# Attention and Cognitive Process in Mobile

Phase 1: Neuroscience and eye tracking research results. January 2019

**Neurons Inc – Applied Neuroscience 2018**

NEURONS INC

MMA

# The **background** of this study

How long does an ad need to be shown on a screen to be recognized and processed cognitively?

The mobile industry has long used rules of thumb to classify ads according to whether they will have the **opportunity to be seen by consumers**. But few studies have actually looked at this effect in detail, and basic research in psychology and cognitive neuroscience suggests that consumers may respond faster to ads than the industry standards suggest.

The purpose of this study is therefore not to analyze ad effectiveness, but rather to identify when the opportunity to see (OTS) happens and support this with scientific evidence:

## How long does an ad need to be shown on a screen to be recognized and processed cognitively?

By using literature review and experimental design, the MMA commissioned Neurons Inc to test the effects of brief ad durations on the OTS using state-of-the-art applied neuroscience solutions.

In this study, we have tested 900 participants using EEG and eye-tracking to understand how even the briefest durations of ads (from 100ms to 3000ms) can affect consumers' attentional, emotional and cognitive responses to ads. The potential effect of this study is to provide objective measures of OTS for ads on the mobile platform, and through this ensure that industry standards are scientifically grounded.

# The **process** of the opportunity to see

## Stage 1 – Was the ad seen?


**To analyze how long an ad needs to be shown for to be noticed,** we will look at the portion of participants (in %) that have a minimum of three gaze points (60ms) on an ad in a given ad duration.

Our hypothesis was that the percentage of ads seen scores increase as duration also increases, as a longer duration gives participants longer time to view the ad.

## Stage 2 - Relative Time Spent


**Relative time spent** refers to how much time (in %) people spend with the ad out of the total viewability time.

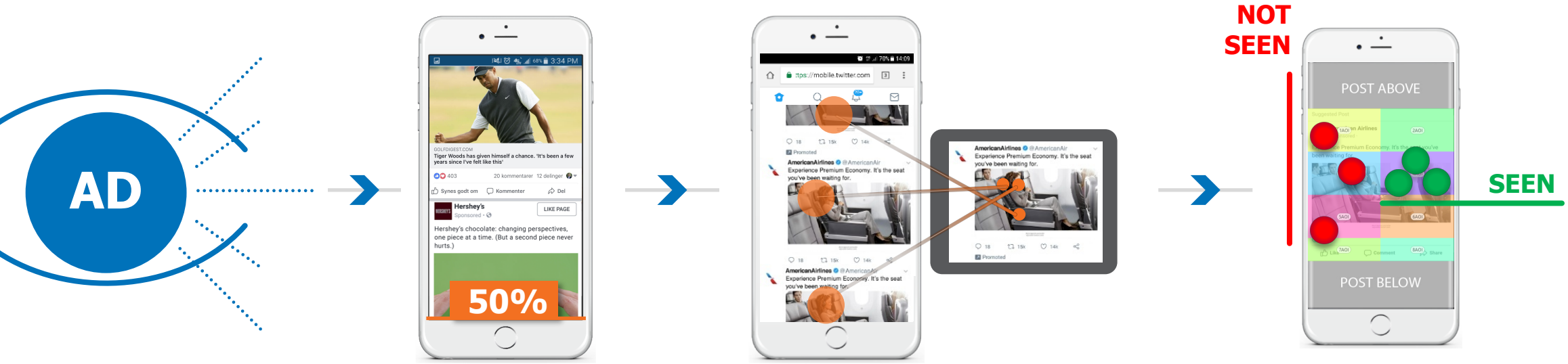
Our hypothesis was that these scores decline as durations increase. This is because once participants have enough time to see all the ad's details, they may shift their attention to something else.

## Stage 3 – Was the ad processed?


Here we look at **how long ads need to be shown to produce a subsequent recognition response**. We look at motivation and cognitive load responses to previously shown posts.

Our hypothesis was that emotion and cognition show significant changes for longer durations, thus following attention.

# How we **marked the ads**




When marking the phases for viewability, we marked from 50% in-screen to 50% out-of-screen.

In any given scrolling speed, the eye-tracking data was marked with a 20ms precision. For each ad, percentage seen was calculated as a minimum of three gaze points (60ms) per participant. However, fixation was not only marked for the ad's absolute position on the screen, but it followed the ad as it got scrolled through.

Therefore an ad which was shown with 100ms duration can have several eye-tracking data points.

When filtering if a post/ad was seen or not seen, we are testing if 3 gaze points of 20ms are within a certain area of the post.

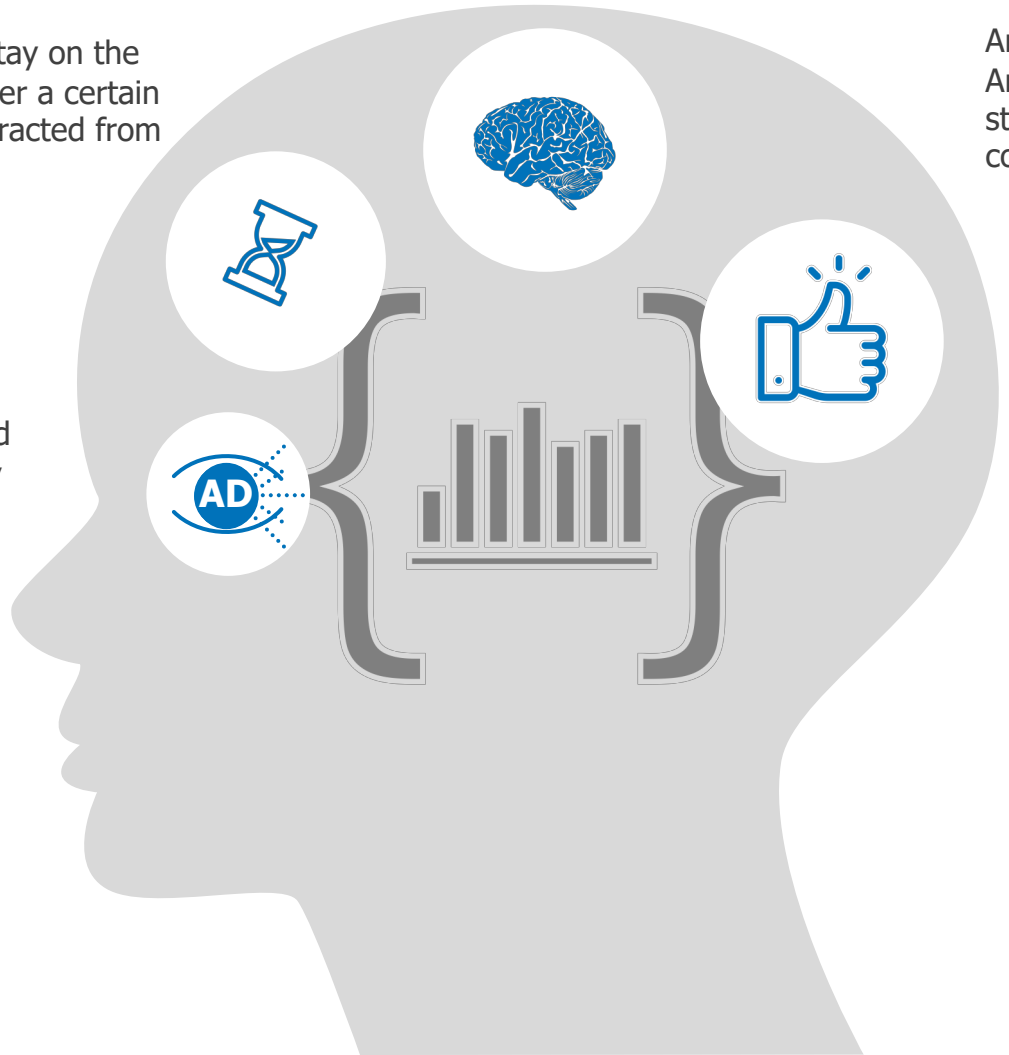
# The metrics

## RELATIVE TIME SPENT

How long do consumers stay on the ad? Do they look away after a certain period of time? This is extracted from the eye-tracker.

## PERCENTAGE SEEN

What are consumers seeing, and what are they missing? Are they distracted or focused? This is extracted from the eye-tracker.




## COGNITIVE LOAD

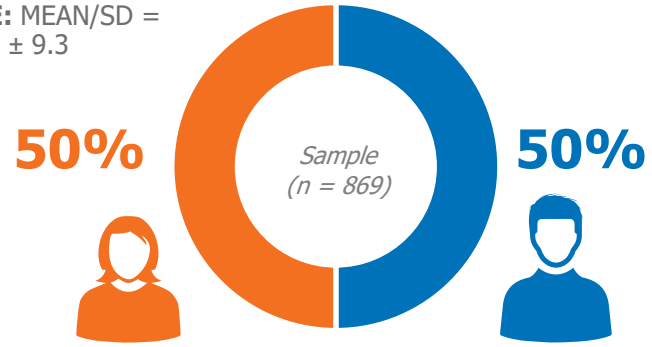
Are consumers processing the information given? Are they experiencing information overload and stress? This is a brain derived score predicting comprehension and learning.

## MOTIVATION

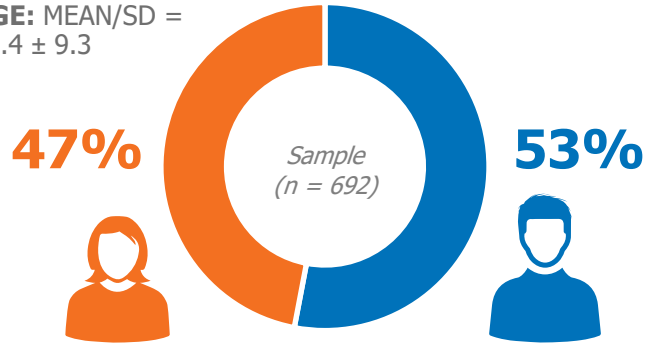
Do consumers display interest and desire? Are they motivated to approach or avoid? This is a brain derived score that is highly predictive of actual preference and choice.

# Study and Participant **details**

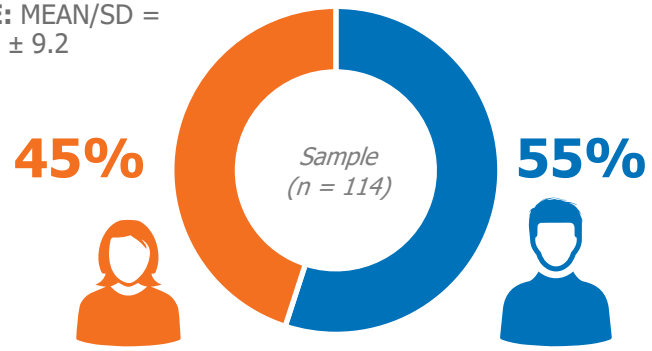
**Overall sample**
**AGE:** MEAN/SD = 35.5 ± 9.3



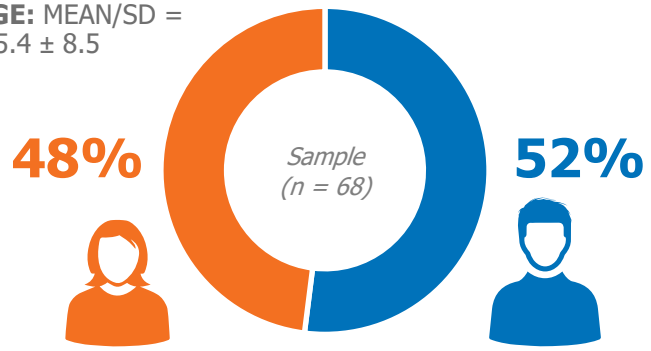

**Mobile**
**AGE:** MEAN/SD = 35.4 ± 9.3




**Desktop**
**AGE:** MEAN/SD = 36.4 ± 9.2




**Control Group**
**AGE:** MEAN/SD = 35.4 ± 8.5




## PROJECT MANAGEMENT

**Project Managers**

Dr. Thomas Z. Ramsøy

Mike Z. Storm

**Logistics & Fieldwork Management**

NEURONS INC

MEDIASCIENCE

## TEST VENUE:

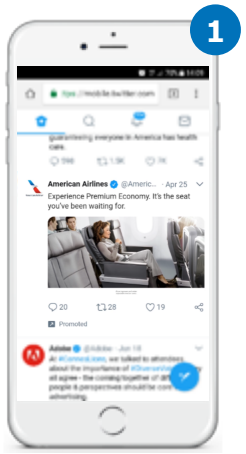
MediaScience
11904 N Interstate 35 Frontage Rd,
Austin, TX 78753, USA

**Fieldwork dates:**

03 April – 16 June 2018

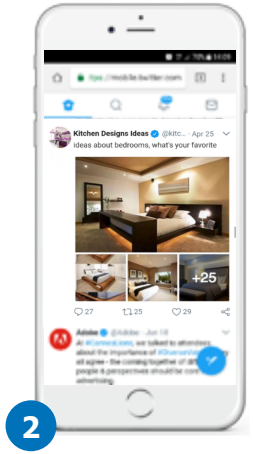
# Study **Stimuli**

Three types of contents were tested in this project. The material to which participants were exposed to comprised of:

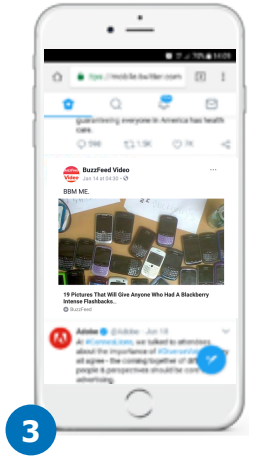



**Ads** – original ads shown in-feed, and which were the main target of the study. A representative sample of 24 ads was selected. To perform sub-analyses, the ads were further split into:

- High and low performance ads (54%/46%)*
- Ads featuring known and unknown brands (58%/42%)
- Static and video ads (50%/50%)




**Organic content** – this content was used as one type of control for the ad effects analyses.




**Fillers** – non-target ads were included in the analyses as a second control condition to which we compared ad responses to.

This setup allowed the assessment of both the main effect of duration on ad responses, but also to compare these responses to other types of contents, to assess whether ad responses were unique or followed a general response pattern to feed durations.



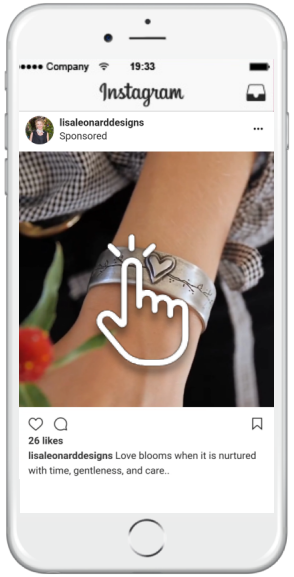
**"High performance" ads scored above average in recall studies. "Low performance" ads scored below average. Recall studies were conducted before this research, from other independent research providers. The MMA only had access to the groupings of these ads as high or low performance based on this definition*

# **Fixed** durations & **natural** condition

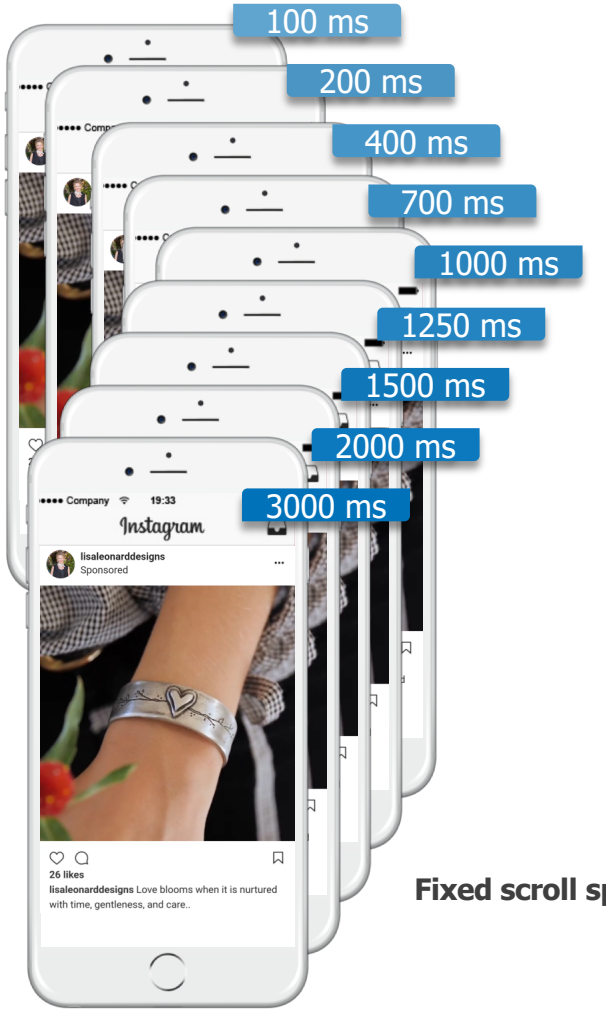
In this study, we have used a combined approach to study the effects of ad duration on cognition and opportunity to see.

To achieve optimal control over ad exposure durations, we have used fixed scroll speeds ranging from 100ms to 3000ms (see figure on right hand).

To test the ecological validity and relevance of the results from the fixed scroll speeds, we have used a natural scroll speed condition. Here, participants were free to scroll their social media feed at their own time. This state gives us information of what the normal range of ad durations that users are normally exposed to.




**Natural scroll speed**




**Fixed scroll speed**



*"High performance" ads scored above average in recall studies. "Low performance" ads scored below average. Recall studies were conducted before this research, from other independent research providers. The MMA only had access to the groupings of these ads as high or low performance based on this definition*

# The **groups** and **orders**

Participants experienced three main ad durations and one natural, self-paced mode. Each participant was pseudo-randomly assigned into one out of 12 possible groups, where the groups were constructed to ensure both a representative sample of each ad and ad duration, and to provide counterbalanced order effects.

The tested scroll speeds were 100ms, 200ms, 400ms, 700ms, 1000ms, 1250ms, 1500ms, 2000ms, 3000ms.

The 12 groups were exposed to a specific order and type of ad duration. This ensured that we could confidently draw conclusions regarding ad duration effects.

All participants always saw all 24 ads once (6 per speed), and they all went through the Natural exposure.




*"High performance" ads scored above average in recall studies. "Low performance" ads scored below average. Recall studies were conducted before this research, from other independent research providers. The MMA only had access to the groupings of these ads as high or low performance based on this definition

# Implicit Post Recognition **(IPR)**

The Neurons Implicit Post Recognition (IPR) test measures direct and subconscious emotional and cognitive responses to posts. During the task, participants were instructed to press a button every time the same picture was shown twice in a row.

**This is a distraction task used to keep participants engaged and focused on the task.** While the double exposure was excluded from the analysis, all other pictures were included as part of it.

In the analysis, a significant change in motivation and cognitive load scores compared to the control group is interpreted as indication of a post recognition. The assumption is that longer ad durations will lead to a stronger emotional and cognitive response, and therefore indicate what the critical ad duration should be to ensure that the ad has an impact.

The measured responses reflect deep emotional and cognitive structures of the brain that are not controlled by conscious thought, but still drive behavior.

Each time a post is shown, we measure the emotional and cognitive responses, and thereby calculate the subconscious post responses.

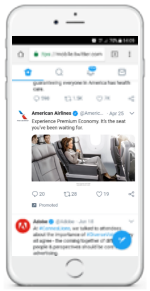
The implicit post recognition test is a reliable measure of subconscious responses to posts, much akin to standard post trackers of conscious thoughts and feelings to posts.

## Implicit post recognition test



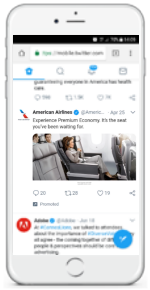

*"High performance" ads scored above average in recall studies. "Low performance" ads scored below average. Recall studies were conducted before this research, from other independent research providers. The MMA only had access to the groupings of these ads as high or low performance based on this definition

# The Participant Experience



Scroll Test 1 (100ms-3000ms or Natural)

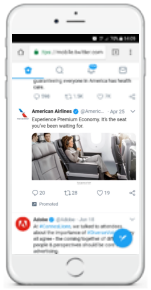

Implicit Post Recognition Test 1



Scroll Test 2 (100ms-3000ms or Natural)

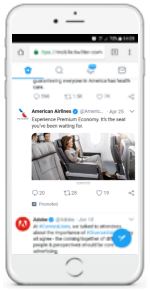

Implicit Post Recognition Test 2


Implicit Post Recognition Test 4



Scroll Test 4 (100ms-3000ms or Natural)


Implicit Post Recognition Test 3



Scroll Test 3 (100ms-3000ms or Natural)

# Taking vertical length into account to ensure valid results

To ensure that the content has the same premise of being attended to, the vertical length of the individual ads and organic posts (post to screen height ratio) are taken into account in the regression model that calculates the results.

In practice, the attention results are therefore corrected on the basis of the vertical lenght of the content. This means that a more horisontal ad is treated attentionally equal to a more vertical ad, and vice versa.

When taking size into account, we ensure that the vertical lenght of an ad is not driving any of the effects.

*When taking size into account for small, medium and large stimuli, we basically weigh the number of fixation with the size. Therefore a stimulus which is 2.5 times smaller than another would have the fixation amount times size difference.*

*DISCLAIMER: this is only an example and does not represent the exact statistical calculation for all 24 stimuli included in the study.*

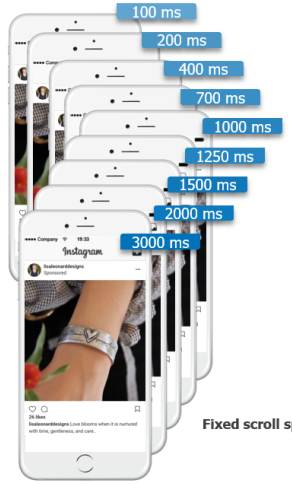
# Automated scroll speeds are comparable to natural exposure

To ensure the validity of the automated scroll speeds, the emotional and cognitive responses within each automated scroll speed is compared to the natural, corresponding ad response when viewers browse freely.

By categorizing natural ad exposures by time spent with the ad content and categorizing that into one of the given scroll speed categories by a margin of 100ms (50 ms for 100ms and 200ms), a comparison is made between natural and automated ad responses.

For the platform experience itself and the subsequent implicit recognition test, no significant differences are found for the various ad exposure speeds between automated scrolls and natural scrolls. This suggests the automated scroll speeds are comparable to natural exposure and thus translate into a real-life context.

Natural scroll speed




Fixed scroll speed

## Platform Experience

| | Motivation | | Cognitive Load | |
|---|---|---|---|---|
| **Duration** | **T** | **p** | **T** | **p** |
| 100 | 0.12 | 0.9067 | 0.50 | 0.6159 |
| 200 | 0.09 | 0.9271 | 0.68 | 0.4982 |
| 400 | 0.94 | 0.3457 | 0.98 | 0.3293 |
| 700 | 0.07 | 0.9453 | 1.16 | 0.2450 |
| 1000 | 0.06 | 0.9542 | 0.11 | 0.9121 |
| 1250 | 0.07 | 0.9405 | 0.33 | 0.7425 |
| 1500 | 0.19 | 0.8472 | 0.48 | 0.6310 |
| 2000 | 0.59 | 0.5564 | 0.47 | 0.6411 |
| 3000 | 0.57 | 0.5674 | 1.27 | 0.2041 |

## Implicit Recognition

| | Motivation | | Cognitive Load | |
|---|---|---|---|---|
| **Duration** | **T** | **p** | **T** | **p** |
| 100 | 0.22 | 0.8259 | 0.69 | 0.4921 |
| 200 | 0.16 | 0.8744 | 0.67 | 0.5022 |
| 400 | 0.05 | 0.9621 | 0.55 | 0.5802 |
| 700 | 1.46 | 0.1430 | 0.003 | 0.9979 |
| 1000 | 0.57 | 0.5713 | 0.69 | 0.4924 |
| 1250 | 1.50 | 0.1326 | 1.52 | 0.1279 |
| 1500 | 0.67 | 0.4999 | 0.17 | 0.8689 |
| 2000 | 0.04 | 0.9679 | 0.37 | 0.7110 |
| 3000 | 2.20 | 0.0283* | 0.59 | 0.5567 |

*When correcting this test for multiple comparisons (Bonferroni correction) this test is no longer significant.

# Automated scroll speeds are comparable to natural exposure

1. **Cognition is fast:** The human brain needs less than ½ second to engage with mobile advertising & trigger a reaction, *positive or negative.*
2. **Time is relative:** Ads in a mobile feed environment get attention faster and trigger stronger cognition, compared to desktop.
3. **Our Brain is faster on Branding:** Cognitive process is accelerated for known brands. This may have negative implications for well-known, not well-liked brands.
4. **Video engages the emotional Brain:** Video ads create emotional response earlier than static, in under a second.
5. **Weak ads work fast:** Weak ads are processed faster and create negative responses in less than a second.

Attention grabbing happens at 400 ms

Higher % seen for mobile ads in all durations vs desktop

Cognitive recognition happens at 400ms and almost all ads are cognitively recognized at 1250ms

Desktop ads never reach full cognitive recognition

# **STAGE 1 –** Percentage of ads seen

**Percentage seen** denotes the percentage of people that have a minimum of three gaze points (60ms) on an ad in a given ad duration.

For instance, 20% of people saw the ad shown. Using the metric in conjunction with the relative time spent, allows you to see how these participants' attention was drawn and maintained. The metric helps to highlight what is seen but also missed.

# Percentage seen is significantly higher already at 400ms

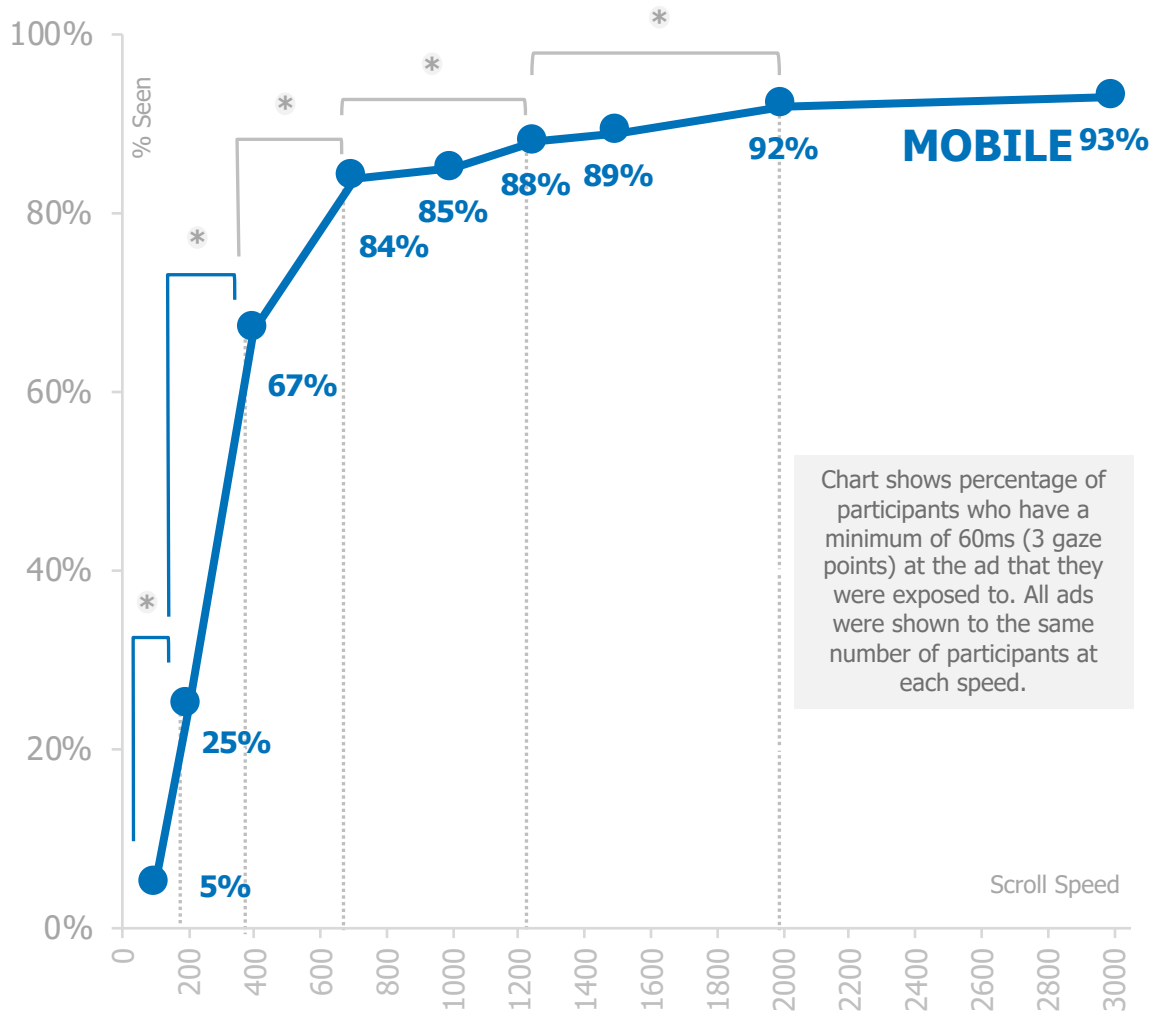
Initially, we are examining the effects of ad duration on the likelihood that the ad post will be seen on a mobile platform.

The largest change in attentional responses of percentage seen is from 5% at 100 ms to 67% at 400 ms speed. This is a substantial change, suggesting that at already at 400 ms of ad exposure, viewers are beginning to follow the contents of the ad.

There are significant incremental changes until 700ms, where the trend flattens out around 85%. Only around 1250 and 2000ms there are again significant shifts in attention.

This shows that most changes in the opportunity to see happen within two seconds of ad exposure.

| Duration | T | p | df |
|---|---|---|---|
| 100 – 200 | 13.99 | <.0001 | 458 |
| 200 – 400 | 29.89 | <.0001 | 460 |
| 400 – 700 | 11.85 | <.0001 | 456 |
| 700 – 1250 | 3.06 | 0.0024 | 455 |
| 1250 – 2000 | 2.51 | 0.0126 | 449 |




*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between duration points.*

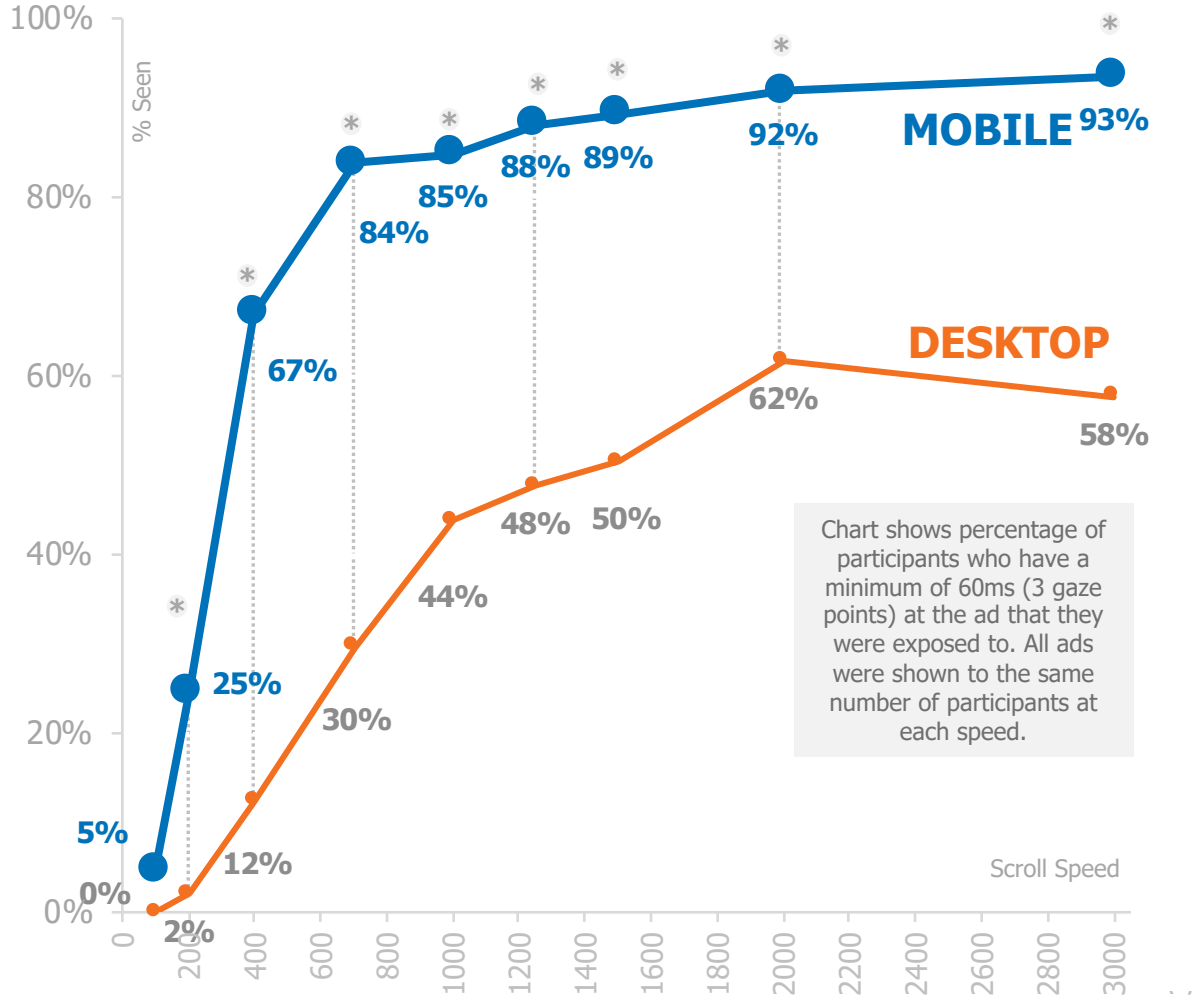
** = significant at p<0.05*

# Substantially more viewers see ads on mobile

Comparing visual attention in terms of percentage seen across mobile and desktop platforms, the results show that mobile is superior at generating attention across all measured scroll speeds.

This dramatic difference may be due to a difference in screen size, in that a mobile screen has less space in which content can be presented, and the desktop can have more distracting materials within the screen.

| Duration | T | p | df |
|---|---|---|---|
| 200 | 7.46 | <.0001 | 272 |
| 400 | 18.18 | <.0001 | 266 |
| 700 | 17.76 | <.0001 | 268 |
| 1000 | 13.85 | <.0001 | 268 |
| 1250 | 13.55 | <.0001 | 265 |
| 1500 | 12.98 | <.0001 | 267 |
| 2000 | 9.74 | <.0001 | 261 |
| 3000 | 12.05 | <.0001 | 265 |




*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

** = significant at p<0.05*

# Video ads and static ads perform equally on attention

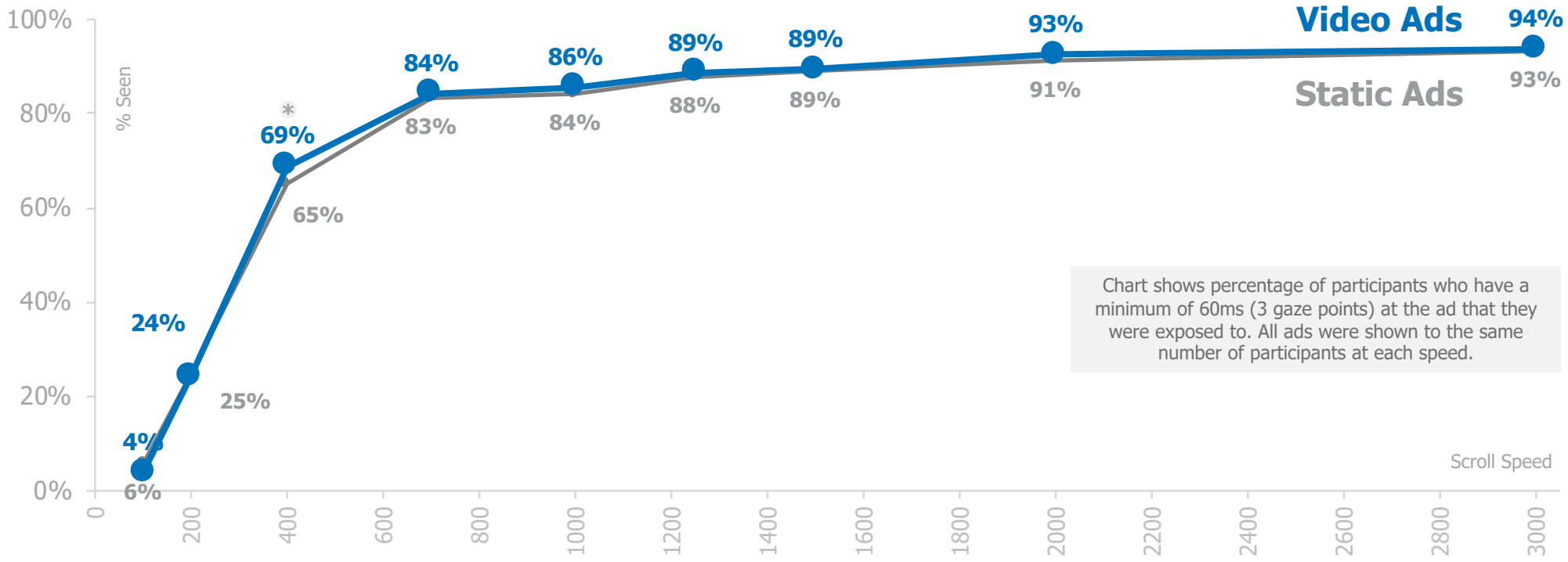



Chart shows percentage of participants who have a minimum of 60ms (3 gaze points) at the ad that they were exposed to. All ads were shown to the same number of participants at each speed.

Video ads show a strong attentional response that is significantly higher for percentage seen at 400ms. This suggests that video ads can attract quicker attention at lower speeds. This is the only occasion meaning static and video ads performs equally.

| Duration | T | p | df |
|---|---|---|---|
| 400 | 4.89 | 0.0271 | 455 |

*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

** = significant at p<0.05*

# No difference in percentage seen for known and unknown brands

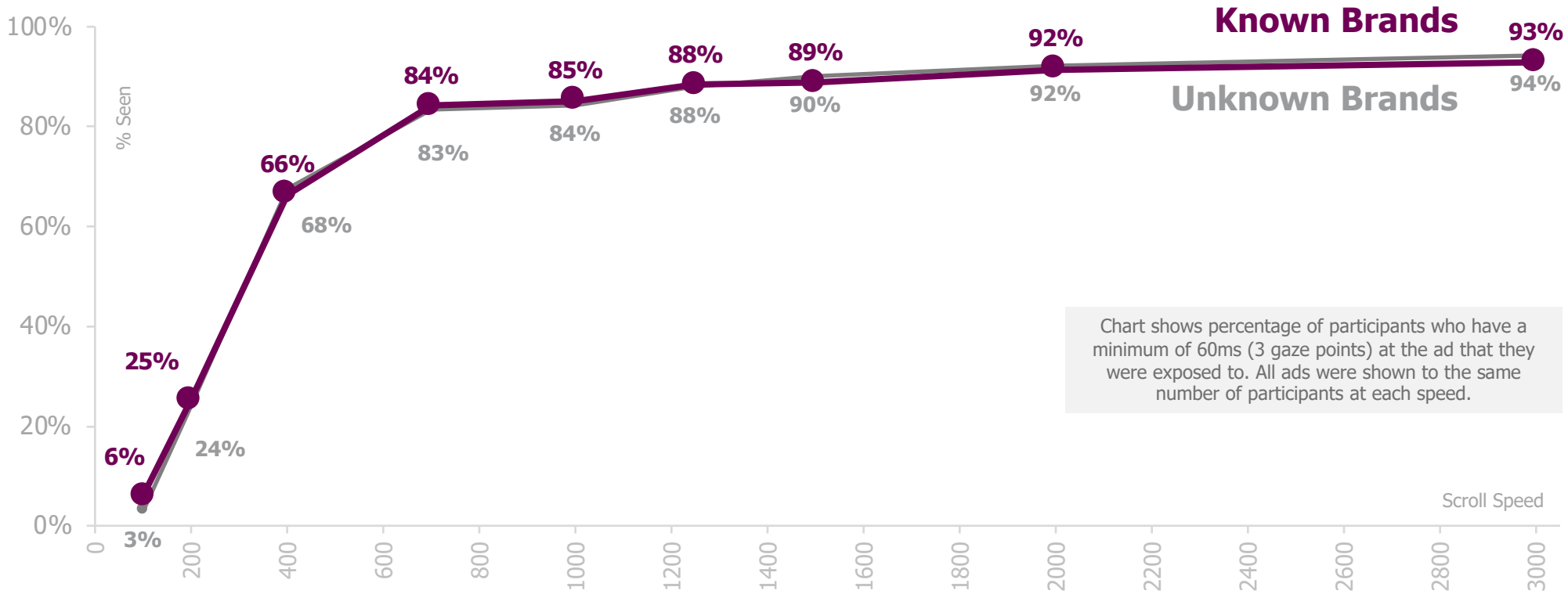



Chart shows percentage of participants who have a minimum of 60ms (3 gaze points) at the ad that they were exposed to. All ads were shown to the same number of participants at each speed.

We do not find any differences between unknown and known brands in %seen when looking across the whole ad post.

This effect can be due to the fact that people are asked to pay attention to the screen and that the post in most cases fill out the whole screen.

| Duration | T | p | df |
|---|---|---|---|

*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

** = significant at p<0.05*

# High and low performance ads show equal attention

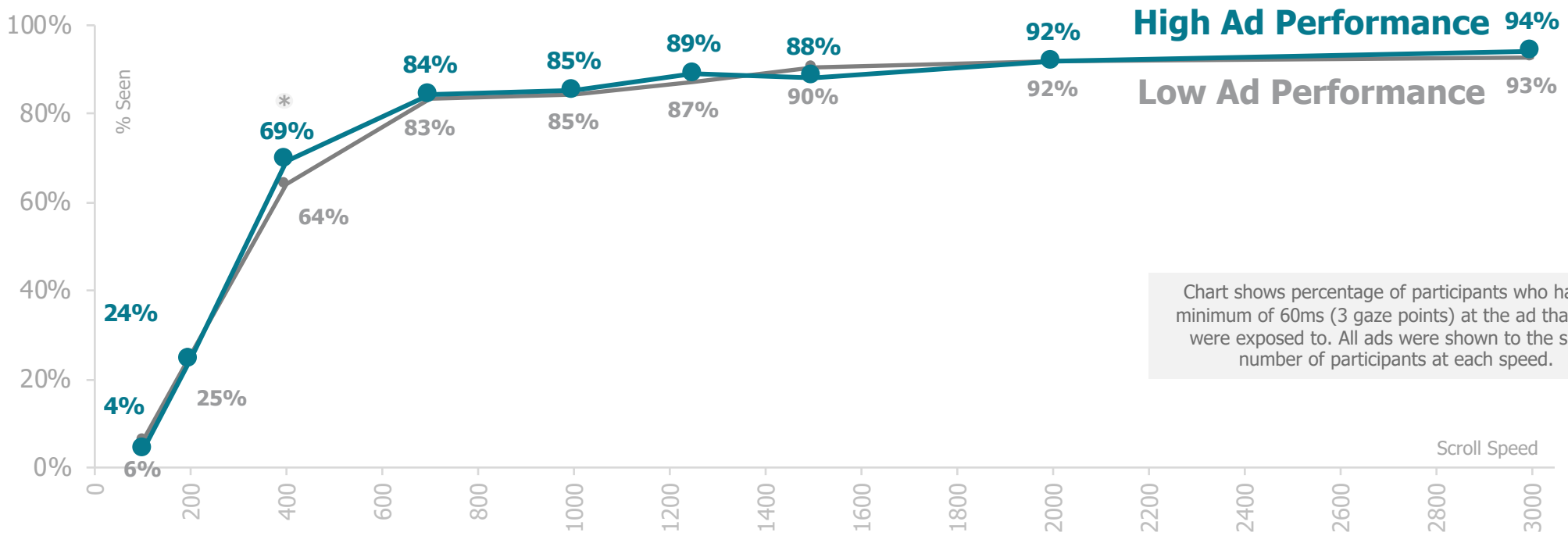



Chart shows percentage of participants who have a minimum of 60ms (3 gaze points) at the ad that they were exposed to. All ads were shown to the same number of participants at each speed.

At 400ms, high performance ads are more prone to grab attention than low performance ads. However, this difference is quickly eliminated at slower and faster scroll speeds, where the two categories of ads show similar performance.

| Duration | T | p | df |
|---|---|---|---|
| 400 | 2.82 | 0.0051 | 455 |

*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

** = significant at p<0.05*

# Ads and organics capture attention similarly

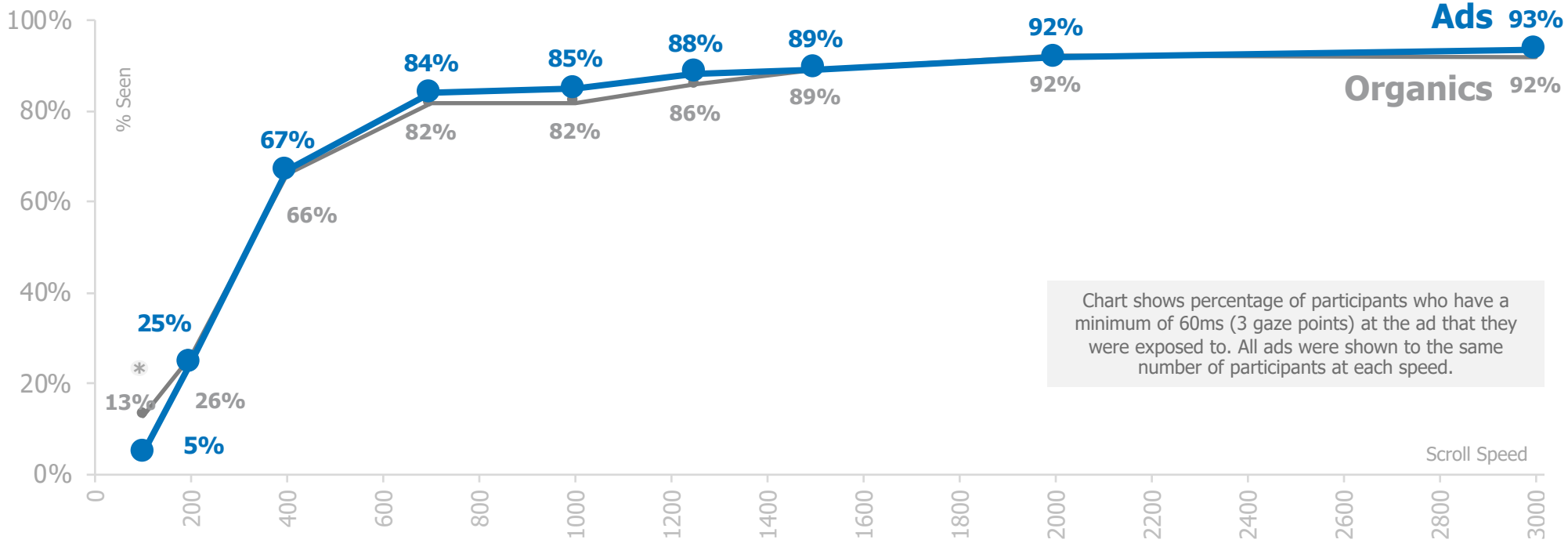



Chart shows percentage of participants who have a minimum of 60ms (3 gaze points) at the ad that they were exposed to. All ads were shown to the same number of participants at each speed.

Already at 100ms, organic posts show a significantly higher percentage seen than ad content. This means that organic can be better at grabbing attention than ad contents at very fast speeds.

However from 100ms and up, ads and organics show a comparable ability to grab attention.

| Duration | T | p | df |
|---|---|---|---|
| 100 | 4.75 | <.0001 | 451 |

*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

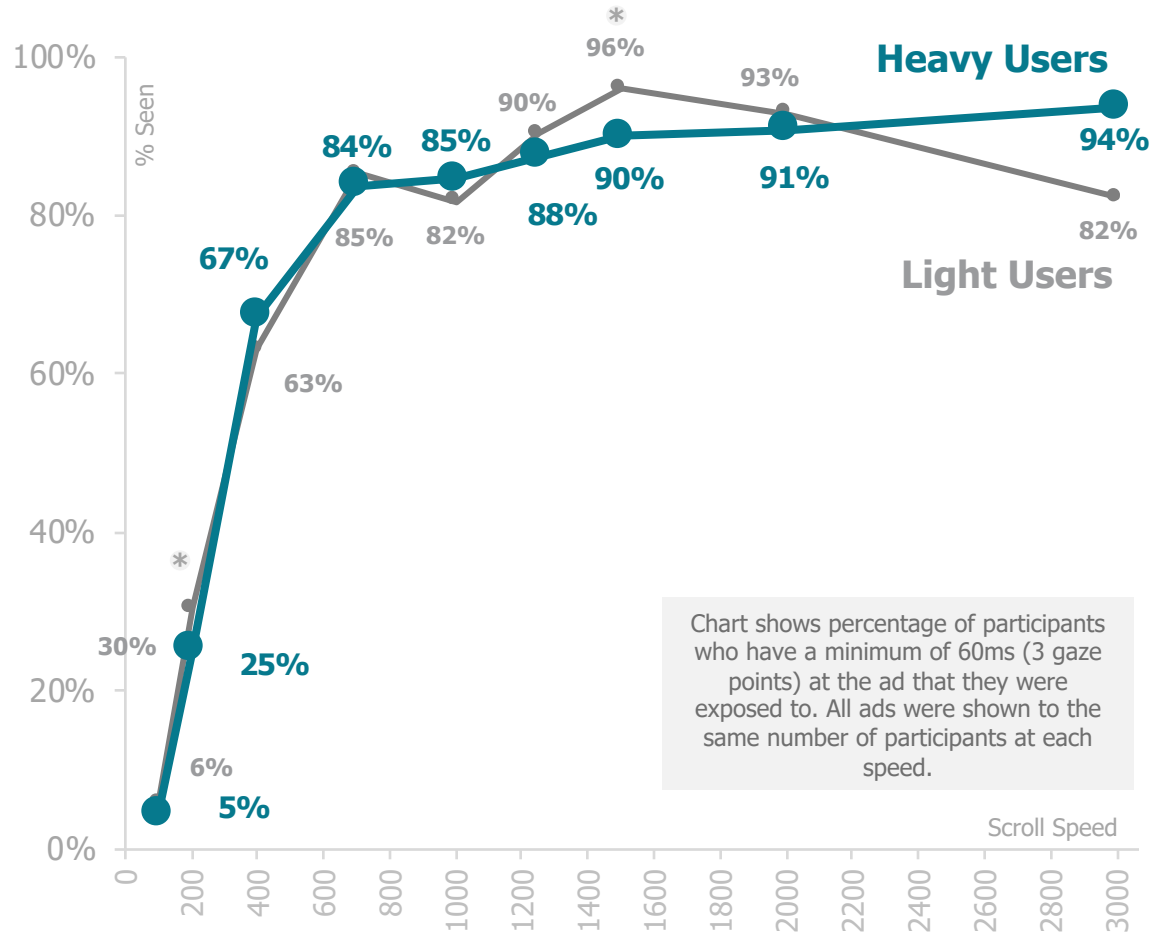
** = significant at p<0.05*

# Heavy and light users fluctuate as speed changes

When comparing light users to heavy users, the former show a significantly greater ability to spot ads at fast (200ms) and medium (1500ms) scroll speeds. Interestingly after 1500ms, light users start to drop off and are likely drawn towards other content. At 3000ms, heavy users are significantly more prone to see ads.

This suggests that light users have faster attention to ad content at fast speeds, an effect that is likely driven by their experience with the given platform. However at slower speeds, attention of heavy users is almost garanteed.

| Duration | T | P | df |
|---|---|---|---|
| 200 | 13.99 | <.0001 | 458 |
| 1500 | 29.89 | <.0001 | 460 |
| 3000 | 11.85 | <.0001 | 456 |



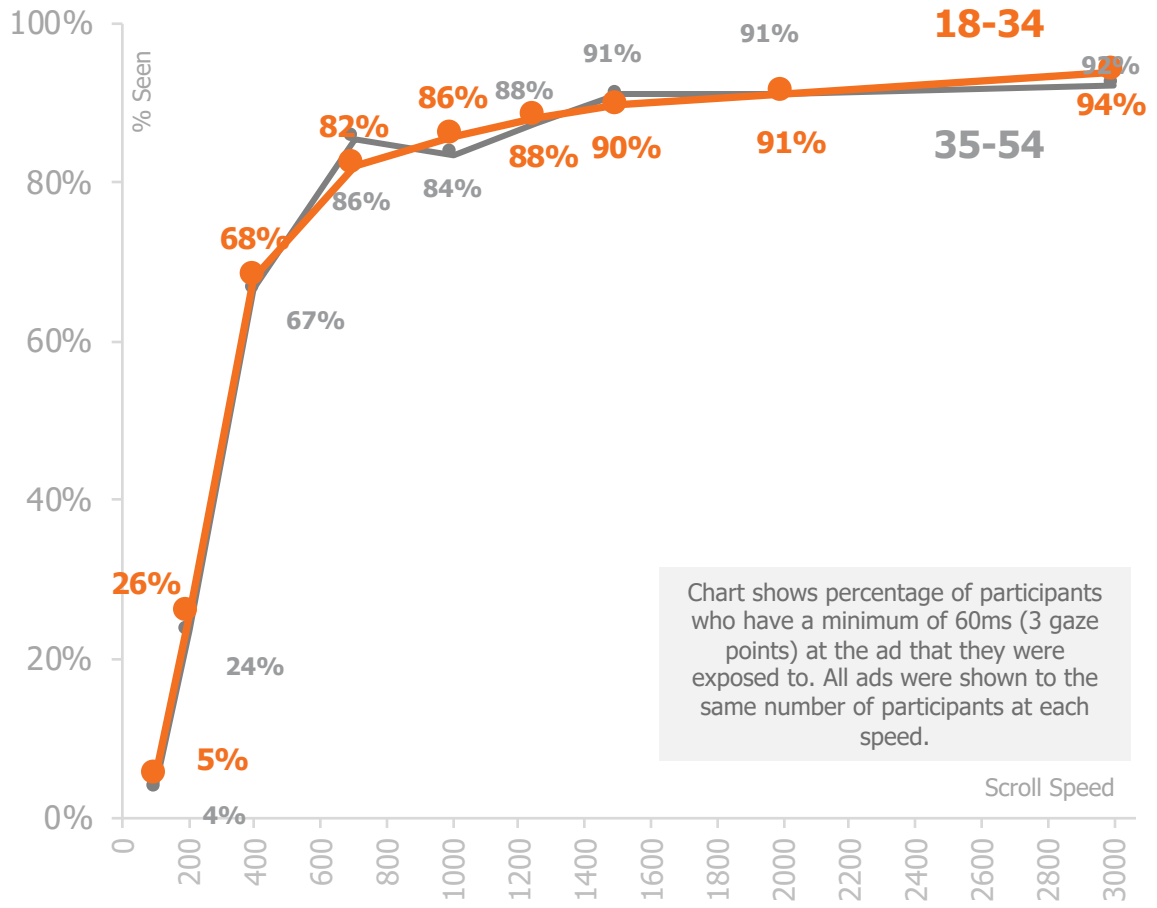

*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

** = significant at p<0.05*

# Age groups show comparable attention to ads over time

When looking at the ad post and % seen we find no significant differences between the younger age group (aged 18-34) and the older age group (aged 35-54). This suggests that attention to ads is comparable for the age groups across the different scroll speeds.

| Duration | T | p | df |
|---|---|---|---|
| | | | |
| | | | |
| | | | |




*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between age groups at duration points.*

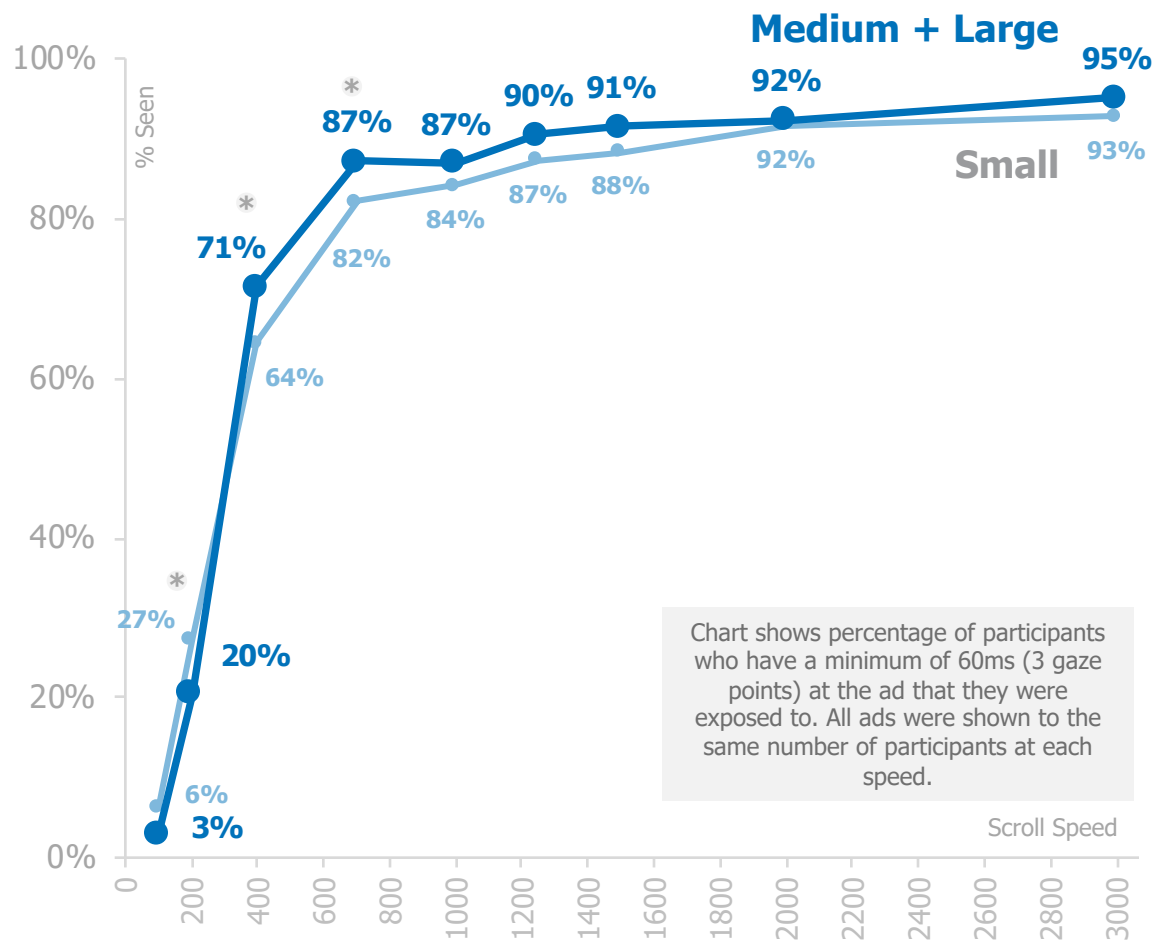
** = significant at p<0.05*

# Ad size determines attention at fast speeds

When comparing different ad sizes, ads that are squared (medium) and more vertical than horisontal (large) show better ability to capture attention at fast speeds such as 400 ms and 700ns, compared to ads that are more horisontal than vertical (small). Yet small ads are better at capturing attention at 200ms.

This suggests that the ads ability to take up screen space significantly influences the ability to grab attention, especially at fast scroll speeds.

| Duration | T | p | df |
|---|---|---|---|
| 200 | 3.05 | 0.0024 | 458 |
| 400 | 3.08 | 0.0022 | 449 |
| 700 | 2.12 | 0.0350 | 439 |




*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

** = significant at p<0.05*

# Ad size determines attention at fast speeds

When comparing different ad sizes, ads that are squared (medium) and more vertical than horizontal (large) show better ability to capture attention at fast speeds such as 400 ms and 700ns, compared to ads that are more horizontal than vertical (small).

This suggests that the ads ability to take up screen space significantly influences the ability to grab attention, especially at fast scroll speeds.

(Results not corrected for post to screen height ratio)

| Duration | T | p | df |
|---|---|---|---|
| 400 | 4.29 | <.0001 | 449 |
| 700 | 2.24 | 0.0253 | 439 |
| 1000 | 3.36 | 0.0009 | 440 |
| 1250 | 3.41 | 0.0007 | 436 |
| 1500 | 3 | 0.0028 | 439 |
| 3000 | 2.71 | 0.007 | 448 |

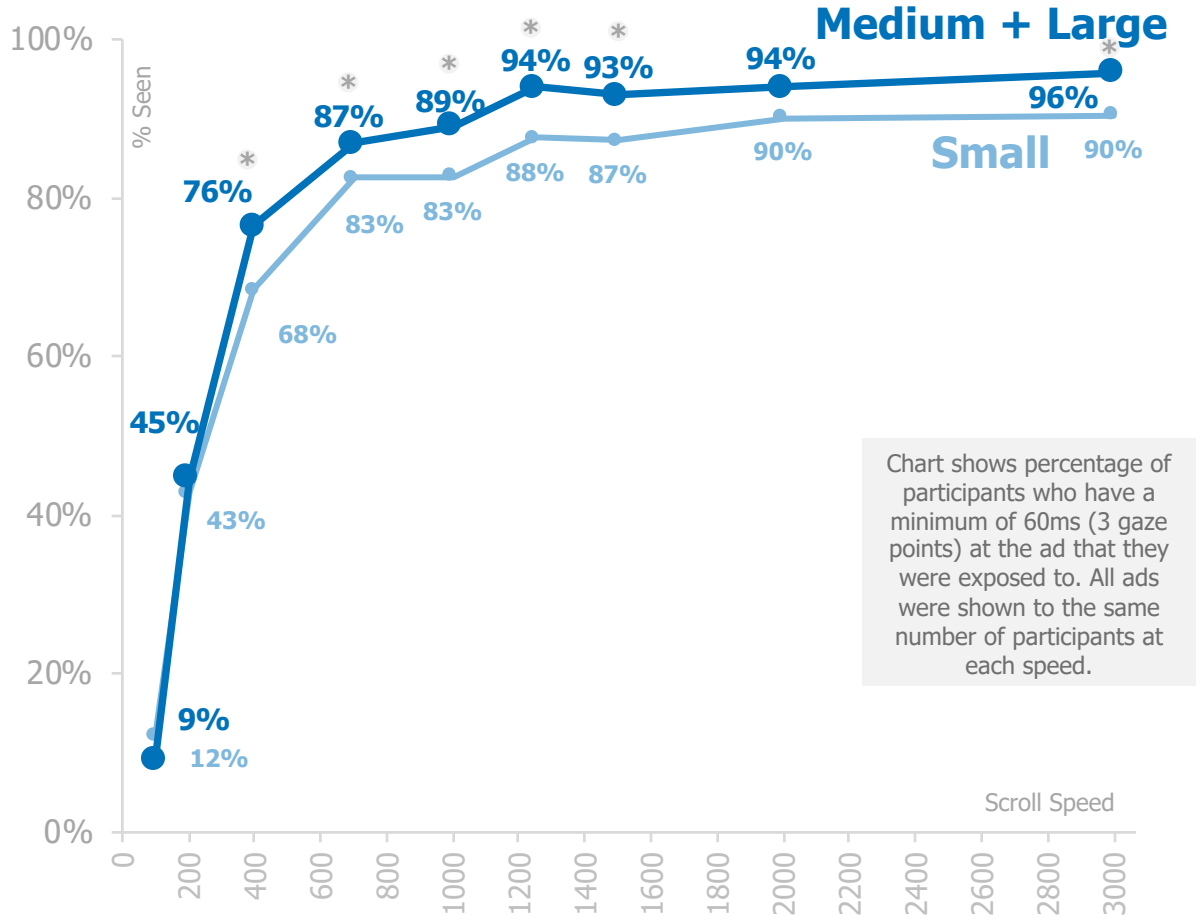



Chart shows percentage of participants who have a minimum of 60ms (3 gaze points) at the ad that they were exposed to. All ads were shown to the same number of participants at each speed.

*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

** = significant at p<0.05*

# STAGE 2 –
# Relative time spent

**Relative time spent** quantifies the amount of time spent, expressed as a percentage, actively attending to a particular area or object relative to how long it is shown on the screen.

Research has shown that time spent attending to an object may be related to higher levels of emotional and cognitive responses.

# Relative time spent to ads declines with availability

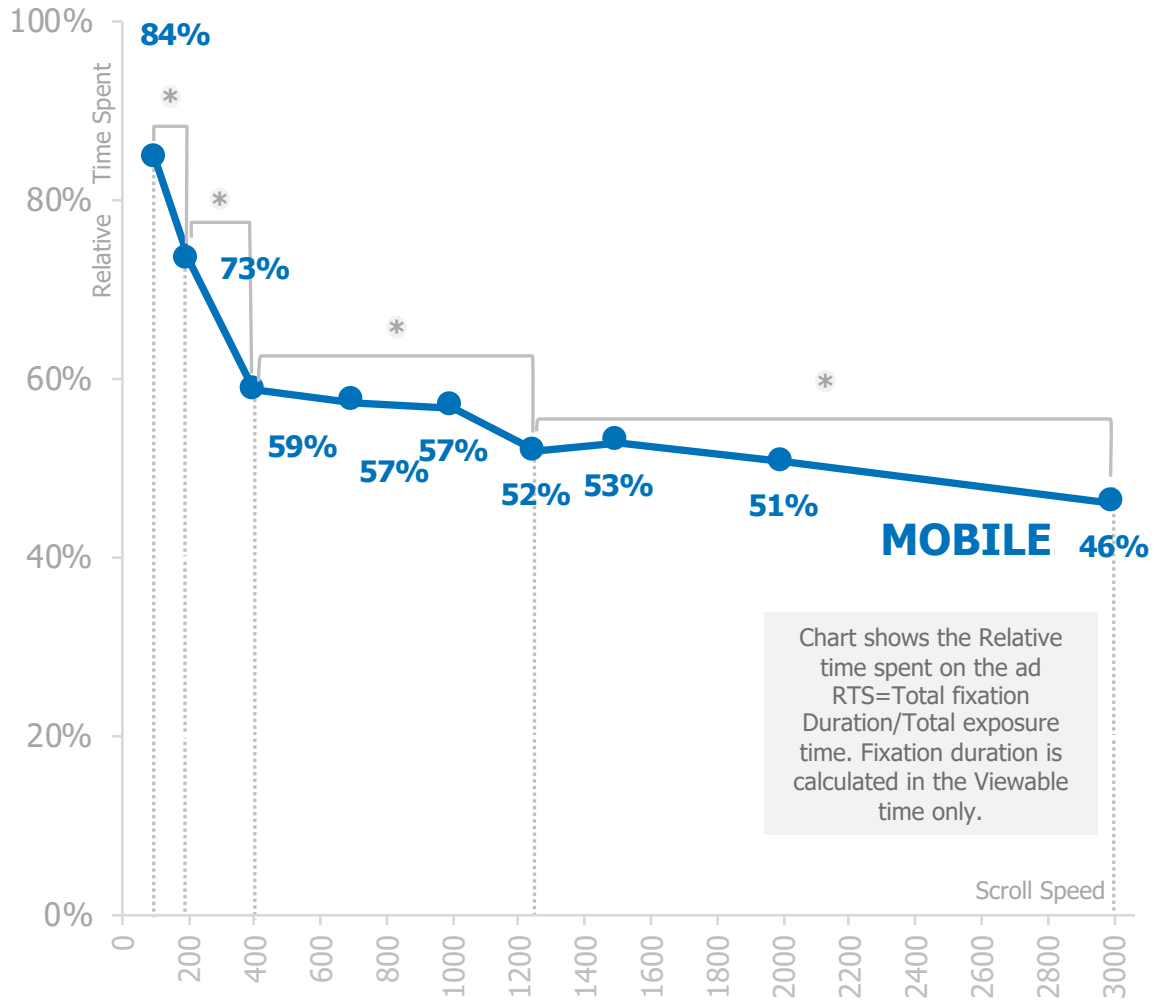
Considering the relative time that viewers spend with ad posts across different speeds of ad post presentation, we find a significant decline with availability.

These results demonstrate that people do not need the full ad post time to process the information before they jump to the next post. Although the results between individual speeds are significant, the sheer percentage remains within 84-46% of the ad post exposure.

Thus, for ads being shown as long as 3000 ms, the ad post is seen for 46% of that duration. This means that even though an ad post is available for 3 seconds, it is attended to less than half the time available, suggesting that ad posts do not need long time to have the opportunity to be seen.

Most ad post responses within one and a half second will be mainly to attentional and emotional responses.

| Duration | T | p | df |
|---|---|---|---|
| 100 – 200 | 4.34 | <.0001 | 225 |
| 200 – 400 | 11.45 | <.0001 | 399 |
| 400 – 1250 | 7.07 | <.0001 | 444 |
| 1250 – 3000 | 6.54 | <.0001 | 448 |



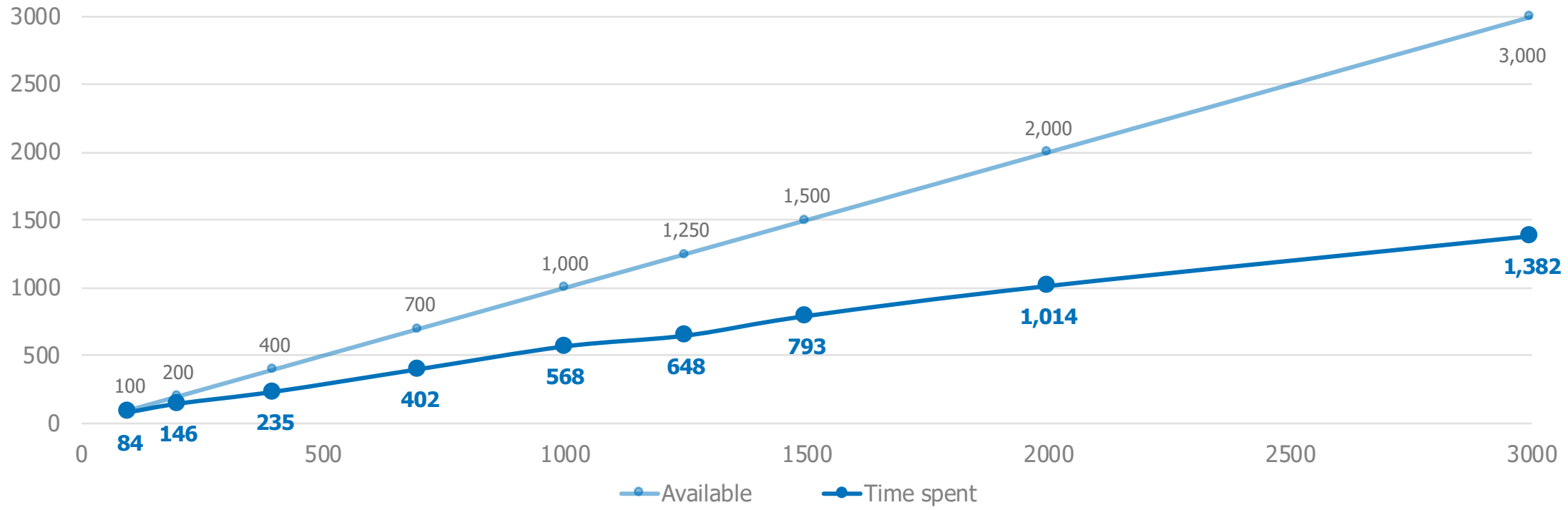

*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between duration points.*

** = significant at p<0.05*

# Time spent compared to available time

When comparing the available time to the actual time spent we find that people do not spent all of the time available. This is most likely due to other posts drawing attention, but also because people have seen and responded to the ads already at fast speeds. It seems that around 700-1000ms the trendline starts dropping and people spend less time with the ads compared to how long they are available.

People spent less than 1500ms with ads even when they are available for 3000ms.



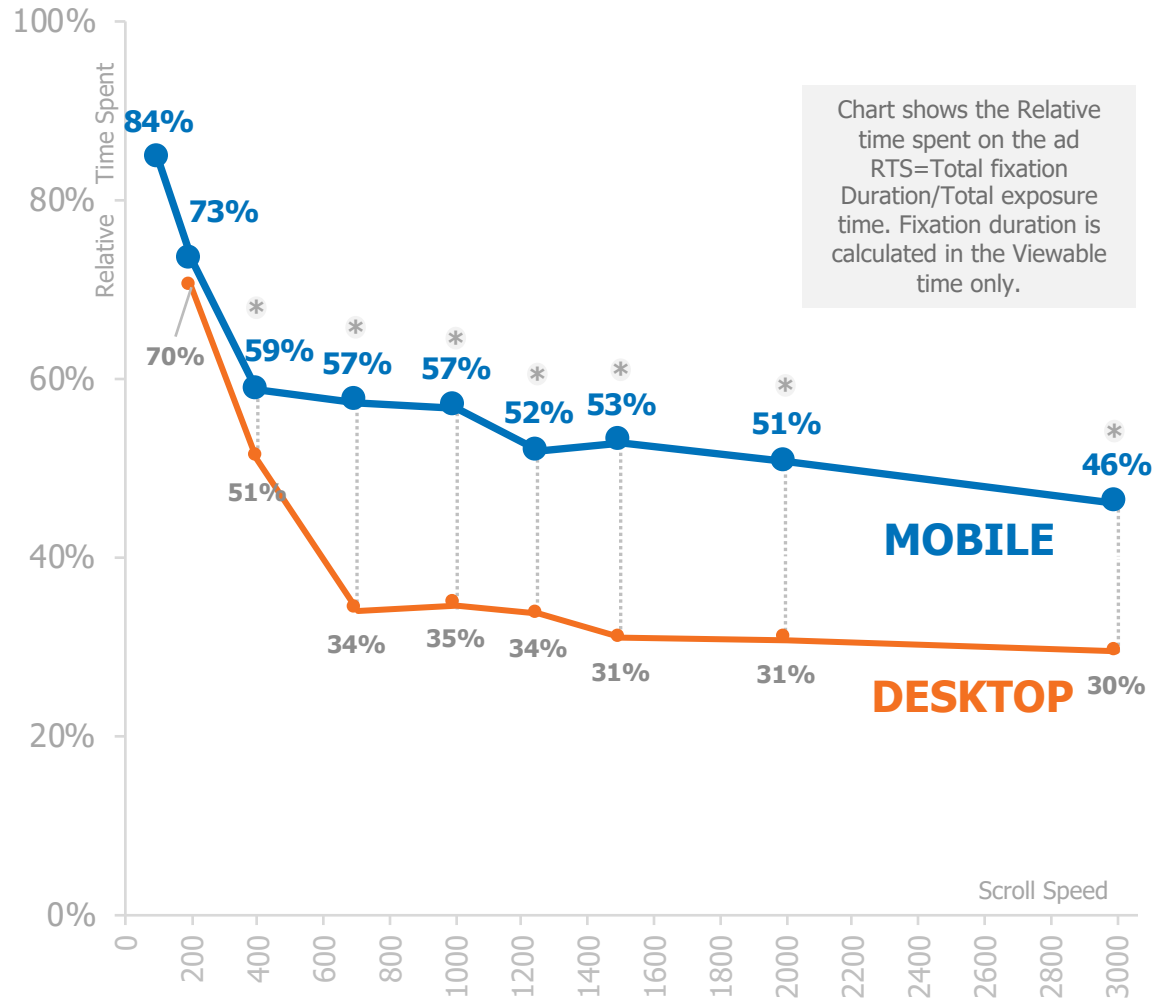
# Viewers spend more time with mobile ads in the long run

For people who pay attention to the ads in both mobile and desktop environments we see a greater drop in attention on Desktop. This suggests that people leave the unit for other information. In mobile we are seeing that ad posts sustains attention much longer giving people the option to both process and understand the content.

Given that relatively few viewers pay attention to desktop ad posts during 400-3000ms compared to mobile ad posts, the viewers that do pay attention is assumed to inherently have same interest in the ad post, thus spending some time with it.

As ad presentation time increases, mobile ads become more interesting. This suggests that mobile ads are not only better at grabbing attention than desktop, but also better at sustaining attention in the long run.

| Duration | T | p | df |
|---|---|---|---|
| 400 | 2.07 | 0.0393 | 238 |
| 700 | 9.18 | <.0001 | 255 |
| 1000 | 10.36 | <.0001 | 255 |
| 1250 | 8.78 | <.0001 | 258 |
| 1500 | 10.65 | <.0001 | 261 |
| 2000 | 10.13 | <.0001 | 256 |
| 3000 | 8.56 | <.0001 | 263 |



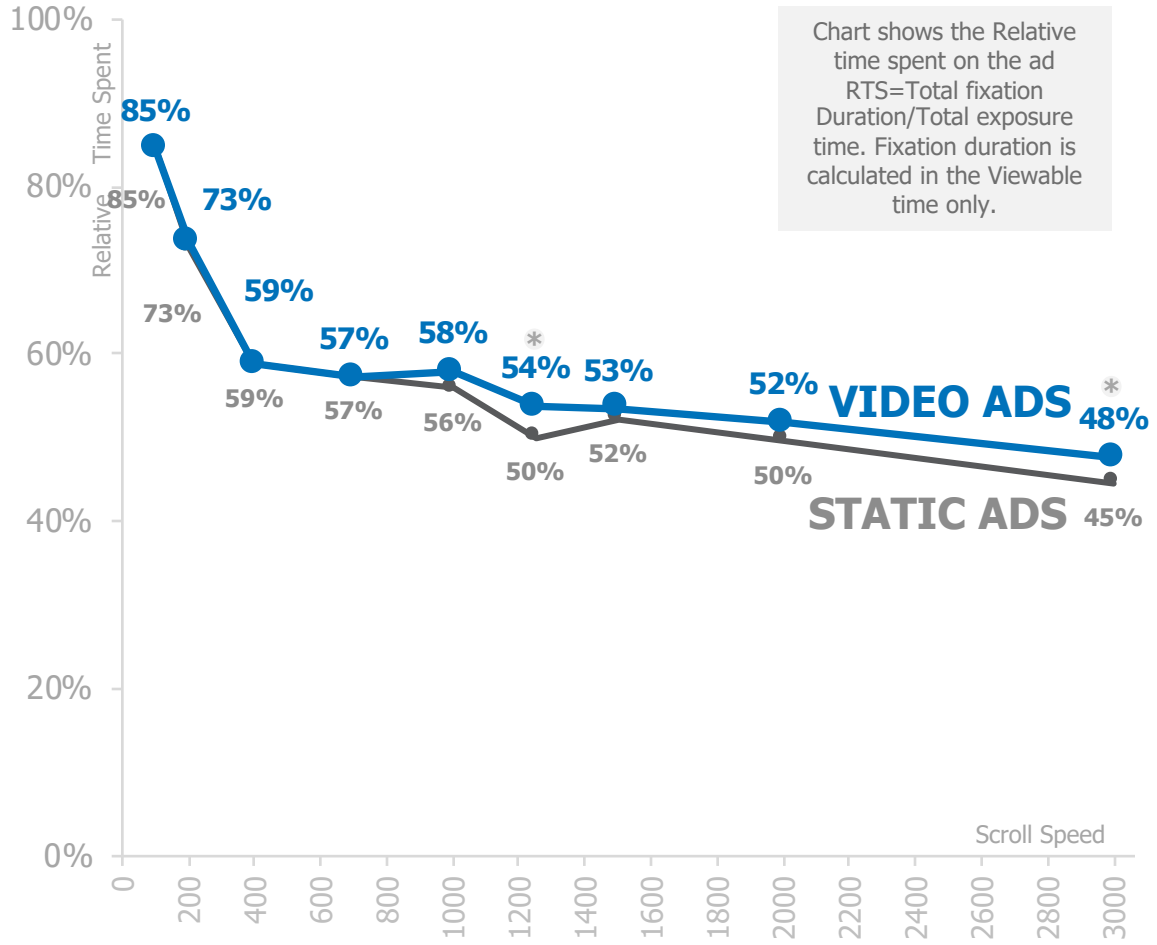

*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points*

** = significant at p<0.05*

# Video ads and static ads have similar sustained attention

Comparing static and videos ads on relative time spent, we see that video ads are generally slightly more sustaining and significantly more at 1250ms and 3000ms. Even though we see these differences, we would say that the attention is very similar.

| Duration | T | p | df |
|---|---|---|---|
| 1250 | 3.16 | 0.0017 | 438 |
| 3000 | 2.71 | 0.0069 | 447 |




*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points*

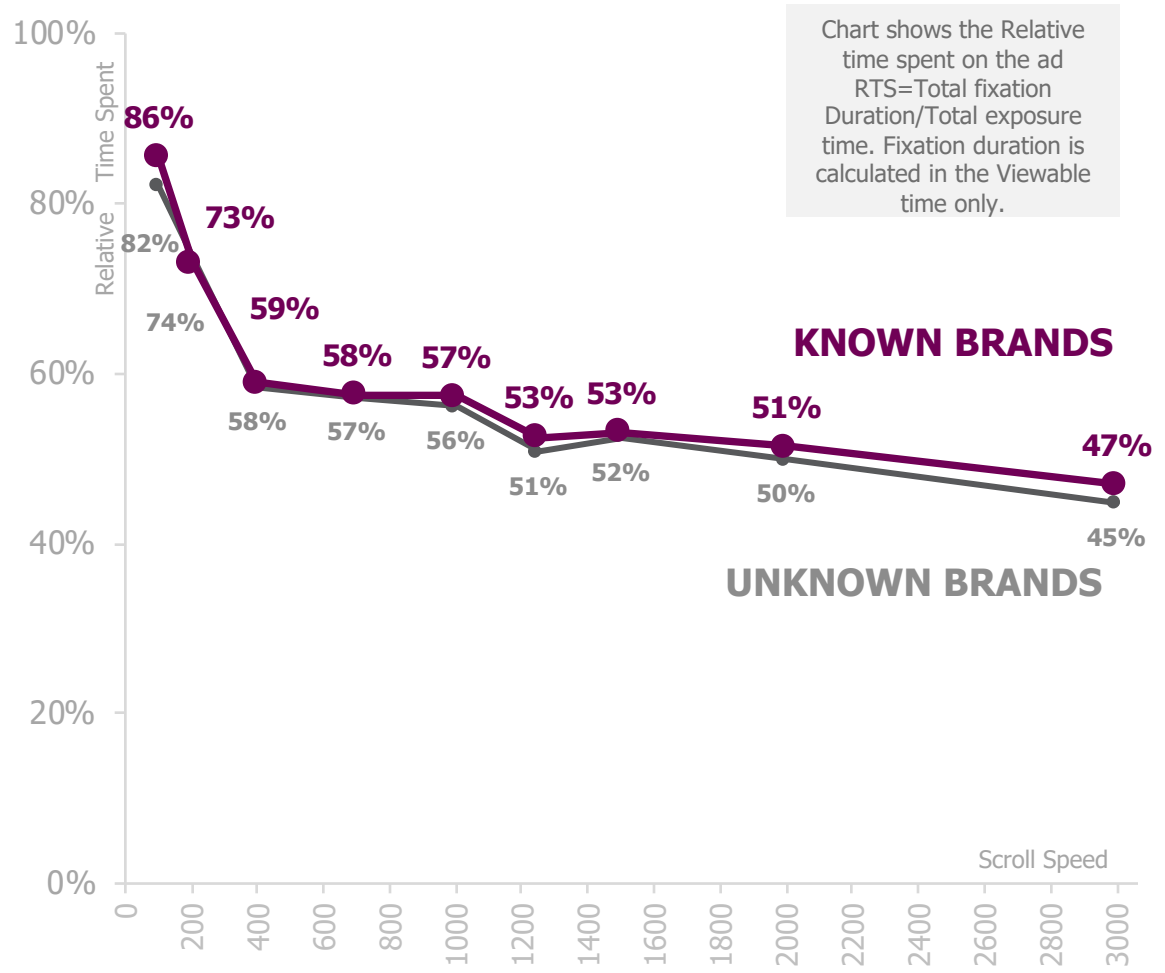
** = significant at p<0.05*

# Users spend equal time with known and unknown brands

Across the different scroll speeds tested, no significant differences are found for relative time spent with ads across known and unknown brands. This suggests that their ability to maintain attention is comparable.

The effects are likely driven by an interaction between a familiarity effect and a novelty effect. Users attend to unknown brands because a novelty effect is triggering a sense of curiosity. At the same time, users require some time for mental categorization of the new input. For known brands, a familiarity effects may influence users to stay more with the content, since most people have an inherent preference for something that they are slightly more familiar with.

| Duration | T | p |
|---|---|---|
| | | |




*Degrees of freedom (DF) = 17*
*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points*

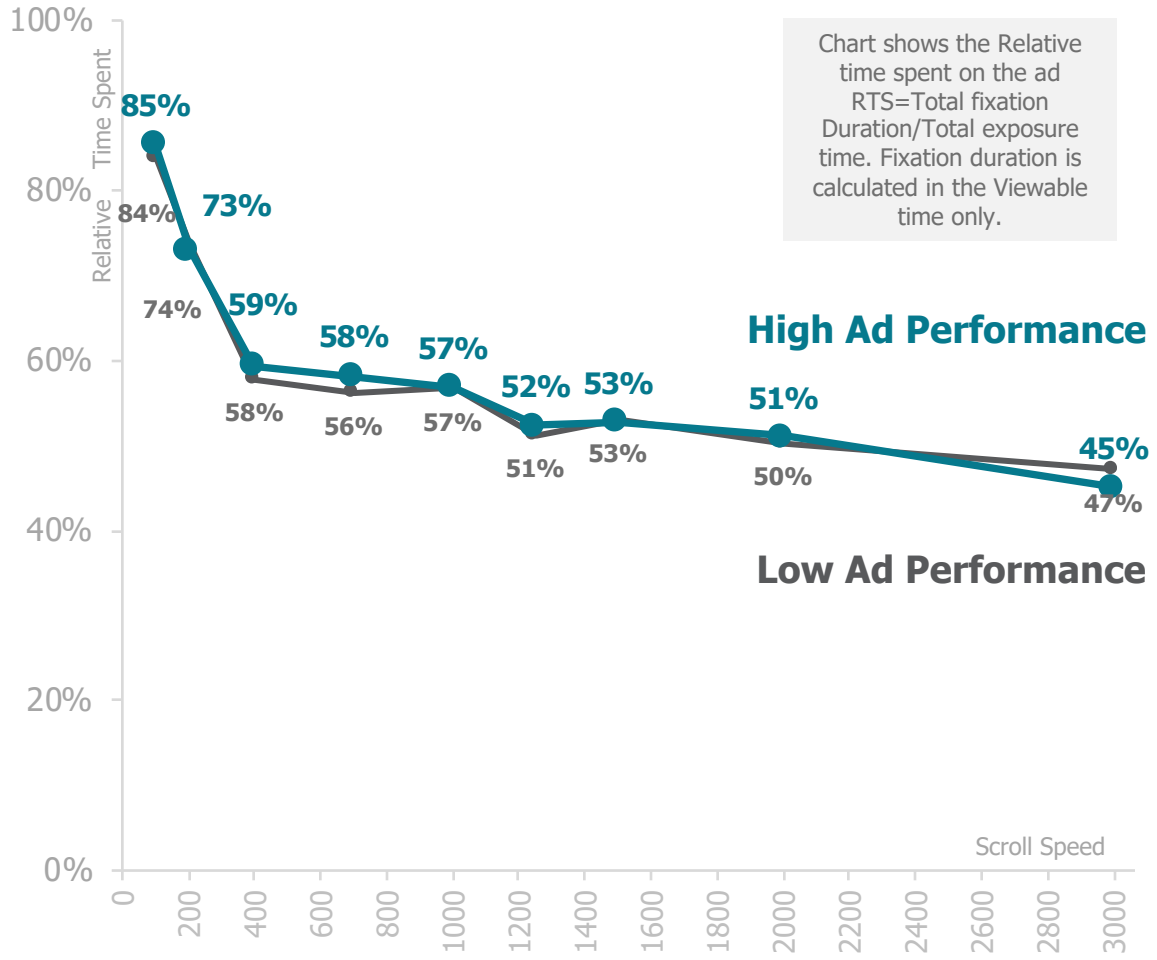
** = significant at p<0.05*

# Viewers spend comparable time across ad performance

Comparing low and high performance ads, the results demonstrate that although high performance ads are able to grab early attention, they show comparable ability to maintain attention as low performance ads.

This suggests that while high performance ads may be successful due to high visual saliency, leading to a strong chance of being seen, their ability to maintain attention is comparable to low performing ads.

| Duration | T | p |
|---|---|---|
| | | |




*Degrees of freedom (DF) = 17*
*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

** = significant at p<0.05*

# Comparable relative time is spent with ads and organics

When looking across all platforms and comparing ad content with organic content, the results show that these two types of content largely performs equally on measures of relative time spent.

The only significant difference is found at 100ms and suggests that ads are better at capturing attention at ultra fast exposures. Yet at slower speeds above 100ms, the two types of content performs similarly.

| Duration | T | p | df |
|---|---|---|---|
| 100 | 2.36 | 0.0204 | 94 |

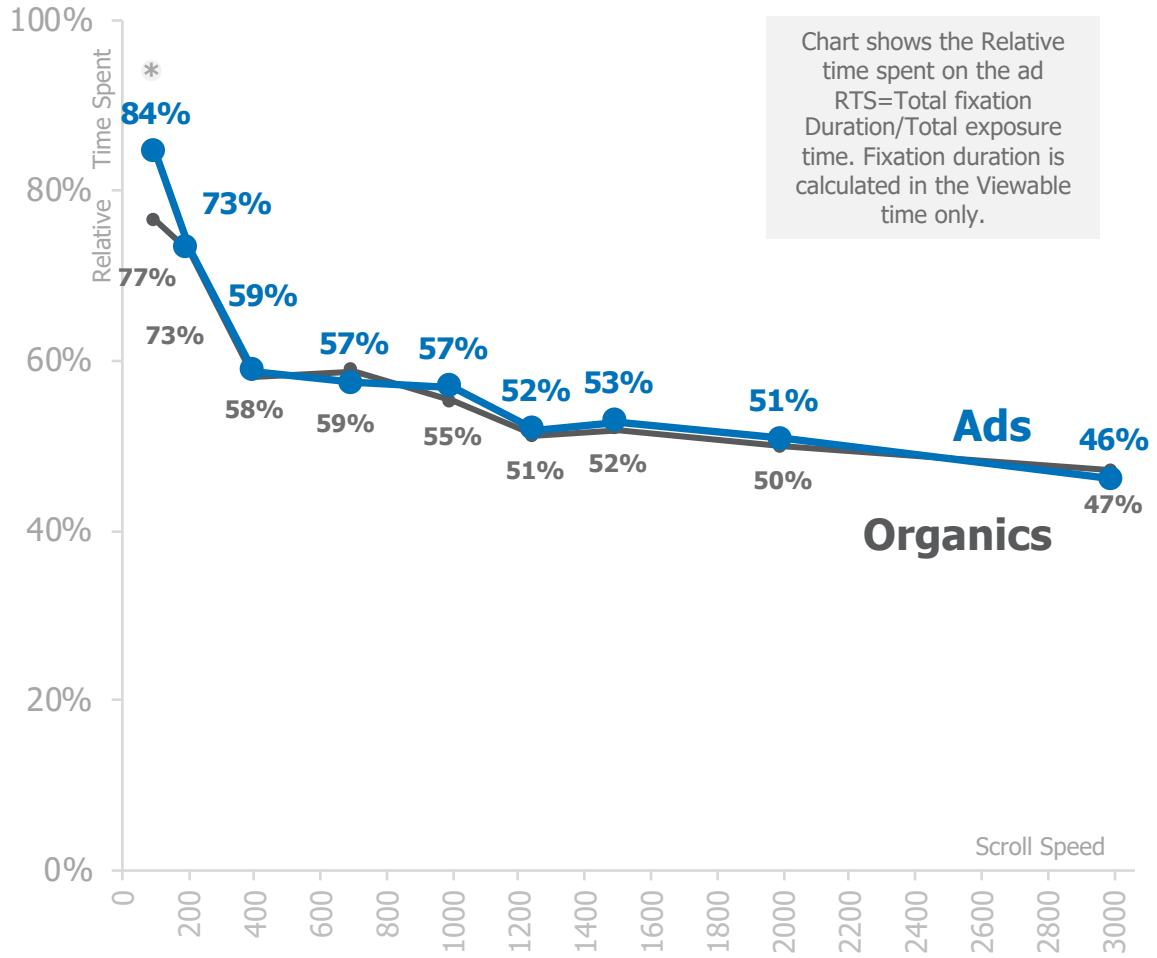



Chart shows the Relative time spent on the ad RTS=Total fixation Duration/Total exposure time. Fixation duration is calculated in the Viewable time only.

*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points.*

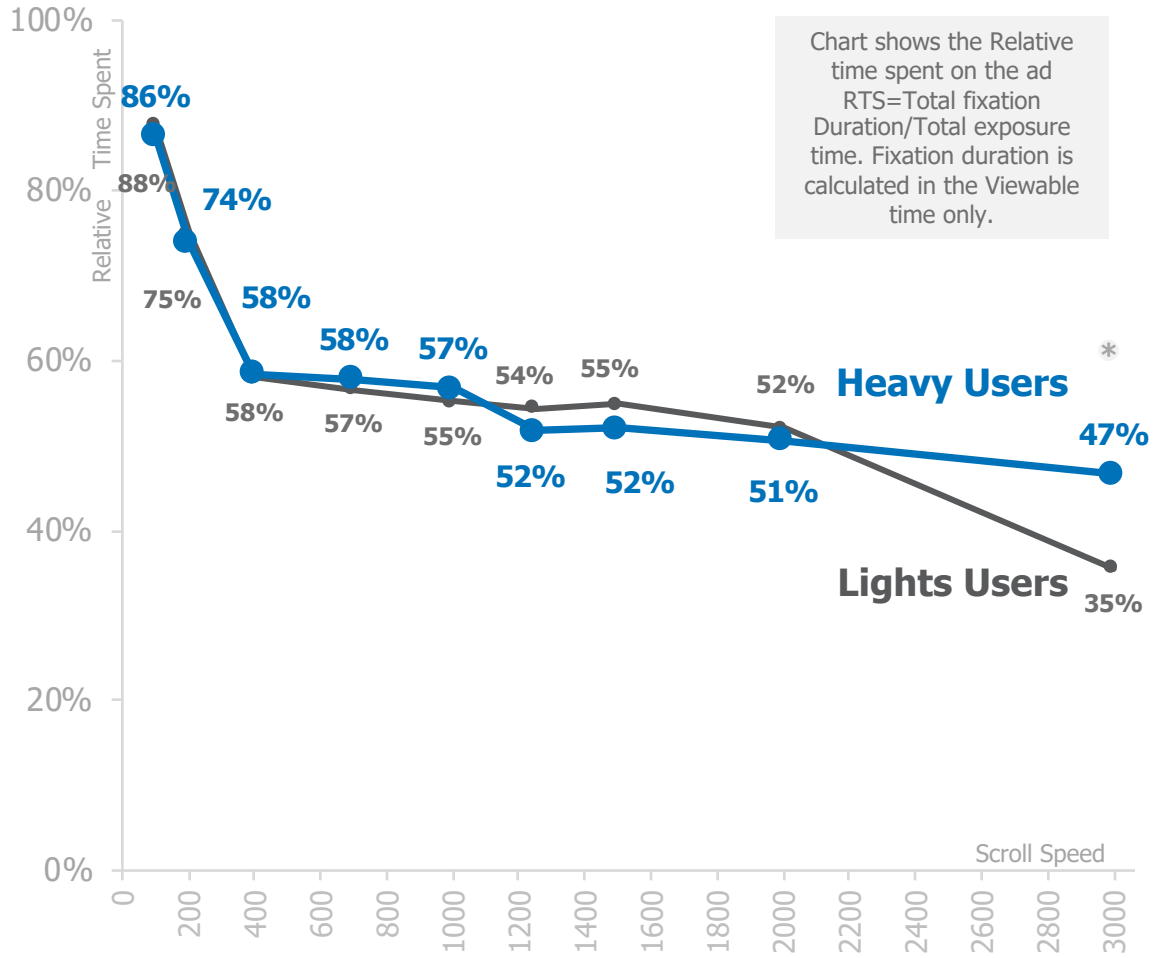
** = significant at p<0.05*

# Light users drop off dramatically during 3000ms scroll speed

At most scroll speeds, the relative time spent of light and heavy users remains comparable. Yet at slow scroll speeds such as 3000ms, light users start to drop off more and spend significantly less time with the ads than heavy users.

This shows that ad content generally maintain the attention of heavy users better when they are exposed for a longer duration. This shows a significant effect from using the platform in the daily life of users.

| Duration | T | p | df |
|---|---|---|---|
| 3000 | 6.06 | <.0001 | 218 |




*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points*

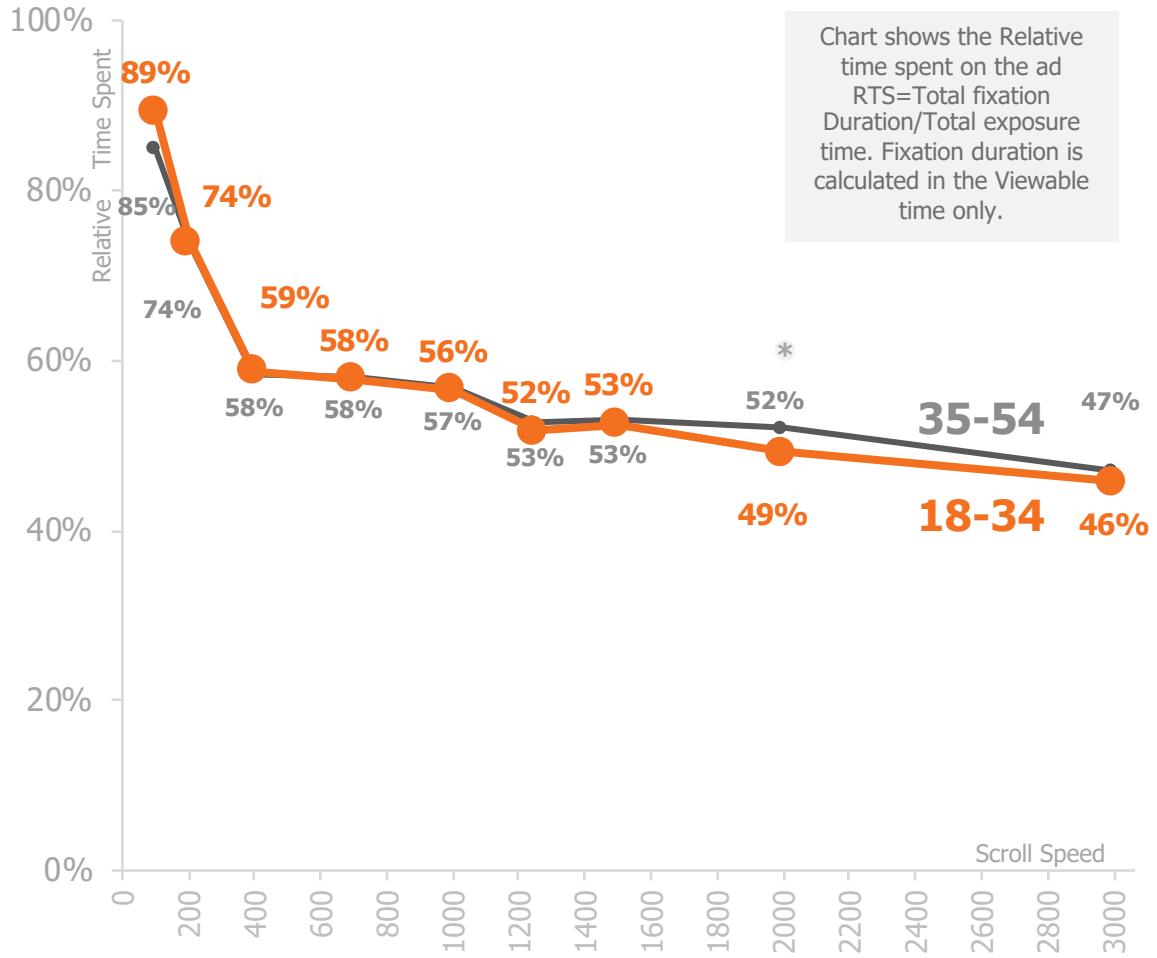
** = significant at p<0.05*

# Older and younger users spend the same relative time

Exploring relative time spent across age groups, the two age groups show comparable relative time spent across most speeds. The only significant difference is found at 2000ms, where the older age group spend more relative time with the ad content.

This shows that there are limited age-related strategies for attending to the information on mobile.

| Duration | T | p | df |
|---|---|---|---|
| 2000 | 2.53 | 0.0121 | 220 |




*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between age groups at duration points*

** = significant at p<0.05*

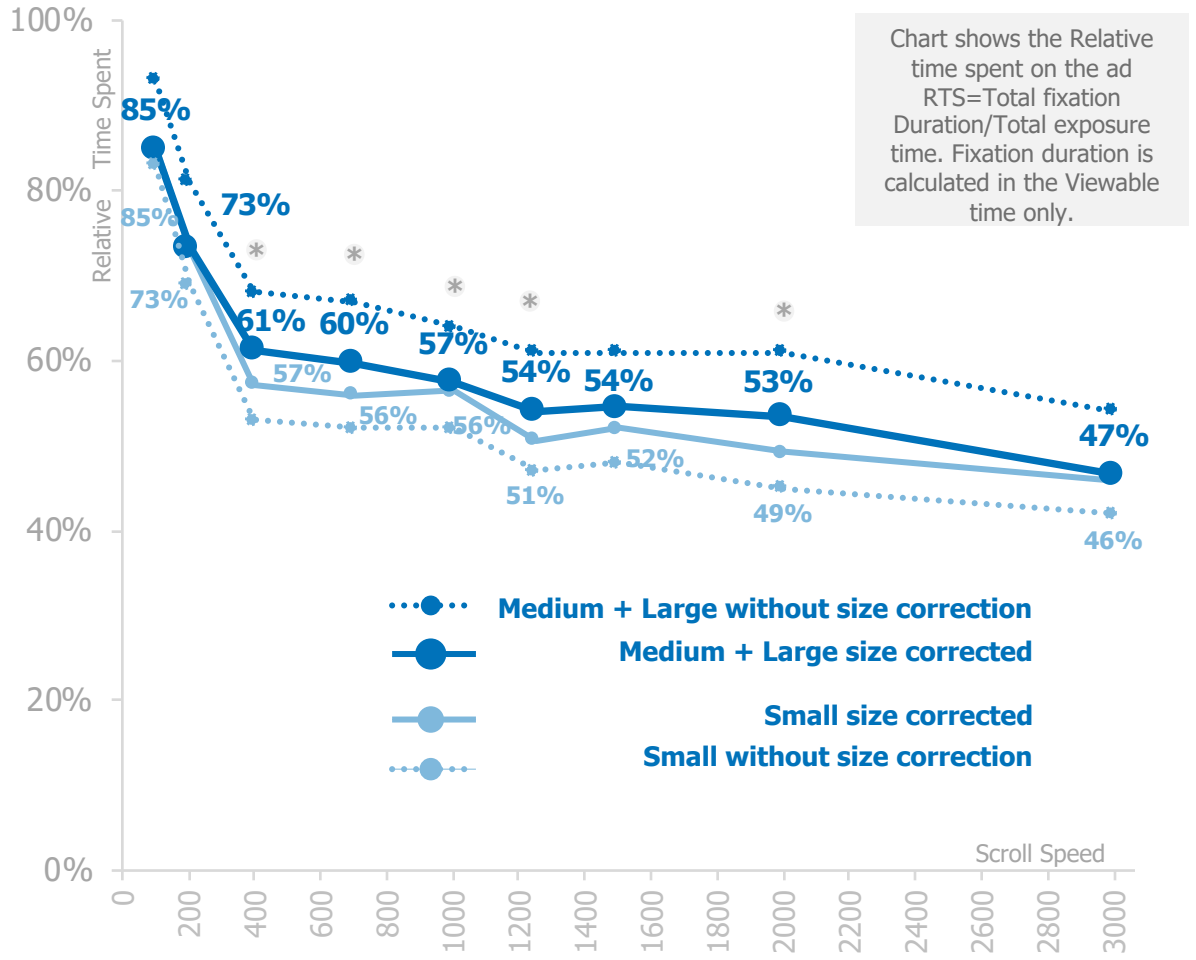
# More relative time is spent with bigger ads

When users are presented with ads that are more vertical than horizontal (large) and square sized (medium), more relative time is spent compared to ads that are more horizontal than vertical (small).

This suggests that relative more time is spent with the ad content when the ad takes up more visual space on the screen. (dotted lines)

Even when taking size into account (the lines) we see a significant difference between medium/large stimuli compared to small stimuli. This shows that the attention differences hold even when given a common denominator.

| Duration | T | p | df |
|---|---|---|---|
| 400 | 2.58 | 0.0103 | 405 |
| 700 | 2.49 | 0.0131 | 416 |
| 1250 | 2.29 | 0.0222 | 420 |
| 2000 | 2.91 | 0.0038 | 419 |




*Tests based on a standard least squares based ANOVA and Student's t-test applied for comparison between categories at duration points*

** = significant at p<0.05*

# STAGE 3 –
# Implicit post recognition

When ads are paid attention to, they are often creating a response. Whether it is an emotional or a cognitive response, such responses demonstrate that the ad has had an impact on the viewer.

In this analysis, we are using emotional scores ("motivation") and cognitive scores ("cognitive load"). This distinction is to differentiate whether participants show an emotional or cognitive recognition response. These may often overlap, but also show slightly different response patterns.

In the analysis we are comparing whether people show any signs of recognizing previously shown ads. This is done by asking participants to focus on a screen where posts are shown for a few seconds at a time, and measuring the emotional and cognitive responses each time a post is shown.

The benchmark used for comparison will be the control group which comprises participants that have not been previously exposed to the stimuli, but have gone through the exact same implicit post recognition test. This will allow us to identify when there are any significant emotional and/or cognitive changes in responses.


**Implicit Post Recognition Test**

Distraction task for keeping participants engaged.

# Cognitive recognition occurs already at 400 ms

For implicit recognition, these results demonstrate that the mobile ads that are shown around a second produce a significantly stronger emotional response.

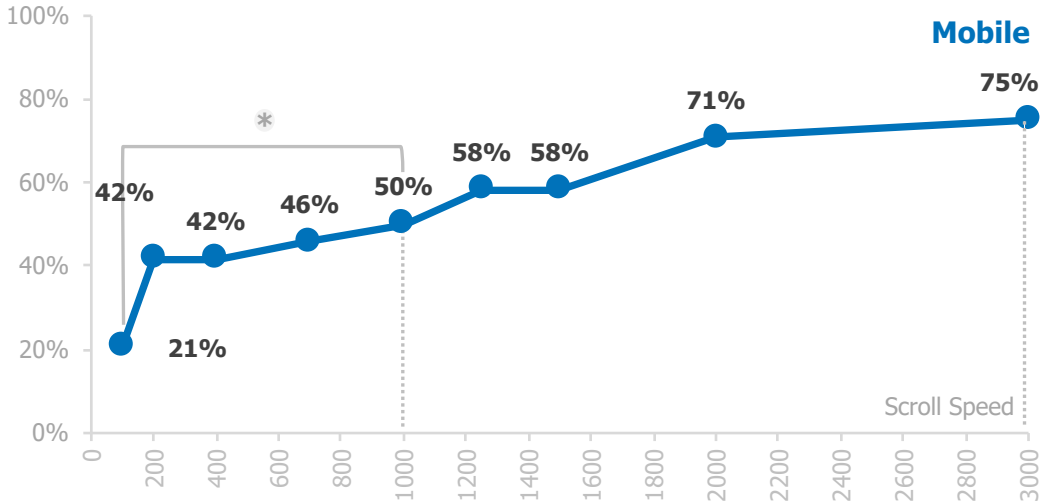
Cognitive response differences occur for ads that have been shown even faster; at 400ms there is almost a tripling of the cognitive implicit recognition responses. These responses again increase significantly at 1250ms where an almost perfect recognition is achieved with 96%.

Together, these responses suggest that cognitive memory responses occur for ads shown faster than emotional memory responses.

## Motivation

| Duration | T | p |
|---|---|---|
| 100-1000 | 2.08 | 0.0385 |

### % of ads that have a motivational change

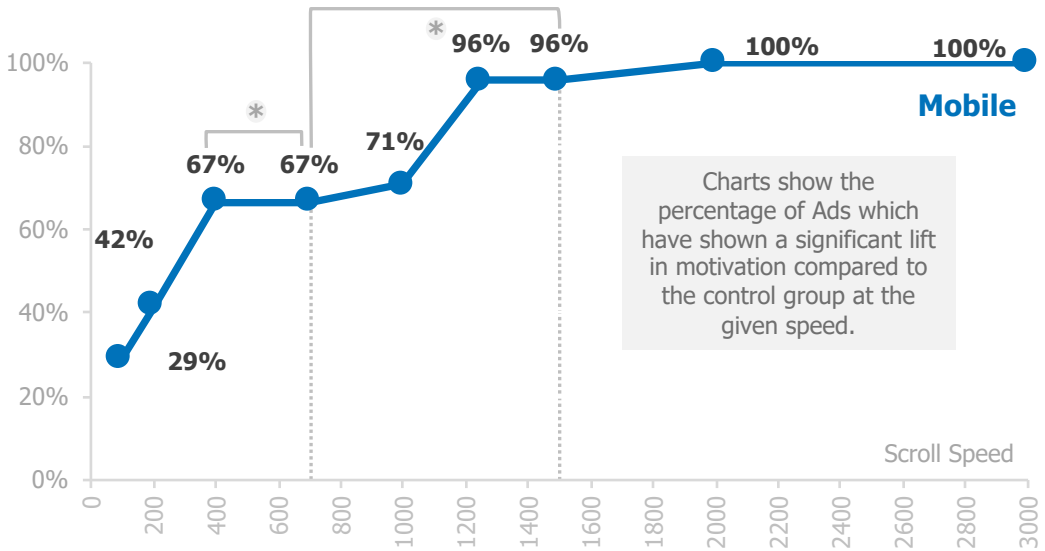



*Degrees of freedom (DF) = 8*

## Cognitive Load

| Duration | T | p |
|---|---|---|
| 100-400 | 3.51 | 0.0005 |
| 400-1250 | 2.73 | 0.0069 |

### % of ads that have a cognitive change




*Degrees of freedom (DF) = 8* ** = significant at p<0.05*

# Mobile shows stronger cognitive recognition compared to desktop

Overall, mobile and desktop align on implicit recognition with regard to emotional recognition. This shows that the platforms perform similarly in enabling this type of recognition.

Yet on cognitive responses, the two platforms diverge significantly at speeds 1250 ms and upwards. This result means that although there are limited effects of platform on implicit emotional responses to ads presented at different speeds, there are indeed cognitive differences.

As such this suggests ads shown on mobile can lead to stronger recognition responses that are cognitive and "factual" rather than emotional.

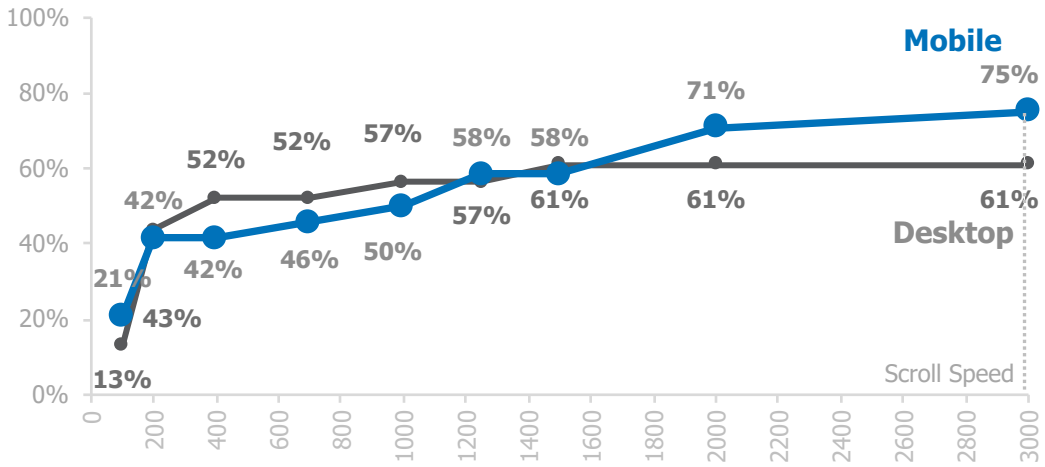
## Motivation

| Duration | T | p |
|---|---|---|
| | | |
| | | |

## Cognitive Load

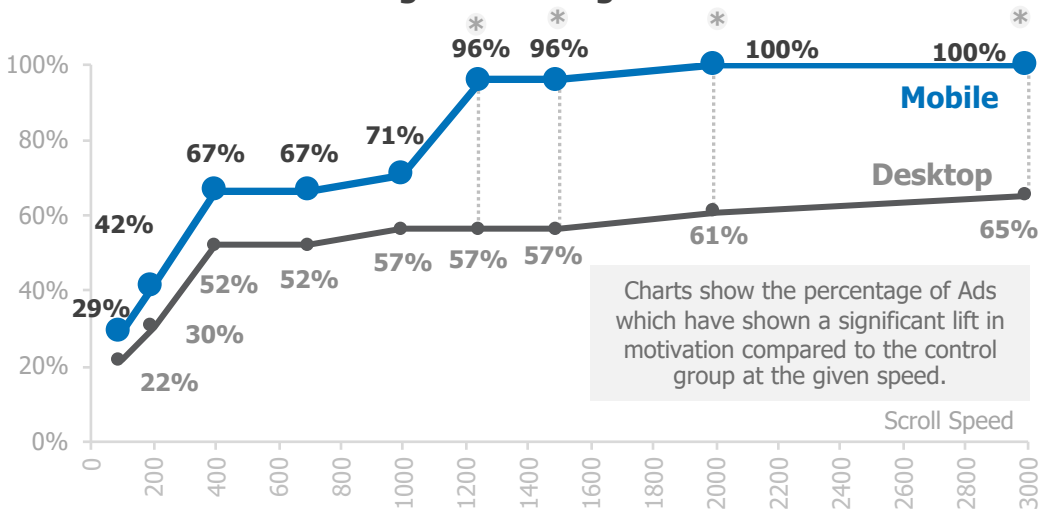
| Duration | T | p |
|---|---|---|
| 1250 | 3.11 | 0.0020 |
| 1500 | 3.11 | 0.0020 |
| 2000 | 3.09 | 0.0021 |
| 3000 | 2.75 | 0.0063 |

### % of ads that have an Emotional recognition change




*Degrees of freedom (DF) = 17*

### % of ads that have a cognitive change




*Degrees of freedom (DF) = 17* * = significant at p<0.05*

# Videos show better emotional recognition

When analyzing differences in terms of post type, we do not see any significant differences between static and video ads in terms of cognitive recognition.

When looking at emotional recognition however, we observe that at faster speeds, videos show quicker responses. This indicates that videos are overall more engaging than static ads.

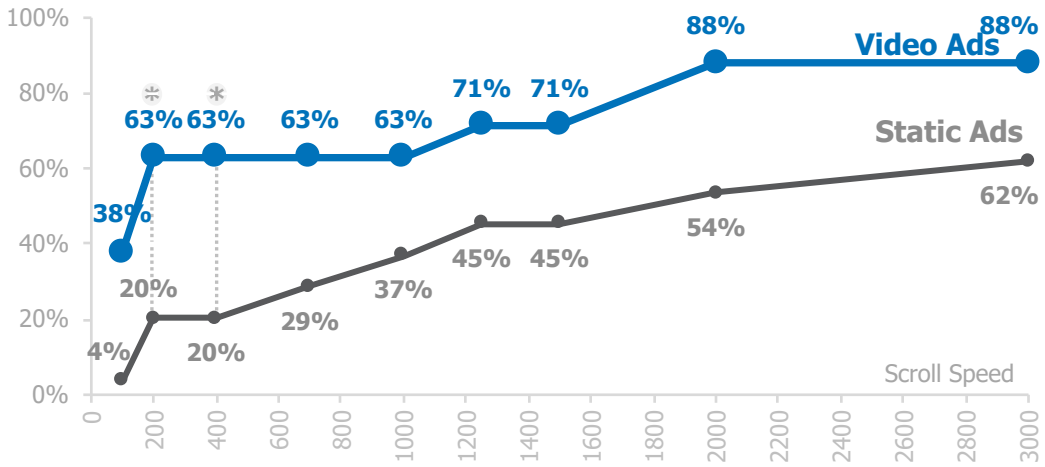
## Motivation

| Duration | T | p |
|---|---|---|
| 200 | 2.29 | 0.0232 |
| 400 | 2.29 | 0.0232 |

## Cognitive Load

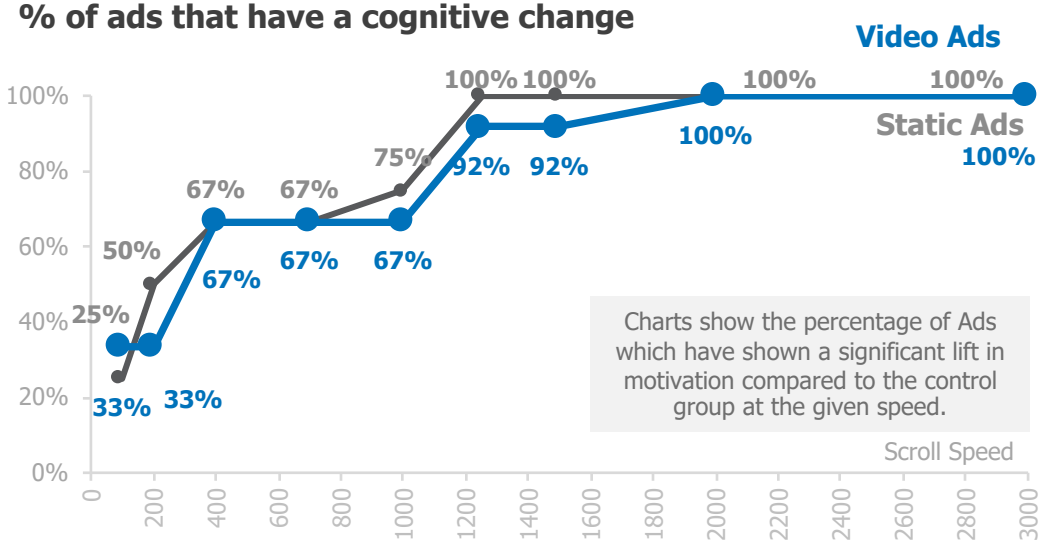
| Duration | T | p |
|---|---|---|
| | | |
| | | |

### % of ads that have an Emotional recognition change




*Degrees of freedom (DF) = 17*

### % of ads that have a cognitive change




*Degrees of freedom (DF) = 17* ** = significant at p<0.05*

# Known brands are more likely to be recognized at shorter durations

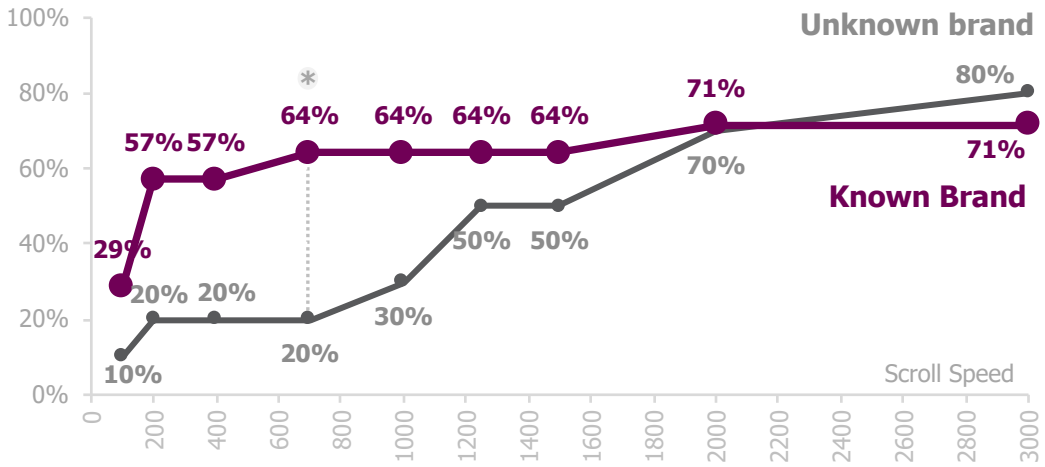
For known and unknown brands, the results clearly show that ads with known brands are much more likely to be recognized during the implicit test, both emotionally and cognitively.

The emotional recognition occurs for slightly faster ad speeds than cognitive responses. This suggests that the brand knowledge effect is more driven by emotional than cognitive effects, although both effects are at play.

## Motivation

| Duration | T | p |
|---|---|---|
| 700 | 2.25 | 0.0256 |

### % of ads that have an Emotional recognition change

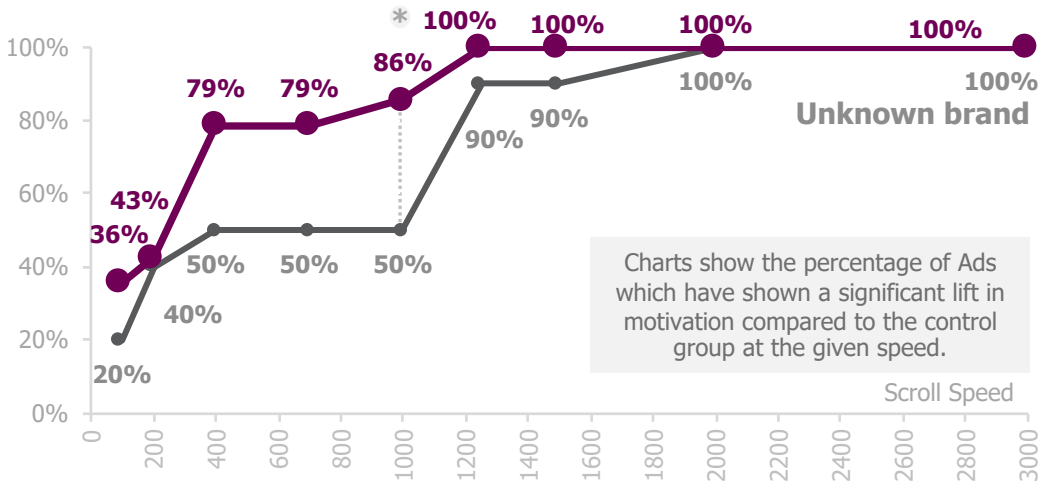



*Degrees of freedom (DF) = 17*

## Cognitive Load

| Duration | T | p |
|---|---|---|
| 1000 | 2.36 | 0.0191 |

### % of ads that have a cognitive change




Charts show the percentage of Ads which have shown a significant lift in motivation compared to the control group at the given speed.

*Degrees of freedom (DF) = 17* ** = significant at p<0.05*

# Ad performance has a modulating effect on recognition

In terms of ad performance, relatively little difference is found between the two conditions, with most highlights being driven by suggestive trends in the results.

Yet performance does seem to have a modulating effect on implicit ad recognition responses. However, since the low performing ads are producing a higher cognitive recognition response, this suggests that recognition itself is not a key driver of ad performance.

Speculatively, the low performing ads may have a higher recognition for the wrong reason. As humans we are hard-wired to recognize negative items in our environment (Ramsøy et al. 2012), thus ads that we do not have a good experience with may simply be recognized earlier on due to this characteristic.

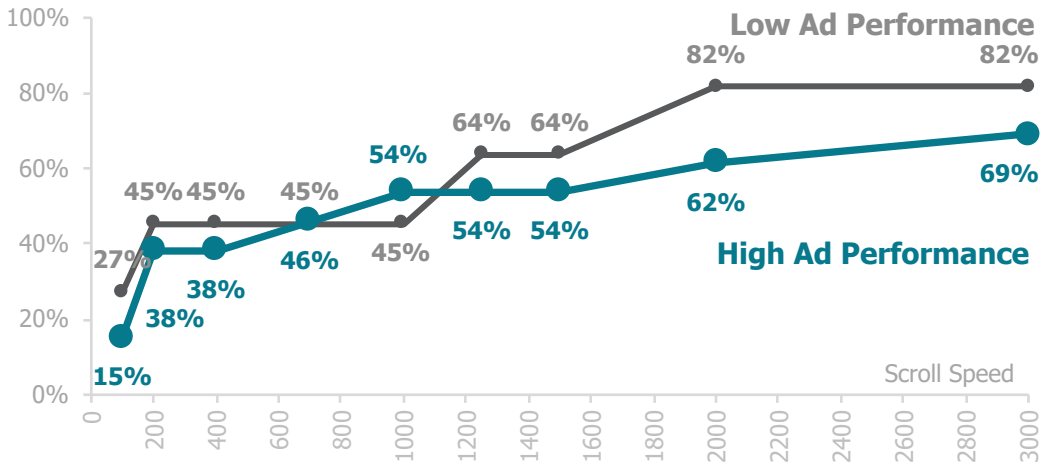
## Motivation

| Duration | T | p |
|---|---|---|
| | | |
| | | |
| | | |

## Cognitive Load

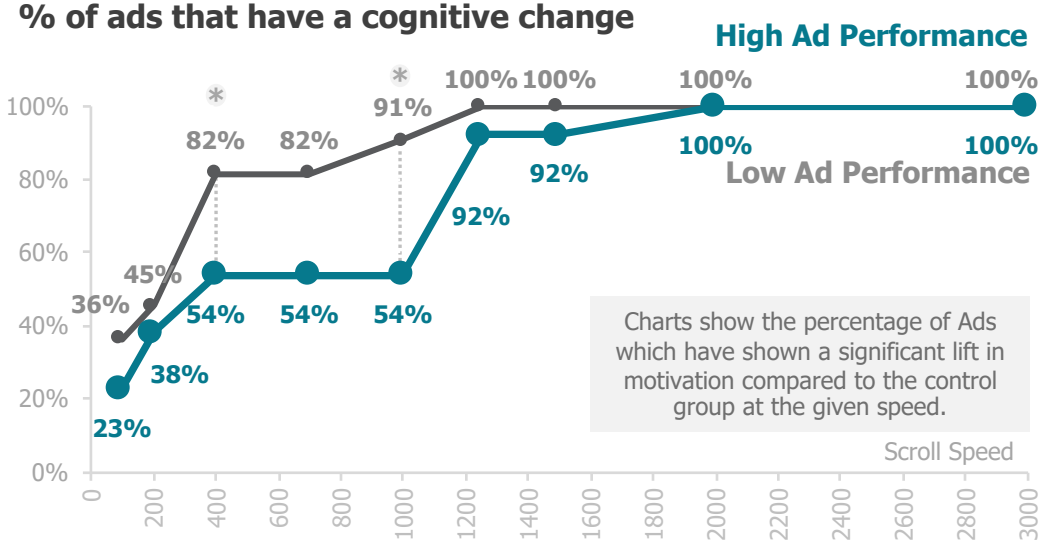
| Duration | T | p |
|---|---|---|
| 400 | 1.87 | (0.0629) |
| 1000 | 2.48 | 0.0140 |

### % of ads that have an Emotional recognition change




*Degrees of freedom (DF) = 17*

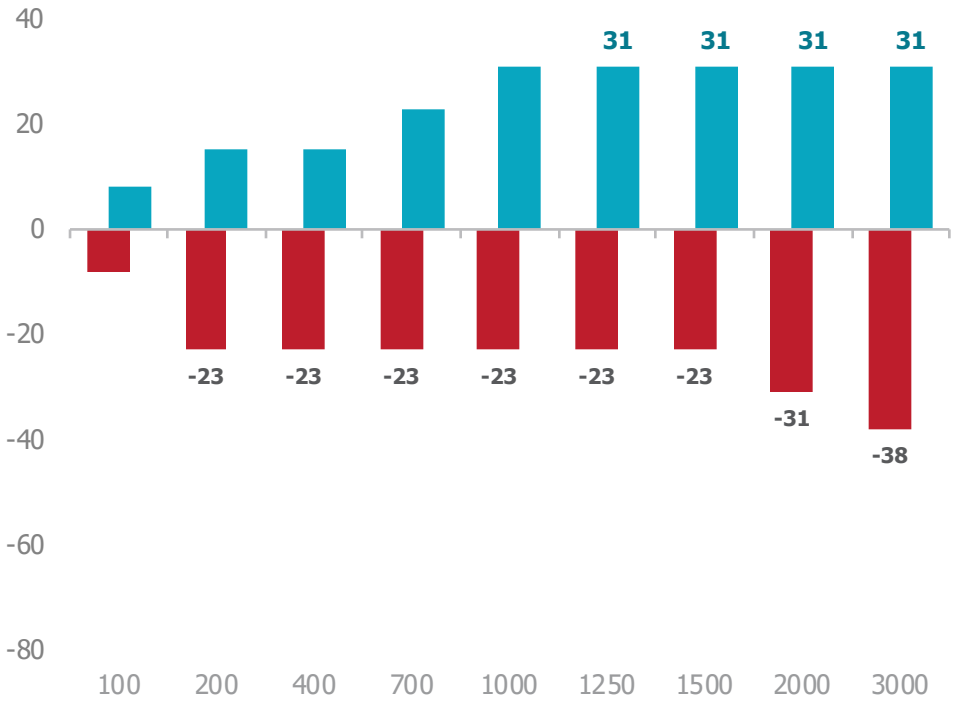
### % of ads that have a cognitive change




*Degrees of freedom (DF) = 17* ** = significant at p<0.05*

# Low performing ads create negative motivation early on

**Low performing ads don't generate positive emotions**




**High performing ads generate mixed emotions, both positive and negative**


** Ineffective/low performance ads: lower quartile in terms of brand recall based on brand lift study*

# Organic content shows greater emotional recognition

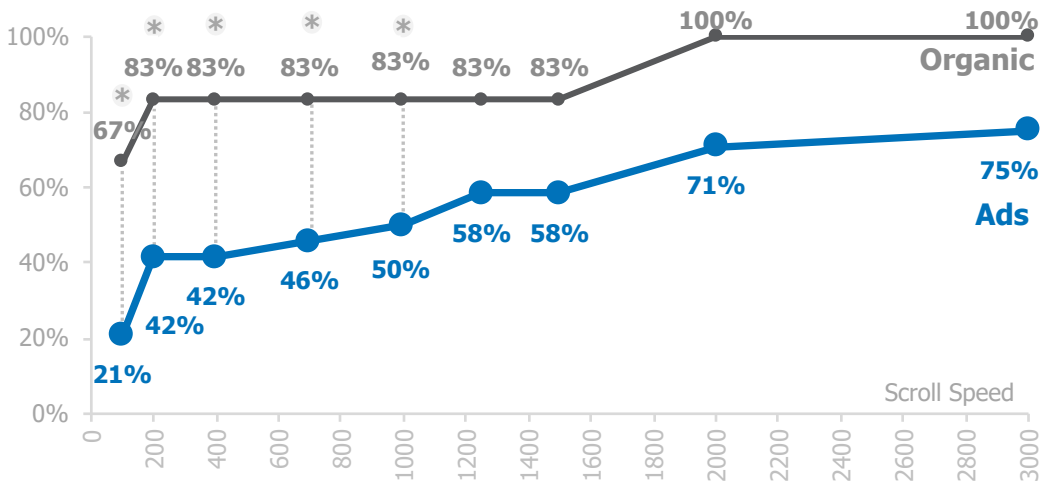
Implicit recognition responses are driven by higher emotional responses to organics than ads. This may be no surprise, as organic content is often more relevant to people, and ads typically more of a nuisance.

Together, this shows that organic content, due to its higher engagement with the mobile viewers, also is more likely to produce an emotional recognition response, especially at rapid presentation of content.

## Motivation

| Duration | T | p |
|---|---|---|
| 100 | 2.89 | 0.0041 |
| 200 | 2.63 | 0.0089 |
| 400 | 2.63 | 0.0089 |
| 700 | 2.37 | 0.0185 |
| 1000 | 2.11 | 0.0361 |

### % of ads that have an Emotional recognition change

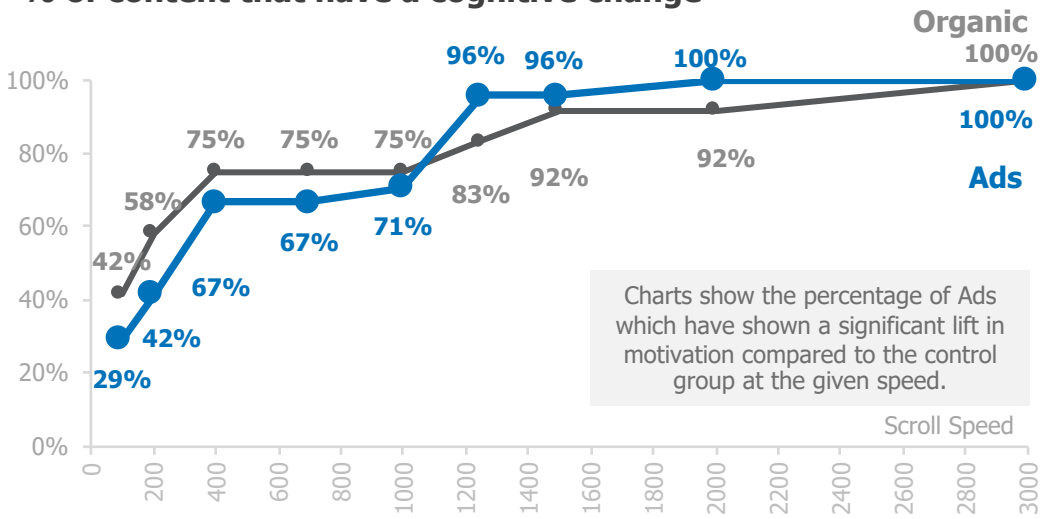



*Degrees of freedom (DF) = 17*

## Cognitive Load

| Duration | T | p |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

### % of content that have a cognitive change




*Degrees of freedom (DF) = 17* ** = significant at p<0.05*

# Implicit recognition is not subject to age related effects

Comparing implicit recognition across age groups, no significant differences are found between any of the three given age groups for emotional as well as cognitive recognition.

The dynamic of responding to ad content at different ad presentation speeds is highly similar and thus age does not seem to be a modulating effect.

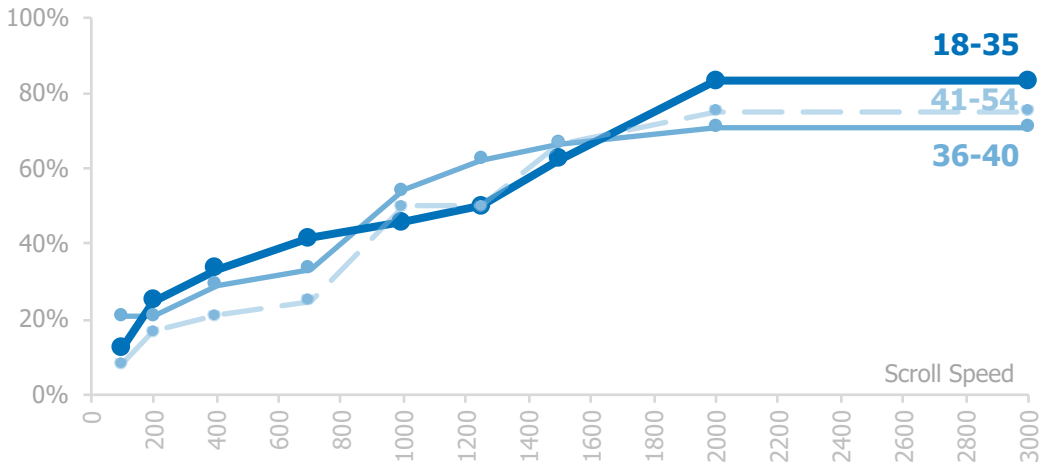
## Motivation

| Duration | T | p |
|---|---|---|
| | | |
| | | |

## Cognitive Load

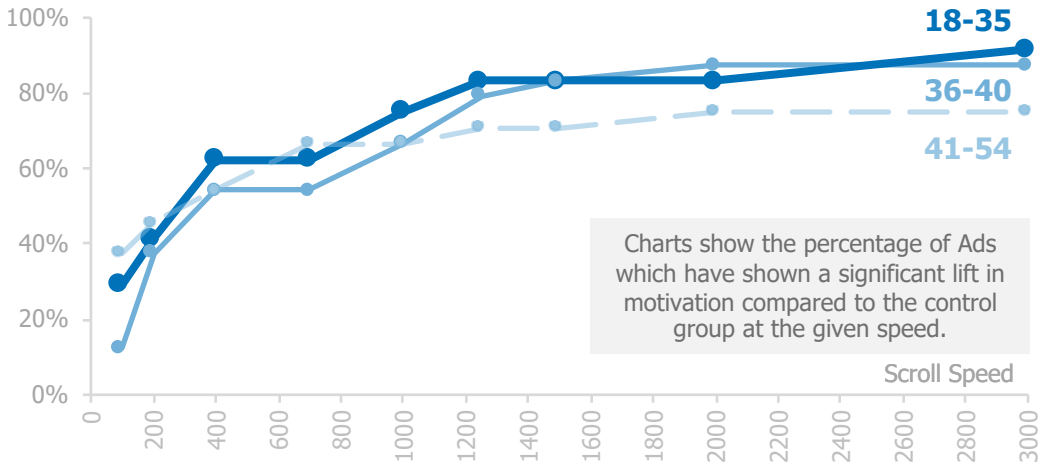
| Duration | T | p |
|---|---|---|
| | | |
| | | |

### % of ads that have an Emotional recognition change




*Degrees of freedom (DF) = 26*

### % of ads that have a cognitive change




*Degrees of freedom (DF) = 26* ** = significant at p<0.05*

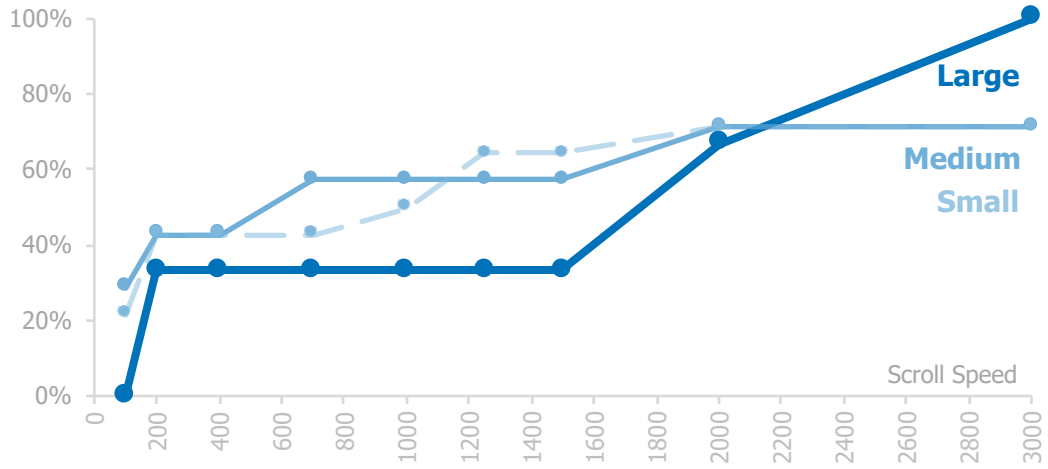
# No significant difference in responses across ad sizes

When comparing emotional and cognitive implicit responses across the different scroll speeds, no significant differences are found between the three different size of ads.

## Motivation

| Duration | T | p |
|---|---|---|
| | | |
| | | |

### % of ads that have an Emotional recognition change

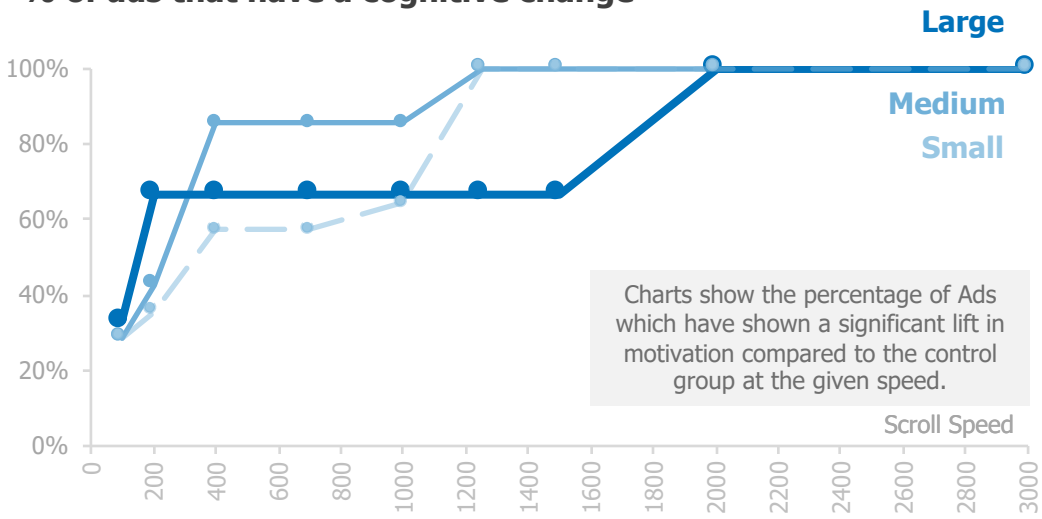



*Degrees of freedom (DF) = 26*

## Cognitive Load

| Duration | T | p |
|---|---|---|
| | | |
| | | |

### % of ads that have a cognitive change




Charts show the percentage of Ads which have shown a significant lift in motivation compared to the control group at the given speed.

*Degrees of freedom (DF) = 26* * = significant at p<0.05*

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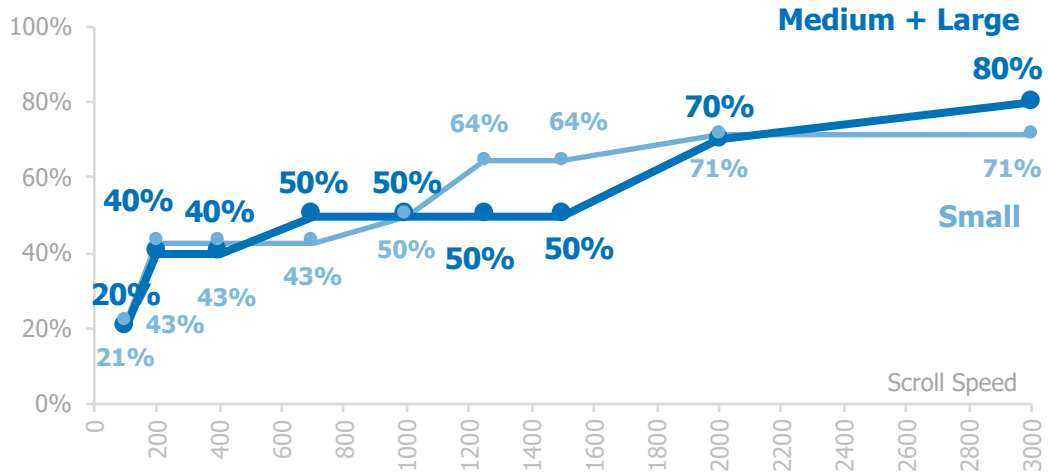
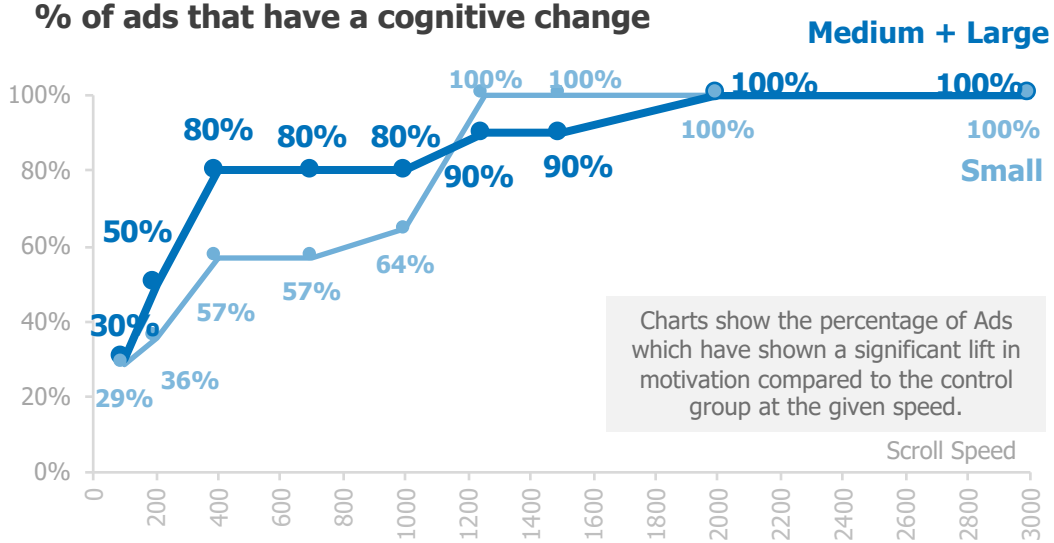



*Degrees of freedom (DF) = 26*

## Cognitive Load

| Duration | T | p |
|---|---|---|
| | | |
| | | |

### % of ads that have a cognitive change

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