00189-6.