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The influence of location-related factors on the perception of billboard advertising

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Abstract

The impact that printed out-of-home advertisements have on the consumer's perception is dependent on several location-related factors. For a long time, however, this influence was only indirectly gathered by measuring the relative performance of different locations of billboard advertising: Advertising agencies were traditionally only measuring consumer movement patterns and estimating "exposure opportunities", but no real visual contacts. In this paper, the influence of the factors competition, distance, environmental complexity, occlusion and viewing angle, used with increasing frequency to improve those estimates on billboard perception, is analyzed using eye tracking technology. Two slightly different walks through a city environment are simulated, and changes in gaze behavior due to a variation of the aforementioned location-related factors are recorded and compared. The results confirm the impact of the environmental complexity and occlusion factors, whereas the influence of the other factors is lower or less conclusive. The results presented in this paper help to better understand how these factors affect human attention and allow for a more precise comparison of the relative importance of these location-related factors on the consumer's perception. Furthermore, they might help to improve existing advertisement measurement systems.

Keywords: eye tracking, visual perception, human attention, billboard location, consumer's perception

1. Introduction and background

Printed advertisements play an important role in marketing today. The oldest written advertisements in existence date back to the ancient Egypt (Unger et al., 2007, p. 281). Nowadays, printed advertisements can be found in a huge variety of forms – as newspaper advertisement or billboard poster, advertising supplement, leaflet or prospectus, catalogue, flyer, sticker and so on; all existing in a vast variety of sizes and formats (Esch, 2015). For consumers, printed advertisements are today ubiquitous, and can be found both at home (in newspapers, journals or as advertising mail) and outside – as posters, lamppost banners or billboards near bus stops or on the side of the road.

In today's world of fragmented media, outdoor advertisement plays an important role in reaching an increasingly elusive consumer (Wilson and Till, 2011, p. 909). Out of home advertising is one of the fastest growing media segments (OAAA, 2015, p. 1), and especially billboards or posters that can often be found in high-traffic areas on the side of the road account for 65 % of the industry revenue in the U.S. (l.c.). In Germany, backlit billboard posters represent more than a quarter of the overall market for outdoor advertising today (Meffert, Burmann and Kirchgeorg, 2012, p. 637). Billboard advertising provides high levels of reach and frequency at a lower cost than other media (Lane, King and Reichert, 2010, p. 371). The contact opportunities are higher than those of other classic advertising media because the majority of the population leaves their house at least once a day (Anspach, 2004, p. 7), so that even consumers that are very mobile and exposed less frequently to traditional forms of media can be reached (Francese, 2003, p. 41; Prasad, 2009, p. 15). Contrary to other forms of advertising, billboard posters cannot be switched, turned off or skipped (Anspach, 2004, p. 7) or interfere with any editorial content – which is probably why it enjoys a comparatively high level of users' acceptance (l.c.; Meffert, Burmann and Kirchgeorg, 2012, p. 651).

Apart from the advertising message and the graphical design of an advertising poster, the location of the billboard on which the poster is presented has important implications for the success of an advertisement as well: While the poster contains the actual information, the backlit billboard has to carry the message on to the target group the advertiser wants to reach (Schweiger

and Schrattenecker, 2009, p. 300). Thus, advertising media bridge the gap of space and time between sending and receiving of an advertising message (Pepels, 2005, p. 21); they form the context of the advertisement (Felser, 1997, p. 267). How efficient this can be done may depend on multiple factors, such as the environment in which the billboard is placed: Are there other outdoor media units competing for the viewers' attention? Is the billboard partly hidden by any obstacles? What is the viewing angle or distance the advertisement is looked at?

Factors like these might influence the impact of out-of-home advertisements, and consequently, the advertising providers assign different performance/price categories depending on the respective placement of their billboards (cf. Bloom, 2000, p. 396; APG|SGA, 2015; Prosser, 2013). In Germany, for instance, the outdoor advertising trade association Fachverband Außenwerbung (cf. FAW e.V., 2012) introduced as of January 1, 2013 a method of measurement called PpS ("Plakatseher pro Stelle"; meaning "poster viewers per billboard location" in German). The PpS method uses GPS data from a representative sample of pedestrians to identify consumer movement patterns (this data is counter checked by a Last Day Recall via telephone interviews). This value is weighted using seven location-related factors, namely the period of exposure, the linear and lateral position of the billboard in relation to the passing traffic, the degree of occlusion of the billboard's position, the number of competing nearby billboards, the overall complexity of situation and environment, the viewing angle and the lighting conditions (l.c., p. 5). Based on these values, the quality of the different billboard locations are determined – and, consequently, also the price.

Sophisticated as this measuring method may be, it still basically determines how many consumers *walk past* a billboard poster, but not how many people actually *look* at it. Even if these advertisement exposure opportunities are later weighted using the above-mentioned location-related factors, they are still basically estimates, not real visual contacts. The objective of this paper, therefore, is a more thorough analysis of the perceptual impact that the location-related factors have on the human perception of billboard advertising – to find out if the said weighting really leads to an improved visibility assessment. In order to do this, eye tracking technology has been used, and a test scenario was developed that simulated two slightly different walks through the city of Leipzig. Both walks (recreated using two different slideshows) featured out-of-home campaigning at various locations, from different distances, viewing angles, etc. These two slideshows were presented to the two different experimental groups, and their gaze behavior was recorded using eye tracking technology. The eye tracking results allowed a direct comparison of both walks as well as a more detailed assessment of the impact these parameters have on human cognition.

2. Materials and methods

The study described in this paper consisted of two parts. In the first part, the effects of location-related factors on the test viewers' perception and information processing of billboard advertising were analyzed using eye tracking technology. In the second part of the test, the unaided recall, aided recall and recognition of the selected billboard advertising was tested for each of the test participants using printed questionnaires.

In preparation of the eye tracking part of the test, the locations of all 119 cm × 175 cm backlit billboards (also known as city light posters; cf. Unger et al., 2007, p. 285; Ströer, 2015) in Leipzig's city center were determined and marked on a Leipzig city map. Next, a walking route through the city was chosen, which provided the basis for the eye tracking test scenario. The route started at Leipzig central station, followed some prominent arterial roads (passing nine city light billboards on the way) and ended at a certain restaurant which was given as the intended destination to the test viewers.

In order to create a low-involvement situation that is typical for the quite unintentional and casual contact with out-of-home advertising (Bloom, 2000, p. 395), the test subjects were left unaware of the real purpose of the investigation. Instead, they were told to memorize the way from the central station to the restaurant in order to be able to describe it later to a friend. In reality, however, the perception of the city light billboards and the influence of the above mentioned location-related factors were tested. Nine different situations have been the subject of research in this study: oclusion, environmental complexity, linear distance, competition of nearby billboards and viewing angle.

In order to do this, two slightly different versions of the walking route were simulated using two series of photographs each that were taken under identic lightning conditions from a pedestrians' perspective (cf. Figure 1). The majority of these photos are neutral stimuli showing ordinary street sceneries that are identical in both versions of the walk. The nine others, however, differ in both versions according to the characteristics of the location-related factors named above, and were each displayed to only one of the groups. In the further course of the text, these situations are named by means of the following abbreviations: occlusion (OC 1 and OC 2), environmental complexity (EC 1 and EC 2),

linear distance (LD 1 and LD 2), competition of nearby billboards (CO 1 and CO 2) and viewing angle.

2.1 Subjects

Sixty test participants (28 males, 32 females) were recruited for the experiments and divided into two groups of 30 persons each. Their age was 24.5 on average, ranging from 17 to 33. Almost all had normal or corrected vision, except for two individuals with a slight cataract and a red-green deficiency, respectively (which, however, had no impact on study results). Although more than three-quarters of the participants attended courses related to media, none of them had special knowledge in outdoor marketing or billboard advertising.

Almost all (95 %) of the participants were residents of Leipzig, and 62 % of them lived there for more than two years. An overall familiarity with the city environment and the approximate location of poster sites there could therefore be assumed as likely.

2.2 Stimuli

As the eye tracking system used for this test was computer-based, two series of photos were used to simulate the walking route mentioned above. Each of these slideshows contained 65 photographs (9 of the relevant city light posters and 56 neutral ones of streets), taken from the perspective of pedestrians (cf. Figure 1). The neutral stimuli were identical in both slideshows, whereas the billboard views varied according to the location-related factors, the linear distance, the degree of occlusion of the billboard's position, the number of competing nearby billboards, the viewing angle and the overall complexity of situation and environment. Each slideshow was presented to the test subjects, one picture at a time, each display lasting 2.5 s (this time interval was determined in pre-tests as a faithful emulation of a normal walking speed). The distribution of billboard advertisements corresponded to their actual placement in the city, and the order and perspective of the photos also reflected reality. However, the photos had on purpose been taken some months beforehand, so that the posters visible on the stimuli where not the ones that were shown on real billboards at the time. Thus, a direct influence of "real" viewings in the preceding week or so could at least be reduced.

The simulated walking route was to reflect a more or less "typical" viewing experience in familiar surroundings – comparable to the situation in which billboard advertising is typically presented and perceived (cf. Deibl, 1997, p. 86; cf. Anspach, 2004, p. 5). The intended destination, the restaurant "PepperHouse Leipzig", on the other hand, was unknown to 82 % of the subjects, so that too intimate a knowledge of the intended path could be considered as unlikely.

2.3 Apparatus and procedure

The stimuli were presented on a monocular, desktop based NYAN 2 XT/EDGE eye tracking system. User reactions were recorded and their visual scan paths were analyzed. In order to assess the relative importance of the main visual components on the billboard advertising, the city light posters were defined as Areas of Interest (AOI) beforehand to compare hit rates, the time to first fixation, gaze durations, etc.

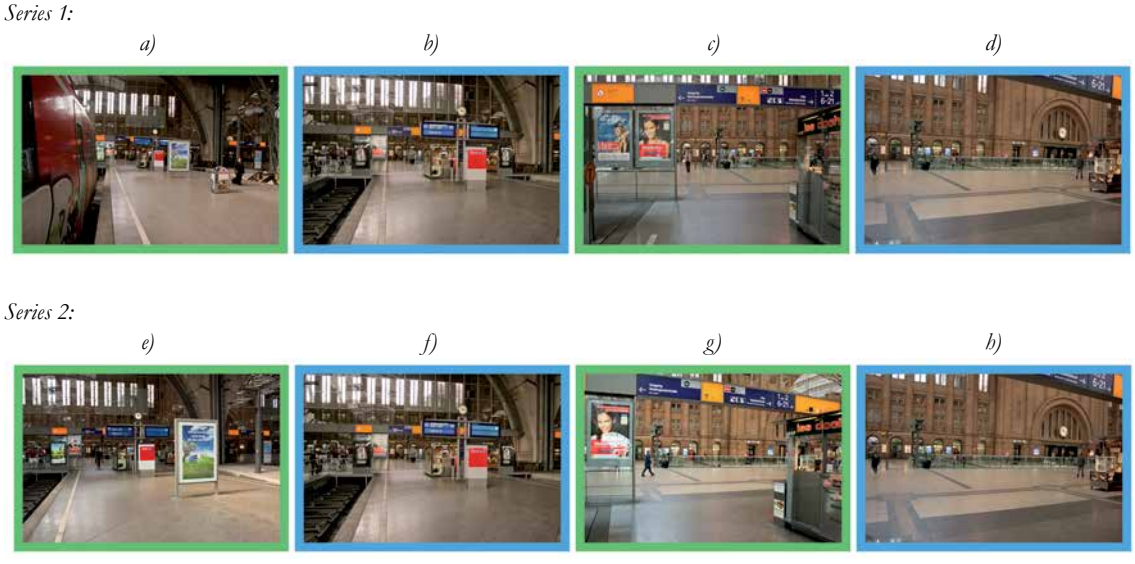

Figure 1: Samples of the two series of photos used in the eye tracking test, where the blue frames (samples (b, f) and (d, h)) mark neutral stimuli that were identical in both series, while green frames test several location-related factors, showing backlit billboards in varying distances (a, e) or a different number of competing nearby billboards (c, g)

The hit rate (in percent) shows the number of participants that fixated the billboard advertising at least once. The time to first fixation (in seconds) indicates when the billboard advertising was first focused. The gaze duration (in seconds) indicates the average viewing time. The fixation count states the number of fixations.

After the test, the participants had to complete a questionnaire, asking them at the outset to name those locations of billboards and all advertising posters shown that they could recall without the aid of a cue or prompt and to mark them on a map (unaided recall). After that, a list of brand names was given to the test participants. They were now asked to identify brands they thought they had seen earlier (aided recall). Finally, the advertising posters in the test (and some others that had not been shown) were presented to the test participants once again, and they had to decide for each of them if they had been part of the test or not (direct recollection).

The statements of the survey were analyzed in order to find tendencies and patterns as to which advertising posters could be remembered and to what extent, and how these recognition values were influenced by location-related factors.

3. Results

In order to assess the eye tracking results presented here, it is helpful to note that the rating system of the German outdoor advertising trade association contains some implicit assumptions on the expected impact of the aforementioned location-related factors. Occlusion of billboards, for instance, is said to lead to a "lower performance" (cf. FAW e.V., 2012, p. 7), competition "reduces the chances of being noticed" (l.c.), and environmental complexity "reduces the impact of the poster site" (l.c.). Therefore, all eye tracking results will be compared with these implicit assumptions in order to find out if the expectations put down in the FAW rating system can be confirmed – or if the gaze behavior leads to different conclusions.

As for the general distribution of attention between the billboard advertising and their environment, the results were largely as expected. In direct competition, the surrounding street life was (on average) not only viewed 4 times longer than the billboards, but it was also fixated 0.5 s faster and over 4 times as often. In sum, however, 61.5 % of the test participants did look at the billboard advertising at any time on average. From a total of 711 fixations on advertisements, 332 (i.e. about half) were first fixations on the corresponding Areas of Interest; 197 fixations were the result of a second look on an area that had already been scanned, and only 182 were third, fourth or further fixations. Thus, the average fixation count for billboard locations was 1.32; implying that the tested advertisements were generally looked at only once or twice. Over 75 % of the first fixations occurred in the first half of the 2.5 s display time; the average time to first fixation was 0.82 s. Furthermore, 56 % of the first fixations on billboard locations were also among the first two fixations on the stimulus as a whole. It is also worth mentioning that in about 40 % of all cases, the fixations on advertise-

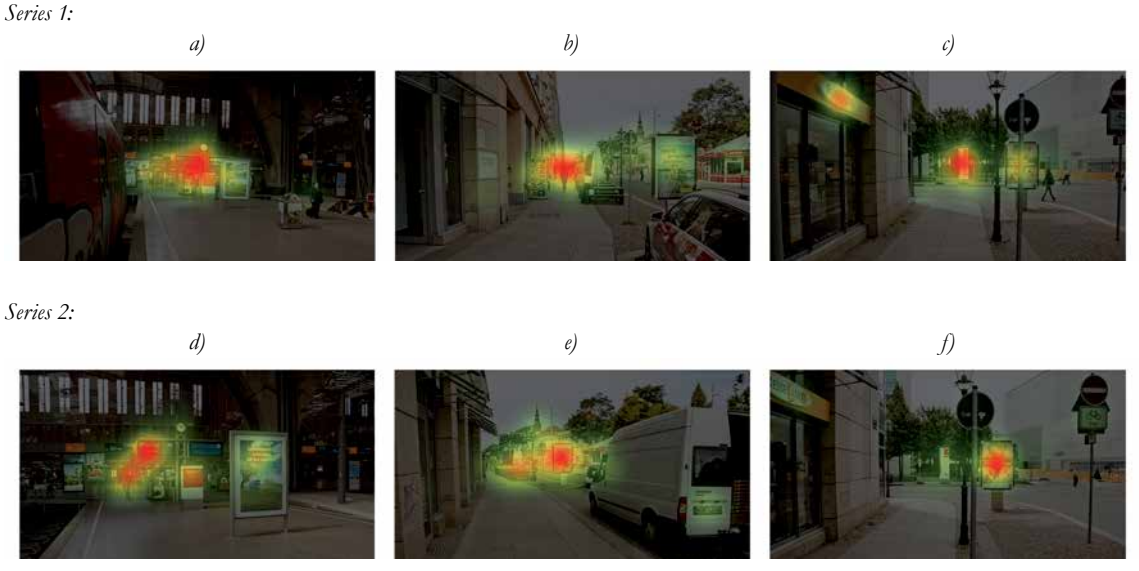

Figure 2: Sample heat maps from location-related factors analysis, where areas of the stimuli that received most attention from the test participants are marked with colored spots (red means a high level of attention, followed by yellow and green), while areas that got minor attention are darkened

ments were long fixations (> 300 ms), which were mostly accompanied by at least one short fixation. The rest of the billboard area fixations were either solitary, short fixations, or sequences of several (i.e. at least two) of these short fixations (about 30 % in both cases). Furthermore, test results showed that location-related factors like linear distance, the number of competing nearby billboards, the overall complexity of the environment, the viewing angle and the degree of occlusion do indeed have an impact on the perception of billboard advertising (cf. Figure 2).

3.1 Impact of the location-related occlusion factor

For the two factors, namely occlusion and environmental complexity, results were more or less as expected. Billboards that were partly hidden by other objects such as a street sign (cf. Figure 2c, 2f; situation OC 1) or pedestrians (situation OC 2), got a considerably lower level of attention than their counterparts without occlusion (cf. Table 1). The corresponding ads were perceived by much fewer participants: on average only 64 % of the subjects fixated partly hidden billboards (47 % in situation OC 1 and 80 % in OC 2, respectively), compared to 90 % fixations on the same ads without occlusion. Both the gaze duration and the fixation count decreased by over 50 % on average, whereas the time to first fixation was on average 0.23 s longer (0.29 s longer in OC 1 and 0.18 s in OC 2, respectively). While unobscured billboards were mostly noticed within the first two fixations on the stimulus as a whole (the average position being 2.52 and 1.67 for situation OC 1 and OC 2, respectively), obscured ads generally needed one fixation more (average position 3.36 and 2.42, respectively).

Moreover, the results differ depending on the cause of the occlusion: If billboards were partly hidden by other objects (such as a road sign), hit rate, gaze duration and fixation count were significantly lower ($p < 0.05$, where p is the probability of getting the observed or more extreme results given that the null hipothesys is true) compared to the wholly visible variant (the time to first fixation also showed a medium but no significant effect). If the billboards, on the other hand, were hidden by pedestrians, the difference was reduced by more than half, so that only the gaze duration showed a significant difference and a medium effect.

Outdoor advertisements without occlusion got in most cases at least one long fixation (> 300 ms), often accompanied by some short ones (48 % and 52 % of 27 subjects who fixated the ads in situation OC 1 and OC 2, respectively). In situation OC 1, where the ad was hidden by an object, 42 % of only 14 subjects that looked at it did so with one single short fixation only, while in situation OC 2, where the ad was hidden by pedestrians, 54 % of the 24 viewers had at least multiple short fixations.

3.2 Impact of the location-related environmental complexity factor

As for environmental complexity, it was to be expected that billboards positioned in low complexity situations would get higher levels of attention than those placed in a higher environmental complexity. Fittingly, the results showed a positive effect on the attentional values for billboards placed in less complex situations (cf. Table 2). Generally speaking, a lower environmental complexity corresponded to earlier fixations on the billboards (position 1.87 and 2.75 instead of 2.37 and 3.18 on average for the two tested situations). In the situation EC 1, lower complexity also meant one long fixation mostly accompanied by at least one short one (for 60 % of the 30 participants that looked at the corresponding ad), whereas high complexity was linked to multiple short fixations (44 % of

Table 1: Eye tracking results for occlusion (average of all individual results, the highest or earliest values, respectively, are marked for clarity)

Situation	Occlusion	Hit rate [%]	Time to first fixation [s]	Gaze duration [s]	Fixation count
OC 1	with	47	0.85	0.20	0.77
	without	90	0.56	0.70	2.80
OC 2	with	80	0.51	0.44	1.97
	without	90	0.33	0.69	2.77

Table 2: Eye tracking results for environmental complexity (average of all individual results, the highest or earliest values, respectively, are marked for clarity)

Situation	Environmental complexity	Hit rate [%]	Time to first fixation [s]	Gaze duration [s]	Fixation count
EC 1	low	100	0.40	0.75	2.87
	high	90	0.61	0.58	2.47
EC 2	low	67	0.62	0.27	1.00
	high	61	0.79	0.24	0.96

Table 3: Eye tracking results for linear distance
(average of all individual results, the highest or earliest values, respectively, are marked for clarity)

Situation	Linear distance	Hit rate [%]	Time to first fixation [s]	Gaze duration [s]	Fixation count
LD 1 Figure 2a, 2d	low	60	0.89	0.28	1.13
	high	50	1.19	0.19	0.77
LD 2 Figure 2b, 2e	low	47	0.80	0.23	0.97
	high	69	1.18	0.33	1.17

27 participants). In the second scene EC 2, however, the results were inverse: here, lower complexity was linked to single short fixations for 50 % of the 20 fixating subjects, whereas higher complexity corresponded to longer fixations (47 % of 17 fixation subjects).

Additionally, an increased environmental complexity seems to have a lower impact on the level of attention than might be assumed. Based on the eye tracking data, only a comparatively small difference between high and low complexity situations was noticeable: Only the time to first fixation was significantly lower ($p < 0.05$) in situation EC 1 and showed a medium effect, while all other eye tracking data did not meet statistical significance and showed small effects at best.

So essentially, the additional visual stimuli didn't seem to distract people much. Only approaching persons or objects tended to get a bit more attention. Apart from that, most of the test participants appeared to pursue their primary objective, which in this case was to focus on the route.

3.3 Impact of the location-related linear distance factor

The impact of the other location-related factors on eye tracking results, however, was lower or different than assumed. Here, the viewing patterns and eye movement parameters recorded via eye tracking showed diverging results for the two situations that had been tested for the corresponding location-related factors.

Regarding the linear distance from the point of first visibility, it was assumed that billboards located close to the participants would receive higher levels of attention than far-distant ones. Accordingly, the time to the first fixation on the advertisement was in both situations higher for the billboards at greater distances (cf. Table 3), and there were more antecedent fixations on other areas of the stimulus. For the situation LD 1 depicted in Figure 2a and 2d, respectively, this assumption was further supported by other results (cf. Table 3): for the billboard at a shorter distance, the hit rate was 10 % higher, the time to first fixation 0.3 s shorter and both the gaze duration (0.28 s vs. 0.19 s) and the fixation count (1.13 fixations on average compared to 0.77 at a greater distance) higher.

However, the analysis of the second situation LD 2 (cf. Figure 2b and 2e and Table 3, respectively) yielded opposite results: the hit rate of 69 %, the gaze duration of 0.33 s as well as the number of fixations of 1.17 on average were higher for the far-distant billboard than the same parameters were for the closer billboard (47 %, 0.23 s and 0.97, respectively). Combining the results of both scenes, the eye tracking data showed no significant differences between shorter and longer distances, and only the time to first fixation had a medium effect size.

3.4 Impact of the location-related competition factor

As for the influence of competition by nearby billboards, it can be stated that astonishingly, in relation to all fixations on the stimulus as a whole, first fixations to ad areas with competition ranked better than those without competition (the position in order of overall fixations being 5.30 and 3.17 for areas without competition, compared to 2.36 and 2.47 for those with competition). Apart from that, the eye tracking results in situation CO 1 showed lower attentional values for a single advertising poster than for the same ad in direct competition, and diverging outcomes in situation CO 2 (cf. Table 4). In the first case, the ad without competition had a significantly lower

Table 4: Eye Tracking results for competition by nearby billboards
(average of all individual results, the highest or earliest values, respectively, are marked for clarity)

Situation	Competition by nearby billboards	Hit rate [%]	Time to first fixation [s]	Gaze duration [s]	Fixation count
CO 1	no	33	1.43	0.12	0.53
	yes	47	0.56	0.17	0.73
CO 2	no	60	0.88	0.26	0.87
	yes	57	0.70	0.25	1.10

time to first fixation ($p < 0.05$, strong effect). In situation CO 2, however, only small effect sizes and no significant results could be detected. Here, it is interesting to note that ads without competition were noticed by more people, but that they were fixated less often and later on than the advertisements with competition.

3.5 Impact of the location-related viewing angle factor

Another interesting result is that no considerable influence of the viewing angle could be detected either, as the values for hit rate, time to first fixation, gaze duration and fixation count did not differ significantly. The only indication that a frontal position might offer a slight advantage can be found in the fact that ads at a 90° angle mostly got longer fixations of more than 300 ms, whereas more acute angles generally led to single short fixations (50 % of 10 subjects looking at the respective ads in both cases).

3.6 Unaided recall, aided recall and direct recognition

The unaided and aided recall test conducted subsequent to the eye tracking test showed that the recall performance was low in spite of the high percentage of viewers that had looked at the billboard ads according to the eye tracking results. The analysis demonstrated that both unaided and aided recall of the advertisements shown (a list of brand names was given to the test participants as aide-mémoire in the latter case) was only successful for less than one-sixth of the test participants on average. Especially during the unaided recall, recollection was often diffuse and, in some cases, inaccurate. Test viewers, for instance, remembered only the main color of advertising posters and erroneously linked them to other, real-world viewing experiences with (outdoor) advertising; e.g. the color red to Vodafone ads, although no such advertisement was included in the test. In the same way, many viewers thought that the advertising of a telecommunications provider, which featured a smartphone, belonged to a well-known technology company like Sony or Panasonic.

In contrast, the direct visual recognition of the advertising posters shown during the test was at a comparatively high level (cf. Figure 3). When the seven advertisement posters that were used during both tests were presented to the test participants along with three others that were not, the advertisements shown were recognized by 42 % of the participants on average. Compared to that, the number of false positives was comparatively low in two subsequently performed tests (5 %), thereby reaching a high statistical significance level ($p < 0.01$). In one case, however, where an additional poster not used in the test had a coloring similar to an advertising poster actually shown, the number of false positive rose to 18 %. On the other hand, which and how many advertising posters were remembered differed widely amongst test participants.

Figure 3: Selected results of the direct recognition of the advertising posters shown in the eye tracking test and three others that had not been shown; the values of the false positives are marked red

4. Discussion

The study expands the knowledge and understanding of consumer's perception of billboard advertising and the influence of the different location-related factors. In sum, the results indicate that the laboratory environment used in this experiment seems to be appropriate to analyze the attentional impact of billboard advertising. According to the eye tracking data, the desired low-involvement situation was recreated, and several basic assumptions on the perception of billboard advertisements could be confirmed. While some obvious disadvantages of an artificial setting remain (e.g. a limited freedom of movement, discrete stimuli vs. continuous perception), they are outweighed by benefits like a stable, controllable environment that guarantees identical conditions for all test participants, leading to quantifiable results that are easy to analyze and to interpret.

4.1 Some reflections on study design

One aspect that influences the perception of advertisements both in real-life scenarios and simulations in the same way is the influence of familiarity. Therefore, a fundamental question during the study design was to what extent a prior knowledge of the city environment, real poster motifs or brands might influence results. It is, after all, quite conceivable that while processing visual stimuli, familiarity or experience may reduce the cognitive workload; which might manifest itself, for instance, in shorter fixation durations (cf. Young et al., 2009, p. 387). In marketing, it is well-known that a single confrontation with a poster advertisement will hardly have a major impact; on the contrary, repeated viewings are an indispensable prerequisite for advertising effects (cf. Esch, 2011, p. 147; Weber and Fahr, 2013, p. 342; Crijns, 2012, p. 324).

This lead to a basic dilemma during the design of this study: By choosing a test environment well-known to the examinees, pre-knowledge effects could certainly influence results. Trying to rule them out completely by using both self-designed posters and stimuli from a city that was totally unknown to the test participants (or, as an alternative, by creating a completely artificial test environment), would have led to a setting that does not reflect any more the real situation in which billboard advertising is normally presented and perceived. Therefore, for this study, the decision was made to create an environment the attendees were probably familiar with. The advertisements, however, were not the ones that were visible at that time in the city, as the photos for the slideshow had on purpose been taken some months beforehand, so that a direct influence of "real" viewings made in the last week or so could at least be reduced. Thus, pre-knowledge effects were not supposed to be completely ruled out, but should be kept within the limits of a more or less "typical" viewing situation.

4.2 Results on the overall distribution of attention

Comparing the general distribution of attention, it can first be said that the city environment in general gets much more attention than the backlit billboards embedded therein. The eye tracking results show that the billboard areas not only get less attention than their surroundings, but that it also takes longer until they get noticed for the first time.

Of course, one has to consider that the environment occupies much more space on most stimuli than the billboards. Taking this into account, the time to first contact is still comparably low for those billboards that attract any attention at all – the first fixation appearing to be part of an orientation phase. On the other hand, the total number of fixations on a billboard advertisement hardly ever exceeds the number of two. This supports previous statements that outdoor advertising is a glance medium (Pant, 2007, p. 199) with usually only a very brief exposure (van Meurs and Aristoff, 2009, p. 82), where contact is only casual and quite unintentional (Bloom, 2000, p. 395).

Nonetheless, the billboard advertisements do get noticed by the majority of passers-by (61.5 % of the test participants). The minimum fixation duration that is considered to be necessary for information uptake (> 100 ms) is reached in almost all of these cases (cf. Link et al., 2008, p. 374), and in at least one third of the cases, there were even long fixations (> 300 ms) which are likely to indicate more intense cognitive processing (cf. Leven, 1991, p. 93). This is also in line with statements attributing high levels of reach and frequency (Lane, King and Reichert, 2010, p. 371) and a repeated exposure rate (Donthu, Cherian and Bhargava, 1993, p. 70) to billboard advertising, producing a major impact (Prasad, 2009, p. 15).

The results of the unaided recall, aided recall and direct recognition tests performed immediately after the eye tracking test, are also in line with prior assumptions. MacInnis and Jaworski (1989, p. 5), for instance, base their discussion of advertisement perception on the assumption that there are several levels of information processing, each involving greater attentional and/or capacity resources. During casual ad/brand processing, they further argue, only processes utilizing few processing resources can be performed, namely feature analysis (the identification of salient properties of the stimulus) and sometimes basic categorization (a combination of features associated with a specific cue and an assignment of corresponding semantic labels, cf. o.c., p. 6). Only features perceived and/or combined at this stage can later be used for recollection – so, observers always see more than they can remember afterwards (Sperling,

1960, p. 1). This is in accordance with post-test survey results, where ad recollection became considerably better with increasing assistance and was best when the test stimuli were actually shown to the test subjects, so that characteristic visual components like the key visual, the dominating color or the product shot were actually visible. Apparently, these visual features helped the participants to reconstruct and to recall the poster motif correctly. Even for the false positives, it could be observed that particularly noticeable visual elements were remembered, although they were erroneously associated with well-known, popular brands that used similar colors or elements in their poster design. This supports the hypothesis that billboard advertising is indeed perceived only fragmentary and at an unconscious level (which would be a certain analogy to results presented in Nikolaus and Bendlin (2015), where similar effects regarding the recollection of packaging designs could be observed).

4.3 Impact of the location-related factors

As for the impact of the location-related factors on ad processing, the results illustrate that simplistic assumptions (e.g. the nearer a billboard the better) do not accurately reflect the complexity of human perception. For some of the named factors, the eye tracking results showed clear trends, whereas for others the results were ambiguous or, in one case, showed no visible effect.

The impact of the occlusion factor is quite obvious. Billboard advertisements that were partly hidden got significantly less attention than the same posters without obstacles. This is in accordance with results of an earlier eye tracking study, albeit with a slightly different objective, showing diminished attention for partially occluded faces (Jiang, Xu and Zhao, 2014, p. 24). However, current billboard rating systems like the German one seem to focus mainly on the length and the extent of occlusion (cf. Löffler, 2014, p. 10; ESOMAR, 2009, p. 19), whereas the results of this study suggest that the type of obstacle also plays an important role – as a road sign obstructing a billboard had a greater impact on the viewer's attention than an occlusion by pedestrians. A possible explanation for this might be that people generally tend to attract attention (cf. Wagner, Baird and Barbaresi, 1981, p. 197, 201; Holmqvist et al., 2011, p. 80; Busch, 2007, p. 31), and that due to the spatial proximity, attention might be redirected from the pedestrians to the advertisement. Consequently, further analysis regarding the influence of different types of obstacles on human perception might be advisable.

Furthermore, a connection between environmental complexity and the attention for billboard advertising was also recognizable. This is also in accordance with basic assumptions, because an increased complexity of the environment is tantamount to a higher number of visual stimuli that the advertisement posters have to compete with. This supposedly has negative effects on information reception because the limited capacity of the human brain (known as the attentional bottleneck) forces cognitive processes to become increasingly selective (cf. Milosavljevic and Moran, 2008, p. 383; Ratneshwar, Mick and Reitinger, 1990, p. 547) – the screening out of less relevant information being considered to be one of the main functions of attention (cf. Kroeber-Riel and Gröppel-Klein, 2013, p. 62; Ratneshwar, Mick and Reitinger, 1990, p. 547; Taylor, Franke and Bang, 2006, p. 22). However, the influence of environmental complexity seems to be somewhat smaller than initially assumed. The biggest distraction was caused, as already mentioned, by oncoming objects or pedestrians, probably because they could cause a collision in the case of real locomotion. This, again, is in accordance with literature stating that mobile objects and people draw eyes (Wagner, Baird and Barbaresi, 1981, p. 201; Holmqvist et al., 2011, p. 80; Busch, 2007, p. 31).

As for the other location-related factors tested here, the results were not always as expected and in some cases were even inconclusive. One possible explanation for this could be that the analyzed location-related factors might differ in terms of importance for the perception of billboard advertising and supersede or superimpose themselves on factors of lower relevance. Concerning the linear distance, for example, it might be expected that an advertisement at a shorter distance has a higher attentional impact than the same poster further away. This would have been in accordance with an earlier study stating that the number of objects noted by pedestrians on a walk around the block decreases as a function of distance (cf. Wagner, Baird and Barbaresi, 1981, p. 199). The present eye tracking results, however, do not confirm such a simple connection (see below).

A similar picture emerges from the data analyzing the impact of competing nearby billboards. In principle, a higher competition should – due to the increased number of visual stimuli – induce a decrease of attention for each one of them. However, the attentional values for a single advertising poster were even lower in one of the two tested situations than for the same ad in direct competition, whereas the second situation led to mixed results. A closer look at the second stimulus revealed, however, that by trying to include the second billboard in the stimulus, other location-related factors like the linear distance had also been marginally altered. Thus, the latter result might be the result of a mutual superimposition.

Looking at the general distribution of attention between billboards, other billboards competing with them and the surrounding environment, it can be stated that the visual attention of the examinees is usually focused either on the center of the image or on the vicinity of

the expected route. This is in accordance with results in Wagner, Baird and Barbaresi (1981, p. 196) stating that "the lion's share of attention is directed along the road straight ahead" while driving on a highway, and that "[w]hen a person walks, most of his eye fixations are directed forward in line with his intended walking route" (Zohar, 1978, p. 677). In those scenes mentioned above with the unexpected results, the billboards with higher attentional values were always nearer to the main focus point of attention and those at a shorter distance or with less competition but lower attentional values were further away. One possible explanation for these results might be that the proximity to the main point of interest plays a more important role than other location-related factors such as linear distance or competition.

The results concerning the last location-related factor, the viewing angle, proved to be inconclusive. Due to the fact that a frontal view provides optimal visibility of the advertising poster, it was to be expected that billboards positioned directly in front of the test participants would get higher levels of attention than those at a more acute angle. According to the eye tracking data, however, the viewing angle had not much influence on gaining and retaining attention.

4.4 Consequences for the improvement of rating systems

In sum, the results presented here indicate that the various location-related factors are not equally important for the perception of billboard advertising and supersede or superimpose themselves on factors of lower relevance. Regarding this, it is interesting to note that some of the factors with a comparably lower relevance are quite prevalent in the advertisement measuring systems of different countries. Although there has been some activity to provide more reliable measurement data on the performance of billboard advertising lately (cf. Jarvis and Eddleston, 2003; Lichtenthal, Yadav and Donthu, 2006, pp. 240, 244), a lack of transparency in research led to very different measurement systems internationally (e.g. TAB, 2014, p. 1; MOVE, 2014; Buitenreclame Onderzoek, 2015). Table 5 shows the occurrence of the factors discussed in this paper in rating systems of various Western countries, where, for instance, the viewing angle or the linear distance are very popular, although their impact in this study was rather limited. Then again, the degree of occlusion, having a comparatively strong impact on the perception of billboard advertising in this study, is only included in the German and Irish measurement system (JCDecaux, 2010, p. 2). Although a weighting of the location-related factors seems advisable according to the results presented here, some rating systems remain unweighted (e.g. FAW e.V., 2012, p. 5), whereas in others, the weighting method is not disclosed (e.g. TAB, 2014, p. 1; Route Research, 2014, pp. 5–6).

Furthermore, previous studies focus on the hit rate as the basic measure of visibility, measuring the proportion of respondents who fixated the panel at least once (Barber, Sanderson and Dickenson, 2008, p. 5). However, the hit rate includes all forms of contacts – both the single short fixations for orientation and the long fixations necessary for a deeper processing (Busch, 2007, p. 15). Therefore, the hit rate alone might not be an appropriate measure for the contact quality, which is why additional measures like the time to first fixation, gaze duration and fixation count have been used in this study as well. This could allow for a more precise determination of the relative importance and of the interdependencies of the location-related factors.

Table 5: Distribution of the location-related factors researched in this paper in the rating systems of various Western countries

	Linear distance	**Degree of occlusion**	**Competing nearby billboards**	**Lateral distance**	**Overall complexity of situation and environment**
Germany	✓	✓	✓	✓	✓
UK	✓	×	×	✓	✓
Netherlands	✓	×	×	✓	✓
USA	✓	×	×	✓	×
Australia	✓	×	×	✓	×
Ireland	✓	✓	×	✓	✓
Switzerland	✓	×	✓	✓	×

5. Conclusions

Although there has been an increasing research interest in outdoor advertising, it still remains an underresearched topic (cf. van Meurs and Aristoff, 2009, p. 83). Consequently, outdoor advertising is frequently criticized for a lack of verified audience measurement research (King and Tinkham, 1989, p. 47), and there is still very little known about the effectiveness of outdoor advertising (Donthu, Cherian and Bhargava, 1993, p. 70).

The impact of location-related factors on the performance of billboard advertising has for a long time been judged rather than measured (cf. Bloom, 2000, p. 406), and as a result, poster audience research systems differ widely from country to country (Bloom, 2000, p. 396). The usage of eye tracking technology to analyze the impact of billboard advertising on human attention and perception, therefore, might be very helpful to identify those factors that influence the recall and overall effectiveness of outdoor advertising (cf. Donthu, Cherian and Bhargava, 1993, p. 70).

The results of this study seem to confirm some basic assumptions on billboard advertising, namely that it can achieve a large coverage and high levels of reach but that billboard ads are at the same time perceived only fleetingly and without conscious attention. The influence of a variety of location-related factors on the attentional impact of billboard advertisements could equally be confirmed. These factors include, for instance, the environmental complexity and the degree of occlusion of the billboard. The influence of other factors, such as the linear distance to the billboard or the number of competing nearby billboards, was, however, lower than expected; rather, a position near the viewers' main point of attention seems to be decisive. Thus a central billboard position could compensate for the negative impact of other location-related factors.

This might imply that common weighting procedures used to determine the influence of location-related factors on the effectiveness of outdoor advertising should be reconsidered. Currently (at least in the German rating system), all location-related factors are equally involved and deficiencies in one area cannot be compensated by more favorable values in another (FAW e.V., 2012, p. 5). Therefore, the results presented in this paper might help to better understand consumer reactions on billboard advertising and help to improve existing advertisement measurement systems that describe the impact of location-related factors.

As the long-term goals of quantifying and qualifying the impact of outdoor advertising are the same all over the world, it seems advisable to ensure a consistent application of measurement structures and particularly contact definitions (cf. Jarvis and Eddleston, 2003); also across national borders. Therefore, studies like this one might build a foundation for further standardizations and adaptations of both the factors influencing the visibility of billboard advertising and their weighting.

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