Is Less the Merrier for Ad Exposure and Audience Attention? A Media Measurement Case Study

Sarangsh Nandi[a] , Dr. Madeline Craft[a] , and Kumar Rao[a]

[a]*Measurement & Impact @ NBCU*

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ABSTRACT

Advertisement-supported media models are built upon an implicit agreement that media publishers make with their audience: the price of free or subsidized content is the audience's attention to advertisements. A key component in the evaluation of an advertiser's return on investment is whether an advertisement held the audience's attention well enough to generate a conversion (e.g., a sale, website/store visit, newsletter sign-up). In our modern era of near-constant access to information, arguably one of the greatest threats to audience attention is information overload. This threat is likely to increase in severity as ad content increases in quantity. Recent research by Abcarian and Rao (in progress) has demonstrated an increase in the number of ad spots generated by media companies over time. How do audiences react to increased ad exposure? Is there an optimal ad duration that elicits higher levels of audience attention? This study seeks to answer these questions. This study adds to the growing body of research on audience attention in the context of ad exposure measurement. Preliminary results indicate that shorter-duration ads (15 seconds) are more effective in garnering audience attention than ads of longer duration (30+ seconds). Our paper includes a more extensive discussion of our findings along with recommendations for future research.

1. Introduction

Advertisement (ad) supported media models are built upon an implicit agreement that media publishers make with their audience: the price of free or subsidized content is the audience's attention to ads. Advertisers pay media companies for the opportunity to place their ads within the media publisher's content. In turn, media publishers pay media measurement companies to monitor campaign performance throughout the lifespan of the ad campaign. Campaign performance metrics include the frequency and unique frequency of ad exposures per individual or household and the ability of an ad to generate a conversion (e.g., a sale, website/store visit, newsletter sign-up). The degree to which an ad is able to generate a conversion is thought to be, in part, a function of the ad's ability to hold the audience's attention well enough to generate the conversion.

Over the past few years, there has been a growing body of research and evidence-based journalism suggesting a decline in human attention span (Lorenz-Spreen et al., 2019; McCormack, 2014). In a previous study, Microsoft Corp. investigated the trend by measuring human attention using surveys and electroencephalogram (EEG) monitoring of brain activity in a sample of Canadians. McSpadden (2014) provided a summary of this study, which showed that the average human attention span decreased from 12 seconds to 8 seconds between 2000 and 2015. This observation led Lorenz-Spreen et al. (2019) to conduct further research aimed at understanding how the increase in content volume affects human attention. Their study revealed that the acceleration of content production leads to the collective exhaustion of human attention, resulting in a tendency to switch more rapidly between content sources. In essence, the findings of Lorenz-Spreen et al. (2019) support the previous study by Microsoft Corp. and provide further insights into the relationship between the volume of content and human attention span.

A plausible explanation for the observed decrease in human attention span is the increasing prevalence of connected devices, as suggested by various studies. These devices, such as laptops, smartphones, smartwatches, and tablets, provide easy access to vast quantities of digital content. According to a press release by Deloitte in 2022, the average U.S. household has 22 connected devices. In 2012, Nielsen, a media measurement company, estimated that around 50% of U.S. consumers used smartphones. Given the significant increase in smartphone adoption over the past decade, this estimate is likely to be even higher today. A recent Pew Research Center survey conducted in early 2021 reported that 31% of U.S. adults engage in "almost constant" online activity, with higher rates of constant online activity observed among younger adults (48% of those aged 18-29) and lower rates among older adults (only 8% of those aged 65 or older) (Perrin & Atske, 2021). It is worth noting that the mere presence of connected devices does not directly affect audience attention; rather, it is the constant flow of information facilitated by these devices that is believed to influence attention. This information can originate from a variety of sources, including social media, text messages, and emails, which trigger notifications that rapidly shift our attention back and forth between content sources.

Although the decline of the human attention span and its causes have been well researched, there is a relative lack of research in the media context, particularly regarding changes

in ad duration and audience attention to such ads over time. This study seeks to fill this gap by exploring recent changes in ad content and audience attention. It is well known that the ad landscape has evolved over the years, potentially as a response to decreasing human attention span. For instance, Abcarian and Rao (in progress) conducted a study that observed a rise in 15-second ads at the expense of 30-second ads. Specifically, in 2015, 15- and 30-second ads accounted for 43.6% and 46.1% of ads, respectively, while in 2021, they accounted for 57.3% and 31.6% of ads, respectively. This raises the question of whether shorter ads, such as 15-second ads, are more effective in holding audience attention than longer-duration ads. The study also seeks to identify any significant changes in audience attention to ads in recent years and determine the characteristics of ads and the ad placement that may influence audience attention.

The construct of human attention is considered a latent variable that cannot be directly measured. Consequently, defining audience attention requires consideration of various factors. In this section, we provide a definition of audience attention used in this study. Additionally, we describe the data utilized in this research and present our exploratory analysis of audience attention to ads. We then discuss the results of our exploratory data analyses and present our conclusions, including limitations of the study and future research directions.

2. Data and Methods

2.1. Data Source

The data utilized in this study was sourced from a prominent media measurement company that tracks the performance of ad campaigns throughout their lifecycle. One key performance indicator is audience attention to ads, which is measured across various environments, including linear, time-shifted, Video-on-Demand, and streaming. The company uses a unified approach to measure impressions and second-by-second attention for all television ads across linear, time-shifted, Video-on-Demand (VOD), and streaming environments.

In this study, we focused solely on linear television ad campaigns, analyzing 17.71 million ad spots aired across different networks from 2018 to 2022. Each row of the dataset represents a unique ad spot and includes information such as the time of day and day of the week the ad spot aired, the network it was broadcasted on, the product category the ad belonged to, as well as audience attention metrics for the ad. The storage limitations of available machines precluded regression analysis of the entire dataset. To overcome this challenge, we employed a sampling technique where we randomly selected 50,000 records from each year (2018-2022), resulting in a representative subsample of 250,000 records, which constitutes approximately 1.41% of the total dataset. We conducted a rigorous comparison of the marginal distributions of various covariates (which are discussed in detail later) between the sample data and the total dataset. Our analysis revealed that the sample was a well-balanced and representative subset of the total dataset, with no significant differences observed between the two distributions. Lastly, the information in the dataset was aggregated at the ad spot level and did not contain any personally identifiable information (PII) about the audience who interacted with the ads.

2.2. Audience Attention

Media measurement companies offer an array of metrics for evaluating audience attention, which can be calculated at the ad spot level and then aggregated across various dimensions, such as campaign, network, program, or daypart. This provides advertisers with a nuanced understanding of ad performance across different contexts, facilitating optimization opportunities and benchmarking against competitors.

The company providing the data for our study also offers an audience attention metric that is calculated at the ad spot level and then aggregated across an entire campaign, network, program, or daypart. The company uses automatic content recognition technology to identify whether a device within their panel of smart TVs played an ad and the associated actions/events. On a second-by-second basis and across the duration of the ad, the following actions/events, which interrupt viewer attention, are identified: device turn-off, channel change, fast-forward/ rewind, accessed the TV guide, etc. While these actions do not fully capture the construct of audience attention (e.g., interaction with streams of information from another connected device are not identified by this methodology), we think of these actions as representing a phenomenon known as “media multitasking”, which is defined as monitoring and interacting with multiple streams of information simultaneously, while also engaging in other tasks (Matthews et al., 2022a). Media multitasking is thought to be a symptom of the ever-decreasing human attention span (McSpadden, 2014), and is something advertisers seek to avoid because it can decrease ad effectiveness (Garaus et al., 2017).

In this study, we utilized an audience attention metric referred to as the "completion rate," which quantifies viewer behaviors that interrupt their attention during ad viewing, as previously listed. Specifically, completion rate is calculated as the percentage of devices present at the start of an ad and for the entire duration of the ad, ranging from 0% to 100%. Notably, completion rate varies as a function of several ad spot characteristics such as placement of an ad within a commercial break, show genre, and daypart. Therefore, when conducting statistical analyses of audience attention metrics, it is essential to include these characteristics as covariates to account for their influence on completion rate and thereby obtain a more accurate understanding of audience attention metrics.

2.3. Covariates

We controlled for the influence of various covariates in our multivariate analysis. The covariates considered in this study are all attributes related to delivery of an ad and consists of the following: pod position, daypart, show genre, and day of the week. Pod position and order describe the placement of a pod, which is a commercial block within a program that consists of a set of ads. The pod order is the placement of the pod within a program, and the pod position is the placement of an ad within that pod. In the dataset, the placement of the ad within a pod (pod position) is classified as either F (First), M (Middle), or L (Last). The term daypart refers to the portion of the broadcast day an ad airs in. The definition of these portions can vary. In this dataset, daypart is defined as a variable consisting of 6 levels: (1) late fringe: Monday – Sunday (11 PM- 6 AM), (2) weekday morning: Monday - Friday (6 AM-10 AM), (3) weekday daytime: Monday - Friday (10 AM-6 PM), (4) early fringe: Monday - Saturday (6 PM- 8 PM) and Sunday

(6 PM – 7 PM), (5) prime time: Monday - Saturday (8 PM - 11 PM) and Sunday 7 PM – 11 PM), (6) weekend daytime: Saturday - Sunday (6 AM – 6 PM). Each ad spot in our dataset airs within a program that belongs to a particular program genre. The program genre variable classifies the content of a program according to the niche category that best describes the program content (e.g., entertainment, news, drama). Finally, day of the week is an important covariate to inform how audience attention varies across a day and whether the behavior varies across weekdays and weekends.

3. Results

3.1. Exploratory Analysis

We conducted an examination of the marginal distributions of the four covariates included in subsequent multivariate analyses (see Table 1). The dataset contained a larger proportion of ads positioned in the middle of ad pods (74%), belonging to entertainment genre (72%), and aired during late fringe/daytime hours (51%). These findings highlight important patterns in the data and provide valuable insights into the distribution of covariates in our sample. Furthermore, the observed distributions provide important context for our investigation of audience attention metrics and informs our subsequent multivariate analyses (discussed in the next section).

Table 1. Distribution of covariates (ad spot characteristics) from sample data (N=250,000).

Covariates	(%)
Pod Position	
Middle Pod	73.54%
Last Pod	11.63%
First Pod	14.83%
Show Genre	
Entertainment	71.46%
Sports	12.10%
News & Information	14.72%
Infomercial	0.67%
Various Programs	0.26%
Hispanic	0.75%
Unknown	0.03%
Daypart	
Early Fringe	8.65%
Late Fringe	25.78%
Prime Time	14.58%
Weekday Daytime	25.29%
Weekday Morning	12.02%
Weekend Daytime	13.69%
Day of Week of Airing	
Monday	14.53%
Tuesday	14.22%
Wednesday	14.43%
Thursday	14.43%
Friday	14.38%
Saturday	13.93%
Sunday	14.07%

We also examined the bivariate relationships between our dependent variable of interest, completion rate, and the four covariates and two predictors of substantive interest. The results of these analyses are presented in Tables 2 and 3. Overall, we observed that completion rates were relatively high, exceeding 90% across all levels of the covariates and predictors. Notably, pod position, and show genre exhibited a good degree of discrimination between average completion rates.

Table 2. Completion Rate distribution across covariates (ad spot characteristics).

Covariates	(%)
Pod Position	
Middle Pod	95.49%
Last Pod	98.90%
First Pod	98.54%
Show Genre	
Entertainment	98.28%
Sports	97.83%
News & Information	97.92%
Infomercial	90.41%
Various Programs	97.99%
Hispanic	98.61%
Unknown	98.29%
Daypart	
Early Fringe	98.07%
Late Fringe	98.04%
Prime Time	97.78%
Weekday Daytime	98.43%
Weekday Morning	98.31%
Weekend Daytime	97.98%
Day of Week of Airing	
Monday	97.86%
Tuesday	98.20%
Wednesday	98.20%
Thursday	98.24%
Friday	98.21%
Saturday	98.19%
Sunday	97.99%

Table 3. Completion Rate distribution across predictors.

Predictors	(%)
Year of Airing	
2018	98.25%
2019	98.15%
2020	98.08%
2021	98.12%
2022	98.03%
Ad Duration (seconds)	
15	98.71%
30	97.47%
60	96.12%
> 60	93.76%
< 60	97.88%

We also plotted the bivariate relationships as a function of time and observed several interesting trends. While not all trends were statistically significant, some of the graphs revealed meaningful patterns that informed our interpretation of the results. To illustrate this approach, we present a couple of the graphs from our analysis, which are shown in Figures 1 and 2.

Figure 1 shows the trend in completion rates across all ads between 2018 to 2022. While our analysis revealed a decline in completion rates during this time period, the magnitude of the decline was relatively small, with rates decreasing by only 0.3% on average, from 98.3% in 2018 to 98% in 2022. Figure 2 shows the trend in completion rates by ad length. The completion rates of 15-second ads were consistently high (98.7% on average) and relatively stable across the five-year period from 2018 to 2022. However, longer ads, greater than a minute in length, showed lower completion rates over time, while all other ad lengths also showed some decline over time.

Overall, our findings suggest that while completion rates have declined slightly over time, they remain relatively high and indicate a high level of engagement with ads among the target audience. Moving forward, we sought to identify the drivers of completion rate from a multivariate perspective, which we discuss in detail in the next section. By incorporating multiple covariates in our analysis, we aimed to gain a more comprehensive understanding of the factors that influence completion rates and their relative importance in predicting audience attention.

Figure 1. Illustration of the trend in completion rates across all ads that aired on a set of networks from 2018 to 2022.

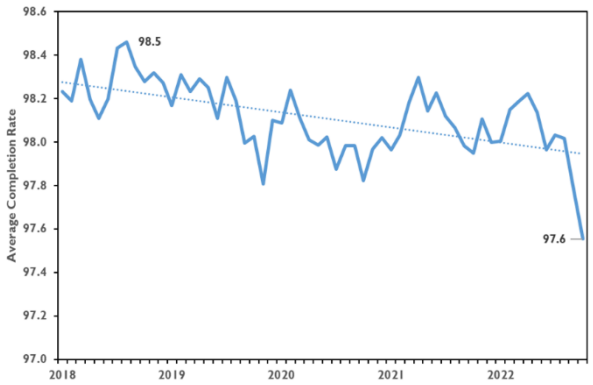
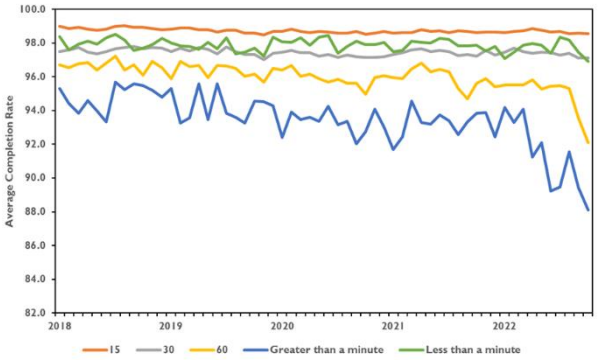


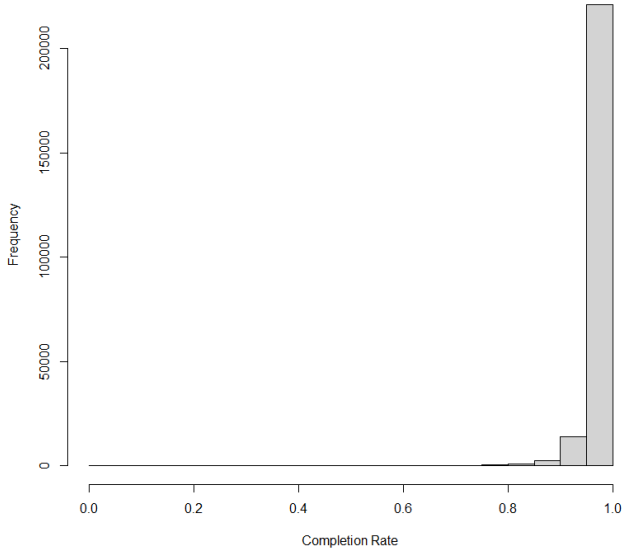
Figure 2. Illustration of the trend in completion rates by ad duration for ads that aired on a set of networks from 2018 to 2022.



3.2. Multivariate Analysis

We conduct a multivariate analysis to understand the impact of ad duration and time on attention, controlling for important ad spot characteristics. The outcome variable, completion rate, is a negatively skewed proportion, ranging from 0.01 to one (see Figure 3). The beta distribution can be used to model continuous variables restricted to the unit interval (0, 1) (e.g., proportions). Our dataset contains proportions restricted to the unit interval (0, 1]. In other words, our dataset does not contain completion rates equal to zero, but it does contain 6,834 completion rates equal to one. Because the number of ones constitutes such a small proportion of the total (2.73%), we subtract 0.000001 from each one and specify a beta distributed model for the slightly adjusted completion rate.

Figure 3. Distribution of completion rate before adjustment.



Beta regression is a type of generalized linear model of the mean of the dependent variable, which can be linked to linear independent variables through a logit link function. The beta regression specification introduced by Ferrari and Cribari-Neto (2004) and implemented in the betareg function from the R package betareg (Cribari-Neto & Zeileis, 2010) also includes a model for the precision of the dependent variable, which can be linked to linear independent variables through a log link function. That is, both the mean and precision of the dependent variable can be assumed to vary as a function of independent variables.

Using the betareg function from the R package betareg, we produce three nested versions of our analysis of completion rate. The first model includes only the date as a predictor in the model of the mean, the second model includes the date and the ad duration as predictors in the model of the mean, and the third model includes the date, the ad duration, and the ad spot characteristics show genre, pod position, day of the week, and daypart as predictors in the model of the mean. In all three models, the precision is not assumed to vary as a function of independent variables (i.e., the precision is assumed to be constant). The model results are contained in Table 4 and a description of the results is as follows.

The first model shows that the effect of date is significant ($p < .001$). Because the beta coefficients of the model of the mean are on the logit scale, we exponentiate them to facilitate interpretation. These exponentiated coefficients are referred to as "odds ratios" and can be interpreted as the probability of the event (i.e., completion) relative to the probability of the non-event. The coefficient on date can be interpreted as follows: for a one-day increase, completion is 99.99% as likely to occur. That is, as time goes on, the completion rate decreases.

The second model shows that, even controlling for ad duration, the effect of date is significant ($p < .001$), and the size of the effect is the same as in the first model. The coefficients of ad durations of 30 and 45+ seconds (with 15-second ad durations as the reference group) are significant ($p < .001$). The change from 15- to 30-second ad durations results

in completion being 60.62% as likely to occur, and the change from 15- to 45+ second ad durations results in completion being 35.49% as likely to occur. That is, as ad duration increases, completion rate decreases.

Table 4. Summary of model results from three nested beta regression models.

Term	Estimate	exp(Estimate)*	Std. Error	Statistic	P value	Significance
Model 1						
Mean Model with Logit Link						
Intercept	6.2400	-	0.13	49.39	p < .001	***
Date	-0.0001	99.99%	0.00	-18.26	p < .001	***
Precision Model with Log Link						
Intercept	3.6025		0.01	531.40	p < .001	***
Model 2						
Mean Model with Logit Link						
Intercept	6.945	-	0.12	56.69	p < .001	***
Date	-0.0001	99.99%	0.00	-22.41	p < .001	***
Ad Duration: 30	-0.5005	60.62%	0.01	-70.25	p < .001	***
Ad Duration: 45+	-1.036	35.49%	0.01	-80.27	p < .001	***
Precision Model with Log Link						
Intercept	3.7461		0.01	567.40	p < .001	***
Model 3						
Mean Model with Logit Link						
Intercept	6.4800	-	0.19	34.63	p < .001	***
Date	-0.0002	99.98%	0.00	-26.93	p < .001	***
Ad Duration: 30	-0.4514	63.67%	0.01	-65.72	p < .001	***
Ad Duration: 45+	-0.9807	37.50%	0.01	-81.45	p < .001	***
Show Genre: Entertainment	0.1159	112.29%	0.14	0.81	0.42	
Show Genre: Hispanic	0.0978	110.28%	0.15	0.67	0.51	
Show Genre: Infomercial	0.2935	134.11%	0.15	1.98	0.05	*
Show Genre: News & Information	-0.0567	94.49%	0.14	-0.40	0.69	
Show Genre: Sports	0.0113	101.14%	0.14	0.08	0.94	
Show Genre: Various Programs	-0.1376	87.14%	0.15	-0.90	0.37	
Pod Position: Last	1.2870	362.19%	0.01	99.77	p < .001	***
Pod Position: Middle	0.7268	206.85%	0.01	92.51	p < .001	***
DOW: Monday	0.0018	100.18%	0.01	0.15	0.88	
DOW: Tuesday	-0.0121	98.80%	0.01	-1.03	0.30	
DOW: Wednesday	0.0063	100.63%	0.01	0.54	0.59	
DOW: Thursday	0.0103	101.04%	0.01	0.88	0.38	
DOW: Saturday	-0.0223	97.79%	0.01	-1.64	0.10	
DOW: Sunday	-0.0093	99.07%	0.01	-0.69	0.49	
Daypart: Late Fringe	0.2498	128.38%	0.01	20.08	p < .001	***
Daypart: Prime Time	-0.0746	92.81%	0.01	-5.62	0.00	***
Daypart: Weekday Daytime	0.1639	117.81%	0.01	13.00	p < .001	***
Daypart: Weekday Morning	0.2421	127.39%	0.01	16.88	p < .001	***
Daypart: Weekend Daytime	0.1125	111.91%	0.02	7.22	0.00	***
Precision Model with Log Link						
Intercept	53.196	-	0.3452	154.1	p < .001	***

* exp(beta) represents the change in the odds of the outcome for a one-unit change in the independent variable.

The third model shows that, even controlling for ad duration and other important ad spot characteristics, the effect of date is significant ($p < .001$), and the size of its effect increases in magnitude from -0.0001 to -0.0002. After converting to an odds ratio, we see that a one-day increase results in completion being 99.98% as likely to occur, ceteris paribus. The ad duration results of the third model are similar in direction and magnitude to the results of the second model (see Table 4).

The effects of show genre are interpreted relative to genre unknown. The only genre with a significantly different average completion rate from genre unknown is the genre of infomercial. After converting to an odds ratio, we see that the change from unknown genre to infomercial results in completion being 134.11% as likely to occur. That is, average completion rate is much higher for ads placed within the infomercial genre than the unknown genre, ceteris paribus.

The effects of pod position are interpreted relative to the first pod position. Both the middle and last pod positions have significantly different average completion rates from the first pod position, ceteris paribus ($p < .001$). After converting to an odds ratio, we see that the change from the first to the middle pod position results in completion being 206.85% as likely to occur, and the change from the first to the last pod position results in completion being 362.19% as likely to occur. That is, ads placed in later pod positions tend to have higher completion rates. None of the effects of day of the week are significant. That is, no days of the week have higher/lower average completion rates relative to Friday.

The effects of daypart are interpreted relative to the early fringe daypart. All dayparts have significantly different average completion rates from the early fringe daypart, ceteris paribus ($p < .001$). Two of the most notable daypart effects are those of prime time and weekday morning. After converting to odds ratios, we see that the change from early fringe to prime-time results in completion rate being 92.81% as likely to occur, and the change from early fringe to weekday morning results in completion rate being 127.39% as likely to occur. That is, average completion rates are relatively lower for the prime-time daypart and relatively higher for the weekday morning daypart.

We produced the Akaike and Bayesian information criterion (AIC and BIC, respectively) as measures of model fit for all three models (see Table 5). Both AIC and BIC are relative model fit indices that considers model performance and complexity, with lower values indicating better fit. Upon examination of both indices for all three models, we see that the third model, which controls for all important ad spot characteristics, is the best-fitting model.

Table 5. Summary of relative model fit indices for three nested beta regression models.

	Fit Statistics	
	AIC*	BIC*
Model 1	-373687	-373669
Model 2	-381343	-381298
Model 3	-393256	-393039

4. Discussion and Conclusions

Our findings demonstrate that attention to ads, operationally defined as the completion rate, has shortened in recent years. This finding provides support to the findings summarized in our literature review, that the human attention span has shortened in recent years. Of course, this change in attention to ads over time could be a function of relevant ad spot characteristics also changing over time. To explore this idea, we conducted a multivariate analysis and showed that, even after controlling for the ad spot characteristics of pod position, show genre, daypart, and day of the week of airing, completion rates have shortened over time.

In our work in the field of media measurement, we have observed an increase in 15-second ads at the expense of 30-second ads over time. The results of our analyses confirm that 15-second ads have indeed increased concomitant with the decrease of 30-second ads from 2018-2022. Upon confirmation of this finding, we wondered whether the change in attention to ads over time could be attributed to changes in ad duration over time. Our multivariate analysis also showed that the decline in completion rates over time is significant, even after controlling for changes in ad duration over time.

The decline of audience attention to ads over time is only relevant to the extent that attention to ads has a significant influence on conversion rates because the goal of advertising is not just to garner audience attention but to generate conversions. Therefore, future research should be conducted to examine (1) whether there is an effect of attention on conversion rates and (2) whether the direction and/or magnitude of the effect has changed over time. Although we

would hypothesize that there is a positive correlation between attention to ads and conversion rates, we acknowledge that negative relationships between media multitasking and cognitive functioning that have been uncovered in the literature[1] (Alzahabi & Becker, 2013 ; Cain & Mitroff, 2011). Media multitasking could be conceptualized as a type of "interruption" to ad viewership, resulting in lower completion rates. That is to say, it is not obvious whether the direction of the effect of attention to ads on conversion rates would be positive or negative.

Finally, our research operationally defined attention to ads as the percentage of devices present at the start of an ad that remain present through the entire duration of the ad (or the completion rate). It is important to note that attention is a latent variable that can be defined in myriad ways. Completion rate only represents one aspect of attention to ads. Future research should examine whether our results hold under a more holistic approach to measuring attention to ads.

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[1] A study by Alzahabi and Becker (2013) found that heavy media multitaskers demonstrated an increased ability to switch between two tasks when compared with light media multitaskers. Another study by Cain and Mitroff (2011) showed that heavy media multitaskers maintain a wider attentional scope than light media multitaskers.