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Abstract

The digital marketing industry continues to experience tremendous challenges caused by rising consumer privacy concerns. One of the industry's most notable challenges revolves around the constant technological advancements and changes that these advancements pose on the advertiser's strategies. My study explores the relationship between advertising expenditure and key performance indicators, such as impressions in paid display advertising. Google Chrome's removal of third-party cookies could potentially affect this relationship. I chose this topic because of my passion for online consumer behavior and the role of technology and advertising in the continually evolving field of my study, where consumers' behavior plays a significant role as they continue to worry about their data usage. My study relied on the quantitative methodology, utilizing a descriptive correlation analysis through a scatter plot and a statistical analysis of a linear regression model to study the effect of Google Chrome's third-party cookie removal on the relationship between advertising expenditure and impressions before and after Google introduced the "Tracking Protection" phase in January 2024. To answer my research question, I studied the dataset of 360 observations on 30 automobile companies in the United States from April 2023 to March 2024.

The findings of my analysis revealed that advertising expenditure continues to be a strong predictor of impressions, despite the removal of third-party cookies by Google. However, the findings from my research question have shown that the event being the removal of third-party cookies for 1 percent of Google Chrome's population worldwide currently does not affect the performance of paid display advertising. This study contributes to the academic literature by providing empirical evidence on the effect of consumer privacy changes on paid display advertising. Future research is strongly encouraged to study the long-term impact of Google's

"Tracking Protection" phase on paid display advertising performance by considering more observations after the event's occurrence, a larger poll of global Google Chrome users, and studying the event's impact across different industries. This will provide a more comprehensive understanding of the effects of consumer privacy changes on the digital marketing industry.

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Introduction

In the last decade, the continuing advancement of technology has led consumers to have rising concerns regarding their data privacy, while advertisers are struggling to enhance consumers' trust in the customer journey at every point they interact with them online, which has become a dilemma in the digital marketing industry. The enormous amount of data processed by tech giants has made consumers in the digital landscape worry about the data advertisers have on them and how they use it to achieve a high conversion rate. In the fall semester of my senior year, I attended a 2023 New York Advertising Week conference where one of Google's employees mentioned that the uniqueness of Google is that it interacts with its users at every action a Google account user takes online while tracking it and selling to advertising networks. In my literature review, I will define consumer privacy and third-party cookies and discuss their critical aspects while exploring the economic implications of consumer privacy choices in the digital marketing industry. Then, I will discuss how privacy concerns impact personal information sharing and the effectiveness of advertising transparency. Finally, I will cover the removal of third-party cookies, its effect on digital marketing, and how companies compensate for data usage, which leads to this study's research question - Exploring the Potential Effect of Google Chrome's Removal of Third-Party Cookies on Paid Display Advertising.

Literature Review

→ Defining Consumer Privacy

According to Lanier and Saini (2008), the general definition of consumer privacy primarily revolves around two forms of control: the control of the presence of others in the marketing environment and controlling transactional information. These theoretical frameworks

enclose consumer knowledge, in which consumers are informed how a firm's information practices and privacy policies are utilized. Nevertheless, it's important to note that consumer privacy cannot be considered absolute for several reasons, primarily because it frequently depends on cultural, situational, and individual factors.

While comprehensive, this understanding of consumer privacy needs to be viewed in the context of the evolving digital marketing landscape. In the work of Choi et al. (2023), consumer privacy in digital marketing is connected to tracking online activities and targeted advertising. Choi et al. (2023) emphasize that consumer privacy not only involves managing online consumers' privacy information but also explores complex interactions between consumer knowledge, advertising practices, and privacy regulations. For instance, the study's findings state that when consumers opt into tracking and comply with a company's privacy policies, they often weigh the benefits of receiving quality product information through online advertising. This is a crucial factor that advertisers consider since consumers willingly opt in. However, consumer tracking, while enabling advertisers to target consumers more effectively, often raises privacy concerns. These concerns can lead to ad wearout according to study by Choi et al. (2023), where consumers become unresponsive to targeted advertising despite previously showing interest in the product featured in the ad throughout their customer journey.

→ Defining Third-Party Cookies

Within digital marketing, marketers apply various tools for tracking purposes, which is why I decided to define a third-party cookie as part of my literature review and further research question that I will cover. According to Shuford et al. (2018), third-party cookies, or ad trackers, play the most significant part in digital marketing and web tracking. They differ significantly in

the areas of origin and application as compared to first-party cookies. First-party cookies are data points that websites create when a user visits the site. Whereas third-party cookies are data points that are developed and managed by domains other than the site a user is currently visiting. These are usually developed by advertising networks or analytics companies, and they are applied to perform cross-site tracking, enhance user experience, and manage the advertising spaces that are not locally on the site visited. Mayer & Mitchell, (2012) state that this technology touches upon a major privacy concern since third-party cookies record and keep information on users' web browsing habits, such as search history without user's authorization or even acknowledgment.

The utilization of third-party cookies is a complex system of data exchange among advertisers, which has been raising substantial privacy concerns. As pointed out by Shuford et al. (2018), although third-party cookies are essential for the internet's economic model services that consumers may either pay for directly or use for free in exchange for personalized advertisements, they also have the potential of becoming a violation of users' privacy. Mayer and Mitchell (2012) emphasize that aside from legal uses such as targeted advertising, third-party cookies can be used for advertisers' intrusive tracking methods: various behavior-tracking technologies that aggregate vast amounts of personally identifiable information without users' awareness or informed consent. Moreover, the process can be highly threatening, considering how few users read privacy policies. However, Shuford et al. (2018) note that "Do not track" laws and advertising-blocking browser extensions, designed to give users control over who uses their information, are not as effective since these methods are primarily voluntary for advertisers and have weak legal power behind them.

→ Privacy Choices and their Economic Implications in Digital Marketing

Throughout my literature review, I also decided to focus on the economic implications of consumer privacy choices that affect the digital marketing industry. The study by Choi et al. (2023) focuses on exploring the "purchase journey" and how advertising influences consumers' decisions throughout it, along with the economic implications in the industry. For instance, the paper illustrates how the connection of consumer privacy decisions affects the economics of the digital marketing realm. The study finds that consumers' choices to opt in or out of online tracking significantly influence the advertising strategies and the profitability of both advertisers and ad networks, which causes a dilemma in the industry because the consumer journey process entails repetition at its core. Consumers become less reactive to the repetitive ads, leading to a declining profitability trend in the industry.

The study by Choi et al. (2023) also used a game theory model to illustrate these complex relationships. The game theory model developed by Choi et al. (2023) involves three key players: consumers, advertisers, and ad networks. These participants engage in multi-period interactions, where consumers' decisions to opt in or opt out of tracking affect the advertising strategies. For example, in the game theory model, the authors indicate that on one hand, when consumers opt in for tracking, it leads to an increased efficiency of advertising, allowing advertisers to deliver tailored ads based on a consumer need; however, that does not necessarily mean that it will generate higher profit due to difficulties in converting consumer interest into a purchase caused by ad wear out. The research by Choi et al. (2023) also demonstrates that consumer privacy highlights a broader economic impact, as it illustrates how consumer privacy regulations and choices can restructure the digital marketing industry. These changes influence not only consumers' experiences, causing them to be numb to advertising, but also the

profitability and strategies of all players in the market, including advertisers and ad networks. The players now have to adjust and implement more transparent strategies that will allow them to capture consumer's attention online while respecting their privacy.

The study by Acquisti et al. (2016) focuses on the trade-offs customers face between privacy and personal data sharing, highlighting the economic value and implications of protecting personal information. The introduction of Web 2.0 described by Wang et al. (2012) introduced a web evolution by creating user platforms that enabled user interaction, collaboration, and sharing. This change transformed people's roles from being information consumers to active creators of personal data — a subject they explore in depth in their research. Emerging markets, and services such as travel agencies, record companies, and news media use consumer data for targeted advertising allowing this shift to have enormous effects on the digital marketing sector. The study by Acquisti et al. (2016) emphasizes the difficult balance that exists between customer privacy and economic efficiency, pointing out that although consumer privacy choices can result in more efficient and targeted advertising, they also pose problems for consumer benefits and market dynamics. It clarifies the conflict of interest that more security for privacy could result in less information being available to advertisers, which could lower the market's overall effectiveness for digital advertising. Additionally, the research by Acquisti et al. (2016) addresses the financial trade-offs between personalization and privacy, arguing that although protecting personal information improves consumer welfare, privacy may also reduce the efficacy of personalized advertising, which could have an impact on the profitability. Along with the game theory model presented by Choi et al. (2023), integrating these viewpoints could offer a better understanding of the economic implications of consumer privacy choices.

→ How do privacy concerns reduce consumer's willingness to share personal information?

In addition, I examined how privacy concerns reduce consumers' willingness to share (WTS) personal information. According to the global study by Schumacher et al. (2023), conducted across 24 countries, the authors concluded that privacy concerns negatively impact consumer's WTS personal information where cultural context plays a crucial role. Schumacher et al. (2023) used Hofstede's cultural dimensions as a framework to interpret consumers' privacy concerns. For instance, the study finds that in societies with high power distance, where hierarchy and authority are prioritized, consumers are less willing to share personal information when opting in. This trend is observed in countries like Malaysia, Mexico, and China. In contrast, in societies with low power distance societies, which emphasize equality, consumers are more willing to share personal information. This tendency is seen in countries such as Austria, Sweden, and Switzerland.

Furthermore, the study by Schumacher et al. (2023) reveals that other cultural factors affect WTS, including long-term orientation, uncertainty avoidance, and masculinity. For example, in more masculine societies, which include countries such as Japan, Austria, and Switzerland, accomplishments and success are significantly valued, and consumers can be more inclined to share personal information if they see perceived benefits. However, in contrast, less masculine societies, which are more risk-averse, including countries such as Sweden, Netherlands, and South Korea, demonstrate a stronger tendency towards unwillingness to share personal information and consider perceived benefits minor.

A research article by Acquisti et al. (2015) elaborates on how privacy concerns reduce consumers' willingness to share personal information since the study illustrates a factor of

uncertainty on privacy concerns. That is because consumers must understand how to make rational decisions about sharing their data, particularly when evaluating potential consequences and determining whom to trust. The authors refer to a laboratory experiment in which it found that participants are more likely to purchase from merchants with explicit privacy protections if they are informed about them. In other words, reducing uncertainty about privacy practices eliminates information imbalance and increases consumers' willingness to share personal information.

Moreover, the study highlights the context-dependence of privacy concerns. For example, different environments and target data requests provoke different consumer reactions and behaviors. To illustrate, Acquisti et al. (2015) convey that consumers are more likely to provide personal data on websites that offer immediate incentives, such as personalization of services or discounts. Furthermore, the authors state that websites with professional yet user-friendly layout give website users enough confidence to share personal information, implying that businesses need to consider the environment and other situational factors that appeal to consumer comfort and confidence when obtaining consumer data. To conclude, considering the research findings of Acquisti et al. (2015), it is necessary to rethink the existing policies and practices relevant to consumer privacy. Their research suggests that people's confidence in transparency and control over their information may need to be revised to protect them from data misuse. More specifically, privacy rules that take consumer behavior seriously need to be in place and create protection mechanisms that are not based on the assumption of customer awareness.

→ How does Ad transparency affect ad effectiveness?

Another topic I decided to examine is how ad transparency affects ad effectiveness.

According to Kim et al. (2018), ad transparency is a disclosure of how consumers' personal information was used to generate ads. To examine this topic, I relied on the study by Kim et al. (2018), which focuses on the norms of information sharing. According to the study, ad transparency may backfire if it exposes unethical marketing strategies that go against consumer expectations on how their information is used. This is an important finding from the study because it implies that not all types of ad transparency can successfully enhance ad effectiveness. Ad effectiveness declines when advertising transparency efforts expose information that consumers may find objectionable. For example, when ad transparency showcases acceptable information on consumers, it improves ad effectiveness; however, it only does so on platforms that consumers trust, such as Facebook. This is also an important insight to note because it indicates that ad transparency depends not only on the form of content being presented as but also on the platforms on which consumers receive that message. In its study, Kim et al. (2018) conducted several experiments. They discovered that ads that are based on inferred information, such as gender from the name, location from a phone number, and workplace from an email address, according to Pipl Search Documentation (2023), which tech giants collect, showcase decreased ad effectiveness in comparison to ads that are based on stated attributes, where consumers willingly share their personal information showcased better ad effectiveness. Overall, through examining this study, I can conclude that the authors emphasized that understanding consumer preferences and expectations regarding data usage is vital because it can guide advertisers to work towards more effective advertising strategies given the rising concerns from consumers' perspective about privacy and data usage.

While Kim et al. (2018) explore how ad targeting and data use transparency can affect consumer perception and ad effectiveness, the Aguirre et al. (2015) study examines the dynamics

of personalization versus privacy concerns. Since it focuses on how transparency — or lack thereof — in data collection affects consumer response to tailored advertising, it complements Kim et al. (2018). The study supports the issues raised by Kim et al. on ethical marketing techniques and customer expectations, highlighting the significance of data collection and its usage. The Aguirre et al. (2015) study integrates the problem of how transparency influences ad effectiveness by emphasizing that overt (transparent) data collection can reduce the negative consequences of consumer privacy and improve ad effectiveness. For example, consumers who discovered their data was being acquired without consent experienced a notable decline in click-through rates from tailored advertising, according to an exploratory field study conducted on Facebook and secondary data analysis by Aguirre et al. (2015). Yet again, this study emphasizes the need to balance privacy violations and tailored advertising.

→ The removal of Third-Party Cookies and its effect on Digital Marketing

Furthermore, I addressed how removal of third-party cookies could potentially affect the digital marketing industry, a similar research question I plan on studying in my study. According to Business World (2023), Google initiated the first tests of third-party cookie removal on 4 January 2024. This could potentially affect advertisers' revenue due to technology's ability to track consumers' behavior online, which is used to deliver targeted advertising. Google announced this testing as the initial "Tracking Protection" phase that will affect only 1 percent of global Chrome browser users while its effect on advertisers' revenue remains questionable.

According to Lengdell's study (2023), the phase-out of third-party cookies could cause a substantial shift in the digital marketing industry. Advertisers must reconsider their approaches while interacting with potential consumers to keep up with this industry change. Lengdell offers

several innovative ways that advertisers can employ to engage with their customers without utilizing third-party cookies while emphasizing the importance of a firm's digital maturity. According to Gill and VanBoskirk (2016), digital maturity is a systematic model consisting of four dimensions that rely on culture, technology, organization, and insights to help companies determine their digital readiness. Lengdell covers four main strategies that do not depend on third-party cookie technology, which can help advertisers transition. However, I want to highlight the first three that I believe are the most effective in addressing this change.

1. **Data-driven strategy:** a strategy where advertisers shift towards new methods of reaching first-party data by using customer relationship management platforms or search engine optimization data. Through these strategies, companies can align with customer behavior without relying on third-party data that is used to track users via third-party cookies.

2. **Value-based strategy:** Another strategy where companies can shift towards brand and content-centric creation. In other words, firms could stop creating products based on data and start attracting customers through brand propositions and values. Value-based strategy allows firms to develop a deeper emotional connection with clients so that customers become advocates without relying on invasive tracking.

3. **Rethinking allocation strategy:** This strategy suggests that firms should re-adjust their resource allocation strategies. Companies need to focus more on finding the right audience with the help of first-party data and improving inbound marketing experiences.

Moreover, Google's implementation of such a significant industry change remains vital, considering many privacy regulations, such as the California Consumer Privacy Act (CCPA) and

the European Union's General Data Protection Regulation (GDPR) mentioned by Schweidel et al. (2022). Adopting the recommendations provided by Lengdell could allow advertisers to adjust their strategies and help protect customer data. According to the study by Schweidel et al. (2022) the California Consumer Privacy Act (CCPA) and the European Union's General Data Protection Regulation (GDPR) both intend to protect consumers and let them opt out of online tracking. These regulations are also changing how businesses collect and deal with customer data since they give consumers more control and privacy protection; however, they also create difficulties for companies that use consumer data for targeted advertising.

Walker et al. (2019), provide an analysis of the complex relationships among data privacy, technological advances, and legal frameworks. Their research emphasizes technology techniques businesses use to comply with consumer protection laws like the CCPA and GDPR to interact with one another. Walker et al. (2019) specifically argues that although the CCPA and GDPR aim to limit the unrestricted collection and use of personal data, promoting a culture of privacy and consumer empowerment, they also demand a reassessment of tech industry business models. The law pushes businesses to innovate to protect consumer privacy and provide value, pointing to a shift towards technology that improves data protection and privacy regulations.

Furthermore, Walker et al. (2019) highlight the broader societal implications of these privacy laws, pointing out that they may change the rules around using personal data and corporate accountability. The CCPA and GDPR protect individual privacy rights and foster a more reliable digital ecosystem by requiring businesses to implement more open and moral data practices. This shift, however, has its challenges, as companies must balance the requirement to maintain strict privacy standards with the demand for data-driven insights. The perspectives provided by Walker et al. (2019) enhance the preliminary analysis conducted by Schweidel et al.

(2022) and broaden my understanding of the effects of the CCPA and GDPR on digital marketing. These studies point to a turning point in developing digital privacy, where technological innovation, consumer expectations, and legislative constraints meet. Both tech companies and advertisers must negotiate this complex landscape with caution, balancing the ethics of consumer data with their economic objectives.

→ How do companies approach consumer compensation for data usage?

I also decided to examine how companies approach consumer compensation for data usage. To answer this question, I decided to investigate the study by Tomaino et al. (2023), which involved a series of experiments conducted by the authors that analyzed the discrepancies that consumers showcase when they are being compensated with money versus goods for their privacy data. The study showcased the frequent exchange of privacy data for goods and services in our society, where companies collect our browsing histories, geolocation and offer customers "free goods" in return, such as social networks and search results, which the regulatory acts, such as GDPR and CCPA closely monitor.

Tomaino et al. found that consumers are willing to obtain a premium when they sell their personal information for money instead of trading it for goods. This finding raises the possibility that consumers' actual value for privacy may not be reflected in the market techniques currently employed by businesses. The authors explain cognitive psychology's compatibility principle, which can cause this discrepancy. They argue that privacy data is better valued by money than by goods, where online consumers will demand higher compensation for their data being used due to this compatibility, which raises concerns about the weight of privacy data in terms of monetary value. That is because there is no well-defined market price in the consumer privacy

data market; this effect is especially noticeable given the uncertainty related to the value of privacy data. Tomaino et al. (2023) conducted experiments using incentive-based compensation on a streaming platform, such as Netflix. The experiments demonstrated that participants automatically valued their privacy data higher in exchange for money rather than goods. Overall, it can be concluded from this study that there is a significant gap in the value of consumer data, indicating that companies are acquiring data through an accessible technological way compared to what consumers would demand in monetary compensation. The gap also highlights the need to reevaluate incentives in exchanging privacy data and raises significant concerns about how consumer data is valued.

Research Question

The research for this paper will try to answer the following question. Exploring the Potential Effect of Google Chrome's Removal of Third-Party Cookies on Paid Display advertising. This research question aims to test whether Google Chrome's "Tracking Protection" phase decreased key performance indicators of ad effectiveness, such as the number of impressions for paid display ads, for the 1 percent of Google Chrome's user base since third-party cookie removal on January 4, 2024.

Data and Methodology

I will use Semrush's AdClarity — Advertising Intelligence application that collects, analyzes, and aggregates real-time display, video, and social ad occurrences data according to AdClarity — Advertising Intelligence (n.d.). According to About Us (n.d.), Semrush is the SaaS platform for online visibility management and content marketing. I will study the ongoing event by exploring the potential effect of Google Chrome's removal of third-party cookies on paid

display advertising. My research question is based on the hypothesis that shifts toward Google Chrome's "Tracking Protection" phase that occurred on January 4, 2024, where it could potentially decrease the performance of paid display advertising in the long run, while advertisers face a significant industry change due to the issue of excess of consumer privacy data. This change could impact how advertisers distribute their budgets across different platforms, ultimately affecting the effectiveness of paid display advertising as a whole. The theoretical foundation of digital marketing and consumer privacy incorporates concepts from complex relationships of consumer privacy and ad effectiveness while being the basis of this study. These complex relationships may significantly impact advertiser behavior and, in turn, online advertising campaign performance metrics, such as impressions.

The study will use a mixed-methods approach to test this hypothesis, utilizing quantitative data analysis to identify changes in advertising performance. A comprehensive dataset of 360 observations on 30 automobile companies that are present in the US will be studied to examine their ad spend from April 2023 to March 2024. This dataset provides a detailed monthly look at advertising spend and impressions, a measure used by the industry to determine how often an online advertisement is viewed and interacted with, according to the New Media Age (2004). Using this key performance indicator (KPI), I will evaluate the effects of Google Chrome's "Tracking Protection" phase. I will apply tools like the Data Analysis ToolPak in Excel to analyze data and run a regression model to identify performance changes. I will also execute data preparation to clean and organize data in Excel. Furthermore, I will use the same dataset to analyze the effect of Google Chrome's "Tracking Protection" phase to also study the correlation between ad spend and impressions using visual analytics software Tableau. This concise approach combines theoretical understanding with subscription based Semrush's

AdClarity — Advertising Intelligence data to offer a compelling study of how Google Chrome's removal of third-party cookies changes paid display advertising.

Results and Discussion

In this study, I am interested in identifying how the event being Google Chrome's third-party removal affects the effectiveness of advertising ad spending on key performance indicator, in my case, impression in the chosen dataset for this study. To analyze the effect of this event, the regression model will study the effect of the pre-and post-event periods. Data from the pre-event period includes observations collected before the implementation of Google Chrome's "Tracking Protection" phase on January 4th, 2024, starting from April 1st, 2023. The post-event period includes observations collected from January 5th, 2024, until March 31st, 2024, after the change was introduced. In addition, to ensure the model's accuracy, which measures the difference between pre- and post-impression periods, I eliminated 11 observations from 360 due to no ad spending from given advertisers yet no impression performance at a given time, leading to a sample of 349 observations in my study.

First, to study how the event affects the effectiveness of advertising expenditure on impressions, I decided to study the correlation of impressions and expenditure of the automobile industry data between the pre- and post-event periods. I applied descriptive statistics to interpret the findings from the correlation analysis. To analyze the correlation, I first cleaned the data in Excel to eliminate observations that did not have any ad spend within the given time period. Then, I split the time period data in Tableau into two columns, 'years' and 'months', to be used as my dimension variables to have distinct observations for pre- and post-event periods within my correlation analysis. Then, I utilized expenditure and impressions as my measure variables in

Tableau, where I further filtered the data for all observations from the pre- and post-event periods. To interpret the findings from the correlation analysis, I developed a scatter plot in Tableau to visualize the relationship between impressions and advertising expenditures in the pre- and post-event periods, presented in Figure 1 below.

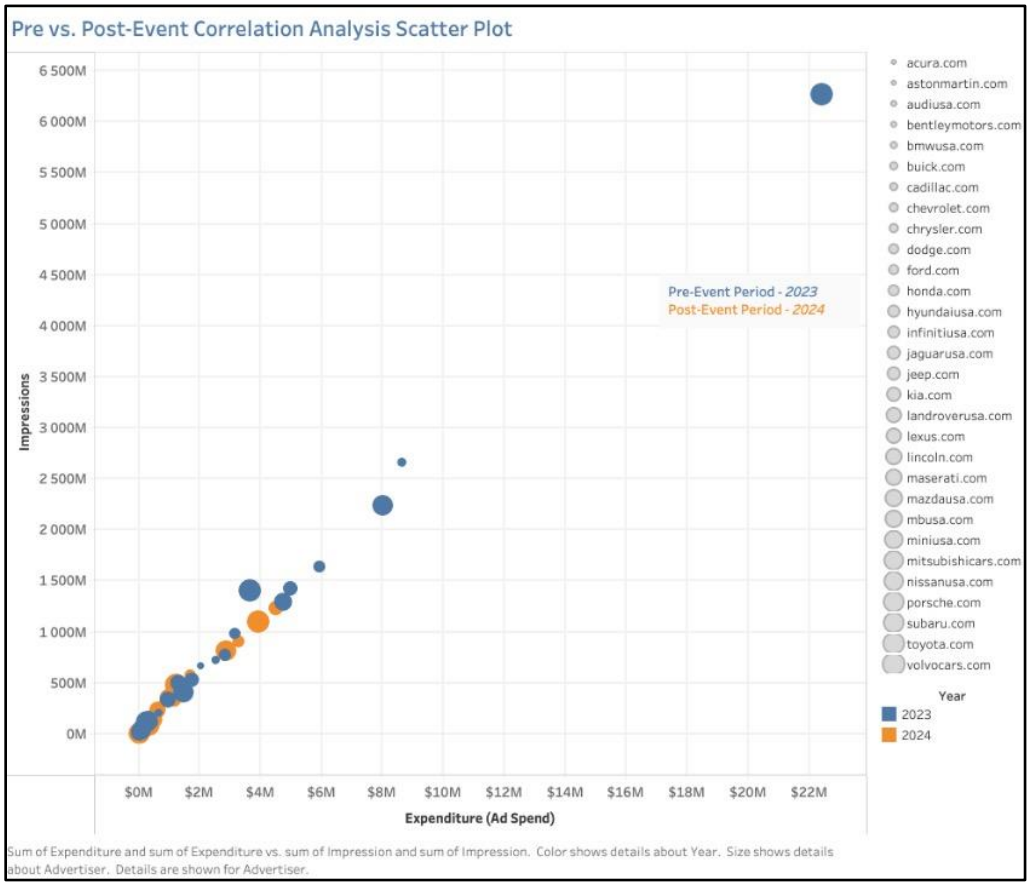

Figure 1: Pre vs. Post Event Correlation Analysis Scatter Plot

As shown in Figure 1 above, the correlation analysis can conclude that there is a strong and positive relationship between advertising expenditure and the number of impressions for paid display ads per advertiser. From this descriptive analysis, the correlation remained strong in both pre- and post-event periods. Furthermore, the advertising expenditure continues to be a significant predictor of impressions in the post-event period despite the removal of third-party

cookies for 1 percent of Google Chrome users. The takeaway that can be drawn is that the digital ad spend landscape might have changed. However, the spending allocation based on expected impressions had not fundamentally changed due to the event. The results from the correlation analysis should also consider the external factors while studying the effects of ad expenditure on ad impressions. The external factor is the recent implementation of Google's third-party cookie removal for the 1 percent of Google Chrome's users, which occurred on January 4th, which could indicate that to further analyze the relationship between ad expenditure and impressions in the future, more observations in the post-event period must be considered due to a small time frame of the post-event period.

To further expand on my research question and study the effect of the event on the relationship between ad expenditure and impressions of paid display ads, I ran a statistical regression analysis. To run the statistical regression analysis, I first had to clean my dataset to eliminate observations without any ad spending data. My dataset consisted of 349 observations with the following columns: advertisers, time period, impressions, expenditure, event, and post-event dummy variable. In addition, to execute the regression analysis, I used three main variables to develop my model: impressions, expenditure, and event presented in Figure 2.

$$\boldsymbol{Impressions} = a + b_1 * Expenditure + b_2 * Expenditure * Event$$

Figure 2: Statistical Regression Model

For this regression model, I used $Impressions$ as my dependent Y variable and $Expenditure$ and $Event$ as my independent X variables. In order to measure the difference between the impressions in the pre- and post-event periods, I developed a post-event dummy

variable that was used to execute the analysis further and applied to one of the independent variables, the $Event$ variable in the model. I had to code the post-event dummy variable for each unique observation in the dataset. The post-event dummy variable contained observations being 1 or 0 based on the following criteria: for data points with a time period after January 2024, the value is 1; otherwise, for all observations before Google Chrome's third-party removal starting from April 1st, 2023, it is 0. Furthermore, in order to run my statistical regression analysis, I had to develop an $Event$ variable, which serves as a variable that studies the effect of Google Chrome's third-party removal on impressions. To populate the $Event$ variable per each unique observation in my dataset, I had to multiply the $Expenditure$ variable by the post-event dummy variable to determine the interaction effect by investigating the event's relationship between impressions and expenditure.

The general goal of this statistical regression model is to study how coefficient b_2 in my model changes because of the event being Google Chrome's third-party removal for 1 percent of the global users. In my model, the b_2 coefficient is the primary value that measures whether the effect of the ad expenditure on impressions is different between the pre- and post-event periods. In contrast, whereas the b_1 coefficient measures the general relationship between expenditure and impressions in this model. To further analyze my statistical regression model, I had to interpret its results, which are presented in the regression model's output below in Figure 3.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9966297260
R Square	0.9932708108
Adjusted R Square	0.9932319137
Standard Error	11905549.66
Observations	349

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	7.23902E+18	3.61951E+18	25535.89217	0
Residual	346	4.90428E+16	1.41742E+14		
Total	348	7.28807E+18			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	4619499.2035170600	735115.4416008890	6.2840459363	0.0000000010	3173641.8827272800	6065356.5243068400	3173641.8827272800	6065356.5243068400
Expenditure	279.8022889248	1.3421063673	208.4799653346	0.0000000000	277.1625752056	282.4420026440	277.1625752056	282.4420026440
Event	0.5686906502	2.6753481246	0.2125669721	0.8317899103	-4.6933014842	5.8306827846	-4.6933014842	5.8306827846

Figure 3: Statistical Regression Model Output

Based on the results of the statistical regression model output presented in Figure 3 above, there is a positive correlation between advertising expenditure and impressions with a coefficient of 279.8. This coefficient suggests that each unit increase in advertising expenditure is associated with an increase of approximately 280 impressions. This strong correlation is supported by a highly significant $t - static$ of 208.48 and a near-zero $p - value$ indicating its significance since it is < 0.05. However, as stated previously, the main objective of my research question is to study how the $Event$ coefficient affects the effectiveness of advertising expenditure on impressions. Considering the $Event$ variable coefficient, which represents the effect of Google Chrome's third-party removal on impressions, is essential to answer my research question. The coefficient for the $Event$ variable is 0.57, which is not statistically significant. This is indicated by the low $t - static$ value of 0.21 and $p - value$ of 0.83. A $p -$

$value$ of 0.83 for the $Event$ variable demonstrates its insignificant change in the performance of paid display advertising despite the modification in the third-party cookie policy since it does not affect the effectiveness of advertising expenditure on impression, whereas otherwise, a $p - value$ would be < 0.05.

Furthermore, the regression's intercept is statistically significant, with a value of nearly 46.1 million impressions, a $t - static$ of 6.28, and a $p - value$ of less < 0.05. The model explains a fundamental level of impressions in the dataset that cannot be explained by ad spend alone, as indicated by its significance. The regression output concludes that ad spending has a significant effect on impressions. However, the removal of third-party cookies for 1% of Google Chrome's user base does not have a considerable impact on impression performance yet. A significant takeaway that can be concluded from this statistical regression model analysis is that the event currently does not have a substantial effect on the effectiveness of advertising expenditure on impressions. This is because the findings from my statistical regression model indicate that despite the event occurrence, the performance of paid display advertising did not decrease during the post-event period after Google's implementation of the "Tracking Protection" phase.

Limitations

While the study provided valuable insights into the relationship between advertising expenditure and impressions in the context of Google Chrome's removal of third-party cookies, it is important to acknowledge its significant limitations. These constraints offer opportunities for further research and the understanding of the study's goals and its application. First and foremost, it is important to consider the fact that Google Chrome's "Tracking Protection" phase occurred

only on January 4, 2024, and is considered a test that the search engine software company plans to extend further in the year, according to Business World (2023). Furthermore, a crucial limitation of this study's outcome is the fact that Google Chrome only removed third-party cookies for 1% of its global user base, which is a highly small sample of users since in 2021 alone Google Chrome's user base consisted of 3.2 billion users worldwide according to Statista (2021). See Appendix A for more information and explanation. This small sample size may have limited the generalizability of the study's findings to the broader population of Google Chrome users.

Due to the event's occurrence at the beginning of this year, the sample of the post-event observations in the dataset remained small due to a limited amount of observation period of 3 months, which is a relatively small amount of time to study such a drastic industry change that could affect advertisers' paid display ads effectiveness and their strategies in the long run. An ongoing study extending beyond the initial three months period following the event could lead to different insights into the evolving digital marketing landscape. In addition, a methodology constraint must be considered since using a linear regression model, while appropriate for this study, is predicated on the assumption of a linear relationship between variables. Alternative methodological approaches, such as time series analysis of the more extended time period, might provide a different perspective on the changes of ad spend effectiveness over time. In addition, as mentioned by Business World (2023), a more extensive global user base affected by the event in the future might have a higher impact on consumers' perception of this privacy change, the advertiser's execution strategies and critical performance indicators objectives, such as impressions.

Furthermore, in order to study this research question in the future on the impact of the event on the effectiveness of paid display advertising a sample of different industry data should be considered and compared across industries. Based on the observations in my sample, the automobile industry allocated significant advertising budgets into digital display advertising while other industries might have smaller advertising budgets that could lead to different effects of ad expenditure on impressions and other key performance indicators. According to Nielsen (2022) automobile industry's expenditure on static display advertising in the United States reached $1.6 billion, which is why it is important to consider other industry's ad spend data to differentiate the effect of the event on different industries. See Appendix B for more information and explanation. The significant advertising budget of the automobile industry suggests that its response to the event may differ from industries with smaller budgets, highlighting the need for industry-specific analysis in future research.

Conclusions

This study examined complex relationships between the continuously rising consumer privacy concerns and the role of advertisers, consumers, and ad networks, such as Google, in advertising strategies. In addition, I studied the technological applications that influence the modern landscape of consumer privacy in advertising, such as third-party cookies. Due to the enormous amounts of data advertisers and ad networks have on consumers, consumer privacy concerns will continue to be vital to study. As discussed earlier, digital marketing is an ever-evolving field that constantly changes due to technological advancements, shifts in consumer expectations, and consumer privacy regulations that advertisers must consider to stay afloat in the industry. The industry's concerns led me to examine the potential effect of Google Chrome's

recent removal of third-party cookies for 1 percent of its global user base in January 2024 on the performance of paid display advertising. In this study, I focused on evaluating the changes in key performance indicators, such as ad impressions within the automobile industry in the US, after the event's occurrence. The analysis obtained from this study discovered key insights that contribute to both academic literature and practical application in the industry.

Through descriptive analysis within my scatter plot in Figure 1, I discovered that advertising expenditure continues to be a strong predictor of ad impressions despite the significant change in the consumer privacy landscape. However, for the statistical analysis of my research question, I developed a regression model, as seen in Figure 2, to further examine the relationship between ad expenditure and impressions after the event occurrence. My regression model output, as seen in Figure 3, has shown that the impact of third-party cookie removal for 1 percent of Google Chrome's users is not as significant at the moment as hypothesized initially, suggesting for the event's recent occurrence and a limited number of observations in the post-event period to examine the change of performance in paid display advertising. Nevertheless, while the impact of Google Chrome's removal of third-party cookies on its limited number of users is minimal, the long-term effects of this change within the industry still need to be investigated since the company plans to extend its pool of affected users later in the year. It is important to note that this conclusion is supported not only by the results of the empirical study but also by the industry's discussions on consumer privacy and the efficiency of digital marketing.

To conclude, future research remains essential to evaluate the impact of the event's occurrence on the performance of paid display advertising. As stated in the limitations of my

study, more observations in the post-event period are required, different methodology approaches and advertising performance data across other industries must be taken into account, considering the vast ad spending budgets across the automobile industry companies used for this study. To conclude, this study advances knowledge on how significant events such as eliminating third-party cookies affect digital marketing. It establishes the foundation for future research to clarify how companies might approach the challenges presented by consumer privacy regulations, consumer demand for transparent advertising, and consistently evolving technology to maintain profitable and effective strategies.

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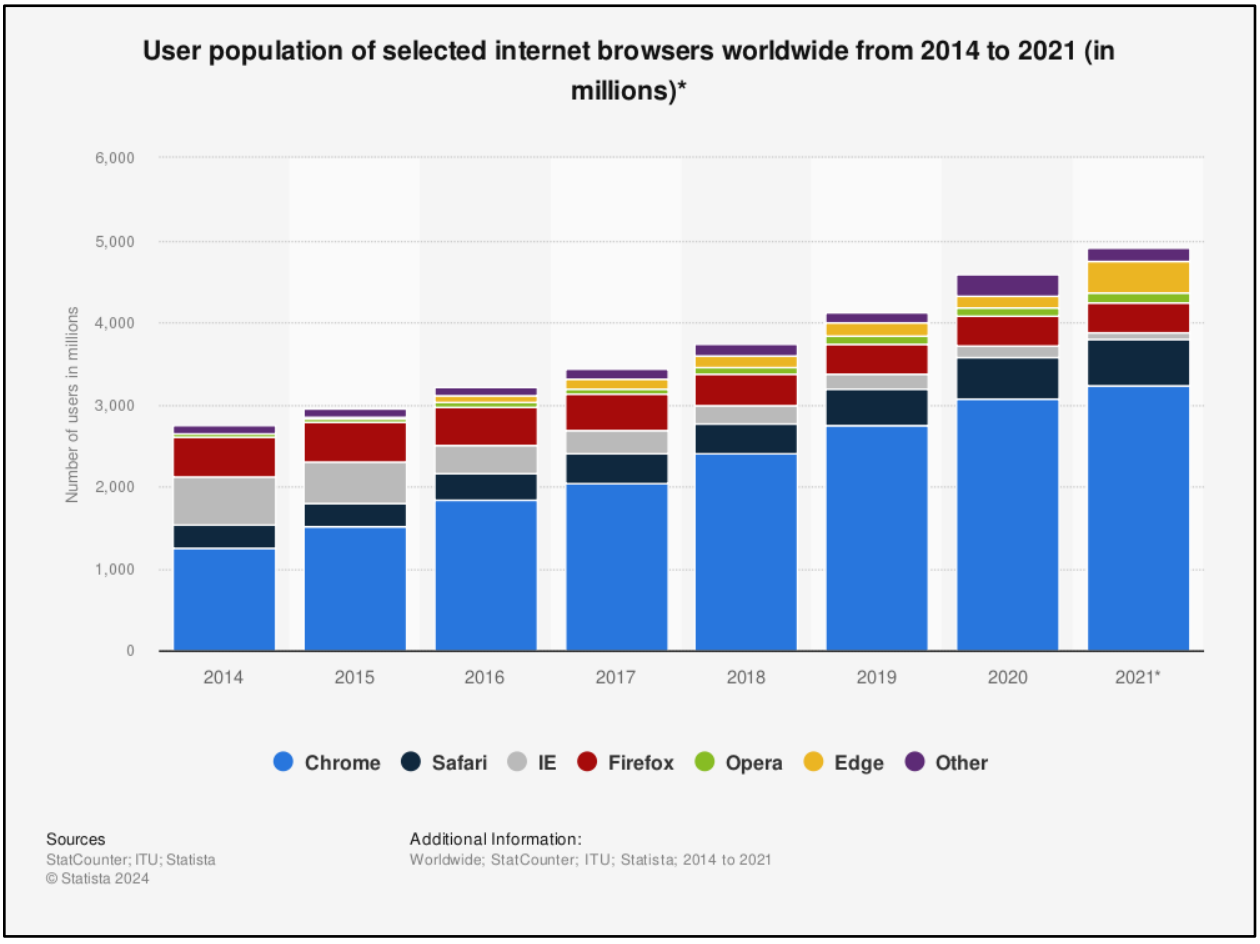
Appendices

→ **Appendix A:** Google Chrome's 2021 worldwide user population

The bar chart below shows the distribution of the user population of selected internet browsers worldwide from 2014 to 2021. Google Chrome's market share is demonstrated in blue, showcasing it as the most dominant market player with nearly 3.2 billion users worldwide, according to Statista (2021).



→ **Appendix B:** 2021 automobile industry's display advertising spend

The bar chart below showcases the automobile industry's ad spend per digital static display advertising in the US from 2019 to 2021. According to Nielsen (2022), the industry's significant ad spend in 2021 was nearly $1.6 billion.