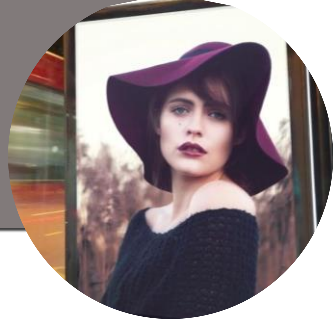
AM4DOOH

THE REALITY OF ATTENTION TO DOOH

CONTENTS

EXECUTIVE SUMMARY

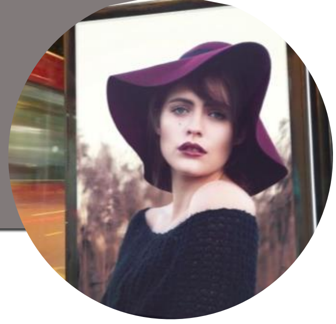


The digital revolution has touched almost every walk of life, and the OOH advertising industry is no exception. In recent years, media owners have enhanced their estates by converting their premium sites into digital screens, offering significant advantages to both media owners in terms of reducing operating costs, and advertisers in terms of increased flexibility and targeting capabilities. Advertisers are increasingly able to choose not just where to reach their audiences when they are out of home, but when, and how often. Digital screens also provide new creative opportunities, allowing for animation and full motion video, and interesting opportunities for integration with mobile and attribution.

It's also generally understood that digital screens receive more attention than their static paper equivalents. But how much more? And what about an individual digital ad on loop with several others? The OOH industry has long used eye tracking metrics to adjust frame audiences for their "realistic likelihood to see" - how should these metrics be applied in the digital era?

To address these questions, a consortium of JCDecaux, Clear Channel, Exterion and APG, with support from FEPE, commissioned Lumen Research to conduct an extensive, multi-country eye tracking study. This study aims to bring existing eye tracking research on attention to OOH up to date by capturing the effectiveness of digital screens. adopting the same methodological framework as previous research as closely as possible.

EXECUTIVE SUMMARY



The key finding is that digital screens, especially when using full motion video creative, are significantly more eye catching than static paper ads. As a result, those exposed to digital ads tend to get a similar or higher 'likelihood to see' (LTS) as their static paper equivalents, despite the smaller window of opportunity to see the ad that comes from being on loop with other ads. In fact, the LTS of full motion digital creative is 25% higher than static frames amongst head-on contacts for drivers and 16% more amongst head-on contacts for roadside pedestrians, while those exposed head-on to full motion video ads in malls and transit locations are equally likely to be seen as static paper.

Set against these uplifts in LTS, is the potential reduction in exposed audience due to digital ads being on rotation with others. These effects can be captured using a simple equation relating the passage duration and the spot and loop lengths, applying "viewability" standards on a par with the internet, i.e. a minimum of 1" exposure. This equation indicates that a reduction in viewability is mainly experienced by drivers, whose speed implies quick passages, while pedestrians longer passages mean they are usually exposed to many of the ads on loop.

Putting these results together means the overall effect on audiences balance out somewhat. Drivers have a greater reduction in viewability, but higher uplifts in likelihood to see among those exposed. Pedestrians, on the other hand, are more likely to be exposed to an digital ad in a loop, but have more modest uplifts in LTS. Overall, the net effect varies. The fact that digital ads are more visually arresting, and that audiences are typically exposed to more than 1 ad, means the audience for a 10" digital ad in a 60" loop is always significantly higher than 1/6th of the frame audience. Based on realistic passage durations, the size of a digital audience varies from around 30% to 80% of a static paper audience, depending on the contact type – 1.8x that implied by the crude method of dividing the audience by 6 at lowest, and up to 5x where the uplifts are strongest.

RESEARCH OBJECTIVES

Digital OOH home screens give rise to many interesting research questions. This research was exclusively focused on understanding the *relative* performance of digital ads versus static paper, in terms of an audience's likelihood to see (LTS) .

Within this overall objective, the research aimed to measure this differential across a number of key dimensions of interest:

- How do digital ads with full motion video, or animation, compare to static digital ads?
- How does the differential in LTS vary for different locations, screen sizes, and eccentricities of approach? Which of these factors should be considered important in adjusting a frame's audience for their "realistic likelihood to see".

DEFINITION LIST

Below is a list of definitions for terminology that will be used frequently throughout this paper

OOH | Out of home: this refers to advertising focused on marketing to consumers in media formats that are accessible to them when they are 'on the go'

LTS | Likelihood to see: a quantitative measure of proportion of individuals that are likely to see adverts in pre-defined environments

SD | Static digital screens

AD | Animated digital screens

FM | Full motion video

SP | Static paper

AIC | Akaike Information Criteria: an estimator of the relative quality of statistical models for any given set of data

TECHNICAL METHODOLOGY

Understanding the attention given to out of home advertising presents some unique challenges. Other media tend to be consumed in relatively constant and stable contexts – newspaper ads within a newspaper, digital ads on websites, and TV ads within ad breaks – whereas OOH advertising appears in numerous different environments, including train stations and roadside, shopping malls, where people do radically different things – they could be driving, waiting for a bus, or finding their way to a train platform. This variety in environment and audience behaviour gives rise to significant research challenges, especially as it cannot be assumed that the relative performance of digital OOH versus static paper is equal across all these different environments. A measurement system with important audience implications requires a solution with good coverage of this variety to be accepted by media markets.

Some other important considerations bear upon the decision over approach:

- **Consistency with existing research:** Data on attention to static paper posters is already widely used to adjust poster audiences for their "realistic likelihood to see". New data should complement rather than replace existing measurement systems. The outputs need to be able to layered into existing metrics seamlessly and logically. Ultimately, what is required is a set of indices to be applied to existing data to adjust for the relative performance of digital

- **Realism and experimental validity:** While test environments need to reproduce the key features of real life, the critical factor in deciding upon methodology is that the test needs to be experimentally valid. Since this research is focused on understanding the *relative* performance of digital OOH vs static, absolute realism is not required, and in fact may inhibit test validity as the real world is full of confounding factors. Rather, the most important consideration is whether our methodology provides a *fair test*

- **Elimination of confounding factors:** Conducting a fair test involves ensuring that the target factor of interest - the impact of digital versus static posters - is the only variable being changed for a measurement. Confounding factors need to be controlled for as much as possible, including creative

- **Variety:** The measurement systems needs to be applicable to a variety of environments, frame sizes, and with different audience eccentricities (head on/parallel). The environments, sizes and eccentricities need to provide sufficient coverage and marry with existing the existing visibility adjustment parameters[1]

- **Scalability:** The measurement systems needs to be capable of being used with a sufficiently large sample to ensure statistical validity for the measurements required

- **International:** The system needs to be capable of being deployed across multiple markets

1. In accounting for this variety and confounding factors, the research aims are in accordance with ESOMAR's *Global Guidelines on out-of-home audience measurement Version 1.0*

THREE ALTERNATIVES

Broadly speaking, three main options were considered at the outset.

1. EYE TRACKING GLASSES

One obvious approach would be to use eye tracking glasses with people in real world situations. This would mean the test environment had a high degree of realism, as study participants would be exposed to posters in almost exactly the manner of the real world. Studies such as these are still subject to research effects: participants would be have to be given routes to walk so that researchers could collect sufficient data across a given number of OOH frames, which might impact the realism of the research. Wearing the glasses themselves might also impact the realism of the approach. While there has been a significant miniaturisation of eye tracking technology in recent years, the experience of wearing which might cause some differences in behaviour on occasions. However, while realistic, approaching data collection in this way has some severe limitations. There are 2 major problems: (i) the high degree of realism in this approach also makes it extremely difficult to conduct a fair test, and (ii), scalability.

In order to conduct a fair test, one needs to hold all potentially confounding factors constant across the dimension of interest. In this case, as we wish to understand the impact of digital vs static OOH, we would like to be able to create samples of frame contacts that are otherwise exactly the same other than the poster format. This would be extremely challenging to conduct at scale in the real world. The best that could be achieved would be to conduct research at sites that were converted from one day to the next from static into digital, placing creative from the same campaign within the frame on both days. This would then need to be repeated in multiple locations, across markets. The practical implications of achieving this would be extremely complex to coordinate, and even then, many other factors remain out of control. Weather conditions in particular could change from one day to the next, which could have important effects on participant behaviour, and on how well the frames stand out in their environments due to differences in the light. This is particularly important for our research as one factor thought to contribute to digital posters performance is the way they are illuminated differently to traditional static poster light boxes. Additionally, any individual participants experience of the study could easily be interfered with by other variables outside our control – the traffic in the environment and other pedestrians could all interact differently with participants and draw their eye in different ways.

These confounding factors could be believed to average out if sufficient data were collected. However, conducting this kind of research at scale is hard. Aside from the need to conduct research over multiple days, the processing of eye tracking data is time consuming. Eye tracking glasses record a video of each person's experience and overlay their eye fixations. As each participant has a different experience, each person's data has to be processed individually. Some machine learning can be used to speed up this process, but even so a single participants response take considerable time to encode and validate.

These limitations clearly make researching in a completely realist environment unfeasible. The complexity and cost of collecting and processing the data would be extremely high, and even then, the resulting data would likely suffer from confounding factors that could mask and interfere with the measurement we are interested in – the relative performance of digital vs static posters.

THREE ALTERNATIVES

2. FILMS & SCREEN-BASED EYE TRACKING

Screen-based eye tracking provides data that is typically much quicker and simpler to process and is often easier to conduct tightly controlled experiments with. In screen-based eye tracking, an eye tracking device is attached to a desktop or laptop computer (usually via USB), and participants eye movements are recorded while they view some stimulus. As each participant is exposed to exactly the same stimulus (or slight variations thereof), it is much easier to process the data in bulk. Recording data is also considerably easier, as the measurement system is portable in its entirety.

Aside from its scalability and low cost in providing large samples, screen-based eye tracking also provides researchers with the ability to conduct controlled experiments which isolate the impact of individual factors, by showing study participants versions of stimulus which are identical apart from a difference in a particular factor of interest. For our purposes, this entails creating stimulus which in one version has a static poster ad, and in another a digital ad, with the ad from the same campaign.

Previous OOH visibility research has used screen-based approaches to take advantage its scalability and experimental robustness. For example, research by Route in the UK involved presenting images of scenes on a screen to respondents for 6-second time periods, from which it was observed how quickly and how likely participants were to see poster of different sizes and in different environments. Clearly, the limitation with replicating this exact approach is that often digital posters have movement in them – and in fact this is likely one of their major advantages over static paper in getting attention. A similar approach for digital would be to use video scenes where people are exposed to posters of different kinds.

The difficulty with this approach lies in creating test and control stimulus. To be able to compare digital vs static frames while keeping all other things equal, we would require participants to be shown films that were identical except for the presence or absence of digital OOH frames. Replacing static frames with digital frames within live video is no easy matter. Just as with the real world eye tracking glasses approach, there would be considerable complexity in coordinating the recording of these films around refitting poster sites as digital, and similar problems with being unable to control for other factors like the weather, and other activity in the films.

3. VIRTUAL ENVIRONMENTS

The issues in creating a tightly controlled study outlined above led to the solution of creating virtual environments of scenes. The great advantage of virtual environments is that one is able to edit them to exactly the needs of the research, allowing tight and systematic control of both the factor of interest and confounding factors. Virtual environments can also be integrated with eye tracking directly, with fixations directly associated with 3D objects within the environments, making for fast and easy processing of the data. This setup therefore was best suited to our needs: it enables large scale data collection across multiple markets, and gives us the control to edit the scenes to isolate the factors of interest.

One consideration in using virtual environments was whether to allow study participants to explore the virtual environments using a controller of some kind, or whether the passage of individual in the environment was fixed and "on rails". In order to provide the tight control of participant experience necessary we elected to fix the individuals path in the environment. If participants were given control over their path through the environments, it is likely some study participants would struggle to navigate the environment naturally, no matter what the control device used, and there would be no way of ensuring participants were exposed to all the different frame locations. It would also be likely that different frame approaches would influence attention dramatically.

The drawback of using virtual environments is that they are of course somewhat superficial. This however is always the case in any experiment. What is important is not that the real world is created exactly in an experiment, but that the experimental environment is sufficiently realistic so that the findings from the study can be applied to the real world. This involves taking careful steps to ensure the factors that we are holding consistent in our virtual environment – the weather conditions, the lighting levels, traffic levels, walking and driving speeds, other signage in appropriate languages, etc., as well as just the general look and feel of them, are representative.

THREE ALTERNATIVES

3. VIRTUAL ENVIRONMENTS (CONTINUED)

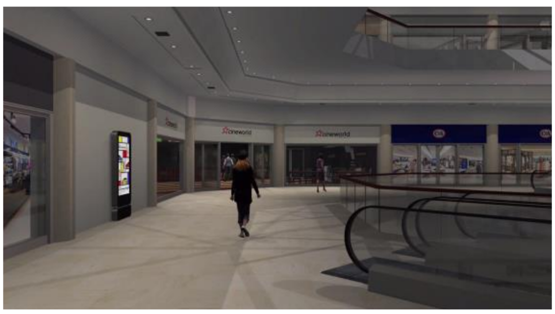
The Virtual Environments were built by Buzz3D. 5 main environments were made: 2 drives, each of which involved a section of motorway and town driving, or 3 walks, each either in a shopping mall, a rail station or a metro station.

RAILWAY

METRO

HIGHWAY

TOWN



MALL

Figure 1: Stills of the 5 distinct, generated environments as indicated in the above labels

3. VIRTUAL ENVIRONMENTS (CONTINUED)

Soundtracks were also made for each of the environments, in order to make the participant experience even more immersive.

During the research (including in pilot phases which were built into the research to confirm the approaches validity), all study participants were asked whether they thought the environments were realistic. A large majority of respondents thought the environments were realistic, with only 3% of the sample thinking they were not, predominantly due to misrepresentative low levels of litter.

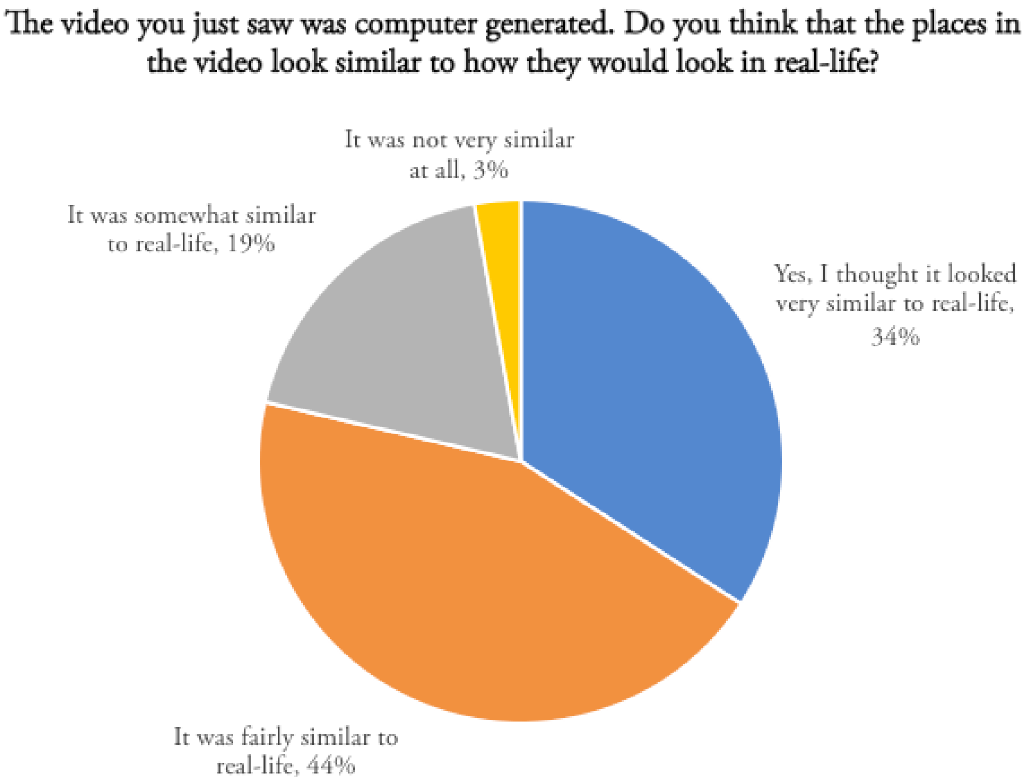


Figure 2: Percentage split of respondents, grouped by how similar they felt in the simulated environments

EXPERIMENTAL DESIGN

The great advantage of using virtual environments for this kind of research is the ability to readily create edits of the environment to test the impact of particular factors of interest – and to carefully and tightly control for confounding variables.

TARGET VARIABLE: AD FORMAT

The research was focused on isolating the impact of digital OOH. There are few aspects of digital OOH that were thought to be important in influencing attention: the additional illumination that comes from the digital screens themselves, and the opportunities for movement that digital screens offer. The study was designed not simply to compare static paper (henceforth, SP) to digital generally, but to digital of different kinds: static digital (SD), animated digital (AD - where the creative lightly animates) and full motion video (FM - which employs actual video recorded footage in some way in the creative).

The general principle of the research was to expose participants to ads in different formats in the same locations, with the same levels of traffic, lighting conditions, sounds, etc. – everything held constant except for the ad format. Once the environments had been designed and built, different versions of the environments were made such that at each location, there was one version of the environment with a static paper poster, another in SD, another in AD and another in FM.

Figure 3: Examples of OOH ads of various sizes (2m^2 bus shelter, 12m^2 in rail atrium & 0.2m^2 escalator panel)

EXPERIMENTAL DESIGN

DIMENSIONS OF INTEREST

In order to understand whether the relative performance of digital vs static varied at all, the environments were populated with poster locations of different sizes and eccentricities, representing the most common kinds of OOH contacts.

Size (m2)	2		12		0.2 (Escalators)
Eccentricity	Head on	Parallel	Head on	Parallel	Parallel
Drive	Y	Y	Y	Y	
Roadside Pedestrian		Y	Y	Y	
Mall	Y	Y	Y		
Railway station	Y	Y	Y	Y	Y
Metro station	Y	Y	Y	Y	Y

Table 1: Dimensions of interest

EXPERIMENTAL DESIGN

POTENTIAL CONFOUNDING VARIABLES

The research took into consideration the potential for confounding variables to bias the results, including creative, advertiser category, ad viewability, audiences, order effects, participant fatigue and interpretation and the fieldwork environment.

In order to mitigate any creative effects, adverts were sourced from campaigns that were available in all 3 formats – i.e. static, animated and full motion. A particular campaign was allocated to each frame location in the environments, so that the "target" creatives were shown in different formats to different cell groups in exactly the same locations. As the research was pan-European, international brands were chosen, across a mix of advertiser categories. Each target ad was exposed only once to each participant. Additionally, there were multiple locations to represent each contact type (e.g. 2m head-on driver), so that the overall effect for each measurement would come from a mix of creatives.

An important aspect of digital OOH is the way that ads typically occur on a loop that includes other adverts. While there are some variations in precisely how this occurs in terms of the number of ads on loop, and their duration, generally speaking, ads are 10" in duration, and often in a loop of 6 ads. Since this is the most common deployment in European markets, this is how target adverts appeared on the digital screens in our environment. Filler ads were inserted around the target creatives, again from a mix of brands and advertiser categories. The moment of transition when the target ad came into view differed between the screens, in order to ensure that different levels of viewability were created for target ads; sometimes they transitioned into view when the frames were far away while other times they were very close. This meant the full 10" was not always in view, just as in real life. The transitions were however always timed to commence within standard visibility distances[1], namely 63m for $2m^2$ posters and 100m for $12m^2$ posters.

Participants were recruited to be nationally representative groups with a mix of genders and age groups. Order effects were mitigated as the sequence of different contact types in the environments were mixed up rather than clustered in different types, and the ad format exposed was randomised and rotated across the study cells. The different versions of the environments were not edited such that there was an environment for each of the 4 formats (i.e. a SP cell, a SD cell, and so on), but rather each respondent would see every format, but in different sequences. The full cell structure is shown below in Table 2.

In order to mitigate participant fatigue, each would only see a selection of the environments. Each participant was allocated one of the driving environments, one of the roadside sections, and one of the internal environments. Ultimately, this produced 12 cells, with 3 sets of environment sequences, each with 4 different sets of format rotations, as shown in Table 1. All participants were all tested in identical conditions, on identical hardware (see figure 4) and given the same set of instructions. Each recording booth isolated participants field of view to minimise distractions from the outside world, and each was given a set of headphones to listen to the sound track.

1. Visibility distances as established by Route in the UK

EXPERIMENTAL DESIGN

Figure 4: Still of the test environment

Studies were conducted with Tobii X2 eye trackers, with a frequency of 30hz. Distinct fixations are defined the above parameters: unique gaze points lasting for at least 100ms within an area of 34 pixels. The fixation definition used in this research was chosen to match definitions used in previous visibility research, with a suitable adjustment for screen size on the pixel threshold.[1]

Respondents were recruited via in street intercepts, weight to be nationally representative. The total sample was 468, split across the UK, France, Switzerland and Sweden:

- Reading, UK: 114 (October 2016)
- Paris, France: 124 (March 2017)
- Winterthur, Switzerland: 109 (March 2017)
- Stockholm, Sweden: 121 (March 2017)

1. See http://route.org.uk/wp-content/uploads/2017/03/route-visibility-dynamic-scenes-report.pdf for justification of 100ms fixation duration threshold, and https://www.tobiipro.com/learn-and-support/learn/eye-tracking-essentials/types-of-eye-movements/ for more details of fixation definition. Many studies confirm individuals receive information in fixation of 100ms, and often lower e.g. Salthouse, T.A & Ellis, C.L (1980) *Determinants of eye-fixation duration, American Journal of Psychology 93 (2), pp.207-234*

CELL ROTATIONS

4 versions of each environment were made, each a different sequence of ad formats

Environment	Location code	Size (m2)	Eccentricity	Creative	A	B	C	D
Drive 1	Loc01	12	Parallel	Stella Artois	SD	SP	FM	AD
Drive 1	Loc02	2	Head on	Chanel	SP	FM	AD	SD
Drive 1	Loc03	12	Parallel	Air New Zealand	AD	SD	SP	FM
Drive 1	Loc04	2	Head on	Bad Neighbours	SD	SP	FM	AD
Drive 1	Loc05	2	Head on	Burberry	AD	SD	SP	FM
Drive 1	Loc06	2	Head on	Taylor Swift	FM	AD	SD	SP
Drive 1	Loc07	12	Head on	Shell	SP	FM	AD	SD
Drive 1	Loc08	12	Head on	Netflix	SD	SP	FM	AD
Drive 1	Loc10	2	Parallel	Coca-Cola	SP	FM	AD	SD
Drive 1	Loc11	12	Head on	Jaguar	AD	SD	SP	FM
Drive 1	Loc12	2	Head on	Thierry Mugler - Angel	SP	FM	AD	SD
Drive 1	Loc13	12	Parallel	KFC	FM	AD	SD	SP
Drive 1	Loc14	2	Head on	H&M English	SD	SP	FM	AD
Drive 1	Loc15	12	Head on	Grey Goose Vodka	FM	AD	SD	SP
Walk to Mall	Loc139	2	Parallel	Amazon Kindle	SD	SP	FM	AD
Walk to Mall	Loc138	2	Head on	Heineken	AD	SD	SP	FM
Mall	Loc144	2	Head on	Estee Lauder	SP	FM	AD	SD
Mall	Loc141	2	Head on	BMW	SD	SP	FM	AD
Mall	Loc136	12	Head on	Victor & Rolf	FM	AD	SD	SP
Mall	Loc142	2	Parallel	Bell & Ross	AD	SD	SP	FM
Mall	Loc140	2	Parallel	Miss Dior	FM	AD	SD	SP
Mall	Loc143	2	Head on	Robinson Crusoe	AD	SD	SP	FM
Mall	Loc137	2	Head on	Mango	FM	AD	SD	SP
Mall	Loc135	12	Head on	Cadbury	SP	FM	AD	SD
Drive 2	Loc230	2	Parallel	Coca-Cola	SP	FM	AD	SD
Drive 2	Loc231	2	Head on	BMW	FM	AD	SD	SP
Drive 2	Loc232	12	Head on	Grey Goose Vodka	SP	FM	AD	SD
Drive 2	Loc233	12	Parallel	Stella Artois	SD	SP	FM	AD
Drive 2	Loc234	2	Head on	Chanel	AD	SD	SP	FM
Drive 2	Loc235	12	Parallel	Air New Zealand	AD	SD	SP	FM
Drive 2	Loc236	2	Head on	Amazon Kindle	SD	SP	FM	AD
Drive 2	Loc203	12	Head on	Shell	FM	AD	SD	SP
Drive 2	Loc202	2	Head on	Estee Lauder	SP	FM	AD	SD
Drive 2	Loc237	2	Head on	Mango	SD	SP	FM	AD
Drive 2	Loc200	2	Parallel	H&M English	AD	SD	SP	FM
Walk to Rail station	Loc200	2	Head on	Bad Neighbours	SD	SP	FM	AD
Walk to Rail station	Loc201	12	Head on	Netflix	SD	SP	FM	AD
Railway Entry	Loc300	12	Head on	KFC	FM	AD	SD	SP
Railway Entry	Loc301	12	Parallel	Jaguar	AD	SD	SP	FM
Railway Entry	Loc302	2	Head on	Bell & Ross	SP	FM	AD	SD
Railway Entry	Loc303	0.2	Parallel	Heineken	SD	SP	FM	AD
Railway Entry	Loc304	0.2	Parallel	Miss Dior	AD	SD	SP	FM
Railway Entry	Loc305	2	Head on	Thierry Mugler - Angel	SD	SP	FM	AD
Railway Entry	Loc306	2	Parallel	Robinson Crusoe	AD	SD	SP	FM
Railway Entry	Loc307	2	Parallel	Taylor Swift	FM	AD	SD	SP
Railway Entry	Loc308	12	Parallel	Corona	FM	AD	SD	SP
Railway Entry	Loc309	12	Head on	Cadbury	AD	SD	SP	FM
Railway Exit	Loc308	12	Head on	Hennessey	FM	AD	SD	SP
Railway Exit	Loc310	2	Parallel	Burberry	SP	FM	AD	SD
Railway Exit	Loc306	2	Head on	Boucheron	AD	SD	SP	FM
Railway Exit	Loc311	0.2	Parallel	Nobody's Child	FM	AD	SD	SP
Railway Exit	Loc312	0.2	Parallel	SkyRide	SP	FM	AD	SD
Railway Exit	Loc313	2	Head on	Tarzan	FM	AD	SD	SP
Railway Exit	Loc314	12	Head on	National Geographic	SP	FM	AD	SD
Walk to Metro	Loc200	2	Head on	Bell & Ross	FM	AD	SD	SP
Walk to Metro	Loc201	12	Head on	Netflix	SD	SP	FM	AD
Metro Entry	Loc204	2	Head on	Bad Neighbours	SP	FM	AD	SD
Metro Entry	Loc210	2	Parallel	Taylor Swift	SP	FM	AD	SD
Metro Entry	Loc211	2	Parallel	SkyRide	SD	SP	FM	AD
Metro Entry	Loc212	2	Parallel	Nobody's Child	AD	SD	SP	FM
Metro Entry	Loc213	2	Parallel	Burberry	FM	AD	SD	SP
Metro Entry	Loc214	0.2	Parallel	Miss Dior	FM	AD	SD	SP
Metro Entry	Loc220	0.2	Parallel	Heineken	SP	FM	AD	SD
Metro Entry	Loc226	12	Parallel	Jaguar	SP	FM	AD	SD
Metro Entry	Loc227	12	Parallel	National Geographic	SD	SP	FM	AD
Metro Entry	Loc228	12	Parallel	Corona	AD	SD	SP	FM
Metro Entry	Loc229	12	Parallel	Cadbury	FM	AD	SD	SP
Metro Exit	Loc227	12	Head on	KFC	SD	SP	FM	AD
Metro Exit	Loc226	12	Parallel	Dom Perignon	SP	FM	AD	SD
Metro Exit	Loc220	0.2	Parallel	Bulgari	SD	SP	FM	AD
Metro Exit	Loc214	0.2	Parallel	Kung Fu Panda	AD	SD	SP	FM
Metro Exit	Loc213	2	Parallel	Thierry Mugler - Angel	FM	AD	SD	SP
Metro Exit	Loc212	2	Parallel	Tarzan	AD	SD	SP	FM
Metro Exit	Loc211	2	Parallel	Calvin Klein	SD	SP	FM	AD
Metro Exit	Loc210	2	Parallel	Prada	SP	FM	AD	SD
Metro Exit	Loc209	2	Parallel	RSM	FM	AD	SD	SP

Table 2: All cell rotations

PARTICIPANT CELLS

Cell	1	2	3	4	5	6	7	8	9	10	11	12
Environments	Drive 1				Drive 2				Drive 3			
	Walk 1				Walk 2				Walk 3			
	Mall				Railway				Metro			
Rotation	A	B	C	D	A	B	C	D	A	B	C	D

Table 3: Participant cells, environments and rotations

RESULTS

LIKELIHOOD TO SEE

The primary metric under investigation in the research was the percentage of 'target ads' that are seen by participants. Digital screens allow media owners to show a number of ads in rotation on the same screen (a typical rotation is a loop is six ads, each shown for 10 seconds). For instance, if a screen is viewable for 60 seconds as a pedestrian walks in a mall, they might be exposed to six separate ads via the same digital screen. In contrast, static frames necessarily show the same ad for the whole of the time available. But if a specific ad in a rotation in a digital frame (the 'target ad') is only available to be seen for 1/6th of the time available, does that mean that it only gets by 1/6th of the audience?

The answer is no. Target ads in digital rotations are almost as likely to be seen as static posters by pedestrians, and more likely to be seen drivers.

Looking across all frame sizes and eccentricities, figure 5 shows the results for drivers and pedestrians across the different formats, firstly, the likelihood to see the frame at all (regardless of which ad is playing, if it is a digital frame), and then to see the target ad within the frame.

Overall, digital frames are more likely to be seen than static paper posters, for both pedestrians and drivers. Where static posters are seen by 40% of drivers, even a static digital frame is seen by 51%. These views do not entirely go to the target ad – but almost everyone who sees the frame sees the target ad (49%).

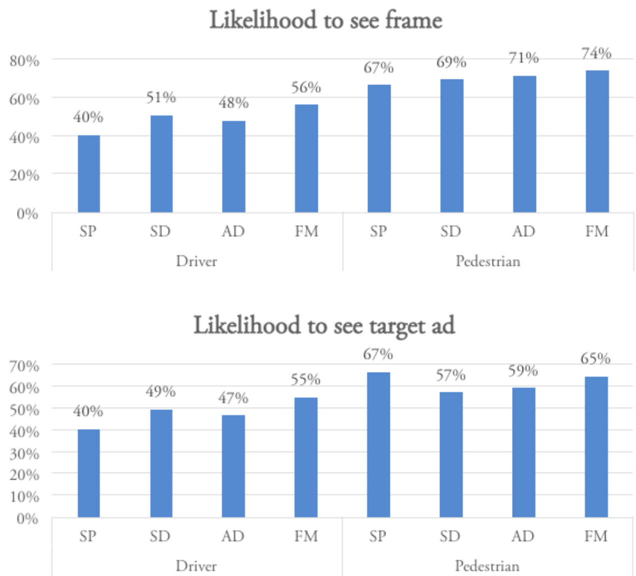


Figure 5: Likelihood to see across drivers & pedestrians

This is because the passage duration of a driver is relatively quick, meaning that for the period that the screen is within the visibility distance, the target ad is necessarily mostly shown. Interestingly, animated digital ads perform similarly to static digital in terms of likelihood to be seen. The small decrease in LTS for animated digital is not statistically significant. Full motion video does have a significant benefit beyond static digital though, increasing the LTS the target ad to 55%. This implies that for drivers are 35% more likely to see full motion digital ads that they are exposed to. This effect is due to the combination of the greater visibility of a digital screen that comes from its illumination, and the additional movement and opportunity for more engaging creative that full motion video ads are afforded.

Similar effects are seen for pedestrians. As with drivers, digital frames are more likely to be seen than static paper posters, with larger effects for full motion video. One difference however with drivers however is that pedestrians are slightly less likely to see the target ad. This is because pedestrians have much longer passage durations than drivers. A static poster may be visible for up to minute, assuming a full passage at normal walking speed to a large poster. This gives a long "opportunity to see". Digital ads have a smaller window of opportunity to get noticed. During this window they are more likely to be noticed than if they were paper, with this effect offsetting the fact that there is less time to see the ad.

RESULTS

LIKELIHOOD TO SEE (CONTINUED)

To illustrate this point further, figure 6 shows the dwell times people spend looking at frames at different distances. For drivers, an ad may be visible from quite some distance. However, they tend to actually engage with it only when it is quite close: attention to advertising is bunched towards the end of the viewable duration time, with digital screens getting significantly more attention than static panels. Pedestrians, on the other hand, are more likely to attend to ads as soon as they become visible, and attention is more evenly distributed across the time available. As with drivers, digital screens are more likely to be noticed at every stage.

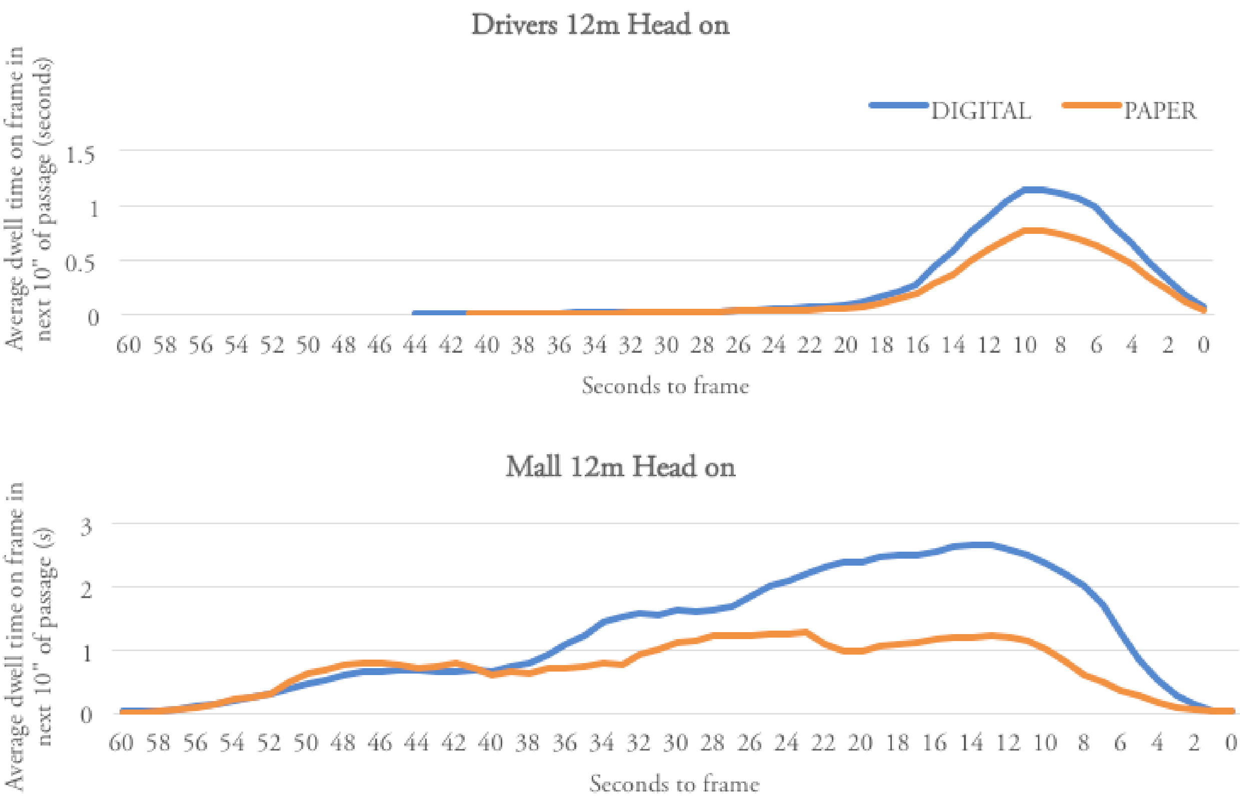


Figure 6: Ad dwell times for drivers & pedestrians by seconds to frame

LIKELIHOOD TO SEE (CONTINUED)

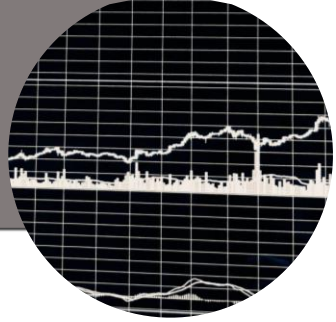
Table 4 shows the likelihood to see the target ad for each type of contact of interest, across all the different combinations, as well as the implied indices of digital performance based against static paper.

		Driver				Internal					Roadside pedestrian		
		Head on		Parallel		Head on		Parallel			Head on	Parallel	
		2m	12m	2m	12m	2m	12m	2m	12m	0.2m	12m	12m	2m
LTS target ad	SP	49%	59%	4%	22%	77%	75%	57%	65%	65%	63%	75%	84%
	SD	58%	63%	9%	42%	66%	74%	39%	50%	62%	67%	63%	82%
	AD	54%	59%	10%	35%	66%	68%	44%	61%	58%	77%	76%	83%
	FM	66%	67%	18%	36%	78%	75%	44%	61%	67%	83%	71%	88%
Index vs. SP	SD	1.18	1.07	1.90	1.93	0.86	0.99	0.68	0.77	0.97	1.06	0.83	0.98
	AD	1.09	1.01	2.17	1.63	0.86	0.90	0.78	0.93	0.90	1.21	1.01	0.99
	FM	1.33	1.14	3.97	1.69	1.01	1.00	0.77	0.94	1.05	1.32	0.95	1.04

Table 4: Relative standout & dwell times of ads from differing vantage points

This research demonstrates that digital advertising is significantly more eye catching than static posters. Each digital ad in a rotation is almost as likely to be seen as static poster ad in the same location, despite their lower time in view to the audience. For drivers, the LTS of target ads on digital screens is in fact higher than static ad. Full motion digital screens gain a third more attention than static paper for both drivers and pedestrians.

RESULTS



STATISTICAL TESTING

Statistical analysis has been performed over the data in order to determine robustness of the findings, and give guidance on which factors are important influencing the relative impact of digital vs static.

Table 5 shows p-values[1] for statistical tests of LTS target ad for the 3 digital formats, each versus the null hypothesis of equivalence to static paper. This supports the overall robustness of the research, with highly statistically significant results for drivers and internal pedestrians, and weakly significant results for roadside pedestrians. The weaker results for roadside pedestrians are mainly generated by the sample sizes involved (there were fewer roadside contacts in the environments), rather than the size of the effect. As statistical significance should not be confused with economic significance, the roadside results can be understood as valid to be applied, with their directional similarity to the internal pedestrians supporting the likelihood that similarly robust differences would occur at larger samples. Details of these hypothesis tests are in Appendix 1.

	Driver	Internal	Roadside pedestrian
SP vs. SD	0.000	0.000	0.386
SP vs. AD	0.002	0.000	0.082
SP vs. FM	0.000	0.048	0.045

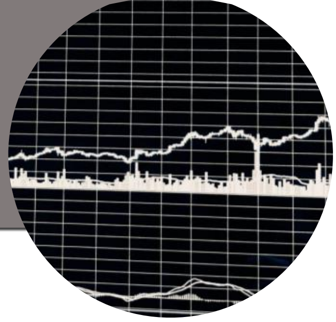
Table 5: P-values of tests of difference in LTS target ad[2]

In order to understand which of the factors under investigation have an influence on the size of the digital impact on audience size, alternative specifications of regression models were built and compared. A batch of Generalised Linear Regression models were created using a Logit link function as appropriate for proportions like likelihood to see. Different models can be evaluated according to their "Akaike Information Criteria" (similar to an R^2, but appropriate for modelling proportions). A lower AIC indicates an improved model specification, in the sense that the information in the data is being used more efficiently. Details of these regression models are in Appendix 2.

Model	AIC
General model with all interactions	15193
Static and Animated digital equivalent	15172
Static, Animated and Full motion equivalent	15192
Digital effects equivalent across sizes	15167
Digital effects equivalent across sizes and approaches (differing by environment only)	15172
Digital effects equivalent across sizes and environments (differing by approach only)	15224

Table 6: Statistical modelling across AIC numbers

[2] Note: A p-value of less than 0.01 means significant at 99% confidence, p<0.05 is 95% confidence, and so on



STATISTICAL TESTING

The most general model includes all possible interactions between the factors. This model assumes that it is necessary for all combinations of poster size, environment, eccentricity and ad format to be distinctly measured, with no equivalence in effects across any dimensions. As can observed in the tables below, animated digital tends to perform similarly to static digital, and this is supported by a lower AIC for a model that assumes they work equivalently. Further reduction in the model could be achieved by assuming that the relative effects of the different formats are equivalent across the different sizes of ads. This is as simplified as the model could be however; simplifying further by assuming that the uplifts were equivalent for different eccentricities or for different environments raised the AIC, indicating that these simplifications left some important information in the data unused.

The analysis supports the ultimate use of 12 indices, as below

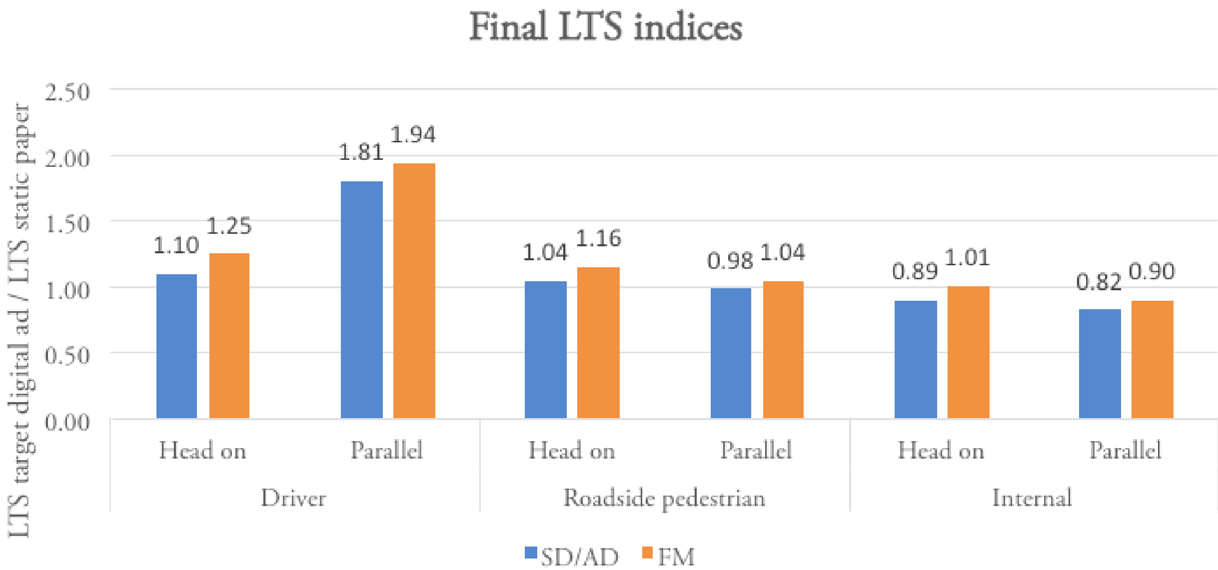


Figure 7: LTS across vantage points

IMPLEMENTATION

The research provides indices of the relative attention given to digital ads versus static posters for those who are exposed to them. This is however only part of the story. In order to implement these indices it is necessary to also include in the calculations a measure of the viewability of digital ads. Because digital ads appear on rotation with other ads, and audience passages can be shorter than the full loop of all the ads on a screen, only a fraction of the overall frame audience will be exposed to the ad. Its only for this fraction of the audience that benefits from the increased attention from digital screens and full motion creative.

Unlike viewability for internet advertising, viewability for OOH can be understood without recourse to experimental or tracking data. For static posters, audience measurement protocols ensure viewability is 100%. Audiences are only counted if they are exposed to both sides of a poster, and if obstructions never obscure more than 10% of an ad. For digital OOH ads, the situation is slightly more complex ads, as typically ads are on rotation with others, meaning not all of the total frame audience will be exposed to a particular ad. Fortunately, a relatively simple formula can be applied to calculate the viewability of an ad in a digital OOH site. This factors in the length of the ad, the number of ads on rotation, and the passage duration for audiences.

Digital OOH viewability formula

$$\% \text{ Viewable} = \min\left(\frac{\textit{Passage duration} + \textit{Spot duration} - 2}{\textit{Loop duration}}, 100\%\right)$$

The intuition behind this formula is explained in figure 8. To begin with, we assume that a frame's audience will pass the frame at different points in the loop of the ads, and that there is an equal chance that an individual's passage will start at any given moment in the loop. Assuming the loop is 60" long, there is a 1 in 60 chance that an individual will start their passage in any particular second in the entire loop. Our aim now is to understand the chance that an individual's passage will occur such that they will be exposed to at least 1" of the target ad. Any passage that begins at most 1 second less than the total passage duration before the target ad will be exposed to at least 1" of the ad, as will any passage that begins before the final second of the target ad.

Naturally, viewability cannot go over 100%, so it is capped at this level, should the passage be long enough for people to be exposed to some ads more than once.

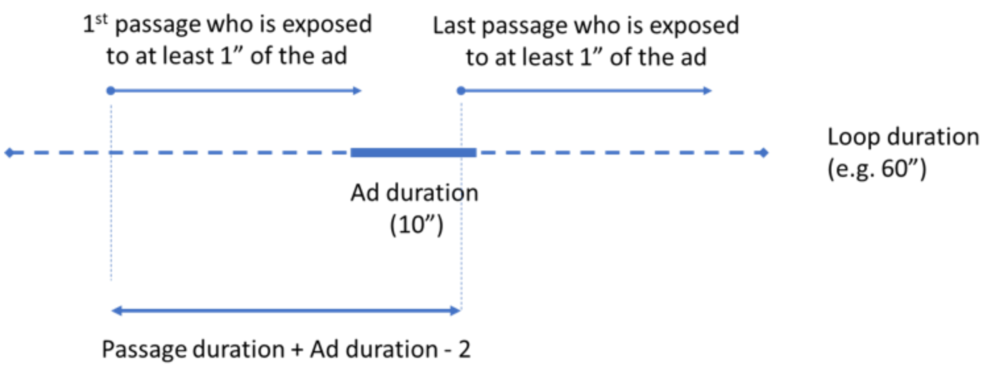


Figure 8: Derivation of viewability formula

CONCLUSIONS

In order to calculate the proportion of the frame's audience that will view a given digital ad, this viewability formula can be combined with the indices for the uplift in LTS measured in this research, as well as existing visibility adjustment figures for static paper, in the following way.

METRIC	Static paper LTS	X	Digital OOH viewability	X	Digital attraction multiplier	=	Digital LTS
MEASUREMENT	What % of a frame audience views a static paper ad?		When digital, what % of the frame audience is exposed to an individual ad?		How much more does digital attract the eye vs static paper?		What % of the frame audience views an individual digital ad?
SOURCE	Existing visibility research		Viewability equation		LTS DOOH / LTS SP		

Figure 9: Method for implementing research findings with existing visibility research for static paper

The rationale for this using this formula to implement the research findings is that doing so makes the best use of the available research data. One alternative would have been to use the data we collected on the LTS of different frame types more directly. However, this study has focused on measuring the *relative* attention levels of static and digital ads, rather than the *absolute* levels. Existing visibility research typically provides a more comprehensive view on the overall likelihood to see static posters than we obtained in this study.

Among others, Route research in the UK is an instructive case. This research, as an example, involved showing participants a series of photographs, some of which contained poster sites, each for 6 seconds. The range of aspects displayed in these photographs provides a full picture of how people attend to poster sites from many different perspectives. For example, the 2008 study *An integrative eye-tracking study of visibility hit rates for poster panels in UK environments*, conducted by Dr. Paul Barber, involved 580 photographs[3]. In contrast, this research involved a more limited set of different approaches and visual aspects on poster sites. Indeed, part of the research design was to tightly control approach so a fair test was conducted between the different format types. While each contact type was represented in the test by a several locations, the variety in approach was necessarily more limited. Accordingly, the static paper results from this research should not be seen as competing with those from existing visibility research; studies such as Route's reflect the large range of possible approaches to a poster that people may take, in a way that this research does not. This study measures the differential in LTS between static paper and digital ads *for the same approaches*. The methodology selected is suited to this particular purpose, which is distinct from previous static paper visibility research, and should be considered as separate and complementary.

3. http://route.org.uk/wp-content/uploads/2017/07/Visibility-Research-Visibility-Hit-Rates-for-Poster-Panels.pdf

CONCLUSIONS

IMPLEMENTATION (CONTINUED)

Some indicative results from applying this approach are shown in the table below, using reasonable assumptions about passage durations of the different contact types.

Audience	Size	Approach	Passage duration	Spot duration	Loop duration	Viewable % (Digital)	Digital attraction multiplier Av LTS target digital/LTS target SP		Overall % of SP audience		Overall % of SP audience - Indexed vs 1/6th	
							S/AD	FM	S/AD	FM	S/AD	FM
Drive	2	Head on	7	10	60	25%	1.10	1.25	27%	31%	1.6	1.9
	2	Parallel	3	10	60	18%	1.81	1.94	33%	36%	2.0	2.1
	12	Head on	13	10	60	35%	1.10	1.25	38%	44%	2.3	2.6
	12	Parallel	7	10	60	25%	1.81	1.94	45%	49%	2.7	2.9
Internal	2	Head on	25	10	60	55%	0.89	1.01	49%	55%	3.0	3.3
	2	Parallel	15	10	60	38%	0.82	0.90	32%	34%	1.9	2.1
	12	Head on	35	10	60	72%	0.89	1.01	64%	72%	3.8	4.3
	12	Parallel	20	10	60	47%	0.82	0.90	38%	42%	2.3	2.5
Roadside pedestrian	2	Head on	30	10	60	63%	1.04	1.16	66%	73%	4.0	4.4
	2	Parallel	20	10	60	47%	0.98	1.04	46%	49%	2.8	2.9
	12	Head on	40	10	60	80%	1.04	1.16	83%	92%	5.0	5.5

Figure 10: Indicative relative audiences

CONCLUSIONS

IMPLICATIONS

These results lead to a several important conclusions for both advertisers and media owners:

- Owing to the reduction in viewability, the audience for an individual digital ad is lower than a static paper ad. However, the reduction is much less than the reduction in time in view. The share of the frame audience who view an ad can usually be expected to be at least double its share of time shown, and in some cases three, four or even 5 times.
- The relative sizes of audiences for static paper and digital ads varies quite considerably between different environments. Digital ad audiences are a higher proportion of static paper audiences for pedestrians than drivers, as their slower passage allows for exposure to several digital ads, and each is almost as likely to be seen as static paper, despite having less time in view. Digital ads receive lower viewability rates than pedestrians, although they are offset somewhat by a higher likelihood to be seen for those exposed compared to static paper.
- While the audience for an individual digital ad is lower than a static paper ad, the value of a digital screen is considerably more than a static paper poster site, since they can host several advertisers at once. This supports further investment by media owners.
- Full motion video is significantly more eye catching than static digital or digital with light animation. Advertisers will likely see improved campaign and brand awareness by using creative that takes employs full motion video.

[1] Note: Any views occurring beyond the visibility distance have been removed from the analysis entirely. It is assumed that any views beyond this distance are unlikely to be effective for a brand, as the ad is not discernible

CONCLUSIONS

OUTSTANDING RESEARCH QUESTIONS

This research provides both media owners and advertisers with robust figures with which to determine the audience for digital OOH ads. The viewability formula also allows for considerable flexibility in different specifications in the length of ads and the number of ads on rotation. This research provides firm answers to advertisers wishing to know their digital ads are to be seen, on average. There remains however, several outstanding questions about the most effective use of digital screens, such as:

1. Time of day: Does targeting adverts at appropriate times of day increase engagement?

2. Ad length: All digital ads in this research were 10" in duration. The viewability formula allows an understanding of the effect of different ad lengths on exposure, but how does ad length effect how likely exposures are to be seen?

3. Frequency: How does frequency of exposure influence LTS (and dwell time)? Do multiple exposures to digital ads work differently to multiple exposures of static paper?

4. Passage speed: The environments involved exposures in which drivers were travelling both in towns and on dual carriageways, giving us a mix of passage speeds to calculate average effects. It is likely that drivers in heavy traffic would receive considerably higher levels of viewability and exposure to many more ads, and this may affect their LTS target ads. Similarly, all pedestrians were walking at typical speeds in our environments, but clearly many contacts occur when individuals are more stationary. How does attention and viewability change at different passage speeds?

5. Branding and message take-out: Given the higher engagement full motion video receives, how should ads be designed to ensure messages land and the brand is attributed? How does this vary across different environments?

APPENDIX

APPENDIX

1. HYPOTHESIS TESTS

Environment	Format 1	Format 2	n1	n2	p1	p2	p hat	z	p-value	Conclusion (95%)
Driver	1.SP	2.SD	1283	1283	40%	49%	45%	4.7	0.000	Significantly higher LTS
	1.SP	3.AD	1283	1284	40%	47%	43%	3.3	0.002	Significantly higher LTS
	1.SP	4.FM	1283	1277	40%	55%	48%	7.5	0.000	Significantly higher LTS
	2.SD	3.AD	1283	1284	49%	47%	48%	-1.4	0.149	Cannot reject null hypothesis of no statistical difference
	S/AD	4.FM	5127	1277	48%	55%	49%	4.6	0.000	Significantly higher LTS
Internal	1.SP	2.SD	1581	1544	66%	55%	61%	-6.1	0.000	Significantly lower LTS
	1.SP	3.AD	1581	1555	66%	57%	61%	-5.5	0.000	Significantly lower LTS
	1.SP	4.FM	1581	1585	66%	63%	64%	-2.1	0.048	Significantly lower LTS
	2.SD	3.AD	1544	1555	55%	57%	56%	0.6	0.324	Cannot reject null hypothesis of no statistical difference
	S/AD	4.FM	6265	1585	60%	63%	61%	1.7	0.091	Cannot reject null hypothesis of no statistical difference
Roadside pedestrian	1.SP	2.SD	210	225	70%	69%	70%	-0.3	0.386	Cannot reject null hypothesis of no statistical difference
	1.SP	3.AD	210	218	70%	78%	74%	1.8	0.082	Cannot reject null hypothesis of no statistical difference
	1.SP	4.FM	210	208	70%	79%	75%	2.1	0.045	Significantly higher LTS
	2.SD	3.AD	225	218	69%	78%	74%	2.1	0.047	Significantly higher LTS
	S/AD	4.FM	861	208	74%	79%	75%	1.5	0.123	Cannot reject null hypothesis of no statistical difference

Environment	Format 1	Format 2	n1	n2	p1	p2	p hat	z	p-value	Conclusion (95)%
Driver	1.SP	S/AD	1283	5127	40%	48%	46%	4.9	0.000	Significantly higher LTS
	1.SP	4.FM	1283	1277	40%	55%	48%	7.5	0.000	Significantly higher LTS
Internal	1.SP	S/AD	1581	6265	66%	60%	61%	-4.3	0.000	Significantly lower LTS
	1.SP	4.FM	1581	1585	66%	63%	64%	-2.1	0.048	Significantly lower LTS
Roadside pedestrian	1.SP	S/AD	210	861	70%	74%	73%	1.1	0.218	Cannot reject null hypothesis of no statistical difference
	1.SP	4.FM	210	208	70%	79%	75%	2.1	0.045	Significantly higher LTS

2. DETAILS OF REGRESSION MODELS

2. 1 General model with all interactions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.03962	0.10522	-0.37652	0.706532
ActionMall	1.818996	0.397726	4.573493	4.80E-06
ActionMetro	-3.66173	28.27337	-0.12951	0.896953
ActionRailway	1.112059	0.263473	4.22077	2.43E-05
ActionWalk	0.518303	0.273923	1.892151	0.058471
Size..m.	0.030758	0.014587	2.108587	0.03498
Head.on..ParallelParallel	-3.28273	0.424435	-7.73436	1.04E-14
digitalTRUE	0.359384	0.149979	2.396226	0.016565
animationTRUE	-0.10929	0.150532	-0.72604	0.467814
full_motionTRUE	0.339122	0.15464	2.19297	0.02831
ActionMall:Size..m.	0.181855	0.105283	1.727291	0.084115
ActionMetro:Size..m.	1.491527	14.13525	0.105518	0.915965
ActionRailway:Size..m.	-0.08922	0.030876	-2.88975	0.003855
ActionWalk:Size..m.	0.011634	0.036869	0.315544	0.752348
ActionMall:Head.on..ParallelParallel	0.054847	0.512274	0.107065	0.914737
ActionMetro:Head.on..ParallelParallel	7.443716	28.27656	0.263247	0.79236
ActionRailway:Head.on..ParallelParallel	2.650784	0.510801	5.189462	2.11E-07
ActionWalk:Head.on..ParallelParallel	4.105665	0.603673	6.801138	1.04E-11
Size..m.:Head.on..ParallelParallel	0.143785	0.040045	3.590567	0.00033
ActionMall:digitalTRUE	-0.92248	0.47886	-1.92641	0.054053
ActionMetro:digitalTRUE	1.937748	28.27689	0.068528	0.945366
ActionRailway:digitalTRUE	-0.89548	0.363186	-2.46562	0.013678
ActionWalk:digitalTRUE	0.012701	0.385218	0.032971	0.973698
Size..m.:digitalTRUE	-0.01363	0.020803	-0.65535	0.512244
Head.on..ParallelParallel:digitalTRUE	0.277799	0.539675	0.514753	0.606725
ActionMall:animationTRUE	0.154149	0.378451	0.407314	0.683777
ActionMetro:animationTRUE	0.730448	0.59838	1.22071	0.222196
ActionRailway:animationTRUE	0.178889	0.35313	0.506582	0.612448
ActionWalk:animationTRUE	0.471058	0.399449	1.179269	0.238291
Size..m.:animationTRUE	-0.00297	0.020816	-0.14258	0.886623
Head.on..ParallelParallel:animationTRUE	0.362196	0.455963	0.794354	0.426989
ActionMall:full_motionTRUE	0.406309	0.417775	0.972556	0.330774
ActionMetro:full_motionTRUE	0.855215	0.6081	1.406372	0.159614
ActionRailway:full_motionTRUE	0.075884	0.364434	0.208223	0.835054
ActionWalk:full_motionTRUE	0.311209	0.42745	0.728059	0.466577
Size..m.:full_motionTRUE	-0.00549	0.021526	-0.25504	0.798689
Head.on..ParallelParallel:full_motionTRUE	0.71131	0.418615	1.6992	0.089282
ActionMetro:Size..m.:Head.on..ParallelParallel	-1.63926	14.13531	-0.11597	0.907677
ActionRailway:Size..m.:Head.on..ParallelParallel	-0.11113	0.054746	-2.02986	0.042371
ActionMall:Size..m.:digitalTRUE	-0.17429	0.112391	-1.55072	0.120968
ActionMetro:Size..m.:digitalTRUE	-1.15312	14.13549	-0.08158	0.934984
ActionRailway:Size..m.:digitalTRUE	0.074327	0.04359	1.705155	0.088166
ActionWalk:Size..m.:digitalTRUE	-0.05346	0.050758	-1.05332	0.292197

2. 1 General model with all interactions (cont.)

	Estimate	Std. Error	z value	Pr(>|z|)
ActionMall:Head.on..ParallelParallel:digitalTRUE	0.45057	0.664768	0.677785	0.497908
ActionMetro:Head.on..ParallelParallel:digitalTRUE	-3.06389	28.28202	-0.10833	0.913731
ActionRailway:Head.on..ParallelParallel:digitalTRUE	-0.18236	0.667344	-0.27326	0.784653
ActionWalk:Head.on..ParallelParallel:digitalTRUE	-0.76862	0.810708	-0.94808	0.343088
Size..m.:Head.on..ParallelParallel:digitalTRUE	0.033513	0.05165	0.648851	0.516435
ActionMall:Size..m.:animationTRUE	-0.0127	0.054737	-0.23193	0.816591
ActionMetro:Size..m.:animationTRUE	-0.09825	0.107132	-0.91714	0.359071
ActionRailway:Size..m.:animationTRUE	-0.03183	0.043189	-0.737	0.461125
ActionWalk:Size..m.:animationTRUE	0.031025	0.05227	0.593554	0.552811
ActionMall:Head.on..ParallelParallel:animationTRUE	-0.31753	0.589195	-0.53891	0.589946
ActionMetro:Head.on..ParallelParallel:animationTRUE	-0.95659	0.75134	-1.27318	0.202955
ActionRailway:Head.on..ParallelParallel:animationTRUE	-0.42117	0.595111	-0.70771	0.479125
ActionWalk:Head.on..ParallelParallel:animationTRUE	-0.73301	0.783682	-0.93534	0.349615
Size..m.:Head.on..ParallelParallel:animationTRUE	-0.0344	0.045072	-0.76332	0.44527
ActionMall:Size..m.:full_motionTRUE	-0.03088	0.058727	-0.52578	0.599041
ActionMetro:Size..m.:full_motionTRUE	-0.08085	0.114466	-0.70635	0.479971
ActionRailway:Size..m.:full_motionTRUE	-0.02551	0.044153	-0.57769	0.563472
ActionWalk:Size..m.:full_motionTRUE	-0.00785	0.053149	-0.14772	0.882561
ActionMall:Head.on..ParallelParallel:full_motionTRUE	-0.94647	0.585356	-1.61691	0.105898
ActionMetro:Head.on..ParallelParallel:full_motionTRUE	-1.83013	0.736449	-2.48508	0.012952
ActionRailway:Head.on..ParallelParallel:full_motionTRUE	-0.75757	0.573336	-1.32133	0.186391
ActionWalk:Head.on..ParallelParallel:full_motionTRUE	-0.79534	0.795622	-0.99965	0.31748
Size..m.:Head.on..ParallelParallel:full_motionTRUE	-0.0857	0.042674	-2.0082	0.044622
ActionMetro:Size..m.:Head.on..ParallelParallel:digitalTRUE	1.111527	14.13559	0.078633	0.937324
ActionRailway:Size..m.:Head.on..ParallelParallel:digitalTRUE	-0.09553	0.074218	-1.28721	0.198022
ActionMetro:Size..m.:Head.on..ParallelParallel:animationTRUE	0.160351	0.116823	1.372596	0.169878
ActionRailway:Size..m.:Head.on..ParallelParallel:animationTRUE	0.108126	0.069681	1.551729	0.120727
ActionMetro:Size..m.:Head.on..ParallelParallel:full_motionTRUE	0.213475	0.122646	1.740572	0.081759
ActionRailway:Size..m.:Head.on..ParallelParallel:full_motionTRUE	0.120934	0.068281	1.771126	0.07654

Null deviance: 16810 on 12252 degrees of freedom
Residual deviance: 15049 on 12181 degrees of freedom
AIC: 15193

2. 2 Static and animated digital acting equivalently

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.03962	0.10522	-0.37652	0.706532
ActionMall	1.818996	0.397726	4.573493	4.80E-06
ActionMetro	-3.66173	28.27337	-0.12951	0.896953
ActionRailway	1.112059	0.263473	4.22077	2.43E-05
ActionWalk	0.518303	0.273923	1.892151	0.058471
Size..m.	0.030758	0.014587	2.108587	0.03498
Head.on..ParallelParallel	-3.28273	0.424435	-7.73436	1.04E-14
digitalTRUE	0.304673	0.129349	2.355436	0.018501
full_motionTRUE	0.393832	0.134726	2.923211	0.003464
ActionMall:Size..m.	0.181855	0.105283	1.727291	0.084115
ActionMetro:Size..m.	1.491527	14.13525	0.105518	0.915965
ActionRailway:Size..m.	-0.08922	0.030876	-2.88975	0.003855
ActionWalk:Size..m.	0.011634	0.036869	0.315544	0.752348
ActionMall:Head.on..ParallelParallel	0.054847	0.512274	0.107065	0.914737
ActionMetro:Head.on..ParallelParallel	7.443716	28.27656	0.263247	0.79236
ActionRailway:Head.on..ParallelParallel	2.650784	0.510801	5.189462	2.11E-07
ActionWalk:Head.on..ParallelParallel	4.105665	0.603673	6.801138	1.04E-11
Size..m.:Head.on..ParallelParallel	0.143785	0.040045	3.590567	0.00033
ActionMall:digitalTRUE	-0.84493	0.440425	-1.91844	0.055055
ActionMetro:digitalTRUE	2.327479	28.27492	0.082316	0.934395
ActionRailway:digitalTRUE	-0.80554	0.317147	-2.53997	0.011086
ActionWalk:digitalTRUE	0.243272	0.338073	0.719583	0.471782
Size..m.:digitalTRUE	-0.01518	0.017915	-0.84736	0.396796
Head.on..ParallelParallel:digitalTRUE	0.463095	0.481466	0.961842	0.336129
ActionMall:full_motionTRUE	0.328757	0.373099	0.881153	0.378235
ActionMetro:full_motionTRUE	0.465485	0.508514	0.915381	0.359992
ActionRailway:full_motionTRUE	-0.01405	0.318576	-0.0441	0.964824
ActionWalk:full_motionTRUE	0.080639	0.385505	0.209177	0.83431
Size..m.:full_motionTRUE	-0.00394	0.01875	-0.21027	0.83346
Head.on..ParallelParallel:full_motionTRUE	0.526015	0.340293	1.54577	0.12216
ActionMetro:Size..m.:Head.on..ParallelParallel	-1.63926	14.13531	-0.11597	0.907677
ActionRailway:Size..m.:Head.on..ParallelParallel	-0.11113	0.054746	-2.02986	0.042371
ActionMall:Size..m.:digitalTRUE	-0.18082	0.108773	-1.66235	0.096442
ActionMetro:Size..m.:digitalTRUE	-1.20555	14.13535	-0.08529	0.932034
ActionRailway:Size..m.:digitalTRUE	0.058263	0.037656	1.547239	0.121806
ActionWalk:Size..m.:digitalTRUE	-0.03997	0.044959	-0.88903	0.373988
ActionMall:Head.on..ParallelParallel:digitalTRUE	0.287883	0.590741	0.487324	0.626029
ActionMetro:Head.on..ParallelParallel:digitalTRUE	-3.57112	28.27901	-0.12628	0.899509
ActionRailway:Head.on..ParallelParallel:digitalTRUE	-0.39806	0.590877	-0.67368	0.500512
ActionWalk:Head.on..ParallelParallel:digitalTRUE	-1.12891	0.718864	-1.57041	0.116319
Size..m.:Head.on..ParallelParallel:digitalTRUE	0.016149	0.045924	0.351655	0.725097
ActionMall:Size..m.:full_motionTRUE	-0.02435	0.051465	-0.47305	0.636175
ActionMetro:Size..m.:full_motionTRUE	-0.02842	0.095999	-0.29603	0.767205
ActionRailway:Size..m.:full_motionTRUE	-0.00944	0.038307	-0.24651	0.805287
ActionWalk:Size..m.:full_motionTRUE	-0.02135	0.047642	-0.44804	0.654127
ActionMall:Head.on..ParallelParallel:full_motionTRUE	-0.78378	0.499701	-1.5685	0.116765
ActionMetro:Head.on..ParallelParallel:full_motionTRUE	-1.3229	0.610107	-2.16831	0.030135
ActionRailway:Head.on..ParallelParallel:full_motionTRUE	-0.54186	0.482184	-1.12376	0.261114
ActionWalk:Head.on..ParallelParallel:full_motionTRUE	-0.43505	0.701806	-0.6199	0.535326
Size..m.:Head.on..ParallelParallel:full_motionTRUE	-0.06833	0.035529	-1.92333	0.054439
ActionMetro:Size..m.:Head.on..ParallelParallel:digitalTRUE	1.1954	14.13543	0.084568	0.932605
ActionRailway:Size..m.:Head.on..ParallelParallel:digitalTRUE	-0.04029	0.064829	-0.62154	0.534242
ActionMetro:Size..m.:Head.on..ParallelParallel:full_motionTRUE	0.129601	0.102786	1.260888	0.207349
ActionRailway:Size..m.:Head.on..ParallelParallel:full_motionTRUE	0.065694	0.057937	1.133883	0.256844

Null deviance: 16810 on 12252 degrees of freedom
Residual deviance: 15064 on 12199 degrees of freedom
AIC: 15172

2. 3 All digital effects equivalent

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.03962	0.10522	-0.37652	0.706532
ActionMall	1.818996	0.397726	4.573493	4.80E-06
ActionMetro	-3.66173	28.27337	-0.12951	0.896953
ActionRailway	1.112059	0.263473	4.22077	2.43E-05
ActionWalk	0.518303	0.273923	1.892151	0.058471
Size..m.	0.030758	0.014587	2.108587	0.03498
Head.on..ParallelParallel	-3.28273	0.424435	-7.73436	1.04E-14
digitalTRUE	0.432129	0.122217	3.535759	0.000407
ActionMall:Size..m.	0.181855	0.105283	1.727291	0.084115
ActionMetro:Size..m.	1.491527	14.13525	0.105518	0.915965
ActionRailway:Size..m.	-0.08922	0.030876	-2.88975	0.003855
ActionWalk:Size..m.	0.011634	0.036869	0.315544	0.752348
ActionMall:Head.on..ParallelParallel	0.054847	0.512274	0.107065	0.914737
ActionMetro:Head.on..ParallelParallel	7.443716	28.27656	0.263247	0.79236
ActionRailway:Head.on..ParallelParallel	2.650784	0.510801	5.189462	2.11E-07
ActionWalk:Head.on..ParallelParallel	4.105665	0.603673	6.801138	1.04E-11
Size..m.:Head.on..ParallelParallel	0.143785	0.040045	3.590567	0.00033
ActionMall:digitalTRUE	-0.76434	0.429408	-1.77999	0.075078
ActionMetro:digitalTRUE	2.498344	28.27436	0.088361	0.92959
ActionRailway:digitalTRUE	-0.81291	0.301459	-2.69659	0.007005
ActionWalk:digitalTRUE	0.246441	0.321989	0.765371	0.444051
Size..m.:digitalTRUE	-0.01665	0.016946	-0.98236	0.325924
Head.on..ParallelParallel:digitalTRUE	0.709328	0.455966	1.555661	0.119789
ActionMetro:Size..m.:Head.on..ParallelParallel	-1.63926	14.13531	-0.11597	0.907677
ActionRailway:Size..m.:Head.on..ParallelParallel	-0.11113	0.054746	-2.02986	0.042371
ActionMall:Size..m.:digitalTRUE	-0.18638	0.107776	-1.72933	0.083749
ActionMetro:Size..m.:digitalTRUE	-1.21573	14.13532	-0.08601	0.931461
ActionRailway:Size..m.:digitalTRUE	0.055933	0.035624	1.570105	0.116391
ActionWalk:Size..m.:digitalTRUE	-0.04476	0.042714	-1.04781	0.294726
ActionMall:Head.on..ParallelParallel:digitalTRUE	-0.00479	0.562605	-0.00851	0.993214
ActionMetro:Head.on..ParallelParallel:digitalTRUE	-4.09492	28.27804	-0.14481	0.884862
ActionRailway:Head.on..ParallelParallel:digitalTRUE	-0.64294	0.56001	-1.14809	0.250932
ActionWalk:Head.on..ParallelParallel:digitalTRUE	-1.31667	0.683219	-1.92715	0.053961
Size..m.:Head.on..ParallelParallel:digitalTRUE	-0.01207	0.04354	-0.27716	0.78166
ActionMetro:Size..m.:Head.on..ParallelParallel:digitalTRUE	1.244842	14.13539	0.088066	0.929825
ActionRailway:Size..m.:Head.on..ParallelParallel:digitalTRUE	-0.01326	0.06126	-0.21641	0.828666

Null deviance: 16810 on 12252 degrees of freedom
Residual deviance: 15120 on 12217 degrees of freedom
AIC: 15192

2. 4 Digital effects equivalent across all sizes

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	0.026294	0.080204	0.327837	0.743035
ActionMall	2.425381	0.289435	8.379702	5.31E-17
ActionMetro	-1.14221	0.339839	-3.36103	0.000777
ActionRailway	0.835543	0.183867	4.544282	5.51E-06
ActionWalk	0.724665	0.209188	3.464175	0.000532
Size..m.	0.018653	0.007448	2.504341	0.012268
Head.on..ParallelParallel	-3.10179	0.209993	-14.771	2.25E-49
digitalTRUE	0.222015	0.085006	2.611756	0.009008
full_motionTRUE	0.373019	0.088875	4.197128	2.70E-05
ActionMall:Size..m.	0.007117	0.021795	0.326552	0.744007
ActionMetro:Size..m.	0.316876	0.042682	7.424147	1.14E-13
ActionRailway:Size..m.	-0.04797	0.015416	-3.11185	0.001859
ActionWalk:Size..m.	-0.02239	0.018625	-1.20199	0.229369
ActionMall:Head.on..ParallelParallel	-0.40077	0.413987	-0.96807	0.333008
ActionMetro:Head.on..ParallelParallel	4.676392	0.400935	11.66373	1.95E-31
ActionRailway:Head.on..ParallelParallel	2.645732	0.296376	8.926954	4.38E-19
ActionWalk:Head.on..ParallelParallel	3.768637	0.515337	7.312957	2.61E-13
Size..m.:Head.on..ParallelParallel	0.13182	0.015589	8.455782	2.77E-17
ActionMall:digitalTRUE	-1.48058	0.296894	-4.98688	6.14E-07
ActionMetro:digitalTRUE	-0.30241	0.369294	-0.81889	0.412848
ActionRailway:digitalTRUE	-0.41663	0.185293	-2.24848	0.024545
ActionWalk:digitalTRUE	-0.0005	0.216901	-0.0023	0.998166
Head.on..ParallelParallel:digitalTRUE	0.545491	0.178872	3.049613	0.002291
ActionMall:full_motionTRUE	0.196395	0.244817	0.802213	0.42243
ActionMetro:full_motionTRUE	0.399173	0.370845	1.076389	0.281754
ActionRailway:full_motionTRUE	-0.08495	0.189248	-0.44887	0.653526
ActionWalk:full_motionTRUE	-0.06923	0.234751	-0.29491	0.768061
Head.on..ParallelParallel:full_motionTRUE	-0.13176	0.160267	-0.82215	0.41099
ActionMetro:Size..m.:Head.on..ParallelParallel	-0.44029	0.045636	-9.64779	5.02E-22
ActionRailway:Size..m.:Head.on..ParallelParallel	-0.11839	0.02433	-4.86591	1.14E-06
ActionMall:Head.on..ParallelParallel:digitalTRUE	0.564093	0.456753	1.235005	0.216829
ActionMetro:Head.on..ParallelParallel:digitalTRUE	-0.97761	0.413141	-2.36628	0.017968
ActionRailway:Head.on..ParallelParallel:digitalTRUE	-0.7221	0.284108	-2.54164	0.011033
ActionWalk:Head.on..ParallelParallel:digitalTRUE	-0.96288	0.603489	-1.59552	0.110595
ActionMall:Head.on..ParallelParallel:full_motionTRUE	-0.16607	0.410382	-0.40467	0.685719
ActionMetro:Head.on..ParallelParallel:full_motionTRUE	-0.46336	0.405547	-1.14257	0.253218
ActionRailway:Head.on..ParallelParallel:full_motionTRUE	0.152834	0.274095	0.557595	0.577121
ActionWalk:Head.on..ParallelParallel:full_motionTRUE	0.206171	0.631357	0.326553	0.744006

Null deviance: 16810 on 12252 degrees of freedom
Residual deviance: 15091 on 12215 degrees of freedom
AIC: 15167

2. 5 Digital effects vary by environment only

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.06085	0.07453	-0.81648	0.414226
ActionMall	2.126612	0.217726	9.767385	1.55E-22
ActionMetro	-0.60253	0.226801	-2.65664	0.007892
ActionRailway	0.995177	0.159204	6.250974	4.08E-10
ActionWalk	0.848734	0.201503	4.212024	2.53E-05
Size..m.	0.018695	0.007461	2.505656	0.012222
Head.on..ParallelParallel	-2.69747	0.153987	-17.5175	1.05E-68
digitalTRUE	0.350964	0.073735	4.759799	1.94E-06
full_motionTRUE	0.337046	0.074228	4.540658	5.61E-06
ActionMall:Size..m.	0.006945	0.021677	0.320378	0.748682
ActionMetro:Size..m.	0.314612	0.042466	7.408594	1.28E-13
ActionRailway:Size..m.	-0.04813	0.015429	-3.11958	0.001811
ActionWalk:Size..m.	-0.02247	0.018622	-1.20644	0.227646
ActionMall:Head.on..ParallelParallel	-0.00583	0.211977	-0.02752	0.978045
ActionMetro:Head.on..ParallelParallel	3.786111	0.260826	14.51582	9.62E-48
ActionRailway:Head.on..ParallelParallel	2.113008	0.206855	10.2149	1.70E-24
ActionWalk:Head.on..ParallelParallel	3.078962	0.279794	11.00438	3.64E-28
Size..m.:Head.on..ParallelParallel	0.130796	0.015535	8.419208	3.79E-17
ActionMall:digitalTRUE	-1.12985	0.206813	-5.46316	4.68E-08
ActionMetro:digitalTRUE	-0.83288	0.11947	-6.97141	3.14E-12
ActionRailway:digitalTRUE	-0.64438	0.132275	-4.87155	1.11E-06
ActionWalk:digitalTRUE	-0.18169	0.200815	-0.90477	0.365589
ActionMall:full_motionTRUE	0.144824	0.198324	0.73024	0.465243
ActionMetro:full_motionTRUE	-0.11899	0.118574	-1.00354	0.315601
ActionRailway:full_motionTRUE	-0.03792	0.132818	-0.28551	0.775255
ActionWalk:full_motionTRUE	-0.02469	0.21636	-0.11414	0.90913
ActionMetro:Size..m.:Head.on..ParallelParallel	-0.43709	0.045412	-9.62507	6.27E-22
ActionRailway:Size..m.:Head.on..ParallelParallel	-0.11717	0.024291	-4.82353	1.41E-06

Null deviance: 16810 on 12252 degrees of freedom
Residual deviance: 15096 on 12215 degrees of freedom
AIC: 15172

2. 6 Digital effects vary by approach only

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	0.164506	0.070968	2.318016	0.020448
ActionMall	1.292184	0.146675	8.809841	1.25E-18
ActionMetro	-1.25767	0.21076	-5.96732	2.41E-09
ActionRailway	0.506378	0.128128	3.952129	7.75E-05
ActionWalk	0.711551	0.143535	4.957335	7.15E-07
Size..m.	0.018606	0.007434	2.502685	0.012326
Head.on..ParallelParallel	-2.48021	0.166768	-14.8722	4.99E-50
digitalTRUE	0.031503	0.066085	0.476701	0.633575
full_motionTRUE	0.387045	0.06917	5.595601	2.20E-08
ActionMall:Size..m.	0.007147	0.021582	0.331161	0.740523
ActionMetro:Size..m.	0.314521	0.042447	7.409661	1.27E-13
ActionRailway:Size..m.	-0.04793	0.015424	-3.10766	0.001886
ActionWalk:Size..m.	-0.02259	0.018604	-1.2144	0.224596
ActionMall:Head.on..ParallelParallel	0.011268	0.209369	0.053817	0.957081
ActionMetro:Head.on..ParallelParallel	3.769776	0.260337	14.48039	1.61E-47
ActionRailway:Head.on..ParallelParallel	2.092643	0.206448	10.13639	3.81E-24
ActionWalk:Head.on..ParallelParallel	3.048296	0.279262	10.91555	9.71E-28
Size..m.:Head.on..ParallelParallel	0.130311	0.015485	8.4151	3.93E-17
Head.on..ParallelParallel:digitalTRUE	-0.21395	0.094311	-2.2686	0.023293
Head.on..ParallelParallel:full_motionTRUE	-0.15478	0.096498	-1.60399	0.108716
ActionMetro:Size..m.:Head.on..ParallelParallel	-0.43662	0.045377	-9.62205	6.45E-22
ActionRailway:Size..m.:Head.on..ParallelParallel	-0.11662	0.024257	-4.80753	1.53E-06

Null deviance: 16810 on 12252 degrees of freedom
Residual deviance: 15172 on 12227 degrees of freedom
AIC: 15224