E. Individuals and Organizations
Hi,

I am writing to express my opposition to the proposed sign district for the former May Co. building at Fairfax and Wilshire. The proposed sign district is not compatible with the visual environment of the neighborhood, and would destroy the uniqueness and aesthetics of a historically significant building.

Please deny the proposed sign district for the former May Co. building. Thank you for considering my opinion.

Robert Aronson
108 Catamaran Street
Venice, CA 90292
---------- Forwarded message ----------
From: jeanette baer <jenmedbybaer@yahoo.com>
Date: Fri, Sep 12, 2014 at 10:59 AM
Subject: 
To: "luciralia.ibarra@lacity.org" <luciralia.ibarra@lacity.org>

I wa born and raided in Los Angeles-I still have family living there and my parents lived and worked in th MOVIE industry fo years-PLEASE DO NOT let this hppen-i is n iconic and beautiful building-we have lost too many of ou buildings t deconstruction-wened to keep them and member our hisotry no destroy it! Than you Jeanette M Baer

--
Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
From: Kim Cooper <tours@esotouric.com>
Date: Thu, Oct 9, 2014 at 4:30 PM
Subject: Feedback re: ENV-2013-1531-EIR
To: luciralia.ibarra@lacity.org

Luciralia Ibarra
Environmental Analysis Section
Department of City Planning
Case Number: ENV-2013-1531-EIR
luciralia.ibarra@lacity.org

Dear Ms. Ibarra,

I am writing to share feedback on the signage component of the DEIR for the Academy Museum project in the Historic-Cultural Monument May Company Building (Case Number: ENV-2013-1531-EIR).

As an architectural historian and Los Angeles tour guide, whose business is showing the gems of our city's built environment to thousands of tourists and interested locals each year, I am very concerned about the massive, unusual and obtrusive digital signage proposed for the exterior of the building, including alteration of its central gold pillar with an outline of the Oscar (TM) figural logo, illuminated five-story supergraphic signs on three of the buildings corners, and the filling of its window bays.

Since 1939, the Streamline Moderne May Company building has stood at attention at the Western end of the Miracle Mile, a sculptural masterpiece of glittering gold and elegant black and white horizontals. It is a work of art. To wrap it so completely in digital signage would serve to make an Historic Cultural Monument nothing more than the armature for a billboard. This is an inappropriate and insensitive proposal that the Department of City Planning must discourage. The Academy Museum should use unobtrusive printed signage that does not overwhelm or architecturally transform its landmark building.

I beg you to preserve the beautiful architectural vista at Wilshire and Fairfax for the benefit of future generations of Angelenos and all lovers of the Streamline Moderne. I am sure I am not the only native Angeleno whose earliest memories include eagerly looking for the "stack of pennies building" as my family drove through the Miracle Mile.

Thank you for your consideration, and best regards,
Kim Cooper
Esotouric bus adventures
http://www.esotouric.com

--
Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
Dear Ms. Ibarra,

I would like to state my support for the Academy Museum project planned for the corner of Wilshire and Fairfax. I work directly down the street on Wilshire – I love the neighborhood as it is now but that is not to say things cannot be improved upon. Some of the sidewalk areas are not conducive to walking, and I think too much of the Miracle Mile is car-oriented rather than pedestrian- and bike-friendly. From what I can tell, the new Museum will completely revitalize both the frontage on Wilshire and Fairfax and the open area behind the building. Both are extremely unwelcoming at present and in desperate need of a change. The Miracle Mile area will become much more walkable once this project is completed, and I think that should be considered a public benefit.

A few comments on the environmental report: I drive to work most days, and the biggest addition to traffic comes from people just like me – daily commuters. Excluding the afternoon rush hour (and somewhat the morning rush hour as well), the area is not very crowded and easy to navigate. The real trouble times are the morning and evening rush hours, when daily commuters are traveling between home and work. Generally, these types of trips are the ones that affect traffic the most. Visitors who come to the area to visit the museums generally don’t affect my commute – they arrive after I’m already at my desk and depart before my trip home (except Fridays, of course, when they stay for the jazz concerts at LACMA). This fact is one of the reasons I love working here so much – the various different uses in the neighborhood (museums, residential, office, commercial) act harmoniously with one another, making the area dynamic without overpopulating the streets at any one time.

Regarding design – the city needs more projects like this! Los Angeles has an amazing amount of diverse architectural styles represented, and the way these various styles play off one another gives the city its unique character. I love that the new design incorporates a new, amazingly modern wing next to the LACMA West building – it’s just the right amount of preservation and of new, cutting edge design.

Thank you for allowing me to give my input.
Regards,

--
Luciralia Ibarra  
City Planner  
Major Projects  
Department of City Planning  
200 N. Spring Street, Rm 750  
Los Angeles, CA 90012  
Ph: 213.978.1378  
Fx: 213.978.1343
From: Joyce Dillard <dillardjoyce@yahoo.com>
Date: Tue, Oct 14, 2014 at 3:57 PM
To: Luciralia Ibarra <Luciralia.Ibarra@lacity.org>

You assume no significant impacts in SURFACE WATER HYDROLOGY or SURFACE WATER QUALITY.

You have not based your reports or mitigation on the current requirements of the LA Regional Water Quality Control Board for surface water and hydrology. Monitoring and Reporting is not sufficiently addressed.

Contaminants have not been addressed in relationship to allowable Total Daily Maximum Loads. Low Impact Development (Ordinance) has not been addressed for mitigation measures.

You are in a METHANE ZONE with potential oil field gases.

Groundwater impacts should be addressed.

There is no data submitted.

Joyce Dillard
P.O. Box 31377
Los Angeles, CA 90031

--
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Fax: (213) 978-1343
E-mail: luciralia.ibarra@lacity.org

10/4/2014

RE: Le Melange HOA Comments on ENV-2013-1531-EIR

The following are comments from David Fanarof, resident at 637 S. Fairfax, Unit 501, Los Angeles, CA 90036, (directly west from the proposed site for the proposed Academy Museum of Motion Picture Museum).

ENV-2013-1531-EIR

State Clearinghouse Number: 2013051086
Council District: 4
Community Plan Area: Wilshire
To whom it may concern:

Sometimes a photograph can speak a thousand words (please see the attached photo fig.1).

This photo was taken directly outside my sole bedroom window located at 637 S. Fairfax Ave, Unit 501. There are no other residents living within such close proximity to the proposed project than the small community that encompasses 637 S. Fairfax Avenue. Our mix of 20 residential and 2 commercial units likely sits less than 100 ft. from the proposed project. We will inevitably hear and breathe the inevitable demolition and construction more sensitively than anyone else. We will also encounter the ensuing traffic pinches and endure the sights and sounds for decades to come.

As I sit writing this comment, I am already very conscious of the noise created by the jack hammering and demolition currently underway at The Peterson museum located more than twice the distance down the street from my window. I can only imagine what the full blown demolition of the 1946 addition to the May Co. Bldg and the construction of the 1000 seat theater space will entail. It doesn’t take complicated noise studies, traffic reports, air quality analysis, contaminant reports, etc. to appreciate the unique impact this project will have on 637 S. Fairfax.

I’m not an engineer, planner or land use attorney, yet I did my best to comprehend the DEIR as much as possible from a lay perspective. As a sensitive site, our building did receive some noticed attention.

However, I do not recall any specific mitigation measures that would alleviate our community’s well placed concerns that we hope can be addressed early on in the process and before the final EIR is submitted.

I believe there is another letter coming on behalf of our HOA that I hope will better detail some of our concerns, but to be safe I will briefly state what I know some of them to be here:

1. Fugitive Dust. Many in our community are well acquainted with fugitive dust issues that emanated from the “Levitated Mass” construction and installation. This project of a much grander scale and as such we expect significant impacts that will require some negotiated solutions. These may include several power/window washes and financial assistance to repaint once construction has been completed.
2. Noise. Noise from demolition, construction, increased traffic to a re-activated Wilshire/Fairfax corridor and future event noise is all inevitable and will at times be significant. Many of the windows/sliding doors that face East towards the project are master bedroom windows. We hope some sort of corresponding window treatments/soundproofing can be considered as viable mitigation measures where reasonably deemed necessary to dampen sound in sensitive areas.

3. Light. As I’ve already stated, there are many bedroom windows that directly face the project. We are hopeful that the ultimate nighttime illumination plan is sensitive to this reality. I’ve seen a couple renderings floating around online. Some look vastly brighter than others.

4. The EIR calls out 6th/Fairfax and Wilshire/Fairfax, but we don’t hear about Orange/Fairfax where there is already heavy congestion on the street due to the $99 Cent Store. This is a result of inadequate space for trucks to complete their drops offs and inadequate parking. This will increase once a planned staging area for The Purple Line construction takes over the Johnnie’s parking lot. Orange and Fairfax sits directly west of the proposed project.

5. Combined effects of large-scale surrounding projects - The DEIR points out the numerous large-scale projects already set to occur in the immediate vicinity and adjacent to our building (i.e., The Academy Museum, The Peterson, The Purple Line Extension). It points out that the combined effects will create significant impacts if these projects coincide, which it appear destined to do, but fails to lay out any mitigation plans. We hope the final EIR will address this issue as our building will encounter the brunt of these combined impacts.

Thank you in advance for your consideration.

Regards,

David Fanarof
637 S Fairfax Ave. 501
Los Angeles, CA 90036
Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
Ms. Ibarra:

I have attached my comments for the above referenced draft. I sent them to you already, but I was not sure if it went through.

Thanks,

Teresa Kiely Feldman

--

Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
October 14, 2014

Luciralia Ibarra
City of Los Angeles Department of City Planning
200 North Spring Street, Room 750
Los Angeles, CA 90012
Fax: (213) 978-1343
E-mail: luciralia.ibarra@lacity.org

VIA Email

Re: Academy Museum of Motion Pictures
ENV-2013-1531-EIR State Clearinghouse Number:2013051086
Council District: 4 Community Plan Area: Wilshire
Project Location: 6067 Wilshire Boulevard, Los Angeles, CA 90036

Dear Ms. Ibarra:

I am writing to comment on the Draft Environmental Impact Report (DEIR) for the above referenced project. I urge you to reject the report as it stands, and demand a more in-depth review of the impacts of the project.

I am a resident of the Beverly Grove neighborhood. I have lived in this neighborhood since 1994, first at Park La Brea, and then in my current home at 6231 West 6th Street. I live one block from the project site, just outside the 500-foot radius, between Fairfax and Crescent Heights. I want to see a vibrant project at this site, and I want the Museum to be successful in bringing an exciting venue with cutting-edge architecture to my neighborhood.

However, this Application and its DEIR is one of the first I have seen that indicates the hopes of the developer that the project not be successful, downplaying the potential hours of operation or use as an entertainment center, in order to create the illusion of a low-impact project. This Application is much too vague with regard to the planned hours of operation, its relationship with LACMA, Museum Associates, and neighboring property owners with regard to parking and traffic mitigation, and the specific uses of the site by outside parties. In addition, the Traffic Study is full of errors and omissions regarding street designations, speed limits, and parking limitations, and the entire DEIR virtually ignores the existence of the Wilshire Plan and the Beverly Grove residential neighborhood directly to the west of the project. Their Project Summary states that the area to the west of the project is commercial – There are small stores along Fairfax, but the entire area from Fairfax to San Vicente is a heavily impacted residential neighborhood. The Applicant is not being realistic with regard to the negative consequences that the adjacent neighbors will experience if this project is developed as planned. The developer must be required to face the true impacts, and develop a comprehensive plan that includes the elimination of the sign district, traffic calming measures for the residential areas surrounding
the project, real parking that is held by covenant, and specific community benefits, either onsite or in the adjacent area, that may offset any negative impacts at the site.

I served on the Mid City West Community Council (MCWCC) for five years, and I was a member of the Planning and Land Use Committee (PLUC) and the Transportation, Parking, and Streetscape Committee (TP&S) for those five years. I regularly attend MCWCC meetings and Beverly Wilshire Homes Association (BWHA) meetings to stay active and informed about our neighborhood.

In my time on the MCWCC, I worked with many applicants regarding requests for discretionary action. Even in a case as simple as a request for a Beer and Wine license, we looked carefully at potential impacts on adjacent residential neighbors, and at impacts on traffic and noise when applicants requested to host special events or have live music. One of the first pieces of information we required was the hours of operation. The Academy Museum has stated that they may follow the hours of LACMA; they have stated that they may open as early as 9 a.m. They have stated that they will close at 10 p.m., or at Midnight, or at 3 a.m. There is no way a traffic study can properly address impacts given such vague parameters. Indeed, the traffic study has no a.m. traffic data; it only addresses midday traffic. As a resident of 6th Street, I am well aware of the gridlock going westbound during the a.m. commute period. Their proposed solution of changing the timing of the lights merely adds volume to the street; it does nothing to protect the residential area, especially between Fairfax and Crescent Heights. There is already a great deal of cut-through traffic on the local streets between Fairfax and San Vicente; this will just add to it.

Even with downplaying the traffic to be created by this project, there are still several intersections where traffic congestion cannot be mitigated to acceptable levels. Fairfax and 6th, Fairfax and 3rd, Fairfax and Wilshire, and the San Vicente/Burton Way/La Cienega intersection are all failures under their plan. All of these streets hem in the Beverly Grove neighborhood, making it virtually impossible to travel within and outside the neighborhood. With The Grove, LACMA, the Palazzos, CBS, Cedars Sinai and other projects, the neighborhood is already congested; this project only adds to an impossible situation.

There are also errors in the existing traffic study that make the study inaccurate. Speed limits listed for streets such as 6th between Fairfax and San Vicente, as well as Colgate Avenue among others are too high. The study says there are a.m. and p.m. parking restrictions on these streets, which is not true. These errors make is seem that traffic can flow much faster than it actually can. In addition, the City and the neighborhood have been working diligently to calm traffic in the neighborhood, not speed it up, by installing speed humps, landscaped medians, and removing parking restrictions during peak hours. Indeed, the Wilshire Community Plan states that Crescent Heights, while
technically a Secondary Highway, should be treated as a Collector Street along its residential area. In addition, they list Ogden Street as a street that provides access to the property, when that street has been vacated, and cannot be used for vehicular traffic.

Regarding the [Q] Conditions on the property: The Property Owner, Museum Associates, has been developing this site in a piecemeal way without oversight due to its rights under the [Q] Conditions, and now it is using this Applicant to remove the portions of the Conditions that are inconvenient to them. Further analysis of the [Q] Conditions must be done to judge how this would affect the environment. The Applicant has done nothing to analyze the environmental impacts of removing the [Q] conditions. They did not include a Project Alternative that shows a project developed according to the [Q] Conditions; they just use the scare tactic of discussing a million square-foot hotel/office building. They do not show an alternative project that has the public plaza, open space, landscaping, and street trees that should be provided on that site. They propose no additional curb cuts along Fairfax to create better flow around the project. They do not show how impacts would be mitigated by reducing the lighting and providing an adequate parking structure.

This project sits on Parcel D of an old Development Agreement from 1993. In that agreement, several parcels were upzoned and others were downzoned. This parcel was originally comprised of three separate lots: The May Company site was Regional Commercial, and the other two parcels were zoned Parking and Parking Structure. In order to preserve the May Company building, the other two lots were upzoned to C2-2, and a large project was approved for the site. In addition to the zone change, there were many [Q] Conditions placed on the sites, mostly community benefits such as increased setbacks, extra public open space, and a higher concentration of street trees.

The Agreement expired without this parcel being developed in the original manner, but the [Q] conditions remained, mainly to provide community benefits due to the impacts of development on the other parcels. Under the Agreement, Museum Associates was allowed to build two pavilions without any community review, and their promise that they would not do a large development on Parcel D was a major factor in their being granted the Ogden Vacation. They also reduced the available parking at that time, by removing an old structure and building an underground garage. This Applicant is a tenant, not the property owner, but wants to remove all of the [Q] Conditions. They are leasing one portion of the Parcel; Museum Associates has the right to come back any time to add a large development. If the property owner and the Applicant want to remove the [Q] Conditions, they must provide guarantees that this is the end of any further development on Parcel D.

There are many other issues with this project, most having to do with the Applicant’s disregard of the surrounding residential neighborhood. This Applicant
has not even provided the basic, specific information that we require from a Mom and Pop restaurant owner in order to provide them with a CUP for alcohol. This project is too large and has too much potential for success for them to do such a limited review of the impacts on the neighborhood. I urge you to reject this EIR as inadequate, and require the Applicant to do a revised traffic study, find real parking or plan to construct a parking structure, lock down the hours of operation, show a Project Alternative with the [Q] conditions in place, remove the request for a sign district, and show some concrete examples of how they will reduce cut-through traffic and parking congestion in the adjacent Beverly Grove and Miracle Mile neighborhoods.

Thank you for your attention in this matter.

Sincerely,

Teresa Kiely Feldman
6231 West 6th Street
Los Angeles, CA 90048

(213) 841-1167 cell

mrsfeldo@aol.com
From: Adrian Fine <afine@laconservancy.org>  
Date: Tue, Oct 14, 2014 at 5:13 PM  
To: "luciralia.ibarra@lacity.org" <luciralia.ibarra@lacity.org>

Please use this version instead as there was an error in formatting on the previous version. Thank you! --Adrian

Adrian Scott Fine

Director of Advocacy

Los Angeles Conservancy

523 West Sixth Street, Suite 826

Los Angeles, CA  90014

(213) 430-4203

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Membership starts at just $40

Join the Conservancy today
Ms. Luciralia Ibarra

Project Coordinator, Environmental Analysis Section

Department of City Planning

200 N. Spring Street, Room 750

Los Angeles, CA 90012

Email: luciralia.ibarra@lacity.org


Dear Ms. Ibarra:

On behalf of the Los Angeles Conservancy, thank you for the opportunity to comment on the Draft Environmental Impact Report (EIR) for the Academy Museum of Motion Pictures Project (AMPAS). Please find attached the Conservancy’s comments. We applaud the Academy’s commitment to rehabilitate the historic May Company Wilshire building (“Original Building”) as part of the proposed project. Reactivating this building is important and will infuse new vitality into the historic Miracle Mile corridor.

We look forward to working together to further refine this project so that it may address our outstanding concerns regarding the Tearoom’s preservation, appropriate signage and placement, material conservation of exterior cladding, and the details of the proposed connector structure between the Original Building and the new sphere.

Please let me know if you have any questions.
Best, Adrian

Adrian Scott Fine

Director of Advocacy

Los Angeles Conservancy

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Join the Conservancy today

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Dear Ms. Ibarra:

On behalf of the Los Angeles Conservancy, thank you for the opportunity to comment on the Draft Environmental Impact Report (EIR) for the Academy Museum of Motion Pictures Project (AMPAS). We applaud the Academy’s commitment to rehabilitate the historic May Company Wilshire building (“Original Building”) as part of the proposed project. Reactivating this building is important and will infuse new vitality into the historic Miracle Mile corridor. Throughout our ongoing conversations with the project development team the proposed project has evolved and continually been improved. While we still have some outstanding concerns, we believe that additional refinements can be made and measures implemented to address these to ensure the historic building is protected in the future as well as the integrity of its iconic design, materials and setting.

I. Historic Significance of the May Company Building

Completed in 1939 and subsequently expanded in 1946, the May Company Building at 6067 Wilshire Boulevard remains one of Los Angeles’ most iconic structures. Designed by noted architects Albert C. Martin and Samuel Marx as the May Company’s new Miracle Mile location, the building is significant for its Streamline Moderne architecture and its design that responded to the growing influence of the automobile on the retailing business. The building’s corner detailing, with its gold-tiled cylinder (sometimes referred to as the “perfume bottle”), firmly established the May Company’s striking presence at Wilshire and Fairfax to traveling motorists. The building’s series of large showcase windows along Wilshire and Fairfax and a rear entrance adjacent to parking further catered to patrons arriving by automobile.
The building’s exterior retains a high degree of integrity. The ground floor and corner detailing are clad in polished black granite, while the upper floors of the Wilshire and Fairfax facades are clad in panels of Texas shell limestone and contain ribbons of steel-frame windows. The showcase windows and streamlined canopy wrapping around the main facades are fashioned from copper. Remaining historic fabric on the interior primarily includes the fifth floor tea room, with its coved ceiling, mantle and sculptural wall details.

The May Company Wilshire building received a Determination of Eligibility for listing in the National Register of Historic Places in 1983 and is listed in the California Register of Historical Resources. In 1991, the original 1939 portion of the building was designated a Los Angeles Historic-Cultural Monument (HCM #566).

II. The Final EIR should address design refinements of the proposed project to further mitigate impacts on the Original Building

   a. The Tearoom

In contrast to the highly intact exterior of the former May Company Building, the interior has very little historic fabric remaining. The Character-Defining Features Analysis in the Historic Resources section of the draft EIR notes that the Tearoom, which is located in the southern portion of the Penthouse, is intact and is considered one of the few contributing interior features to remain in the building. As described in Draft EIR, “the contributing Tearoom retains the floor plan, ceiling height, plaster wall finishes, heavily molded and coved plaster cornice, two black granite, Cordova shell stone and marble fireplace mantels (painted) with Streamline Moderne detailing and concave circular niche and decorative plaster urn over-mantel, door openings into kitchen and lobby, and steel Streamline Moderne multi-pane windows and doors on the south and west walls.” (4.c.3-21)

As currently proposed, the Tearoom would be removed to make way for a reconfiguration and expansion of the Penthouse to the south. We are concerned that the intact Tearoom would be lost to make way for the expansion without further explanation or mitigation measures. It is unclear why the historic fabric of the Tearoom could not be retained and incorporated within and as part of the expanded volume of the Penthouse. We suggest additional information and analysis be provided to address this issue.

   b. Cultural Heritage Commission review

Because the Original Building is designated as Los Angeles Historic-Cultural Monument #566, we feel it is important that the City’s Cultural Heritage Commission (CHC) be given the opportunity to review the project in a public hearing and provide comments in the form of a recommendation and vote. Proposed modifications to designated Historic-Cultural Monuments are routinely reviewed by the Cultural Heritage Commission and/or the City Architect. Therefore, the process of reviewing the proposed project and specific aspects such as signage in the future should include the Cultural Heritage Commission.
We understand that the James Goldstein Office (HCM #829), a landmarked office interior designed by master architect John Lautner (removed from its original Century City office building and rescued by the Los Angeles County Museum of Art), had been proposed for incorporation into the renovated May Company Building. We did not see mention of the Goldstein Office in the Draft EIR and request further information about the whereabouts and condition of this landmarked interior, and whether it is proposed for inclusion in the Original Building and as part of this project.

**c. Preservation Plan**

The Materials Conservation and Preservation Plan will be an important guiding document for the rehabilitation and future maintenance of the Original Building. As stated in the Draft EIR, the Cladding of the Original Building is a significant character-defining feature and the Cladding panels are currently exhibiting a range of deterioration including limited cracking, spalling, and staining indicative of localized water damage and metal corrosion. While a goal of the Preservation Plan is to retain and improve the integrity of the primary facades of the Original Building and to avoid significant impacts associated with façade rehabilitation, some concerns remain unaddressed.

It is unclear whether any testing has been accomplished to determine the success of detaching the limestone cladding panels intact, or whether attempts at detaching might result in a high incidence of fractured panels. The proposed salvage of cladding panels from the 1946 addition would provide a set of identical panels that could be used as replacements for those exhibiting deterioration beyond repair on the Original Building, though it is unclear what percentage might be successfully detached intact for that purpose. The ability to access the original quarry for the purposes of creating new cladding panels if necessary is also notable.

However, priority should be placed on retaining as many of the cladding panels on the Original Building as possible, in keeping with the *Secretary of the Interiors Standards*. The Draft EIR notes that “temporary removal and replacement of the exterior Cladding” may be required to “to introduce a vapor barrier necessary to maintain humidity levels consistent with required museum conditions.”

Testing to determine the success of removing the Cladding panels should be conducted early on. If analysis is found to result in a large proportion of damaged panels, the project should seek alternatives other than the “temporary removal and replacement” of cladding to introduce a vapor barrier. Because little of the interior retains historic fabric, alternatives that could accomplish the desired climate control from the interior of the walls while leaving the exterior Cladding intact should be analyzed.

**d. Clarification of latest design features/inconsistencies with renderings and descriptions provided in Draft EIR**

The Draft EIR appears to contain contradictory descriptions and illustrations of the project, making it difficult to ascertain the latest stage of the design. The Conservancy requests clarification with the project illustrations and once again stresses the need for up-to-date illustrations and congruity throughout the Draft EIR so that the project can be properly analyzed.
For instance, the Project Description states “circulation elements, including escalators, elevators and potentially stairs, would be accommodated within the Original Building in the area along the North façade where the 1946 Addition would be removed.” Figure 28 of the CEQA Impact Analysis section clearly depicts this interior stair configuration, and Figure 37 in the same document also appears to match the Project Description. However, Figure 2-6 in the Project Description depicts a prominent exterior staircase providing vertical circulation among floors. Figure 003 in the Conceptual Signage Plans in appendix H-3 also depicts this exterior stair configuration.

The Project Description states that “the Sphere’s shape and the planned use of a variety of façade treatments, including glass and metal, are intended to reduce its perceived mass and visual impact.”(2-13). At 165 feet in height, the Sphere will rise approximately 43 feet higher than the roof parapet of the Original Building, which is 87 feet in height. By contrast, Figure 30 in the CEQA Impact Analysis section depicts the Sphere as lower in height compared to the Original Building’s roof parapet. Additionally, while mostly obscured by an illustrated tree in Figure 30, the Sphere appears to be plainly visible to eastbound traffic on Wilshire and within the viewshed of the primary facades of the Original Building.

Design elements of the New Wing that remain a concern are the decorative vertical “spire” projections that rise above the level of the parapet of the Original Building. We believe these draw greater attention to the addition connector than necessary. These elements appear in Figure 2-6 in the Project Description, Figures 29, 37, 38 and 39 of the CEQA Impact Analysis section, and Figure 004 in Appendix H-5 containing the Academy Museum Conceptual Signage Plans. Yet in the rendering on the cover page of the Light and Glare Technical Report, the design is modified and does not include these decorative vertical projections, though the exterior stair circulation is still present. Clarification and a consistent set of drawings is recommended.

e. Sign District and Conceptual Signage Plans

The creation of a Sign District is a component of the proposed project, and several purposes and objectives are outlined in the Project Description of the Draft EIR. One of these objectives calls for ensuring that “signs are responsive to and integrated with the aesthetic character of the structures on which they are located, including reuse of the storefront windows on the Original Building, and are positioned in a manner that is compatible both architecturally and relative to the other signage onsite.”(2-25)

While the historic Original Building provides several opportunities for the display of new signage that is compatible with historical uses at the site, including the use of flag pole signs for the original eight flag poles and utilizing the historic display windows along the main facades for compatible displays, we have concerns with several of the proposed signage types that appear inconsistent with historical advertising or signage at this building. Again, we believe it is important for the Cultural Heritage Commission to have an opportunity to review and comment on the proposed Sign District, as part of the EIR process and in the future when additional signage is proposed.
**Banner Signs:** These signs are proposed to take the form of six supergraphic displays ranging from 46-51 feet in length and 12-40 feet in width that would be attached to the limestone cladding of the upper facades. Three signs of this type are depicted in the Conceptual Signage Plans: one located at the southeast corner of the Original Building at Wilshire Boulevard, and two located along the Fairfax Avenue elevation, at the northwest corner and directly north of the Corner Tower. We are concerned that signage of this size and scale will overwhelm the architecture of the building and the balanced design of the facades. In particular, the two banner signs proposed for the Fairfax elevation would cover a substantial amount of the façade when the removal of the 1946 addition is taken into account.

**Identification Sign I-E-2 (Oscar silhouette):** This sign, proposed for placement on the Corner Tower, would measure 63 feet in length and 46 feet in width. While historic signage advertising the “May Company” in neon individual lettering was originally present on the black granite blades framing the Corner Tower, the gold mosaic tile clad cylindrical tower has never featured signage. It has always been the most prominent architectural feature of the building. While the analysis in the Standards and Design Guidelines Conformance section of the Draft EIR states that this proposed signage would be “installed in conformance with the Standards so as not to harm architectural materials such as the Tile or Cladding,” we are concerned that this signage would greatly detract and take away from the iconic tower’s original design. We suggest further clarification regarding what material the signage would be constructed from, and what its day and evening visibility would be.

**Digital Display Box Signs (historic display windows):** This signage would be located in the series of historic display windows along the ground floor of the Wilshire and Fairfax facades. While the reactivation of these historic display windows is appropriate for signage and interactive displays, we are concerned that the employment of too many of the display windows at any given time could overwhelm the architecture.

**Digital Display Box Signs (fourth floor windows):** This signage would be projected from sections of windows along the fourth floor of the building, where historic signage was never utilized. Two ribbons of windows along Wilshire and one ribbon along Fairfax are proposed to serve as “Display Box Signs.” It is unclear what kind of treatment is called for here and how this might distract from the aesthetics of the Original Building’s design.

Given our concerns about the maximization of signage on the Original Building, we question why so much signage has been proposed for the historic structure when opportunities exist to utilize the New Wing for advertising purposes. We note that some signage has been proposed for placement on the Sphere, but we encourage the project team to transfer more signage to that location. The Original Building should not be used for maximum signage placement in order that the Sphere be unobstructed for maximum architectural impact. The May Company Building is one of Los Angeles’ most iconic structures and its masterful design is achieved through bold forms, contrasting materials, and the spare use of decorative details. The introduction of too much signage in non-historic locations would significantly compromise the aesthetics of the historic building’s design.
III. **Conclusion**

We appreciate the opportunity to comment on the Draft EIR and this important proposed project. When completed it will reuse the historic May Company Wilshire Building and activate it for a vibrant and exciting new use. We look forward to working together to further refine this project so that it may address our outstanding concerns regarding the Tearoom’s preservation, appropriate signage and placement, material conservation of exterior cladding, and the details of the proposed connector structure between the Original Building and the new sphere.

**About the Los Angeles Conservancy:**
The Los Angeles Conservancy is the largest local historic preservation organization in the United States, with over 6,000 members throughout the Los Angeles area. Established in 1978, the Conservancy works to preserve and revitalize the significant architectural and cultural heritage of Los Angeles County through advocacy and education.

Please feel free to contact me at (213) 430-4203 or afine@laconservancy.org should you have any questions.

Sincerely,

Adrian Scott Fine
Director of Advocacy

cc: Office of Historic Resources, Cultural Heritage Commission, City of Los Angeles Council District 4
I think it is really a shame that there is no plan for additional parking for the new Academy Museum. We absolutely need more parking and every time an exhibit opens there it is a parking nightmare. There is plenty of space to expand current parking garage and/or build a new structure. I thought there were regulations specifying a number of parking spaces for each new or renovated public space!

Roz

--
Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
From: Jonathan Golfman &lt;jgolfman@mrcstudios.com&gt;
Date: Tue, Oct 14, 2014 at 10:22 AM
Subject: Academy Museum Support Letter
To: "luciralia.ibarra@lacity.org" &lt;luciralia.ibarra@lacity.org&gt;

Please see attached.

--
Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
October 14, 2014

Jonathan Golfman
743 N. Orlando Avenue
Los Angeles, CA 90069

Luciralia Ibarra
Environmental Analysis Section
Department of City Planning
200 N. Spring Street, Room 750
Los Angeles, CA 90012

Dear Ms. Ibarra:

I am a long-time resident of our City, and a Miracle Mile resident. I am writing to express my full support for the Academy of Motion Pictures Museum Project.

I am a supporter of walkability – to me providing walkability is an offset to any potential traffic impacts. I spend a tremendous amount of time walking in my neighborhood. My understanding is that the Museum project is well designed from a walkability standpoint. I’ve been told that there will be two entrances to the Museum, one on Wilshire, which will be a great reactivation of the Wilshire/Fairfax corner and one on the North side adjacent to a beautiful public Piazza. The design should also open up the entire westside of the LACMA campus which I believe has been needed for years. Additionally, the Museum should be able to take advantage of the new Metro station, as will all of Museum Row.

I believe that this Museum will directly benefit our community and this City. What better way to celebrate Los Angeles’s movie making heritage than the creation of a Museum dedicated to movies!

I support this project and urge you to move forward and approve the Academy Museum.

Sincerely yours,

[Signature]

Jonathan Golfman
From: Dennis Hathaway <dennis@banbillboardblight.org>
Date: Tue, Oct 14, 2014 at 9:05 AM
Subject: Corrected Copy of DEIR Comments
To: luciralia.ibarra@lacity.org

Dear Ms. Ibarra:

I discovered that the comments letter I sent to you yesterday contains some typos, so I would like to replace it with the corrected copy attached here. I apologize for any inconvenience.

Thank you,

Dennis

Dennis Hathaway

President, Coalition to Ban Billboard Blight

2700 Military Ave., Los Angeles, CA 90064

310-386-9661

--

Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
October 12, 2014

Luciralia Ibarra  
Environmental Analysis Section  
Department of City Planning  
200 N Spring Street  
Los Angeles, California 90012

Re: Case Number: ENV-2013-1531-EIR  
Academy of Motion Pictures Museum.

Dear Ms. Ibarra:

The Coalition to Ban Billboard Blight is a registered non-profit organization that represents individuals, homeowners associations, civic organizations, and other community groups in the city of Los Angeles. Its mission is to advocate for public policies, regulations, and decisions that protect the city’s visual environment from negative impacts of outdoor advertising.

Following are comments on the DEIR for the above referenced project. These comments are limited to section 4.A.1. Aesthetics and Views, 4.A.2. Light and Glare, and Appendix C, Aesthetics and are specifically addressed to impacts of the signage proposed for entitlement by provisions of a proposed sign district.

I. The Proposed Signage is Not Compatible with the Architecture of the Original Building

The proposed signage is not compatible with the architecture of the Original Building and its status as a city historic-cultural monument. Contrary to the assertions in Appendix C-1, Table 4, the proposed signage is not consistent with the policies of the Miracle Mile CDO by being incorporated into the overall design of a building and complementing the facade or architectural elements on which it is placed. According to the conceptual signage plan, three “banner” signs¹ are to be placed on three corners of the building and one banner sign is to be placed on the north side of the entry tower. These vinyl or fabric signs will have a total surface area of 5768 sq. ft. and will be illuminated without any time restrictions. They extend from just above the canopy level nearly to the roofline of the building and will be highly prominent in near and distant views of the building. Contrary to the DEIR's conclusions, this signage will be in stark and jarring visual contrast to the architecture of the Original Building and will clearly detract from its historic design.

¹ Note: There is no category of “banner sign” in the city sign code. These proposed signs fit the definition of “supergraphic signs”, which are listed as prohibited sign types.
Likewise, the 16 digital displays proposed for the Original Building are wholly incompatible with its architecture. The street level windows of the Original Building were static department store displays. Converting them to digital displays that allow full animation greatly detracts from the building's historic nature. Even worse, the proposal to allow such digital displays for special events in 11 upper story windows and projected signage over the entire building surface makes a mockery of the idea of historic preservation of the city's architectural past. In fact, during these special events up to 12 times a year with a duration of up to 3 days, the building would become a spectacle of color and light. It is extremely difficult to conceive of such an extravaganza “complementing” the facade or architectural elements on which it is placed.

Another detraction from the historic architecture are the 8 proposed 16 x 4 ft. flag pole signs. Many historic photographs of the building when it operated as a department store show no signs or flags on the poles, which indicates that they were not intended for permanent flag or banner displays. The poles may now be appropriate for temporary signage, but not as a display of large advertising signs on a permanent basis. The proposed flag pole signs would also be lighted with no time restriction, which causes yet more detraction from the architectural values of the Original Building. Finally, the Oscar identification sign on the gold entry tower, which is the single most distinctive element of the building's architecture, is nothing less than an insult to anyone concerned with preserving the city's architectural past. It is inconceivable that this brightly-lit, almost 3,000 sq. ft. sign would not be a major distraction from the building's historic architecture.

II. The Proposed Signage Lighting Levels Are Far Too High

The lighting levels of the proposed signage are far too high. Contrary to the assertions in Appendix C-1, Table 5, proposed sign illumination is not at the minimum required for nighttime readability. According to Appendix C-1, Section 6.6 Spill Light and Glare Impact Assessment-Signage, the permanent digital displays at sidewalk level would have a maximum luminance of 500 candelas per square meter. The nearly 3,000 sq. ft. “Oscar” ID sign on the entry tower would also have a maximum luminance of 500 cd/m² while the four banner (supergraphic) signs would have a maximum luminance of 200 cd/m².

According to a study entitled “Luminance Criteria and Measurement Considerations for Light-Emitting Diode Billboards” by the Lighting Research Center at Rensselaer Polytechnic Institute, “the preferred luminance of simulated outdoor signage for legibility and acceptability under nighttime viewing conditions, sign luminances of no more than 100 cd/m² were found to optimize legibility and acceptability, even when competing signs were present.” In “Digital LED Billboard Luminance Recommendations” researchers at Arizona State University also recommended luminance levels not to exceed 100 cd/m². According to these researchers, high brightness in contrast to the lower brightness of the street or road in a driver's view could increase risk of accidents because of the delay in visual adaption after viewing a sign. In the case of the 16 permanent digital displays proposed for this project, which are generally at the level of the driver's eyes, the high contrast poses a hazard not only for other motorists but for pedestrians crossing the street at the busy intersection of Wilshire Blvd. and Fairfax Ave. The three supergraphic signs proposed for the Fairfax Ave. and Wilshire Blvd. frontages and the Oscar ID sign lighted at five times the recommended level would also pose a hazard.
III. Full Motion Video Displays are Hazardous and Incompatible with the Miracle Mile CDO.

Even more than brightly lit static digital displays, full motion video animation proposed for the permanent and temporary digital signage creates a substantial hazard for motorists, cyclists, and pedestrians at the intersection of Wilshire Blvd. and Fairfax Ave. The Miracle Mile CDO calls for “creating an environment in which pedestrian and automobile traffic can safely exist.” The CDO further states that these issues can be addressed by consideration of lighting and signage, among other things. Motorists whose field of vision includes five-story lighted supergraphic signs, animated digital displays in storefront windows, and colored light shows projected on the walls of the Original Building are in clear danger of being distracted and thus present a substantial hazard to other motorists, cyclists, and pedestrians.

In a study entitled “External Driver Distractions: The Effects of Video Billboards and Wind Farms on Driving Performance,” researchers at the University of Calgary found through use of driving simulations that the presence of the video signs affected a number of driver performance measures. In the simulated environment of the study, significantly more collisions occurred in the full motion video sign environment than in the presence of static signs. In another study entitled “Investigating Driver Distraction: The Effects of Video and Static Advertising,” by the Transport Research Laboratory in London, drivers in a simulated environment with both video and static advertising signs were found to have spent longer looking at video signs, glanced at video signs more frequently, shown greater variation in lateral lane position with video signs, and braked harder on approach to video signs, among other behaviors. The study concluded that video advertisements caused a “significantly greater impairment” to driving performance than static advertisements.

The proposed signage clearly detracts from the historic May Co. building's architecture and is inconsistent with building's historic-cultural monument status, the luminance of the signage is far higher than necessary, and the animated signage is a potential hazard for motorists, cyclists, and pedestrians. The DEIR's conclusion that the signage proposed for this project results in no significant environmental impacts is thus seriously flawed, and should be rejected. Unless effective mitigations can be identified that mitigate these impacts to a level less than significant, the project should not proceed.

Sincerely,

Dennis Hathaway, President
ABSTRACT
The present paper summarizes luminance measurements and calculations for advertising billboard signs located adjacent to highways. The primary purpose of the present information is to provide preliminary estimates of conventional externally-illuminated billboard panel luminances in the driving environment. These estimates could form a partial basis for maximum luminance requirements for electronic billboards adjacent to highways using self-luminous light sources such as light-emitting diodes. Also discussed are considerations when making luminance measurements of billboard signs in the field.
INTRODUCTION
Billboards using light-emitting diode (LED) sources are beginning to become commonplace on many highways. They differ from conventional, externally-illuminated billboards because they are self-luminous both in daytime and nighttime conditions. They can also be operated to present multiple sign messages over a fixed period of time. Transportation agencies might have an interest in developing maximum luminance specifications to help ensure that LED billboards do not create glare or distraction to nearby drivers (1-3).

The present paper summarizes luminance measurements and calculations for advertising billboard signs located adjacent to highways. The main purpose of this information is to provide transportation agencies with estimates of conventional externally-illuminated billboard panel luminances in the driving environment during the daytime and during nighttime conditions. These estimates could form a partial basis for maximum luminance requirements for electronic billboards adjacent to highways using self-luminous light sources such as LEDs. This paper does not address issues pertaining to the temporal characteristics of electronic billboard signs (e.g., flicker or sequencing messages), nor does it address the potential brightness enhancement of saturated colors that can be produced by LEDs (4) relative to other lighting configurations.

EVALUATION METHODS
The sources of evaluation information in the present paper include the following:

- Review of illuminance recommendations from the Illuminating Engineering Society of North America (IESNA) and lighting industry sources and calculations of resulting luminances
- Field measurements of the luminances of several billboards in the Albany, NY region
- Computer simulation of a billboard lighting installation based on industry recommendations

Published Recommendations for Lighting Billboards
The IESNA Lighting Handbook (5) contains recommendations for illuminating billboard signs and other large advertising panels. These recommendations are based on two factors: the surrounding location (bright versus dark surroundings, as might be found in urban and rural settings, respectively), and the average reflectance of the information on the billboard. Consideration of this latter factor is impractical, because the information on billboards is subject to continual change. A billboard containing a mostly dark-colored sign today could be converted to one containing a mostly light-colored sign tomorrow.

Since the recommendations of the IESNA are stated as recommended illuminances for sufficient conspicuity, and since it is unlikely that the lighting system on a billboard will be changed if the color of its sign information changes, it is probably reasonable to expect many billboard exterior lighting systems to provide the higher illuminance recommended by the IESNA. For locations with bright surroundings the recommended illuminance is 1000 lx and for locations with dark surroundings, the recommended illuminance is 500 lx. Assuming a white sign face (having a reflectance, $\rho$, of 0.8), the luminance (L, in cd/m²) of such a sign with an illuminance (E, in lx) of 1000 lx is 250 cd/m², and the luminance (L) of the same sign face with an illuminance (E) of 500 lx on it is 130 cd/m², using Equation 1:

$$L = \frac{E\rho}{\pi}$$  
(Equation 1)

Marketing information from two manufacturers was reviewed to determine if industry recommendations differed from those of the IESNA. One manufacturer repeated the IESNA recommendations verbatim and another recommended an illuminance of 800 lx, which is between the IESNA values for bright and dark surroundings described above. Assuming a white sign face, this illuminance would result in a luminance of 200 cd/m², according to Equation 1.

Field Measurements of Billboard Luminances
During March 2008, when sky conditions were mostly clear during the afternoon, and clear (with a waning gibbous moon) during the evening, a series of luminance measurements of several existing billboard signs was conducted along Interstates I-787 and I-90 in and near Albany, NY. Daytime measurements were made between 3:00 and 4:30 p.m., and nighttime measurement between 9:00 and 10:30 p.m. All measurements were made with a hand-held, portable luminance meter (LS-100, Minolta).
**TABLE 1** Summary of Billboard Sign Characteristics and Luminance Measurements

<table>
<thead>
<tr>
<th>Sign location, type and color</th>
<th>Direction of travel facing sign</th>
<th>Distance of sign from roadway edge (ft)</th>
<th>Measurement location (and distance)</th>
<th>Daytime luminance (cd/m²)</th>
<th>Nighttime luminance (cd/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-787 conventional (white)</td>
<td>northbound</td>
<td>125 (from southbound side)</td>
<td>I-787 southbound (n/a)</td>
<td>23,100</td>
<td>not measured</td>
</tr>
<tr>
<td>I-787 conventional</td>
<td>southbound</td>
<td>280</td>
<td>Erie Boulevard (340 ft away)</td>
<td>1230</td>
<td>4</td>
</tr>
<tr>
<td>I-90 conventional (beige)</td>
<td>westbound</td>
<td>70</td>
<td>Erie Boulevard (70 ft away)</td>
<td>2880</td>
<td>160</td>
</tr>
<tr>
<td>I-90 conventional (purple)</td>
<td>westbound</td>
<td>25 (from eastbound side)</td>
<td>Erie Boulevard (70 ft away)</td>
<td>540</td>
<td>8</td>
</tr>
<tr>
<td>I-90 conventional (white)</td>
<td>westbound</td>
<td>60</td>
<td>Anderson Drive (310 ft away)</td>
<td>3300</td>
<td>180</td>
</tr>
<tr>
<td>I-90 conventional (white)</td>
<td>eastbound</td>
<td>180</td>
<td>Watervliet Avenue (80 ft away)</td>
<td>13,100</td>
<td>240</td>
</tr>
<tr>
<td>I-90 conventional (yellow)</td>
<td>eastbound</td>
<td>75</td>
<td>Westgate Plaza (150 ft away)</td>
<td>3950</td>
<td>150</td>
</tr>
<tr>
<td>I-90 LED (yellow)</td>
<td>westbound</td>
<td>75</td>
<td>Anderson Drive (290 ft away)</td>
<td>3810</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>I-90 westbound (n/a)</td>
<td>not measured</td>
<td>160</td>
</tr>
<tr>
<td>I-90 LED (light green)</td>
<td>eastbound</td>
<td>75 (from westbound side)</td>
<td>Anderson Drive (300 ft away)</td>
<td>4170</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>I-90 eastbound (n/a)</td>
<td>not measured</td>
<td>220</td>
</tr>
</tbody>
</table>

Most of the measurements were made from locations on the shoulder of the highway to avoid interfering with traffic. For conventional billboards, the direction of view is generally unimportant as long as specular (i.e., shiny) reflections from the billboard surface are avoided. Measurements of an existing, double-sided static LED billboard adjacent to I-90 were also made. To check for possible directional changes in luminance, nighttime measurements were made both from an off-highway location and from locations along the highway shoulder lanes facing each side of the LED billboard.

Dimensions and distances from the highway for all signs were estimated using imagery from Google Earth™. All signs were 48 ft wide and 14 ft high. Table 1 summarizes the sign locations and luminance measurement values. Luminance measurements were made from distances ranging from about 70 to 340 ft from the sign; the circular aperture of the luminance meter covered a spot of uniform color ranging from 1.2 ft in diameter (at 70 ft) to 6 ft in diameter (at 340 ft).

**Computer Simulation Model**

Using photometrically accurate computer modeling software (AGi32, Lighting Analysts), and based on the recommendations for the number of luminaires, mounting and spacing for a sign 48 ft wide and 14 ft high that were provided by one of the billboard luminaire manufacturers, a virtual sign lighting installation was created. The face of the sign was assumed to be white with a reflectance of 0.8; the mounting pole and ground surfaces were assumed to have reflectances of 0.25. Figure 1 illustrates the model used in the simulation.

The luminaires used in the simulation (Sign-Vue II, Holophane) were equipped with 400 W metal halide lamps according to manufacturer recommendations. A total of four luminaires were used, and were oriented as recommended by the manufacturer for the 48 × 14 ft billboard size. Luminaires photometric distributions are design and light source specific. There was no ambient illumination (e.g., assuming nighttime viewing with no contribution from surrounding city lights) and the initial lumen output was used for the metal halide light sources, assuming new lamps at the beginning of operating life.

Table 2 summarizes the calculated illuminances (in lx) on, and the calculated luminances (in cd/m²) of the sign, and Figures 2 and 3 illustrate the modeled sign's illuminance and luminance distributions, respectively.
SUMMARY OF EVALUATIONS

In general, the luminances of the billboard signs were consistent among the three different analysis methods. Estimations of luminance from the IESNA and industry recommended illuminance recommendations resulted in maximum values (for white sign surfaces) of around 200 to 250 cd/m². This is consistent with the maximum value of 240 cd/m² measured in the field for the existing billboards, and with the average and maximum values of 210 and 277 cd/m², respectively, found in the computer simulation analysis. As described above, the computer simulation analysis assumed new lamps and no light loss factors from dirt, lumen depreciation or other factors. It probably represents close to the maximum light level for the sign under the type of illumination that was simulated.

During the daytime, the maximum sign luminance (for a sign facing the south, toward the sun on a mostly clear day) measured was 23,100 cd/m². This is close to the predicted luminance of 22,900 cd/m² that would be expected for a white, vertical surface facing the sun, on a clear day and with a solar altitude (angular distance above the horizon) of about 30º (5). Based on these characteristics, it is probably reasonable to expect that the luminance of a conventional billboard would not be likely to exceed about 280 cd/m² during the nighttime (assuming typical lighting practice as represented by the IESNA and industry recommendations, and by the lighting systems used on the signs that were measured in the field), or about 23,000 cd/m² during the daytime.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Illuminance and Luminance Summary for the Simulated Billboard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Illuminance (lx)</td>
</tr>
<tr>
<td>Average</td>
<td>829</td>
</tr>
<tr>
<td>Max</td>
<td>1094</td>
</tr>
<tr>
<td>Min</td>
<td>412</td>
</tr>
</tbody>
</table>

One sign face (toward eastbound traffic) of the LED billboard adjacent to I-90 that was measured during nighttime exhibited a luminance (of the lightest-colored portion of the display) that was higher than 280 cd/m² when measured from the off-highway location, although its nighttime luminance was only 220 cd/m² when measured from the highway. The sign face toward westbound traffic did not exceed 280 cd/m² from either location at night. During the daytime, the LED billboard sign faces (the signs displayed the same messages during both daytime and nighttime measurements) had luminances well under 23,000 cd/m². Since a portion of the daytime luminance is created by daylight reflecting from the sign surface it is not possible to determine the contribution of the LED sources in the sign to the sign's daytime luminance, but it is probably less than 540 cd/m², the measured luminance of a dark-colored (purple) westbound-traffic-facing conventional billboard sign. In any case it is almost a certainty that the output of the LEDs in the billboard that was measured is adjusted according to ambient (day/night) conditions, with higher output during the daytime. It was observed that the LED billboard was equipped with two cameras or detectors facing the sky behind each sign face, and it is likely that these are devices to detect day/night conditions in order to adjust the sign luminance accordingly.
DISCUSSION
The LED billboards in this study appear to use arrays of colored LEDs in clusters to create colors within a gamut defined by the LEDs in the clusters, such as red, green and blue. Combinations of these three colors can be used to create all other colors. For example, red and green LEDs in combination will result in a yellow display; and red, green and blue LEDs in combination will result in a white display. One would expect that the color with the highest luminance would be white, since it is a combination of all three colors. Neither of the sign faces on the existing LED billboard were white during the time of measurement (one face was largely light green and the other was largely yellow). Presumably, the luminances would have been somewhat higher than the values in Table 1 if the sign faces were white.

The measured luminances of the LED billboard signs differed by about 20% to 30% depending upon the location from which they were measured. The luminances of both sign faces of the LED billboard were lower from the off-highway locations than from the measurement locations along the highway. It seems unlikely that the LED billboard was designed to have any specialized angular distribution of light since the maximum luminance was not measured from the on-highway location. Observations of each sign face's appearance, while driving past it during the nighttime measurements, indicated that the sign face luminances did not seem to change much as one drives past
them. Thus, it would appear reasonable to expect the luminance of the sign directly in front of the sign to be similar to its luminance at the angles from which it is expected to be seen on the highway, at least for signs similar to the one that was measured.

If there were a specification that LED billboards should not exceed a particular luminance during either daytime or nighttime conditions, it would probably be a significant task to develop a laboratory test to verify that a particular sign meets such a specification. For one thing, all of the billboards measured for the present study, including the LED billboard, were large (48 ft in width) and setting them up inside a laboratory with dark-colored walls (to minimize stray light) to measure the luminance would be difficult. Although it is likely that the billboard signs are constructed from smaller panels that would be easier to measure in the laboratory [similar to luminance specifications from the Institute of Transportation Engineers for pedestrian signals (6)], this may not be true for all LED billboards.

Measurement of the signs in the field is possible, as the present study indicates, but several caveats need to be considered. LED output is related to ambient temperature with lower temperatures generally resulting in higher light output (7), so a sign measured during winter might have a higher luminance than the same sign measured during the summer, assuming the control system does not compensate for this effect. Light from the ambient environment also contributes to luminance, but except for the brightest urban environments, this factor is unlikely to contribute significantly to the sign luminance. In any case, such measurements should probably be made while the sign display is white (or as light-colored as possible) in order to present the maximum luminance.

The Institution of Lighting Engineers (8) in the United Kingdom recommends luminance measurements of advertising signs when installed, for the purpose of confirming that they meet specifications. A luminance meter aperture of 1º or less is recommended, and measurements from directly in front of the sign are recommended. Garvey (9) measured the luminances of on-premise advertising signs (not billboards) in Pennsylvania, and for externally illuminated signs, the maximum luminance measured was 132 cd/m². Garvey (9) reported that these luminances were well below the levels (~600 cd/m²) for advertising signs suggested by the ILE to limit glare in urban areas; similarly, none of the billboards measured in the present study appeared to create significant glare to drivers. And based on the results of a study of the preferred luminance of simulated outdoor signage for legibility and acceptability under nighttime viewing conditions (10), sign luminances of no more than 100 cd/m² were found to optimize legibility and acceptability, even when competing signs were present.

A more pertinent concern may be the potential for distraction caused by dynamic messages on the faces of LED billboards (1). Lee et al. (3) investigated driver behavior such as eye glances in response to LED billboards changing every eight seconds and found that although glances to LED billboards were slightly longer than to conventional billboards, the overall time for drivers’ eyes on the road was similar between billboard types; from these results Lee et al. (3) concluded that LED billboards were probably safety-neutral compared to conventional types. This conclusion is not without controversy, however (2).

Finally, the LED billboards, being made of arrays of LEDs, are not perfectly uniform surfaces. If viewed from a very close distance (such as, perhaps, a few feet away), they will appear as an array of bright points against a darker background. At a viewing distance of 50 ft, a luminance meter with an aperture of 1º would subtend about 10 in. It is likely that this distance would assure that a 1º aperture would cover a large enough area of a sign face to be approximately uniform, but this could be checked by making several measurements at slightly offset points near the same location to ensure that the luminance values were similar.

ACKNOWLEDGMENTS
The study summarized in this paper was sponsored by the New York State Department of Transportation (NYSDOT). Barbara Abrahamer, Bruce Davis, Rodney Delisle, Cheryl Duprey, Patrick Galarza, Carlos Quiles and Donald Roberts from NYSDOT, Emmett McDevitt from the Federal Highway Administration, and Conan O'Rourke from Rensselaer’s Lighting Research Center provided valuable input during the planning of the study.

REFERENCES
Digital LED Billboard Luminance Recommendations
How Bright Is Bright Enough?

DRAFT

Christian B. Luginbuhl, U.S. Naval Observatory Flagstaff Station
Howard Israel, Phoenix, Arizona
Paul Scowen, Arizona State University
Jennifer and Tom Polakis, Tempe Arizona
9 November 2010

Summary

Careful and sensible control of the nighttime brightness of digital LED signage is critical. Unlike previous technologies, these signs are designed to produce brightness levels that are visible during the daytime; should too large a fraction of this brightness be used at night serious consequences for driver visibility and safety are possible. A review of the lighting professional literature indicates that drivers should be subjected to brightness levels of no greater than 10 to 40 times the brightness level to which their eyes are adapted for the critical driving task. As roadway lighting and automobile headlights provide lighting levels of about one nit, this implies signage should appear no brighter than about 40 nits. Standard industry practice with previous technologies for floodlit billboards averages less than 60 nits, and rarely exceeds 100 nits. It is recommended that the new technologies should not exceed 100 nits.

Introduction

Illuminated signage, for both advertising and informational purposes, has been a fixture of the modern nighttime environment since at least the invention of electric lighting. Until recently, the principal use of artificial lighting has been to make signs legible at night: ambient lighting, including skylight and sunlight, has been considered adequate for daytime visibility. With the advent of digital LED billboards, however, this is no longer true. Digital LED billboards must generate brightness sufficient to make them legible during the daytime as well as at night. The brightness necessary to make a sign legible during a full sunlit day can be many thousands of candela per square meter (also called nits); products available on the digital LED billboard market commonly advertise maximum luminances between 6500 and 7500 nits. This creates the potential risk of a blinding nighttime brightness should an inappropriate adjustment for nighttime conditions be made. Thus, the question arises of an appropriate limit to the brightness of a sign at night, whether a digital LED billboard or any other kind of sign.

Background: Sign Brightness, Drivers, and Visibility

The principal safety and regulatory concerns for drivers viewing signage from a roadway is that 1) the sign, by its very nature, is seeking to attract the gaze of the driver, i.e. the advertiser intends the driver to look directly at the sign (and away from the roadway) for a period of time sufficient to discern the sign’s message or messages. Besides the obvious issue of a driver taking his or her eyes from the driving task, viewing the sign leads to the second problem, 2) the eye adapting toward the brightness level of the sign. Thus, when the driver returns his gaze back to the roadway, in all cases illuminated to a much lower brightness than the sign, for some period of time the driver's vision is no longer optimally adapted to seeing objects on the roadway. This changing visual adaptation when brightness levels change is
referred to in the technical literature as "transient adaptation." Drivers that have their visibility reduced for objects on the roadway, even momentarily, will be at greater risk for accidents.

The Illuminating Engineering Society of North America (IESNA) recognizes this issue in numerous places in its literature. The *IESNA Lighting Handbook* (9th edition, page 3-9) states:

"If the change in [brightness] lies completely within the range of operation of the cone photoreceptors [i.e., daytime vision], a few minutes is sufficient for adaptation to occur. ... As for direction of change... changes to a higher [brightness] can be achieved much more rapidly than changes to a lower [brightness]." [emphasis added]

This last sentence says that the eye will adapt much more quickly when moving from the dimly lighted roadway to the bright sign, but much more slowly when returning to the dim roadway.

Design brightness levels for illuminated roadways are in the range of one nit (varying from about 0.3 to 1.2 nits, depending on roadway type (IESNA RP-8-00, 2000)). Thus, a driver viewing a billboard illuminated to (for example) 100 nits, and then returning his gaze to the roadway, must adapt his eyes to a brightness range of about 100:1.

What then is an acceptable ratio for transient adaptation, such that a driver’s vision will not be hampered when viewing both more brightly and less brightly illuminated areas while driving? *IESNA RP-33-99, Lighting for Exterior Environments* (page 42) states:

"If... roadways are lighted to a base level, [adjacent] areas should be no brighter than ten times that level. Additional brightness will not attract more attention, and may present a hazard to motorists on adjacent roadways."

Further, in *IESNA RP-20-98 Lighting for Parking Facilities*, we find (page 2):

"It is intended that a driver (or pedestrian) looking at the brightest spot in the field of view will also be able to detect an object in the dark areas within the field of view. This detection can occur only if the maximum-to-minimum illuminance is limited to a range that the human eye can see."

This is followed by the numerical recommendations (page 3, Table 1) of 15-20:1. In other words, the brightest area should appear no more than 20 times as bright as the faintest to assure that the brightness remains within a range that the human eye can see.

In *IESNA RP-2-01, Lighting Merchandise Areas* (page 58), we find:

"... luminance ratios between the lighted retail area and its surroundings should not exceed 20:1. Increasing the lighting level does not add to merchandise attraction, and may create a hazard to motorists on adjacent roadways or a nuisance for neighbors. A value of 10 times the average surrounding task luminance is a maximum that should be utilized for the focus merchandise. This will provide merchandise appeal without producing hazards or creating conflicts with other nighttime events."
The IESNA recommendations for advertising sign brightness (IESNA Lighting Handbook, 9th edition, page 17-26) are inconsistent with all recommendations noted above. Brightnesses between 250 and 1400 nits are listed in the table titled "Recommended Luminous Background Sign Luminances." These recommendations, if visible to highway drivers, will subject drivers' eyes to a brightness ratio of 250-1400:1. According to their own recommendations this ratio is unsupportable and will lead to compromised visibility and safety on public roadways. From the maximum ratio of 20:1, and assuming roadways are illuminated to about one nit, signs should be no brighter than 20 nits. It is perhaps telling that nowhere in the discussion of recommended advertising sign brightnesses is transient adaptation or the vision of drivers mentioned.

**Lighting for Conventional Floodlit Billboards**

A series of measurements made for this report in August 2009 (55 billboards, Phoenix metro area), November 2010 (3 billboards, Chicago area), as well as deduced from data supplied for Tucson billboards by M. Mayer, give an idea of brightness levels commonly seen in usual floodlit signs. These signs were constructed and illuminated in most cases without any restrictions on sign brightness. It seems reasonable to assume that the signs are illuminated to a brightness considered satisfactory by the industry; if they were not, in most cases there were no regulations preventing them from increasing the lighting levels.

**Tucson Metro Billboards.** A lighting inventory undertaken by M. Mayer lists the areas, number and types of lamp used for illumination for 510 billboard faces located throughout the Tucson metropolitan area. Since no direct luminance measures were made for this survey, we deduced approximate luminances using a set of assumptions describing the physical characteristics of the sign lighting installation\(^1\). These assumptions allow the conversion of total initial lamp lumens and area of the signs to the maintained luminance values shown in Figure 1.

\(^1\) Initial lamp lumen outputs from the manufacturer’s literature; Light Loss Factor (LLF) = 0.60; Application coefficient of utilization = 0.30; Diffuse reflectance of white vinyl sign surface = 0.70

![Figure 1. Number of billboard faces with indicated predicted maintained luminances in the Tucson metropolitan area.](image-url)
Phoenix and Chicago Metro Billboards. Measures of white surfaces on 55 floodlit billboards in the Phoenix metropolitan area were made in August and November, 2009 using a Minolta LS-100 luminance meter. An additional 3 billboards were measured in the Chicago area in November, 2010. All of these billboards are located in an urban environment. The results are presented in Figure 2; the data are presented in Appendix A.

![Bar chart showing number of billboard faces with indicated measured luminances in the Phoenix and Chicago metropolitan areas.]

Of the total 510 billboard faces inventoried in the Tucson metropolitan area, the estimated average luminance is 59 nits; 83% (424/510) are estimated at 100 nits or less, and 98% (502/510) at 150 nits or less. The Phoenix and Chicago sample shows quite similar results, with an average luminance of 54 nits, and 90% (52/58) measured at 100 nits or less, and 97% (56/58) under 150 nits.

**Toward a Sensible Standard**

Following the most conservative information concerning contrast ratios and transient adaptation, it appears that the maximum luminance for signs visible to drivers on typically illuminated roadways should not exceed approximately 20 nits. This follows directly from the commonly cited maximum contrast ratio of 20:1 appearing in the IESNA literature and roadway luminances of approximately 1 nit.

Twenty nits is considerably below the brightness proposed by the OAAA report, and even below the typical floodlit sign visible to drivers today. Yet IESNA references concerning brightness ratios and transient adaptation, when discussed in any context other than that of signage (see below), indicate that choosing a value higher than 20 nits may have visibility consequences for drivers.

When discussing lighting recommendations for signs directly, IESNA recommendations begin at 20 nits but range higher, in one case much higher. *IESNA RP-19-01 Recommended Practice for Roadway Sign Lighting* recommends that roadway signs be designed with luminances between 20 and 80 nits. The lower value, 20 nits, is consistent with the value deduced from recommended maximum contrast ratios and typical roadway luminances. The higher value, 80 nits, will present drivers with a contrast ratio of
about 80:1, yet is approximately comparable to typical practice for floodlit billboards. In The IESNA Lighting Handbook (9th edition), Figure 17-37 Recommended Luminances for Poster Panels, Painted Bulletins, and Other Advertising Signs recommends illumination levels that are consistent with luminances of 45 – 111 nits\(^2\).

Thus, we suggest that a regulated maximum luminance for any type of sign visible from a roadway, digital LED billboard or other, should not exceed 100 nits in an urban environment. Though it can be easily argued that this value is too high, this limit would be consistent with the vast majority of commercial floodlit billboards in use today, and at least would not increase potential degradation of drivers’ vision above levels experienced with current floodlit billboards. As the adaptation state of drivers’ eyes is generally dominated by the luminance level of the roadway illuminated by headlights, that is around one nit, it may not be necessary to require lower sign luminances in darker surroundings.

**The Outdoor Advertising Association of America Report and Recommendation**

To formulate its own recommendations for sign luminance limits, the Outdoor Advertising Association of America commissioned a study (Lewin, 2008; hereafter referred to as the OAAA report). This report describes "a method for specification of luminance limits for digital billboards based on accepted practice by the Illuminating Engineering Society of North America (IESNA)." Based ultimately on considerations of "light trespass," as developed in another report (*IESNA TM-11-00 Light Trespass: Research, Results and Recommendations*), a recommended "brightness" limit and measurement technique is presented. The technique uses an illuminance meter ("footcandle" meter) held at a height of 5 feet above the ground and a distance of between 150 and 350 feet from the sign under consideration, depending on the size of the sign, and aimed at the sign. The illuminance level with the sign lighting on is compared with a measure made with the sign off: if the value differs by 0.3 foot candles or less the author proposes that the sign brightness is at an acceptable level. Though direct luminance measures or limits are not suggested in this proposed regulatory strategy, the report indicates that this method effectively limits the luminance of signage to 300-350 nits.

**Issues with the OAAA Report**

The OAAA proposed luminance levels are too high, about ten or more times as bright as recommended in most IESNA recommended practices, and three or more times as bright as current accepted practice reflected in billboard floodlighting. They would present drivers with contrast ratios of 300:1 or more. This is unnecessary for advertising effectiveness and unnecessarily risks roadway safety. Further, the OAAA recommendations are consistent with only the highest values gleaned from the IESNA literature, and inconsistent with IESNA recommendations for roadway signs and maximum contrast ratios to minimize transient adaptation problems.

Besides potentially serious practical issues associated with the measurement procedure proposed in the OAAA report (e.g. the location for the suggested measurement may often lie within roadways; determining compliance requires switching the sign on-and-off), there is a fundamental conceptual error in the approach used to develop the strategy and limits.

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\(^2\) IESNA recommended illuminance of 200-500 lux for light copy in dark-light surrounds combined with assumed diffuse sign reflectance of 0.70.
The details of *IESNA TM-11-00* are critical to understand if the results of that study are being appropriately applied to the problem of determining maximum sign luminances. In the study, a group of observers was presented with a variety of very brightly illuminated (2000 to 7500 nits) panels and asked to judge whether or not the panels seemed too bright. An in-depth review is beyond the scope of this discussion, but the following point is critical: the observers were asked only to rate how "objectionable" they found the illuminated panels to appear; no evaluation of visual performance - the ability to see objects or read signs - was attempted. This alone brings into serious question the applicability of the TM-11-00 study to the question of appropriate sign brightnesses, and their potential impact on driver safety.

The fundamental approach of the OAAA report has confused lighting that has been judged to cause an acceptable level of light trespass or even just an "objectionable" sensation with the much more vital issue of sign lighting that compromises the vision and therefore safety of drivers. The ability to see and light trespass/objectionability are essentially unrelated. The OAAA report recognizes this, stating "Digital billboards are not the form of lighting that TM-11-00 was developed to limit." Yet the OAAA report does just that.

Transient adaptation, and not light trespass, or "objectionability," is the overriding concern for public safety with regard to the brightness of signage.

**References**

IESNA, *IESNA TM-11-00 IESNA Technical Memorandum on Light Trespass: Research, Results and Recommendations*
Appendix A

Floodlit billboard luminance measurements presented in this report.

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Notes: 1 measured by P. Scowen; 2 measured by J. and T. Polakis; 3 measured by H. Israel; 4 B. Radner, Assistant Director, Will County Land Use Department, Memorandum 1 November 2010
16
External Driver Distractions: The Effects of Video Billboards and Wind Farms on Driving Performance

16.1 Introduction
The use of driving simulators to investigate different kinds of driver distraction is well established. Specifically, driver distraction is defined as the momentary or transient redirection of attention from the task of driving to a thought, object, activity, event or person (Caird & Dewar, 2007, pg. 196). The Handbook chapter by Strayer, Cooper, & Drews illustrates how driving simulators have been used to determine the effects of cell phones on driving distraction, but also see Caird et al., (2008). The current chapter examines how driving simulators can be used to evaluate external distractions or those objects that draw the attention of the driver outside of the vehicle.

The relative contribution of different categories of driver distraction to crashes is described by Stutts et al., (2001; 2005) and is listed in Table 16.1. The category outside person, object or event row is highlighted. External distractions compose the single largest category of distraction-related crashes comprising about 23% and 29% of distraction crashes. Although external distractions are the most common contributor to crashes, the least is known about why these crashes occur (Caird & Dewar, 2007; Eby & Kostyniuk, 2003). The variety of people, objects and events available for viewing by drivers may deter researchers from wading into this un-drainable empirical swamp. In contrast, in-vehicle technologies such as cell phones, iPods and navigation systems have been studied more extensively using driving simulators (Caird et al., 2008; Chisholm, Caird, & Lockhart, 2008; Tijerina et al., 2000, respectively). In general, a variety of external distractions do not readily collapse into distinguishable categories with some notable exceptions.

The studies reported in this chapter investigated two novel external technologies that are becoming part of rural and urban transportation landscapes; namely, wind turbines or wind farms, and video or electronic billboards. In general, investigations of driver distraction tend to focus where there are financial interests or liability exposure at stake. If alternative
energies become a focus of sustainable economic growth, wind farms are likely to proliferate. Their presence in close proximity to roadways has the potential to affect traffic safety. In contrast, video billboards provide a means to reach consumers in their vehicles. Advertisers are willing to pay owners of video billboards in order to reach drivers. Determining whether it is safe to do so has financial repercussions to advertisers, billboard owners and drivers too. Within the literature reviews that follow, the practical and methodological issues of each kind of external distraction are elaborated.

16.1.1 Video Billboards as a Potential External Distraction

Video billboards, electronic billboards, or video advertising signs represent a relatively new and unknown source of external distraction (Farbry et al., 2001). At night, a walk through Times Square in New York City or Yonge-Dundas Square in Toronto affords an intense visual exploration of both electronic and conventional billboards (see Web Figure 1 on the Handbook web site). Video billboards are more vibrant (range of luminance and colors) and dynamic (contain movement and luminance changes) than static or conventional billboards, making them more conspicuous. Kline & Dewar (2004) define attention conspicuity as the extent to which a sign is sufficiently prominent in the driving scene to capture attention, and is a function of size, color, brightness, contrast relative to surroundings, and dynamic components such as movement and change. It follows that video billboards are more conspicuous than conventional billboards because of their dynamic and brightness properties.

In addition to bottom-up properties, a video billboard provides a stream of images and text that are available for apprehension and reading. The length of an advertisement, content and availability during an approach are some of the external factors that affect the extent to which information processing can occur during glances. Internal factors of the driver also affect the degree a driver to which will look at a video billboard. Familiarity with advertising content, willingness to be distracted in a particular context, and immediate threats to ongoing driving are some of the factors that are likely to affect visual interaction on any given approach. Thus, noticing and encoding of content from a video billboard are affected by numerous external and internal factors to the driver.

Despite a general concern about video billboards’ potential to capture and divert attention, minimal research has been done to determine the impact of video signs on driver behavior and performance (Farbry et al., 2001). Reviews of existing literature up to 2001 find that the contribution of conventional and video billboards to increases in crash rate is difficult to determine due to a number of practical and methodological reasons. Crashes are often an infrequent occurrence and thus are not an ideal measure of relative safety. In addition, distraction may interact with other factors, such as weather and congestion, to produce a crash. A body of equivocal findings, where some studies find crash increases and others do not, was compiled (Farbry et al., 2001). From this review, one study that compared crash rates found a decrease in crashes at both an intersection after the installation of a video billboard and a control intersection. In another study, a lesser decrease in crash rates attributed to a sign outside Boston, compared to greater decreases elsewhere resulted in the removal of the sign. In yet another case, involving a three-vehicle crash, an airline owner of an electronic sign was found indirectly responsible for the crash and the sign was removed. A variety of mitigating factors were also identified across these cases including the context in which a given sign is placed: For example, straight freeway, curves (horizontal

<table>
<thead>
<tr>
<th>Driver Distraction Category</th>
<th>1995 to 1999</th>
<th>2000 to 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside person, object, or event (e.g., vehicle, police, animal, novel events, people or objects in the road, etc.)</td>
<td>29.4 (2.4)</td>
<td>23.7*</td>
</tr>
<tr>
<td>Adjusting radio/cassette/CD</td>
<td>11.4 (3.7)</td>
<td>2.9</td>
</tr>
<tr>
<td>Other occupant (e.g., talking, yelling, fighting, child, infant)</td>
<td>10.9 (1.7)</td>
<td>20.8</td>
</tr>
<tr>
<td>Moving object in vehicle (e.g., insects, animals, objects)</td>
<td>4.3 (1.6)</td>
<td>3.7</td>
</tr>
<tr>
<td>Other device/object (e.g., purse, water bottle, etc.)</td>
<td>2.9 (0.8)</td>
<td>5.2**</td>
</tr>
<tr>
<td>Adjusting vehicle/climate controls</td>
<td>2.8 (0.6)</td>
<td>1.5</td>
</tr>
<tr>
<td>Eating/drinking (e.g., burger, tea, coffee, soda, alcohol, etc.)</td>
<td>1.7 (0.3)</td>
<td>2.8</td>
</tr>
<tr>
<td>Talking/listening/dialing cell phone (e.g., answer, initiate call)</td>
<td>1.5 (0.5)</td>
<td>3.6</td>
</tr>
<tr>
<td>Smoking-related (e.g., reaching for, lighting, dropping, etc.)</td>
<td>0.9 (0.2)</td>
<td>1.0</td>
</tr>
<tr>
<td>Other distraction (e.g., medical, other inside or outside events or objects, intoxicated, depressed, etc.)</td>
<td>25.6 (3.1)</td>
<td>34.8***</td>
</tr>
<tr>
<td>Unknown distraction</td>
<td>8.6 (2.7)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>


Notes: * Standard errors were not reported in Stutts et al. (2005).
** Category was modified to using/reaching for object brought into the vehicle.
*** Other and unknown categories were collapsed.
and vertical, intersections, work zones, etc.); properties of the sign itself (e.g., luminance, size, colors, message length, attention conspicuity, exposure time, etc.); and individual differences (e.g., driver and route experience, age, willingness to look, etc.).

Since 2001, several studies have examined eye movements to video signs. An on-road study on a raised six-lane expressway in Toronto with 25 drivers found that video billboards received significantly more glances per subject per sign ($M = 1.45$) and a greater proportion of longer glances (i.e., those greater than 0.75 s), compared to static billboards (Beijer, Smiley, & Eizenman, 2004). The mean duration of glances to video signs was 0.6 s. A number of researchers have argued that longer glances away from the road present a threat to traffic safety and can result in a higher likelihood of collisions (Green, 2007). In addition, billboards may contribute to the increasingly cluttered driving environment. A driver’s ability to rapidly search visually dense scenes, extract critical information, and respond in a timely manner may be interfered with when a single source of information such as a video billboard draws the attention of the driver to it over information in other equally or more important signs (Ho et al., 2001).

Smiley, Smahel, & Eizenman (2004) addressed whether the presence of video billboards affected glances to other signs, and related questions about the frequency and duration of glances to video billboards. Sixteen participants were fitted with an eye-tracking system and they drove a route with four video billboards; one on an expressway, and three in downtown Toronto. On average, participants looked at video billboards about 48% of the time. About one-quarter (23%) of glances were longer than 0.75 s. Loss of data from 29 of 112 sign approaches (Smiley et al., 2004), which represents a loss of about 26%, makes the statistical analyses and interpretations of the behavioral results somewhat problematic (Tabachnick & Fidell, 2006, Chapter 4).

Smiley et al., (2005) summarize the previous eye movement study (i.e., Smiley et al., 2004) and report the results of a traffic conflict study, a before-and-after crash study, a before-and-after speed and headway study, and a public survey of the perceived safety of billboards. The same four locations in Toronto, which are listed above, were the focus of these studies. The traffic conflict study examined driver behaviors on the video billboard approach and non-video billboard approach to two downtown intersections. A higher incidence of braking without good cause was found in the video billboard approach for one of the two intersections. No differences in unwarranted lateral displacements or delays on a green light were found at either intersection.

The before-and-after crash study examined three downtown intersections before and after the installation of video billboards. When examined individually, two of the three intersections showed an increase in rear-end and total collisions on the video billboard approach, while the third intersection showed a decrease. The results of the before-and-after speed and headway study were inconclusive. Finally, the public survey indicated that 65% of the 152 drivers surveyed said that video billboards had a negative effect on driver attention to pedestrians or cyclists, and 86% of respondents supported restrictions on video billboards. While these studies provide helpful information on the impact of video billboards on drivers, they lack the control and level of analysis that simulator studies provide. Specifically, before-and-after crash studies can be confounded by multiple other contextual issues such as roadway geometry, weather, and increases in traffic flow, while simulator studies control for these issues and provide more in-depth data regarding driver behaviors such as speed and lane position.

Using video clips while driving, Crundall, van Loon, & Underwood (2006) investigated the impact of street-level and raised advertising on drivers’ attention. Eye movement measures indicated that street-level advertising attracted attention to a greater degree than raised advertising because the street-level advertising was further from the line of sight. The extent to which a sign is in the periphery relative to the course of travel seems to affect both the frequency and duration of glances.

Shinar (2007) reports an unpublished study that examined the extent that a sample of experienced drivers in an on-road study looked right, left and at the roadway using a camera installed in the rear-view mirror. On the right hand side of one approach was a large static billboard with a topless male model in it. The opposite direction drive served as the comparison condition. When approaching the billboard, glances to the left (10%) and roadway (68%) were shifted to the billboard (23%). However, on the drive in the opposite direction (i.e., not facing the billboard) drivers looked to the right (10%), left (19%) and to the roadway (71%) accordingly. The explanation given for the results was that drivers allocated their spare attentional capacity to the billboard with little cost to the roadway or left-side glances. By extension, billboards are safe because drivers have spare visual attention to allocate. How spare is spare capacity, however, when an emergency event requires an immediate response? Driving simulators would allow the researchers to address this question and determine if allocating spare visual attention is safe when unexpected driving events such as a lead vehicle braking suddenly or a pedestrian emerging into the roadway occurs. These events are rare and difficult to measure in on-road studies.

To address this gap, a study was conducted to address three central questions: 1) Do video billboards cause an increase in response time to unexpected driving events such as a lead vehicle braking suddenly or a pedestrian emerging into the roadway occurs. These events are rare and difficult to measure in on-road studies.

16.1.2 Wind Turbines as a Potential External Distraction

Wind turbines or wind farms are quickly multiplying along roadways in the U.S., Canada and Europe, but their impact on driver distraction is completely unknown. Many countries expect that wind turbines will provide a larger proportion of energy needs in the future. Wind turbines come in wide variety of sizes and installation patterns, some of which appear along roadways (see Web Figure 2 on the Handbook web site).

An extensive web search and consultation with researchers from around the world found almost no research that attempted...
to determine the relative distracting potential of wind turbines. Typically, planning documents and opposition position papers cite driver distraction as a potential negative impact when considering new wind farm installations. Turbine visibility while driving and road proximity are also mentioned. However, evidence that establishes a firm link between crashes and turbine installations is lacking.

The only previous study on driver distraction and wind farms was performed by David George (2007) and was sponsored by Your Wind Energy Limited (U.K.). In this study four wind farms were investigated along roadways and before- and-after-crash frequencies were compared to matched control roads without farms. No differences in crash rates were found between the wind farm installations and comparison roadways. The body of available evidence on wind farms and driving distraction is insufficient to determine whether a given installation will cause crashes to occur on adjacent roadways.

An exploratory study was conducted to determine the impact of wind turbines placed along roadways on driver distraction. Specifically, do rear-end collisions occur when a lead vehicle brakes hard in the presence of the wind turbines? Are driving behaviors such as speed maintenance and lane keeping negatively impacted? Are older or younger drivers more or less likely to be distracted by wind turbines? Do wind turbines distract drivers from the task of driving?

16.2 Common Methods

16.2.1 University of Calgary Driving Simulator

A pair of experimental studies was conducted in the University of Calgary Driving Simulator (UCDS), which is described in detail elsewhere (Caird et al., 2007; Chisholm, Caird & Lockhart, 2008). Briefly, a Saturn sedan is situated in front of three screens. Each projector displays onto a wrap-around screen, each of which measures 86.5” wide by 65” in height. The total projected forward field-of-view is 150 degrees. Traffic environments and experimental scenarios for the driving simulator were developed and run in HyperDrive (v.1.9.28), which also manages the data collection of roadways. The body of available evidence on wind farms and driving distraction is insufficient to determine whether a given installation will cause crashes to occur on adjacent roadways.

An exploratory study was conducted to determine the impact of wind turbines placed along roadways on driver distraction. Specifically, do rear-end collisions occur when a lead vehicle brakes hard in the presence of the wind turbines? Are driving behaviors such as speed maintenance and lane keeping negatively impacted? Are older or younger drivers more or less likely to be distracted by wind turbines? Do wind turbines distract drivers from the task of driving?

16.2.2 Common Procedures

Participants in both studies were required to have a valid driver’s license, to drive at least 10,000 kilometers per year, and to report not being susceptible to car sickness or being in an at-fault crash within the previous three years. Drivers with graduated or restricted licenses were excluded to control for driving experience. All participants were screened for visual acuity, contrast sensitivity and colour deficiencies.

Each participant drove a short practice drive to familiarize them with the visual properties of the simulated drives and the handling characteristics of the vehicle. Drivers were also told to drive as they normally would in their own vehicle and were reminded to adhere to the posted speed limit signs. Following the experimental drives and questionnaires, participants were debriefed and remunerated for their participation.

16.3 Methods—Video Billboard

16.3.1 Participants

A total of 21 participants (11 males and 10 females) volunteered for the Video Billboard study through the Department of Psychology’s online experiment participation system. Their characteristics are summarized in Table 16.2. Participants were slightly older than the typical university student at 24.5 years of age on average (SD = 7.2 years).

16.3.2 Procedure

Participants drove three experimental drives with each one lasting approximately five minutes. Two static and two video billboards were present in each experimental drive (see Web Figure 3). The order of presentation of the three drives was counterbalanced across participants. In total, twelve billboards were encountered over the course of the three experimental drives. In the simulation, sequences of images were triggered at locations on the approach to a video billboard, somewhat like a flip-book. A new image was displayed as each trigger was passed while driving toward the billboard. Roadways consisted

| TABLE 16.2 Video Billboard Study: Gender, Number of Participants in each Group, Mean Participant Age (Standard Deviation, SD) reported Average of Kilometers Driven per year, Number of Crashes and Number of Moving Violations reported in the last 5 years |
|---|---|---|---|---|---|
| N | Mean Age (SD) | Average Km/Year | Crashes (last 5 years) | Moving Violations (last 5 years) | Visual Acuity, Left Eye | Visual Acuity, Right Eye |
| Male | 11 | 24.18 (5.64) | 18,175 (8,335) | 0.36 (0.5) | 1.09 (1.1) | 20/21 (0.3) | 20/21 (0.3) |
| Female | 10 | 24.80 (8.90) | 23,500 (12,331) | 0.90 (1.1) | 1.90 (2.5) | 20/23 (0.3) | 20/25 (0.4) |
| Total | 21 | 24.48 (7.19) | 20,710 (10,516) | 0.62 (0.9) | 1.48 (1.9) | 20/22 (0.3) | 20/24 (0.4) |
predominantly of two-lane urban highways with four-way and three-way intersections dispersed throughout. Oncoming traffic was present throughout the drives and cross traffic and operational stoplights occurred at intersections.

A lead vehicle was intermittently inserted ahead of the participant at certain times during the drives. The lead vehicle was coupled to the movement of the driver using a programmed script and maintained at least a minimum headway of one second. The lead vehicle would brake at 8 m/s² for 50 m and reaccelerate to the posted speed (see Figure 16.1 and Web Figure 4). The driver had to respond quickly to avoid a rear-end collision. Two lead-vehicle braking (LVB) events occurred in each condition (i.e., video billboard, static billboard, and baseline).

The posted speed limit was 80 km/h throughout the experimental drives. However, drivers had to reduce their speed when the posted speed was changed to 70 km/h. This speed change task occurred once in the presence of a video billboard, once in the presence of a static billboard, and once with no billboard (i.e., baseline) (see Web Figure 5). Speed was measured before and after the 70 km/h sign.

Participant’s memory of the static and video billboards was tested after the simulator drives were completed. Participants were shown twelve images of billboard advertisements on a computer and were asked to identify those that had been present in the experimental drives. The image set included three static billboards and three still images from video billboards presented during the drives, as well as six images that were not present during the drives.

16.4 Results—Video Billboard Study

16.4.1 Experimental Design and Analyses

A mixed-factor ANOVA with billboard condition (video, static, baseline) as the within-subjects factor, and order of presentation of drives (1, 2, 3) as the between-subjects factor, was used to analyze perception response time (PRT) and minimum headway distance (MHD). A significant order effect was found for the lead vehicle braking events. Thus, order was examined in each analysis.

A repeated measures ANOVA was used to analyze the effect of billboard condition for the speed change event and memory test. All follow-up analyses used the Bonferroni correction for multiple comparisons. If sphericity was violated, the Greenhouse-Geisser adjustment was used and is indicated with a G-G next to reported $F$ tests. The frequency of collisions during the lead vehicle braking events were analyzed using Chi-square non-parametric tests. Drive order effects were not significant for the speed change event and memory test.

16.4.2 Perception Response Time

Perception response time (PRT) is defined as the elapsed time (in seconds) from when the lead vehicle brake lights were visible until the participant removes his or her foot from the accelerator pedal and begins to depress the brake pedal (Olson & Farber, 2003). PRT is used in road geometry and traffic control design guidelines and forensic investigations of crashes. There was no main effect of billboard condition on PRT, $F(2, 36) = 2.32, p > .05$. Means and standard errors were similar across conditions, video billboard ($M = .88, SE = .03$), static billboard ($M = .83, SE = .03$), and baseline ($M = .89, SE = .03$). Order of drive presentation was not significant, $F(2, 18) = .35, p < .05$. However, the two-way interaction between order and billboard condition was significant, $F(4, 36) = 6.00, p = .001$ (see Web Figure 6).

Follow-up analyses examined the effect of billboard condition within each order. Order 1 and order 2 did not differ significantly between conditions. However, order 3 follow-up tests revealed a significant effect of condition on PRT, $F(2, 12) = 13.42$, $p < .001$. Participants took significantly longer to respond to the lead vehicle braking in the video billboard condition ($M = .99, SE = .07$), compared with both static billboard ($M = .88, SE = .06$), and baseline ($M = .83, SE = .06$) conditions, $p < .05$. 

FIGURE 16.1  Lead vehicle before (left) and during (right) a braking event in video billboard condition.
16.4.3 Minimum Headway Distance

Minimum headway distance (MHD) is defined as the minimum distance in meters from the simulator’s front bumper to the rear bumper of the lead vehicle during the braking event (Chisholm et al., 2008). Data from the onset of brake pressure until either velocity reached zero or brake pressure was removed were used. Billboard condition had a significant effect on MHD, $F(2,36) = 28.02, p < .001$. On average, participants traveled significantly closer to the lead vehicle when it braked in the video billboard condition ($M = 2.76, SE = .64$), than the static billboard ($M = 7.18, SE = .43$) and baseline ($M = 5.15, SE = .53$) conditions (see Figure 16.2 and Web Figure 7). A significant two-way interaction of condition and order was found $F(4, 36) = 4.984, p < .005$.

Follow-up analyses examined the effect of condition within each order presentation. Order 1 and order 2 revealed a significant effect of billboard condition on MHD, $F(2, 10) = 9.41, p < .005$, and $F(2,16) = 5.01, p < .005$, respectively. Participants came much closer to the lead vehicle in the video billboard condition ($M = 3.51, SE = 1.31$) than in the static billboard condition ($M = 8.97, SE = .74$); however, no difference was found between video billboard and baseline. Order 3 follow-up tests also indicated an effect of billboard condition, $F(2, 10) = 17.008, p < .001$. Significantly shorter minimum headway distances were found in the video billboard condition ($M = 1.52, SE = 1.31$) than in either the static billboard ($M = 7.09, SE = .68$), $p < .05$, or baseline ($M = 6.96, SE = 1.22$), $p < .05$, conditions.

16.4.4 Lead Vehicle Braking Collisions

Lead vehicle-participant collisions were determined by a collision detection algorithm. Fifteen collisions occurred out of a total of 126 LVB events (6 events $\times$ 21 participants). Chi-square analyses found a significant effect of billboard condition on collision frequency ($\chi^2(2) = 12.71, p = .002$). More collisions occurred in the video billboard condition (11) than the static billboard condition (1) ($\chi^2(1) = 9.72, p < .05$). The video billboard also significantly differed from the baseline condition (3), ($\chi^2(1) = 5.49, p < .05$). Thus, significantly more collisions occurred in the video billboard condition than in either the static billboard or baseline conditions.

16.4.5 Speed Change Event

The purpose of the speed change task was to determine whether the presence or absence of billboards caused drivers to delay or miss changes in the posted speed limit. Participant’s velocity was recorded at the posted speed sign in km/h. Speed changes from 80 km/h to 70 km/h were present in all three conditions (video billboard, static billboard, baseline), but did not include those instances of lead vehicle braking. Analyses found no significant differences in velocity across the three conditions: Video billboard ($M = 70.3, SE = 1.09$), static billboard ($M = 73.3, SE = 1.04$) and baseline ($M = 71.7, SE = 1.00$), $F(1, 21) = 1.014, p > .05$.

16.4.6 Memory Test

Participants were given a billboard recognition test at the conclusion of the drives. Twelve billboard pictures were shown sequentially on a computer. Six were present in the drives and six were not. Within each of these sets of six, three were video and three were conventional. A billboard was classified as being remembered when a participant identified if it was present in one of the experimental drives and whether it was a video or static billboard. Only correct responses for video and static billboards were analyzed. Overall, the main effect of billboard condition was not significant, $F(1,20) = .03, p > .05$. Overall, recognition of the video ($M = .35, SE = .08$), and static ($M = .33, SE = .06$) billboards occurred about one third of the time.

16.5 Discussion—Video Billboard Study

16.5.1 General Discussion

An experimental simulator study was conducted to determine the effects of video billboards on driver behavior and performance. The presence of video billboards affected a number of driver performance measures. Significantly more collisions occurred in the video billboard condition than in either the static billboard or baseline conditions. Perception response time (PRT) and minimum headway distance (MHD) measures were affected by the order of exposure to the video, static and baseline billboards. PRT results only found differences among billboard conditions in drive 3 where, as hypothesized, significant delays in PRT were found in the video billboard condition. In general, response times to the braking of the lead vehicle would be expected to decline (Chisholm, Caird & Lockhart, 2008) as participants anticipate the lead vehicle braking events in the presence of a billboard. Order 1 and 2 LVB events are interpretable in the context in which each occurred. In drive 3, the first critical incident occurred next to the video billboard. In drive 1 the first car braking next to a video billboard. Learning may have occurred throughout the drives, and the presence of billboards may have been used as a cue to prepare to brake. Thus, because the first lead vehicle braking event...
in both drive 3 and drive 1 (order 3) were video billboard conditions, and they were presented in that order. PRT in the video billboard condition may be higher than in the static or baseline conditions as learning had not yet occurred and participants were not cued by the presence of a billboard to anticipate a braking event.

When the LVB events occurred in the presence of the video, static and baseline conditions, the MHD results found that participants traveled significantly closer to the lead vehicle in the video billboard condition than the baseline condition, for all orders. Observing the video billboard most likely delayed the participant’s response times to the lead vehicle braking. Taken together, the MHD and collision results indicate that video billboards may have a safety cost when certain events occur. Adjusting speed when a speed limit sign was present was not affected by the presence of video billboards. This result was based on discrete samples of speed at specified locations and did not examine speed adjustment delay over time.

The results of the simulator study, where a lead vehicle braked hard in the presence of the video billboard, found a causal relationship between the presence of the video billboard and collisions with, and delays in responding to, the lead vehicle. A realistic assumption of the performance of those in the simulator study is that their performance is near optimal. The luminance of the video billboards in this study was lower because of the brightness characteristics of the projectors. Thus, the capability to capture attention was not the same as video billboards typically found in traffic environments and therefore drivers’ performances in the simulator would presumably be better than they would on the open road. Furthermore, the limited capability to evaluate night driving was available in some driving simulators (see Handbook chapter by Wood & Chaparro). However, this obvious manipulation was not explored in the present study.

### 16.6 Methods—Wind Turbine Study

#### 16.6.1 Participants

Participants for the Wind Turbine Study were recruited into the study using posters placed around the University of Calgary and nearby community centers. A total of 24 participants, stratified into the age groups of 18 to 25 (younger), 26 to 54 (middle-aged), and 55 and older (older), participated in the study. An equal number of men and women were in each age group. This sample of drivers was entirely different than the sample in the video billboard study.

The mean age of drivers in the younger age group was 22.4 (SD = 1.8), 30.9 (SD = 4.5) in the middle-aged group, and 65.5 (SD = 7.1) in the older age group. The characteristics of the participants in this study are summarized in Table 16.3.

#### 16.6.2 Procedures

Participants drove two experimental drives each lasting approximately 12 minutes, which were counterbalanced across participants. The first experimental drive is illustrated in Web Figure 8. The second drive was similar but the order and location of events and billboards varied. Each participant began in either a residential or industrial area with two lanes. They then drove through a suburban 4-lane road and entered a 6-lane freeway where the posted speed limit was 100 km/h. Drivers were told to stay in the right hand lane while on the freeway and were prompted to stay in that lane. The experimental decision to not allow drivers to change lanes to either the center or left lanes on the freeway ensured that measures of performance were uniformly taken from the lane closest to the wind turbines.

The freeway roadway was developed to resemble Highway 401 in Ontario (see Web Figure 9, left). In particular, a barrier 401 along the route and serve as a comparison measure for participants. The second drive was similar but the order and location of events and billboards was varied. Each participant began in either a residential or industrial area with two lanes. They then drove through a suburban 4-lane road and entered a 6-lane freeway where the posted speed limit was 100 km/h. Drivers were told to stay in the right hand lane while on the freeway and were prompted to stay in that lane. The experimental decision to not allow drivers to change lanes to either the center or left lanes on the freeway ensured that measures of performance were uniformly taken from the lane closest to the wind turbines.

Each modeled turbine was 5 meters in height, 12 meters from the road edge, and 15 meters from the next turbine in a line of turbines that extended for one-half kilometer along the roadway (see Web Figure 9, right). The line of wind turbines incorporated several animation effects. First, three blade speeds were modeled; namely: Off, 60 rpm (slow) and 500 rpm (fast). (The fast speed produced a turbine that appeared to be moving at high speed, but not necessarily at 500 rpm due to frame rate limitations.) Within the line of turbines, two or three turbines (a

<table>
<thead>
<tr>
<th>TABLE 16.3</th>
<th>Wind Turbine Study: Age Group, Mean Age, Kilometers Driven, Crashes, Violations and Visual Acuity of Participant Sample</th>
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<table>
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<tr>
<th></th>
<th>N</th>
<th>Mean Age (SD)</th>
<th>Average Km/Year</th>
<th>Crashes (last 5 years)</th>
<th>Moving Violations (last 5 years)</th>
<th>Visual Acuity, Left Eye</th>
<th>Visual Acuity, Right Eye</th>
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<td>0.36</td>
<td>1.09</td>
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group) were set to a given speed (e.g., slow). Adjacent groups of turbines were set to the next slower or faster speed so that groups of turbines followed a pattern of slow, fast, slow, off. Second, the turbines were rotated around the support structure or pole to simulate tracking the wind direction. A total of 33 turbines were installed; 17 of which tracked the wind as if it originated perpendicular to the roadway, and 16 as if the wind came parallel to the roadway and from behind the driver as they approached the turbines (see Figure 16.3 and Web Figure 10, right). Thus, the turbine blades faced the roadway or the approaching driver. The combined motion of all of the turbines in the wind farm, including the different blade speeds, was intended to collectively attract the attention of drivers.

The traffic or autonomous vehicles that participants encountered during the freeway drives mimicked the types of vehicles found on the 401 and was also similar to platooning behaviors typically found on freeways. For instance in light and moderate traffic flows, clusters or groups of vehicles often travel together while slower vehicles are overtaken and faster vehicles move on to other groups. A platoon or pod of 10 vehicles, including the lead vehicle in the right hand lane, was generated just prior to when the participant entered the freeway. A pod of vehicles would adhere to a number of rules including: Moving to the right if between participant’s vehicle and the lead vehicle (see below); and travel at 100 km/h if in the right lane, 105 km/h if in the center lane, and 110 km/h if in the left lane. At the interchanges (see the three square tiles on Figure 16.4), a number of autonomous vehicles exited the freeway and a similar number merged onto the freeway.

After several minutes of driving on the freeway, the lead vehicle, which was coupled to the velocity of the participant’s vehicle at a 1.0 second time headway, braked at 8 m/s², which is a hard brake and required the participant or following driver to brake and/or steer to avoid a collision (see Web Figure 8, lower left image). Drivers had to respond to the lead vehicle braking events both in the presence and absence of wind turbines. Two wind farms were present at different locations within each experimental drive (see Web Figure 8, lower right image).

16.7 Results—Wind Turbine Study

16.7.1 Experimental Design and Analysis

The experimental design of the study was a 3 × 3 design with treatment (wind farm, billboards, baseline) as a within-subjects variable and age group (18−25, 26−54, 55+) a between-subjects factor. A repeated measures analysis of variance (RM ANOVA) was computed using SPSS (v. 14) using the General Linear Model (GLM). All follow-up analyses used the Bonferroni correction for multiple comparisons. If sphericity was violated, the Greenhouse-Geisser adjustment was used and is indicated with a G-G next to reported F tests. The analyses are organized into lead vehicle braking perception response time, minimum headway distance, mean speed, location velocity, lane keeping, and debriefing questions.

16.7.2 Perception Response Time

Perception response time (PRT) was calculated in seconds from the onset of the lead vehicle braking until the participant responded by applying pressure to the brake pedal (Olson & Farber, 2003). Billboard was not a level of the treatment factor for the PRT analysis because the lead vehicle braking events only occurred at the wind farm and baseline levels. Braking events were limited to two conditions in order to avoid priming the participants from multiple braking events.

Figure 16.4 (Web Figure 11) illustrates that older drivers responded to the lead vehicle braking event slower than younger and middle-aged groups. Overall, age group was significant, \( F (2, 21) = 6.3, p < .007 \), but treatment (\( p = .70 \)) and the treatment by age interaction (\( p = .99 \)) were not. Simple effects tests indicated that age group was significant in the wind farms treatment, \( F (2, 21) = 5.7, p < .011 \) and specifically, the middle-aged group significantly differed from the older age group (\( p < .009 \)).
In the baseline condition, age group was not significant \((p = .12)\), which is illustrated in part in Figure 16.4 by the overlap of the standard error bars.

### 16.7.3 Lead Vehicle Braking Collisions

A collision detection algorithm determined if the lead vehicle and the participant’s vehicle collided. Out of 96 possible lead vehicle braking events, a single collision occurred in the presence of the wind farm. Analysis of the eye movements made by the driver prior to the crash indicated that they were glancing at the speedometer just before the crash occurred. About six seconds prior to the crash, the same participant looked at the turbines and to their rear-view mirror.

### 16.7.4 Minimum Headway Distance

Minimum headway distance was measured in meters from the front bumper of the participants’ vehicle to the lead vehicle rear bumper. The collection period for this variable started when the lead vehicle began to brake and ended when velocity reached zero or the participant removed his or her foot from the accelerator pedal. Minimum headway distance is indicative of how close a driver got to the lead vehicle when it braked. Billboard was not a level of the treatment factor for the minimum headway distance analysis because the lead vehicle braking events only occurred during the wind farm and baseline levels. The single collision identified in the PRT analysis was excluded from the analysis.

Overall, how close a driver got to the lead vehicle when it braked hard was significantly closer in the wind farm condition \((M = 13.5 \text{ meters})\) than in the baseline condition \((M = 23.3 \text{ meters})\), \(F(1, 21) = 41.7, p < .000\). Age group \((p = .32)\) and the age group by treatment interaction \((p = .082)\) were not significant.

### 16.7.5 Mean Speed

Mean speed was collected in km/h during the presence of the wind farm, billboards and baseline treatment conditions. Data was collected during the one-half kilometre distance that the wind farm was located along the roadway. For the billboard, data was collected 100 meters before and after the sign. Baseline measures were collected for 200 meters at a number of matched locations.

Overall, the older driver group adopted slower average speeds \((M = 98.9 \text{ km/h})\) in all three conditions compared to other age groups \((M = 99.6, \text{ younger}; M = 103, \text{ middle-aged})\) (see Figure 16.5 and Web Figure 12). Across treatment conditions, the slowest mean speed occurred in the wind farm condition \((M = 99.1 \text{ km/h})\). The billboard \((M = 101.3 \text{ km/h})\) and baseline \((M = 101.0 \text{ km/h})\) conditions were similar.

The main effects of age group, \(F(2, 21) = 8.5, p < .002\), and treatment, \(F(2, 42) = 4.0, p < .027\), were significant, but the interaction between age and treatment was not \((p = .24)\). Simple effects tests indicated that there were no age group differences in speed in the presence of the wind farms \((p = .12)\). To determine if wind turbines are more distracting to older or younger drivers follow-up analyses were conducted. Significant effects between age groups were found for billboard, \(F(2, 21) = 6.8, p < .005\), and baseline, \(F(2, 21) = 4.2, p < .029\), conditions. For billboard, the middle-aged group differed significantly from the older age group \((p < .005)\). This same pattern of significant group differences also held for the baseline condition \((p < .027)\).
16.7.6 Location Velocity

Location velocity was collected in km/h at the 250 meter point of each wind farm, at the point perpendicular to the placement of the billboards and at matched baseline locations. Location velocity is similar to the analysis of mean speed, but is for a single location instead of over a distance surrounding an object of interest.

Age group, $F(1, 21) = 9.03, p < .001$, and treatment, $F(2, 42) = 7.8, p < .001$, were significant, but not the age group by treatment interaction ($p = .066$). Younger ($M = 98.4$ km/h) and older ($M = 98.0$ km/h) drivers had significantly lower speeds than middle-aged drivers ($M = 102.5$ km/h) ($p < .006, p < .003$, respectively). Drivers had significantly higher speeds when they passed the billboard ($M = 101.4$ km/h) than when they passed the wind farm ($M = 98.0$ km/h) ($p < .002$), but not the baseline location ($M = 99.5$ km/h) ($p = .14$).

16.7.7 Lane Variability

Standard deviation of lane position (SDLP) in meters (m) was collected for the same treatment conditions as mean speed. SDLP is a measure that indicates how well a person maintains their lane position.

No significant differences were found for age group ($p = .50$), treatment ($p = .10$) or the age by treatment interaction ($p = .69$).

16.7.8 Debriefing Questions

Participants were interviewed when they debriefed at the close of the study. They were asked a number of questions including:

- Whether they recognized the road they had traveled on?
- Did they see the wind turbines?
- What they thought the purpose of the study was?

Drivers did not recognize the freeway that they had driven. Of those that guessed a highway ($N = 10$), most thought that it was Highway 1 near the mountains (i.e., TransCanada) or somewhere in Alberta (e.g., Edmonton). All participants said they saw the wind turbines while driving. However, none of the participants thought the study was about the potential impact of wind farms on driving distraction. Some said that the study was about reaction time or driver responses.

16.8 Discussion—Wind Turbine Study

16.8.1 Discussion

The purpose of this driving simulation study was to determine the effects of a wind farm on driving performance and is one of the first to do so. The discussion that follows is organized according to the objectives of the study.

The occurrence of a vehicle braking hard on a 100 km/h freeway is an unlikely event, but does represent a plausible worst case scenario. There were no differences in PRT to a lead vehicle braking whether the wind farms were present or not. However, drivers came significantly closer to the lead vehicle when the wind farm was present than when it was not (i.e., minimum headway distance). This may be because drivers were looking at the wind farm and following the lead vehicle too closely as a result. A single collision did occur in the presence of the wind farms when the lead vehicle braked. However, just prior to the collision, an analysis of eye movements found that the driver was looking inside the vehicle.

Drivers adopted slower speeds, probably due to the novelty of seeing the turbines, when driving by the wind farms. The middle-aged group of drivers had the highest average speed in all conditions. The mean age of this group was relatively young ($M = 30.9$) compared to other samples and may account for the higher speed choice. Lane keeping, as measured by standard
deviation of lane position (SDLP), was not affected by the presence of the wind farms.

Older drivers responded slower to the braking event and adopted slower speeds during freeway driving than other age groups. Results did not find an age by treatment interaction which would indicate that a particular age group was more or less affected by the presence of wind turbines.

The driving performance results of this study are similar to previous research on older drivers. As age increases, the speed adopted by drivers decreases in a variety of contexts (Caird et al., 2007) including freeway driving (Wasielewski, 1984). A slower response to a lead vehicle braking event was also found for older drivers by Strayer and Drews (2004), who were studying the impact of cell phone conversations on driver distraction. Older drivers respond to unexpected events slower than do other age groups (Olson & Sivak, 1986). In contrast to the lead vehicle braking, the one-half kilometer length of the wind farm evaluated in the study was not a surprising event. The turbines could be seen for about 20 seconds at about 100 km/h.

Drivers did look at the turbines when they passed by them. Overall, drivers slowed down slightly while doing so. Lane keeping in the right-hand lane next to the turbines was not affected. Not all drivers looked at the turbines when they drove by them. While some drivers momentarily looked at the wind turbines, the effect of doing so on a number of measures was minimal.

Conclusions and Recommendations

These reported studies are among the first to investigate novel external distractions such as video billboards and wind farms using driving simulation. Although these two studies were similar methodically, they produced somewhat different results. The video billboard study raised concerns regarding the safety of video billboards, specifically as they produced a higher incidence of rear-end collisions. This result was not found in the wind turbine study; however, minimum headway distance and speed reductions produced effects where the driver came closer to the lead vehicle when the wind farm was present and reductions in speed, which is considered an adaptation, respectively.

The lead vehicle braking events in both studies were programmed identically with the exception of the speed that participants were traveling at when the braking events occurred and the driving environment. In both studies the lead vehicle maintained a constant distance of 1 second and braked at 8 m/s² for 50 m. In the video billboard study the participant was traveling at 80 km/h through an industrial environment, while in the wind turbine study the participant was traveling at 100 km/h in a freeway environment. Participants in the wind turbine study traveling at 100 km/h had additional time to react to the braking event as the faster speed created more distance between the driver and lead vehicle.

Overall, the results of this study found minimal impact of wind farms on measures of driving performance. Compared to studies on cell phones and video billboards, small-scale wind farms placed on straight roadways affect driving performance to a lesser degree. The results obtained in the wind farm study are limited to small-scale turbines placed 12 meters from the edge of a straight freeway. The results do not generalize to large wind turbines (e.g., those 100 meters in height). One limitation of this study was that many drivers do not naturally stay in the right hand lane when they encounter slower vehicles. However, if lane change maneuvers were allowed a number of confounding variables would have been introduced into the study, thereby limiting the analysis and interpretation. Glances to the wind turbines from the center and left lanes are less likely because the turbines appear at a greater angle in the visual periphery.

The nature of the distraction in either study is somewhat different. Video billboards are designed to attract the attention of drivers. If looked at, video billboards provoke the driver to read and watch the changing images and text. Thus, video billboards can produce cognitive absorption for a brief period of time. A wind farm is present for a longer period of time and is interesting because of the movement of the turning blades. Not all drivers look at video billboards (Bejier et al., 2004; Smiley et al., 2004) and choosing to do so may redistribute glances from other sampled locations to where the billboard is located.

In theory, because drivers have spare attention, the frequency of glances to the roadway itself is preserved and the only shift of glances is from one side of the road to the other (Shinar, 2007). Thus, “spare” visual attention can be “re-allocated” to look at the billboard without detriment to routine ongoing driving. The question arises, however, what is “spare” and can attention be “re-allocated” when an emergency event occurs which requires the driver to respond quickly? If attention is directed to the billboard or wind farm at the same time that a lead vehicle brakes, how long will it take to detect the braking and can drivers respond adequately under the circumstances? In this kind of event-based test, attention is not assumed to be spare, or re-allocable at no cost to ongoing driving. Either the driver responds adequately or not. Further, glance behavior is considered merely descriptive. How long or how frequently a driver looks at a wind farm or billboard does not answer the question of whether looking is necessarily safe because no consequences necessarily follow. If the eyes are directed towards an external distraction and an emergency event cannot be adequately responded to, the external distraction is, by definition, not relatively safe. The value of the driving simulator, when used to test external distractions, is to determine relative safety when emergency events occur.

Future studies on external distractions may include methods from driving simulation, naturalistic studies and epidemiology. The extent that various distractions affect driving performance, behavior and crash risk would be addressed. In particular, before-after studies (Hauer, 2002) that record crashes over time will hopefully resolve the relative safety of video billboards, wind turbines and wind farms. However, until more data on crashes, adverse behavior and performance decrements can be collected, the absolute safety of video billboards and wind farms has not been conclusively determined.
Recommendations

1. As a practical matter, the placement of video billboards or wind farms should be carefully considered to avoid locations where drivers need to attend to roadway geometry and traffic control devices. Particularly, placement at intersections, merges, curves (horizontal or vertical), and work zones is potentially dangerous. Roadways that have pre-existing accident rates and severity scores that are above norms should not be considered for video billboard installations (Farbry et al., 2001) or wind farms. In addition, these installations should not be visible to drivers while they are engaged in vehicle maneuvers or decision-making activities such as traffic sign reading.

2. More research is needed using valid before-and-after statistical methods (see, e.g., Hauer, 2002) that determine whether or not a relationship exists between crashes and the presence of wind farms and video billboards. The single study on wind farms by George (2007) and those on video billboards reviewed by Farbry et al., (2001) and found by Smiley et al., (2005) were equivocal and more research is needed.

3. Wind farms are currently novel and more likely to attract attention. Static billboards are more common and are frequently ignored by drivers. Additional research is needed to determine whether drivers exposed to wind farms over weeks and months continue to look or ignore them. Drivers may simply ignore wind farms with increased familiarity to them. Eventually, a mixture of drivers who have and have not seen the turbines will be driving by them. Additional research is needed to determine whether this is an issue.

Acknowledgments

The authors would like to thank SkyPower, and Charmaine Thompson, in particular, for funding the Wind Turbine study. Elise Teteris contributed to the experimental design, programming, running and analyzing the Wind Turbine study. We wish to also thank Amanda Ohlhauser who spent many hours reducing data for the Wind Turbine study. Daniel MacAulay & John Michalak helped to run the Billboard study. Bob Dewar provided valuable edits of the Billboard study. Don Fisher, Andrew Mayer & John Lee provided valuable critiques of previous versions of this chapter. Finally, thanks to Susan Chisholm for providing statistical analysis for both studies.

Glossary Terms

Driver distraction: The momentary or transient redirection of attention from the task of driving to a thought, object, activity, event or person (Caird & Dewar, 2007, p. 196).

External distraction: Those objects that draw the attention of the driver outside of the vehicle.

Key Readings


Web Resources

The Handbook’s web site contains supplemental materials for this chapter including a number of the printed figures in color, and additional web-only figures.

Web Figure 1: Times Square with a variety of street signs, conventional billboards and digital billboards.

Web Figure 2: Several rows of wind turbines located near Pincher Creek, Alberta, Canada.

Web Figure 3: Static billboard in driving scenario (left), video billboard (middle and right) in driving scenario.

Web Figure 4: Lead vehicle before (left) and during (right) a braking event in video billboard condition. (Color version of printed Figure 16.1).

Web Figure 5: Speed change sign with no billboard (left), and in the presence of a video billboard (right).

Web Figure 6: Perception response time (PRT) of drivers in the presence of the wind farm and baseline treatment conditions. Standard error bars are shown. (Color version of Figure 16.2).

Web Figure 8: Experimental Drive 1 is shown from start to end with associated road types. The locations of the lead vehicle braking events, billboards, and wind farms are also indicated.

Web Figure 9: A picture of Highway 401 near the town of Puslinch southeast of Toronto (left). A similar section of freeway modeled in the University of Calgary Driving Simulator (UCDS) (right).

Web Figure 10: A close up of a 15 kW wind turbine appears on the left. The line of turbine that was modeled in the UCDS is on the right.

Web Figure 11: Perception response time (PRT) of drivers in the different age groups to the lead vehicle braking events in the presence of the wind farm and baseline treatment conditions. Standard error bars are shown. (Color version of Figure 16.4).

Web Figure 12: Age group differences in average velocity in km/hr in the presence of the wind farms, billboards and baseline treatment conditions. Standard error bars are shown. (Color version of Figure 16.5).
References


Investigating Driver Distraction: 
The Effects of Video and Static Advertising 
A Driving Simulator Study

by M.Chattington, N.Reed, D.Basacik, A.Flint, A.Parkes (TRL)

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INVESTIGATION OF GEOMETRIC DISTRACTION PARAMETERS OF ADVERTISING IN LONDON: SIMULATOR STUDY
Client: Transport for London (TfL), London Road Safety Unit
Kirsty Novis

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Executive summary

Roadside advertising is a common sight on urban roads. The purpose of the advertising is to draw the attention of the maximum number of observers to the displayed product or service but this may represent a source of distraction and therefore collision risk for road users. Wallace (2003) reported the emergence of a consensus that roadside advertising contributes to over-complexity of the visual field and that this may result in excessive driver distraction. A driving simulator study was conceived to investigate the distraction of the driver from the driving task by static and video advertising. More recently research was conducted by Brunel University (Young & Mahfound, 2007) which demonstrated that roadside advertising has a detrimental effect on lane position control. The research also suggested the presence of advertising increased mental workload and eye fixations, drawing attention away from the driving task. The results of the study suggested the effect of advertising billboards may be more pronounced in scenarios which are monotonous or of lower workload rather than an urban environment.

Objectives

To provide guidance on the relative level of distraction caused by roadside billboard advertising with reference to advert:

- type (static vs. video adverts);
- position (placement relative to road);
- exposure time (duration over which advert is visible).

Assessment of driving impairment was made by analysing data recorded in a driving simulator. Visual distraction was assessed by analysing drivers’ scanning behaviour using the output from an eye-tracking system.

Method

The study was conducted using TRL’s driving simulator, CarSim, and its integrated eye tracking system. This has the benefit of allowing drivers to undertake potentially unsafe tasks in complete safety and that driving is conducted in controlled conditions enabling detailed analysis of both driving and visual behaviour.

It was requested that participants should represent a broad spectrum of the driving population to mimic that observed in London. This made the task of selecting suitable advertising content more challenging since it was important to ensure that the advertising used was approximately similar in its capacity to distract drivers. If this were not the case, effects caused by the experimental factors of interest could be diluted by particular adverts that were exceptionally distracting. This was addressed by using a novel and rigorous content validation process.

Content validation study

A range of static and video billboard type adverts were selected. These were presented to participants as paired comparisons using bespoke software and a two-alternative forced choice (2AFC) procedure was employed. This meant that participants were required to indicate which of the two adverts presented they thought most captured their attention. By repeatedly presenting the static and video advert pairs and scoring each advert based on the number of times it was selected, a homogeneous subset of adverts were selected for use in the driving simulator study. Thirty-four participants (16F; 18M) across a wide age range completed the study enabling selection of fourteen suitable static adverts and fourteen suitable video adverts, which were taken forward into the simulator study.
**Simulator study**

The study employed the TRL car simulator which recorded data relating to participants’ operation of the vehicle and the position of the vehicle relative to infrastructure and other traffic. This was used to compare driving behaviour across experimental conditions. An integrated, non-intrusive eye tracking system was used to measure the frequency and duration with which participants looked at the advertising billboards.

Two simulated driving routes were created and 48 participants, mixed by age and gender, were recruited to drive each route in both directions. This gave four drives per participant. Participants were not told the true nature of the trials until they had driven all four drives. A bespoke visual database of a dense urban environment was used to provide a naturalistic setting for the advertising. Each route was approximately 13km in length, and at a steady speed of around 30mph, could be completed in approximately 15 minutes. The simulated routes were built to appear representative of the London hinterland and as such included features such as traffic light controlled junctions; tower blocks; bus stops; bus lanes; shop fronts; moderate traffic density with various vehicle types including cars, motorbikes, taxis, buses, and lorries. This created a relatively high degree of visual complexity and a suitably representative environment for the testing of roadside advertising (see Figure 1). Each route contained seven adverts plus some additional blank advertising boards.

![Figure 1: Example screenshot of the simulated scenarios (including video billboard placed on a building to the left)](image)

There were three factors for analysis in the trial. Advert type; position; and exposure duration. Four configurations of advert position were used on a building to the left; on a building to the right; on an overhead gantry; or three matching/synchronous adverts placed at all three positions.

The advert type factor consisted of two mechanisms of advert presentation – static and video advertising. Static advertisements displayed a simple combination of text and/or pictures that did not change. Video advertisements, in the simulated environment, repeatedly displayed short bursts (up to 6 seconds) of moving pictures equivalent to those that could be seen on a television.
Exposure time was controlled by the placement of infrastructure obscuring the adverts. Driving at 30mph, participants would be able to view at least 50% of the advert for two seconds (short exposure); four seconds (medium exposure); and six seconds or more (long exposure). To reduce factor combinations, exposure time was only varied for adverts positioned to the left of the road. All other adverts were at the intermediate exposure time.

All adverts were presented on a simulated ‘48 sheet’ (6.10m × 3.05m) billboard advert. Investigation of driving and visual behaviour consisted of detailed analysis of performance in the 100m preceding each advert. A dataset of driving behaviour when no adverts were present was established by running the same analyses for the 100m preceding each advert from the drives when participants completed the driven routes in the opposing direction. This meant that the driving situation was similar (e.g. approaching a junction, negotiating a curve etc) but no adverts were visible and so comparisons could be made between this situation and that where adverts were present.

The objective data collected through the simulator and eye tracker were supplemented by participants’ subjective opinions collected using questionnaires. A questionnaire was administered after each drive and a final questionnaire was administered at the end of the trials. These tested participants’ recall of advertising (and also other elements of the route to ensure that the true purpose of the trial was not revealed), their mental workload during hazardous situations, how distracting they found video advertising, and whether they felt such advertising billboards would have an effect on safety.

**Results**

Significant differences were observed across the experimental factors. First, Figure 2 shows the mean number of glances participants made at advertising, this is broken down by each position the advertising appeared.

![Figure 2: Mean number of glances at adverts across advert positions](image)

There is a clear trend in the glance frequency from adverts at ‘All 3’ positions, which received the most glances, through to adverts to the right of the driven vehicle, which received fewest glances. Statistical comparison shows that there were significantly more glances made at video adverts for each positions type.
Figure 3 shows the variation in lateral lane position of the driven vehicle across the factors of advert position and presentation type.

At the centre, left and right positions there was significantly greater variation in lane position when video adverts were present than when static adverts were displayed.

Figure 4 shows the percentage of time that participants spent looking at adverts within the 100m analysis region approaching each advert across factors of presentation type and exposure duration.
It can be seen that at each exposure duration participants spent a greater proportion of their time when viewing video adverts than when viewing static and comparisons at each exposure time reach statistical significance.

Next, Figure 5 shows how drivers’ lateral position varied across the factors of exposure time and advert type.
Again, there were significant differences between static and video advertising at each of the exposure durations. Drivers show more variation in lateral position with static adverts at long presentation durations but greater variation with video adverts at the medium and short durations. Further investigation shows that variation in lateral position is statistically consistent across the three exposure times for static adverts but increases significantly as exposure time decreases for video advertisements.

Whilst approaching each advert, brake usage was monitored and recorded. Figure 6 shows the maximum deceleration observed averaged across participants for each advert type across the exposure durations.

![Figure 6: Maximum deceleration across exposure duration and presentation type](image)

Statistical comparisons indicate that participants decelerated significantly harder with video adverts at both the short and medium exposure durations.

The speed of the driven vehicle in the 100m preceding each advert was recorded. Figure 7 shows participants’ mean speed on approach to each advert.
Comparison of speeds across advert type revealed that speeds were significantly higher in the long and medium exposure times for video adverts over static adverts. It can be seen that speed choice with static adverts appears more similar to control driving than to when video adverts are present.

Analysis of the questionnaire data in this trial indicated that drivers believe that:

- video adverts are more distracting than static adverts;
- video adverts are less safe than static adverts;
- there is no significant difference in distraction caused by adverts placed on the right or left of the road;
- adverts placed directly above the road is more distracting than advertising boards placed on either left or right of the road;
- adverts placed on the right, left and centre of the road ('All 3' configuration) is more distracting than any single board, placed on the left, right or centre of the road.

Many participants also commented in the questionnaire that they felt that video adverts were more hazardous. For examples:

"I found the full motion video advertising billboards very distracting and these were losing my concentration on the road. Static billboards are not very distracting as nothing is moving in them.”

"Other than legal, legitimate road signs giving instructions to motorists, advertising billboards of any sort should be kept away from the sides and above roads. Especially video signs as they could mentally confuse the eyesight and cause accidents.”

"Full motion video make you look at them and stop you from thinking about what is going on around you. Flashing images make you look at them - we think of flashing as a warning. Static boards you can look at like road signs and you normally recognise them without having to look longer at them, if you see them at all!”

---

**Figure 7: Mean speed of approach across exposure duration and presentation type**

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“With static adverts you can possibly take in most of the image at a glance - whereas the motion adverts require a lot more attention to follow sequences etc., therefore taking attention from looking at road and pedestrians.”

Discussion
This study set out to investigate the relative level of driver distraction caused by a range of billboard advertising configurations with a particular focus on the effect of video adverts as compared to static adverts.

An approximately homogeneous set of adverts was defined using a pre-trial content validation study that facilitated comparison of the different advertising configurations in the subsequent driving simulator study. The simulator study revealed numerous interesting differences in behaviour across the experimental factors. When compared to behaviour when passing static adverts, participants in the study:

- spent longer looking at video adverts;
- glanced at video adverts more frequently;
- tended to show greater variation in lateral lane position with video adverts;
- braked harder on approach to video adverts;
- and drove more slowly past video adverts.

This combination of results indicates that video adverts caused a significantly greater impairment to driving performance than that caused by static adverts. One perhaps counterintuitive result is that drivers went slower past the video adverts, which at first glance appears to indicate safer driving. However, visual behaviour analysis suggested that participants were slowing down to view the video adverts. This combined with greater variation in lane position (indicating poorer tracking ability) and harsher braking (indicating slower reaction times) suggests an overall impairment to driving ability when viewing video adverts. The increases observed, particularly at the short duration exposure time are consistent with a greatly increased tendency to drift into the offside lane or onto the nearside kerb, greatly increasing the risk of collision and/or injury. By comparison with other impairments tested on the simulator, cannabis has been shown to increase variation in lane position by 35% whilst trying to write and send a text message caused this measure to increase by 91%. Although, the measures reported here were taken in a different driving environment and context, it is apparent that the impairment to performance when viewing video adverts is of a similar magnitude.

Advertising position had predictable effects on participants’ viewing of the adverts. When the adverts were placed in a position requiring less effort to view, participants were more likely to look at the advert. However, there was an interesting interaction in terms of variation in lane position in that it was video advertising placed on the left of the road ahead that caused the greatest variation in lateral lane position. This suggests that the position an advertisement is placed relative to the observer is significant in determining whether that advertisement can be considered safe.

The questionnaire results support the findings from the simulator in that participants tended to be aware that their driving was more impaired by the presence of video adverts than with static adverts.

Although this study does not provide an exact replica of the situation observed with real driving, there are significant methodological, safety and price constraints that make studies of real world behaviour in relation to distraction by billboard advertising very difficult. In using the driving simulator at TRL, every effort was taken to ensure that this simulator study represented the London driving scene as accurately as possible. In addition, a number of experimental factors could be manipulated in a manner that is not possible in the real world, large volumes of accurate data could be collected, and participants were in complete safety at all times. Through analysis of the experimental
data, this study has provided useful insights into the differential effects of roadside billboard advertising on driver behaviour.

**Further work**

TRL has proposed further work to reanalyse the existing data to establish drivers’ normal (driving and visual) behaviour when adverts are not present. This may help to understand the true level of impairment caused by the various advertising configurations.

Further possible studies may investigate:

- On-road/on-track validation of simulator results
- Simulator study involving greater density of static/video advertising
- Examining the effect of different sizes of static/video advertising
- Benchmarking the effect of different content types (high vs. low distraction)
- A review of collisions in London in relation to the presence of nearby advertising
1 Introduction

The optimal positioning for roadside advertising is a key issue in the marketing and advertising industry, given their ever growing interest in attracting driver’s attention while on the road. There is a distinct lack of direct research into this area, however, there are number of research articles that have considered the effect of stimuli external to the car on the attention of a driver. The advent of affordable plasma and LED screens showing video advertising may result in these forms of advertising being more widely used as highway advertising hoardings. Advertising has already begun to move into a more digital form. For example, in May 2006, London Underground signed a £72m contract with Viacom Outdoor, with a view to installing digital escalators panels and digital cross-track projection.

The purpose of this study was to determine the distracting nature of advertising placed near roads of a similar type to those found in the London area. As part of this study we have also aimed to identify the “worst case” geometric orientation(s) of advertising hoardings i.e. which advertising positions create the greatest distraction for a driver. This report has aimed to provide objective and independent evidence that can be used to support or refute arguments to initial applications to display advertisements. To date, highway authorities have been unable to present evidence demonstrating the distracting nature of advertising hoardings.

While driving a car, it is estimated that attention can be distracted to irrelevant objects and features near the roadway between 20% and 50% of the time (Green, 2002; Hughes & Cole, 1986; Land & Lee, 1994). Concerns have been voiced by Wallace (2003) regarding driver’s ability to cope with the volume of advertising and other distracting features that can be found around roads today. This research suggested that, as drivers, we have a limited capacity to process information (particularly visual) and it is possible that some drivers exceed this threshold due to the increased amount of advertising present around modern roads. There were 23,210 reported collisions in London in 2007 (TfL, 2007). Of these collisions, 261 have a contributing factor of ‘distraction outside vehicle’.

Different types of advertising can also play a part in distracting a driver from their main task: maintaining safe control of the vehicle whilst responding to events in a reasonable time. Crundall et al., (2006) investigated two separate groups of advertising; the first group was termed street-level advertisements (SLAs). These SLAs consisted of mainly bus shelter mounted hoardings and advertisements that were no more than 3 metres above road level. The second group was termed raised-level advertisements (RLAs), these consisted of all types of advertising that is more than 3 metres above the group i.e. large advertisement boards and bridge mounted hoardings. Although this study was based on drivers viewing a video of the drive and not directly travelling the route as a driver, it still has clear relevance to the current research. The authors monitored the participants’ eye movements during the video playback and found that SLAs received the most fixations when the participants were asked to examine the route for hazards. Furthermore, Wallace (2003) notes that billboards are a major contributory factor to distraction incidents. Interestingly, when a driver was asked to look for advertising along the route, it was the RLAs that received significantly more fixations than the lower level advertising (Crundall et al., 2006). The authors also performed a memory test following the trials, in an attempt to examine which mode of advertising was more successful in being retained by the drivers. It was found that although the street-level advertising was fixated more often and for longer periods than the raised level advertising, it was not recognised by the drivers in the memory test. One of the studies main conclusions suggested that street-level advertisements fail to be as effective as the raised advertising. SLAs also provide a strong distraction, supported by the greater fixation time on the advertisement, and this mean that they may be inappropriate to use where it may be possible to use raised advertisement boards. For the purposes of this study high-level advertising boards have been chosen for examination. In the event that video
advertising is used in a busy urban environment to gain drivers’ attention, larger video boards would be more likely to distract a driver.

As previously mentioned in this section, there are a limited number of research articles related directly to advertising and driver distraction. However, one relevant example is the work of Ady (1967). The research examined a number of advertisements along a particular route and the collision rate of that road. It was discovered that one brightly lit advertisement, located on a sharp bend, had a significantly higher crash rate in the area around it. This was used as an example in the Wallace (2003) review of drivers response to advertisements, which brought forward the idea that a driver can be ‘overloaded’ with irrelevant information at critical times during a route.

The most recent study in this area, and the perhaps the most relevant to this current study, was conducted by Young and Mahfound (2007). The research assessed the effects of roadside advertising on driver attention and performance. The research attempted to examine a range of different road types; Urban, Motorway, or Rural. The study involved 48 participants. Data collected included:

- Driving performance – longitudinal and lateral control
- Driving attention – subjective mental workload, gaze behaviour, recall tasks based on road signs / billboards

The study found that the presence of billboards had a detrimental effect on lane position control, and also appeared to increase crash risk. This may have been due to increased driver workload, which was shown to significantly increase when advertisements were present. The results of the study did not find that drivers looked at advertising more in any particular driving environment. However the number of fixations significantly increased when billboards were present, highlighting a possible change in drivers’ scan patterns when advertising was present.

Young and Mahfound demonstrated that roadside advertising could affect driver attention, and thus affect driving performance. There was clear evidence of a change in a drivers’ visual search patterns around advertising.

When examining the process of distraction and its effect on driving, it is important to separate two key processes. The first is that distraction can affect a drivers’ ability to control the car effectively potentially resulting in poor road positioning or loss of control. The second is that any increased cognitive load will increase reaction time to any discrete reaction task. In the context of driving, this can be seen as a need to brake or swerve to avoid collision with an obstacle (i.e. pedestrian, other car). This study aimed to collect both collect information on a driver’s visual behaviour and data on their ability to control the vehicle while driving though the environment. The driven route included a number of pre-programmed events that required a driver to respond by braking. Performance in the presence or absence of various advert configurations was compared. These events varied in type, in some instances it was a pedestrian crossing the road, in others a car braking or changing direction. This gave vital information on a driver’s comparative ability to respond in safety critical situations in the presence of billboard adverts.

The key research questions that have been addressed in this study are:

1. What effect does advert presentation mechanism (static vs. video) have on driver distraction?
2. How does driver distraction vary in relation to exposure time to adverts?
3. What effect does advert position have on driver distraction?
4. Where possible, relationships between the variables were determined.
2 Content Validation Study

2.1 Aims
It was important to use a range of different advertisements in the simulator study, since a single advertisement displayed throughout the trial would lose its capacity to attract the driver’s attention. However, it was also necessary to ensure that the advertisements used within the study displayed similar conspicuity levels, since results could potentially be confounded if some of the advertisements captured attention much more readily than the others. A pre-trial content validation study was undertaken to select one set of static advertisements and one set of video advertisements such that items within each set had similar conspicuity levels. The objective of the study was to present participants with advert pairs and ask which advert of the pair participants found most captured their attention. It was predicted that this would enable selection of a set of static and video adverts that were (approximately) homogeneously conspicuous.

2.2 Method

2.2.1 Advertisement
In order to ensure the validity of the study, it was decided that images from current or past advertising campaigns should be used. Constraints for the advertisements were as follows:

- Advertisements must not be too dark to ensure that they are legible in the simulator environment.
- Static advertisements must be landscape images at a resolution of approximately 800×400 pixels.
- Video advertisements must be approximately 5 seconds long.
- Video advertisements must be of approximately 320×240 pixel resolution.

A large number of static and video advertisements were downloaded from the internet. Many of these did not conform to the criteria set out above and were discarded. Video advertisements were edited to reduce their playing time to 5 seconds. A final set of 28 static and 24 video advertisements were included in the pre-trial content validation study.

The purpose of the content validation study was to present participants repeatedly with pairs of adverts (either static or video advertising – never a mixture of both types) and to ask participants which of the two adverts they found most captured their attention. This gave a total of 756 (28×27) pairs of static advertisements and 552 (24×23) pairs of video advertisements.

It was unrealistic to expect participants to view all combinations of both static and video advertisements; thus, the pairs were randomised and split into twelve blocks, each comprising 63 pairs of static advertisements and 46 pairs of video advertisements. Advert pairs were presented one above the other. Each advert appeared in upper and lower positions an equal number of times to control for any effects of advert position on relative conspicuity.

2.2.2 Participants
Participants were recruited to be representative of the population of drivers in London. Approximately equal numbers of male and female participants were recruited across a wide range of ages.
2.2.3 Trial procedure

A computer programme was specifically designed for the purpose of this study. The programme first displayed a start-up screen for the experimenter to input the participant’s details. The next screen displayed instructions for the participant and would automatically maximise in order to control for the potential effects of desktop clutter. Participants viewed the adverts on a 17” flat panel monitor at a distance of 1m from the display screen. The adverts subtended a horizontal visual angle of 22.8º and a vertical visual angle of 11.4º. This is equivalent to viewing a 48 sheet (6.10m × 3.05m (20ft × 10ft)) billboard advert from a distance of 15.1m.

After reading the instructions, the participant clicked the ‘Start’ button and the program displayed two static advertisements one above the other on the screen (see Figure 2.1). The participant was asked to identify which image they found more ‘attention-grabbing’ by pressing either ‘1’ or ‘2’ on the keyboard to indicate their choice. Each pair of static advertisements was displayed for 2 seconds before a grey screen would ask for their input; it was possible to enter a choice while the images were displayed.

![Figure 2.1: Screen displaying two static advertisements.](placement)

Once the participant had completed the first section displaying 63 pairs of static advertisements, a new instruction screen appeared. The participant then clicked the ‘Start’ button and the program displayed two video adverts, one above the other on the screen. Participants were again asked to identify which advert they found more ‘attention-grabbing’. The video adverts were played simultaneously until they had both finished. Participants had to wait until both adverts had finished playing before a grey screen would be displayed, allowing them to enter their choice.

The program recorded participants’ selection response to each pair along with their age group, gender and participant number.
2.3 Analysis and Results

Data analysis for the pre-trial content validation study was undertaken using SPSS for Windows. Chi square and Fisher’s exact tests were used to explore the effects of age group and gender respectively on advertisement selection, and a univariate analysis of variance was conducted to compare the advertisements in terms of how attention grabbing participants found them. The results are presented in the sub-sections below.

2.3.1 Participant Profile

34 participants took part in the pre-trial content validation study. Table 2.1 shows that there was a similar number of males and females within the sample. While all age groups were represented, there were fewer participants from the highest and lowest age groups.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Gender</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>17 – 25</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>26 – 40</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>41 – 55</td>
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<td>4</td>
</tr>
<tr>
<td>56+</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>18</td>
</tr>
</tbody>
</table>

2.3.2 Static Advertisements

28 static advertisements were presented to participants. A univariate analysis of variance showed a highly significant effect of the static advertisement itself \( F(27, 6580) = 9.079, p < 0.01 \) on whether it was chosen or not, as well as highly significant interaction effects of:

- age and the static advertisement itself \( F(81, 6580) = 2.739, p < 0.01 \) on whether the particular advertisement was chosen or not;
- gender and the static advertisement itself \( F(27, 6580) = 1.039, p < 0.01 \) on whether the particular advertisement was chosen or not;
- age, gender and the static advertisement itself \( F(81, 6580) = 2.672, p < 0.01 \) on whether the particular advertisement was chosen or not.

Chi square tests showed that for six advertisements, age group had a significant effect on whether it was chosen or not. Fisher’s exact tests revealed that the selection of seven advertisements showed a highly significant dependency on gender. Out of these, five showed a highly significant dependency on both age and gender; thus eight advertisements were eliminated from the shortlist to control for the effects of age and gender within the simulator trial. These are shown in Table 2.2.
Table 2.2: Static advertisements for which gender (using Fisher’s exact tests) or age (using Chi-square tests) had a significant effect on selection

<table>
<thead>
<tr>
<th>Advertisement</th>
<th>Gender p</th>
<th>df</th>
<th>N</th>
<th>(\chi^2)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.jpg</td>
<td>.001</td>
<td>3</td>
<td>248</td>
<td>26.623</td>
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<tr>
<td>02.jpg</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09.jpg</td>
<td>&lt;.001</td>
<td>3</td>
<td>231</td>
<td>13.000</td>
<td>.005</td>
</tr>
<tr>
<td>11.jpg</td>
<td>.005</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.jpg</td>
<td>.009</td>
<td>3</td>
<td>244</td>
<td>29.066</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>16.jpg</td>
<td>.004</td>
<td>3</td>
<td>239</td>
<td>31.400</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>18.jpg</td>
<td>&lt;.001</td>
<td>3</td>
<td>238</td>
<td>18.812</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>28.jpg</td>
<td></td>
<td>3</td>
<td>245</td>
<td>19.562</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

A Tukey’s HSD post-hoc test divided the static advertisements into ten homogeneous subsets in terms of how attention-grabbing participants found them. A minimum of 14 advertisements were needed for the simulator study. To minimise the variation between advertisements in terms of how attention-grabbing they were, a further six advertisements were eliminated. The remaining advertisements were distributed across four homogeneous subsets in terms of distraction. The figure below shows these advertisements on a scale representing the number of times the advertisement was selected by participants, divided by the total number of times it was presented.

![Figure 2.2: Subset of static advertisements selected for the simulator study](image)

In summary, it was possible to control for the effects of age group and gender, and to reduce the variation in terms of distraction while selecting a subset of static advertisements to be used in the simulator study.

2.3.3 Video advertisements

24 full motion video advertisements were presented to participants, with a view to selecting fourteen of these for the simulator study. A univariate analysis of variance showed the following highly significant effect of the video advertisement itself \((F_{(23, 4776)} = 11.317, p < 0.01)\) on whether it was chosen or not, as well as highly significant interaction effects of:

- age and the video advertisement itself \((F_{(69, 4776)} = 3.069, p < 0.01)\) on whether the particular advertisement was chosen or not,
- gender and the video advertisement itself \((F_{(23, 4776)} = 3.772, p < 0.01)\) on whether the particular advertisement was chosen or not,
age, gender and the video advertisement itself ($F_{69, 4776} = 2.165, p < 0.01$) on whether the particular advertisement was chosen or not.

The selection of nine advertisements showed a highly significant ($p < 0.01$) dependency on age group, and eight showed a highly significant ($p < 0.01$) dependency on gender. The selection by participants of four advertisements showed a highly significant dependency on both age group and gender. These are shown in Table 2.3 below.

**Table 2.3: Video advertisements for which gender (using Fisher’s exact tests) or age (using Chi-square tests) had a significant effect on selection**

<table>
<thead>
<tr>
<th>Advertisement</th>
<th>Gender</th>
<th>Age</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>04.wmv</td>
<td>&lt; .001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09.wmv</td>
<td>3 212</td>
<td>19.236</td>
<td>&lt; .001</td>
<td></td>
</tr>
<tr>
<td>10.wmv</td>
<td>3 206</td>
<td>21.853</td>
<td>&lt; .001</td>
<td></td>
</tr>
<tr>
<td>11.wmv</td>
<td>3 203</td>
<td>12.724</td>
<td>.005</td>
<td></td>
</tr>
<tr>
<td>13.wmv</td>
<td>&lt; .001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.wmv</td>
<td>3 215</td>
<td>19.418</td>
<td>&lt; .001</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
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<td>3 205</td>
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</tr>
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<td>&lt; .001</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>.001</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>21.wmv</td>
<td>3 202</td>
<td>18.723</td>
<td>&lt; .001</td>
<td></td>
</tr>
<tr>
<td>22.wmv</td>
<td>3 201</td>
<td>14.774</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td>24.wmv</td>
<td>3 .002</td>
<td>14.505</td>
<td>.002</td>
<td></td>
</tr>
</tbody>
</table>

It was not possible to eliminate more than fourteen advertisements to control for these two variables. Thus, a decision was made to control for the effects of age group and eliminate one further advertisement. '04.wmv’ was eliminated as the selection of this advertisement was significantly dependent on gender; this also greatly reduced the variability between advertisements in terms of how attention grabbing participants found them.

**Figure 2.3: Subset of video advertisements selected for the simulator study**
A Tukey’s HSD post-hoc test had divided the static advertisements into nine homogeneous subsets in terms of how attention grabbing participants found them. The final selection of advertisements was distributed across eight homogeneous subsets. Thus, it was possible control for the effects of age group in selecting a subset of static advertisements to be used in the simulator study, and somewhat reduce the effects of gender and the variation between advertisements.

2.4 Conclusion

The content validation study enabled the selection of fourteen static adverts that were approximately matched in terms of their ability to attract the attention of male and female and older and younger viewers. A similar process identified fourteen video adverts that fulfilled the same criteria. As a result, these adverts could be presented in the driving simulator trial providing two important benefits:

- Participants would not become indifferent to the adverts (as they might if the same image were used repeatedly)
- Any differences seen in visual scanning patterns or driving behaviour can attributed more confidently to the configuration (rather than the content) of the advert.
3 Simulator Study

3.1 Aims
The simulator study was the focus of this project, in that the main aims of the project would be accomplished during this section of the study. The aims were to measure and compare the precise distraction levels caused by:

- Advert position (placement relative to the road)
- Advert type (static and video)
- Advert exposure duration (period over which the advert is visible)

3.2 Method
The study employed the TRL car simulator with a bespoke visual database of a dense urban environment, as well as the integrated, non-intrusive eye tracker. Simulator data was used to record and compare driving behaviour across experimental conditions. The eye tracker was used to measure how many times participants looked at the advertising billboards and how long they spent looking at them.

3.2.1 Simulator
The study employed the TRL car simulator running SCaNeR II™ software provided by Oktal (see Figure 3.1).

![Figure 3.1: TRL CarSim (displaying the simulated London database created for this project)](image)

The simulator vehicle is a standard hatchback car and the controls are operated as in a real vehicle. The vehicle is mounted on four electric actuators connected to the axles behind each wheel to provide motion with three degrees of freedom (3DOF); heave, pitch, and roll. The simulator provides 210° forward field of view using three flat screens. A rear screen gives a 60° rearward field of view with a display that is adjusted
to appear correct for each of the driving mirrors. Images are displayed at a resolution of 1280×1024 pixels per channel and updated at frame rate of 60Hz. Simulator data relating to participants’ operation of the vehicle and the position of the vehicle relative to infrastructure and other traffic was recorded at 20Hz and used to compare driving behaviour across experimental conditions.

An integrated, non-intrusive SmartEye™ eye tracking system was used to measure the frequency and duration with which participants looked at the advertising billboards. The integration of the eye tracker and simulator meant that the simulation software could report the specific element within the simulated environment upon which the driver’s gaze was fixated, greatly facilitating data capture and analysis. Further details about the simulator and facilities are provided in Appendix A.

### 3.2.2 Participants

48 participants were recruited to take part in the study. These were selected to cover a wide range of ages, experience levels and both male and female drivers.

### 3.2.3 Independent Variables

The three factors for analysis were Advert position; Advert presentation; and Advert exposure time.

#### 3.2.3.1 Advert position

The distraction level of adverts was tested for four configurations of sign position on a building, billboard, overhead gantry, bridge or other infrastructure as appropriate. These are shown in Figure 3.2 (adverts are highlighted by yellow dashed boxes):

![Position A: On a building to the left](image)

![Position B: On top of a gantry](image)

![Position C: On a building to the right](image)

![Position D: All three positions simultaneously](image)

**Figure 3.2: Examples of the four different advertising positions tested**

#### 3.2.3.2 Advert type

Two types of advert were tested in the trial – static adverts and video adverts. Static adverts were representative of a traditional 48 sheet (3.05m × 6.10m (10ft × 20ft))
billboard advert, displaying a simple combination of text and/or pictures that did not change. Video adverts were displayed on boards of equivalent size as those used for static adverts but repeatedly displayed short (up to 6 seconds) of motion picture adverts (similar to those that could be seen on a television).

3.2.3.3 Advert exposure time

Participants experienced three different exposure times to the adverts visible to the left of the driven route (position A; see Figure 3.2). These different exposure times were achieved by obscuring the advertisements using buildings placed at various distances from the target advert.

Adverts at all other presentation positions (positions B, C and D; see Figure 3.2) were viewed at the intermediate exposure time. However, the means by which the advert was obscured did differ across presentation positions. For adverts at positions A and C (left and right respectively) obscuration was achieved by the placement of buildings ahead of the target advert (see Figure 3.3).

Figure 3.3: Layout of an advert presentation to demonstrate how exposure time variation was achieved through positioning an ‘obscuring’ building

For position B, in which the advert was positioned above the road, obscuration was achieved by the placement of an overarching structure (e.g. a bridge) ahead of the advert. For position D in which adverts are present to the left, to the right, and above the road, obscuration was achieved through curvature of the road such that the adverts were revealed to the driver as they proceeded along the trial route. To control for any differences in distraction caused by the direction of the bend used to obscure the adverts, participants viewed instances of this configuration from left and right bends with equal curvature.

3.2.4 Route Design

Participants drove each route in both directions, giving 4 drives per participant. Each route was approximately 13km in length, and at a steady speed of around 30mph, could be completed in approximately 15 minutes.

There were fourteen combinations of the three variables listed above; these are shown in Table 3.1.
### Table 3.1: Summary table of the combinations of advert position, exposure time, and presentation mechanism

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Position</th>
<th>Exposure time</th>
<th>Presentation</th>
<th>Exposure time controlled by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left (A)</td>
<td>Short (Position (i))</td>
<td>Static Video</td>
<td>Obscuring buildings</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>Static Video</td>
<td>Obscuring buildings</td>
</tr>
<tr>
<td>3</td>
<td>Intermediate (Position (ii))</td>
<td>Static Video</td>
<td>Obscuring buildings</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Video</td>
<td></td>
<td>Static Video</td>
<td>Obscuring buildings</td>
</tr>
<tr>
<td>5</td>
<td>Long (Position (iii))</td>
<td>Static Video</td>
<td>Obscuring buildings</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>Static Video</td>
<td>Obscuring buildings</td>
</tr>
<tr>
<td>7</td>
<td>Centre (B)</td>
<td>Intermediate</td>
<td>Static Video</td>
<td>Preceding bridge</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>Static Video</td>
<td>Obscuring buildings</td>
</tr>
<tr>
<td>9</td>
<td>Right (C)</td>
<td>Intermediate</td>
<td>Static Video</td>
<td>Obscuring buildings</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>Static Video</td>
<td>Obscuring buildings</td>
</tr>
<tr>
<td>11</td>
<td>All 3 positions simultaneously (D)</td>
<td>Intermediate</td>
<td>Static Video</td>
<td>Road curvature (Left bend)</td>
</tr>
<tr>
<td>12</td>
<td>Video</td>
<td></td>
<td>Static Video</td>
<td>Road curvature (Left bend)</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td>Static Video</td>
<td>Road curvature (Right bend)</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>Static Video</td>
<td>Road curvature (Right bend)</td>
</tr>
</tbody>
</table>

Across the four drives, participants encountered each of these combinations twice; once with an accompanying event and once without. The events were used to compare the drivers’ responses to hazards across different combinations of advertisements, and were designed in such a way that they would require a braking response from the driver. Four types of event were used:

1. The lead vehicle (vehicle immediately in front of the participant) braking sharply
2. A pedestrian walking into the road
3. The traffic lights changing from green to red
4. A car turning across the participant’s path

Each of the four types of events was also repeated at a part of the route where there were no advertisements. These four situations were used as a baseline for identifying drivers’ responses to hazards. To ensure that the traffic events were presented in a consistent manner for all participants, the speed of the simulator vehicle was artificially limited to 35mph throughout each drive.

In addition, participants also encountered four blank advertisement billboards across the four drives. These were included to permit analysis of distraction by a display with no advertising content.

#### 3.2.5 Control data

It was found that there was a novelty effect associated with the use of blank billboards creating an associated distraction. This rendered them unsuitable for use in determining control behaviour.

To provide an alternative control dataset, further data analysis was performed, examining the 100m following each advertising board when driven in the reverse direction. For each advert present in the simulated route, driver behaviour was analysed in a 100m zone preceding the advert. Two different routes were used for the original trial
and participants drove the two test routes in either direction giving four drives for analysis.

Control driving behaviour was defined as that observed when no adverts were visible. Since participants drove both routes in either direction, adverts visible when driving a route would not have been visible when driving the same route in the opposite direction. By analysing driver behaviour in the vicinity of the non-visible advert and comparing that to behaviour when the same advert was viewable, it was possible to obtain an estimate of the relative effect of static and video advertising on normal driving behaviour. Figure 3.4 below illustrates how the analysis region for control driving behaviour was defined.

By conducting the same analysis of behaviour in the 100m approaching the advert in the reverse direction, it was possible to compare driver performance when no advertising is visible, in similar road, traffic and visual cue conditions.

It is important at this point to highlight that it is not possible to analyse driver’s visual behaviour. This is due to lack of any visual targets being present in the direction drivers were travelling when examining control data. With no visual targets present (i.e. advertising boards) it is not possible to record data on what drivers were looking at through the control 100m sections. However, all driving related measurements used in this study have been used within this analysis.

3.2.6 Statistical procedures

The statistical procedures used in the analysis are based on examining the differences between the different types of advertising, comparing these results to the way drivers behave when driving normally (with no advertising displayed). This has meant the Analysis of Variance test (ANOVA) is the most appropriate statistical analysis to conduct when examining duration and position effects.

When examining the effects of advertising position, the analysis is a $3 \times 4$ repeated measure ANOVA with planned contrasts. The analysis has been selected as there are three types of advert (control, video and static), and four different positions that the advertising can be positioned (all 3, centre, left, right). The analysis is a ‘repeated-measures’ design as the same task and measurements were used in each case, and each participant experienced all variations of advertising and position.

The statistical procedures used to examine the effects of advertising duration on driver behaviour differ slight from those used to assess positional effects. In this instance, data was examined using a $3 \times 4$ repeated-measures ANOVA. The reason this change was required was due to the number of variables decreasing. The data still contains three
conditions (control, video and static), but now only three durations that were examined (short, medium, long). The analysis remains a repeated measures design, as the same method was used, as the same driver experienced all types of advertising, at each duration.

When comparing advert type, two additional datasets were created. These are “Control – Video” and ‘Control – Static’. In order to make direct comparisons across advert types, and to ensure validity of the comparisons, control data was recorded separately for approaches to video adverts and to static adverts. This has resulted in the analysis being performed as a one-way ANOVA, with four variables. Planned contrasts have been performed to examine the statistical differences between each type of advertising and their respective control data.

Planned contrasts are used throughout the statistical analysis in this study, therefore it is important to state their purpose. Planned contrast analysis is an important test to conduct as the main ANOVA analysis simply identifies whether there has been an effect or impact of a type of condition change e.g. whether the type of advertising used impacts on mean speed or braking. Using this example, it is important to examine the data further to discover which type of advertising has the greatest effect. Throughout section 3.3 the results of any planned contrast have been included and the implications of the result explained.

3.2.7 Questionnaire

The objective data collected through the simulator and eye tracker were supplemented by subjective opinions of participants which were collected using questionnaires. A questionnaire administered after each drive, and a final questionnaire was administered at the end of the trials. These enquired about participants’ recall of advertisements (and other elements of the route to ensure that the true purpose of the trial is not revealed), their mental workload during hazardous situations, how distracting they found video advertising and whether they felt such advertising billboards would have an effect on safety. Participants were not told the true nature of the trials until they had completed all four simulator drives.
### 3.2.8 Data collection and analysis

Table 3.2 shows the measures collected from the simulator trial at 20Hz throughout each simulator drive.

**Table 3.2: Measures recorded during simulator trials**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Unit of measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Glances</td>
<td>Count of glances at target</td>
<td>Number of times a driver has glanced at the advertising board</td>
</tr>
<tr>
<td>Mean Glance Duration</td>
<td>Seconds</td>
<td>The average amount of time that a person has spent looking at an advertising board</td>
</tr>
<tr>
<td>Percentage time looking at target</td>
<td>Percentage of time, time measured in seconds</td>
<td>The percentage of the time within 100m of an advertising board that a driver was looking at the advert</td>
</tr>
<tr>
<td>Time of Last Glance</td>
<td>Seconds</td>
<td>The amount of time that passed between the last glance at an advertising board and the point at which the driver had passed the board</td>
</tr>
<tr>
<td>Distance from Target to Last Glance</td>
<td>Metres</td>
<td>The distance between the driver and the advertising board at the point they made their last glance at the advert</td>
</tr>
<tr>
<td>Standard Deviation of Lane Position (SDLP)</td>
<td>Metres</td>
<td>The standard deviation of the driver’s lateral lane position</td>
</tr>
<tr>
<td>Maximum Brake Position</td>
<td>0-1; where 0 = no pressure, 1 = maximum braking</td>
<td>The maximum depression of the brake pedal by the driver when braking in the area of an advertising board</td>
</tr>
<tr>
<td>Mean Speed</td>
<td>Miles per hour</td>
<td>The average speed of the vehicle during the 100m prior to an advertising board</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td>Miles per hour</td>
<td>The maximum speed of the vehicle during the 100m prior to an advertising board</td>
</tr>
<tr>
<td>Standard Deviation of Speed</td>
<td>Miles per hour</td>
<td>The standard deviation of vehicle speed during the 100m prior to an advertising board</td>
</tr>
<tr>
<td>Object Contact</td>
<td>True or False</td>
<td>Information on whether a driver struck any object during the 100m approaching the advertising board</td>
</tr>
<tr>
<td>Deceleration Rate</td>
<td>Metres per second per second</td>
<td>Maximum deceleration rate achieved by the vehicle when braking in the area of an advertising board</td>
</tr>
</tbody>
</table>

Data was processed and analysed using Microsoft Excel 2003; statistical analyses were conducted using SPSS 14.0. Unless otherwise stated, all graphs within the results section of this report display the 95% confidence interval for each mean. The datasets were analysed to ensure they met the assumptions of parametric data, where this was not the case non-parametric statistics were used.
3.3 Results

3.3.1 Participants

In total, 55 participants were recruited to take part in the trials. Eight participants were unable to complete the trial due to symptoms of simulator sickness\(^1\). Data collection failed for one participant due to technical problem. This resulted in a total participant number of 46 (27M, 19F; mean age = 44.6 years, SD = 16.8). Table 3.3 shows the distribution of participants across age groups.

<table>
<thead>
<tr>
<th>Age group</th>
<th>17-25</th>
<th>26-40</th>
<th>41-55</th>
<th>56+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>Female</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>10</td>
<td>15</td>
<td>12</td>
<td>46</td>
</tr>
</tbody>
</table>

For the main factors of advert type, advert exposure duration and advert position, results for eye movement measures are presented first and driving behaviour results as determined from the simulator measures are presented after. Throughout and where possible, performance in relation to advert type is compared and this is analysed with reference to the control data.

3.3.2 Advert type

The following subsections examine the effect of advert type (video vs. static) on visual and driving behaviour.

3.3.2.1 Eye movement measures

Table 3.4 shows drivers’ observed visual behaviour with static and video adverts and the results of t-test comparisons across the factor of presentation type.

Table 3.4 shows there were a number of significant differences in participants’ visual behaviour found when comparing video and static advertising. Drivers looked at video advertising boards significantly more frequently (\(t_{(1,530)} = 5.714, p < 0.001\)) and for longer (\(t_{(1,530)} = 2.925, p < 0.004\)) than when passing static advertising. In percentage terms, drivers looked at video advertising for 12% longer, and on average made 34% more glances at the advertising.

---

\(^1\) This is an unusually high dropout rate for simulator drives in TRL’s CarSim (usual dropout rate is around 1-2%). It is believed that it was caused by the high level of detail created in the virtual urban environment and the frequent stopping/starting and changes of direction (typical of urban driving).
Table 3.4: Descriptive simulator statistics and results of t-test comparisons (Video vs. Static)

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>Mean</th>
<th>N</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Glances – Video</td>
<td>Count</td>
<td>1.67</td>
<td>531</td>
<td>2.83</td>
<td>5.714</td>
<td>530</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Number of Glances – Static</td>
<td>Count</td>
<td>1.11</td>
<td>531</td>
<td>2.28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Glance Duration – Video</td>
<td>sec</td>
<td>0.27</td>
<td>145</td>
<td>0.22</td>
<td>-0.228</td>
<td>144</td>
<td>0.820</td>
</tr>
<tr>
<td>Mean Glance Duration – Static</td>
<td>sec</td>
<td>0.28</td>
<td>145</td>
<td>0.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% time looking at target – Video</td>
<td>%</td>
<td>4.50</td>
<td>531</td>
<td>9.37</td>
<td>2.925</td>
<td>530</td>
<td>0.004</td>
</tr>
<tr>
<td>% time looking at target – Static</td>
<td>%</td>
<td>3.51</td>
<td>531</td>
<td>9.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of last glance – Video</td>
<td>sec</td>
<td>3.15</td>
<td>114</td>
<td>2.22</td>
<td>-0.567</td>
<td>113</td>
<td>0.572</td>
</tr>
<tr>
<td>Time of last glance – Static</td>
<td>sec</td>
<td>3.31</td>
<td>114</td>
<td>2.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to target last glance – Video</td>
<td>metres</td>
<td>33.89</td>
<td>114</td>
<td>20.02</td>
<td>-1.473</td>
<td>113</td>
<td>0.144</td>
</tr>
<tr>
<td>Distance to target last glance – Static</td>
<td>metres</td>
<td>37.33</td>
<td>114</td>
<td>21.92</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3.2.2 Simulator measures

Maximum deceleration rate

Figure 3.5 shows the mean of maximum deceleration rate of the driven vehicle in the 100m approaching static and video adverts compared to that observed in the control dataset for each advert.

![Figure 3.5: Maximum deceleration rate on approach to static and video adverts vs. control data](image-url)
The one-way ANOVA conducted on maximum deceleration data indicated there was a significant main effect of advert type \( F_{(3,1317)} = 7.15, p < 0.001 \). This suggests that the advert type influences the rate at which drivers’ choose to decelerate. Figure 3.5 indicates that there was a greater maximum deceleration when advertising was present, and that the maximum deceleration was at its greatest when approaching a video advert.

The planned contrasts performed on this data set indicated that there was a statistical difference seen when advertising was present, and the effect was at its greatest when comparing control data to video advertising. Drivers approaching video advertising slowed the vehicle at a significantly greater rate than drivers braking around static advertising. This pattern of behaviour may be due to the driver being distracted by the advertising and braking at a later point.

**Summary**

- Results indicate adverts had a large effect on drivers’ braking behaviour; the presence of any adverts influenced braking behaviour
- Static adverts decrease braking performance when compared to a situation where no adverts were present
- Video adverts were responsible for the greatest change in driver behaviour, with a significant decrease in performance when compared a situation where static adverts were present

**Maximum speed**

Figure 3.6 shows the mean of the maximum speed observed on approach to each advert type.

![Figure 3.6: Maximum speed on approach to static and video adverts vs. control data](image)

The one-way ANOVA analysis performed on maximum speed data collected during the course of this trial indicated there was a significant main effect of advert type \( F_{(3,1317)} = 22.21, p < 0.001 \). The result of the planned contrast analysis indicated that results for
video and static conditions differed significantly from the control data. This suggests that when advertising is present drivers achieve a lower maximum speed on approach. The results also indicate that when comparing the different types of advertising used, that drivers have a slightly but significantly lower maximum speed when passing video adverts.

**Summary**

- Results indicate that the presence of *any* adverts has an effect on drivers’ speed selection behaviour.
- When advertising was present, there was a small but significant reduction in drivers’ maximum speed compared to a situation where adverts were not present. This was seen in both video and static advert conditions.
- Video adverts were responsible for the greatest change in speed selection behaviour, with a significant decrease in maximum speed when comparing a situation where static adverts were present.

**Mean speed**

Figure 3.7 shows the mean speed observed on approach to each advert type.

![Figure 3.7: Mean speed on approach to static and video adverts vs. control data](image)

Statistical results for mean speed indicate there was a main effect of advertising \((F_{(3,1327)} = 87.71, p < 0.001)\). This effect indicates that the advert type impacts on the average speed a driver maintains in the period approaching an advert. As in the case of maximum speed, average speed was shown to be significantly higher in the control data set. This result suggests that the presence of any type of advertising causes a decrease in mean speed in the area prior to the advertising placement. Both types of advertising cause a decrease in average speed, but video advertising causes the greatest decrease \((p < 0.001)\).
**Summary**

- Results indicate that the presence of *any* adverts has an effect on drivers’ speed choice.
- When advertising was present, drivers’ mean speed decreased significantly compared to a situation where adverts were not present. This was seen in both video and static advert conditions.
- Video adverts were associated with the greatest decrease in mean speed, highlighting a significant change in behaviour when comparing to a situation where static adverts were present.

**Standard deviation of speed**

Figure 3.8 shows the mean of the standard deviation of speed observed on approach to each advert type.

![Figure 3.8: Standard deviation of speed on approach to static and video adverts vs. control data](image)

Statistical results when comparing the standard deviation of speed around advertising boards, compared to a control data set, indicated that there was a significant main effect of advertising ($F_{(3,1317)} = 19.72; p < 0.001$). This shows that the presence of advertising causes an increase in speed variability. The planned contrasts also indicated that video advertising affects speed variability significantly more than static advertising ($p < 0.001$).

**Summary**

- Results indicate that the presence of *any* adverts has an effect on drivers’ speed selection behaviour.
- When adverts were present, drivers’ speed variability increased significantly compared to a situation where adverts were not present. This was seen in both
video and static advert conditions. This suggests that the distraction caused by advertising affects a driver’s ability to maintain a safe and constant speed

- Video adverts were linked with the greatest increase in speed variability, highlighting a significant change in behaviour when comparing to a situation where static adverts were present

**Standard deviation of lateral lane position**

Standard deviation of lateral position (SDLP) is a common measure used in simulator studies to assess the driver’s ability to keep control of the vehicle. Poorer control is associated with higher variability, leading to a higher standard deviation in the measure of lateral position. Figure 3.9 shows the mean of the standard deviation of speed observed on approach to each advert.

![Figure 3.9: Standard deviation of lateral lane position on approach to static and video adverts vs. control data](image)

The one-way ANOVA analysis performed on the data presented in Figure 3.9 indicated that there was a significant main effect of advert type ($F_{(3,1327)} = 79.67, p < 0.001$). From the planned contrasts performed it is clear that when approaching a static advertising board, drivers’ lane position varies significantly more than when no advertising was present. However, when comparing the control data from around video adverts to the actual trial data for video adverts, there is no significant difference ($p = 0.12$). There is a significant difference between the static control data and the video condition. It may be the case that, in the control direction for video advertising, there was some feature in the trial design that influenced driver’s lane behaviour. This will be discussed in section 4.2.

**Summary**

- Results indicate that the presence of any adverts has an effect on drivers’ ability to maintain a consistent lane position
- Video adverts cause greater SDLP than static adverts but this is cannot be verified with the control data
3.3.3  Advert exposure duration

The following subsections examine the effect of advert exposure duration on visual and driving behaviour. Note that exposure duration was only compared for adverts presented to the left of the driven lane (position A).

3.3.3.1  Eye movement measures

Mean glance duration

Figure 3.10 shows participants’ mean glance duration to static and video adverts across the factor of exposure duration.

![Figure 3.10: Mean glance duration at static and video adverts across advert exposure duration](image)

When examining glance duration, there was a main effect of duration ($F_{(1,71)} = 5.65$, $p < 0.05$). This effect indicates that the length of time a driver will look at an advert (each individual glance) is influenced by the duration over which the advert is visible on approach.

Planned contrasts revealed that there was a significant difference between video and static adverts in the medium duration configuration ($p < 0.05$). This suggests that drivers approaching a medium duration advert will produce significantly longer glances to a video advert when compared to static advertising in the same placement. There was no significant difference between video and static conditions when a long or short duration advertising board was being approached.

Summary

- Drivers looked at medium duration video adverts significantly longer than static adverts in the same position
- Drivers approaching an advert that was visible for the long duration looked at it significantly longer than adverts visible for a medium or short duration
Percentage time looking at advertisement

Figure 3.11 shows the mean of the percentage of time that participants spent looking at static and video adverts across the duration conditions.

![Bar chart showing percentage time looking at advertisement](image)

**Figure 3.11: Mean percentage of time looking at static and video adverts across advert exposure duration**

The statistical analysis of percentage time looking at a particular advert type and the relationship with the duration of advertising visibility indicated that there were two significant effects within the data. The first main effect was advert type ($F_{(1,72)} = 12.52$, $p < 0.005$, $1-\beta = 0.94$), and the second was advert exposure duration ($F_{(2,144)} = 7.06$, $p < 0.005$, $1-\beta = 0.93$). These effects indicate that the portion of time on approach to an advertisement where a driver will look at the advert is affected by both advert type and advert exposure duration. Figure 3.11 shows that participants spent a greater percentage of the approach looking at video adverts. The planned contrasts conducted as part of the ANOVA indicated that there were significant differences in all three duration conditions ($p < 0.01$).

Summary

- Drivers looked at video adverts significantly more than static adverts, independent of advert exposure duration
- Drivers spent significantly more time looking at adverts on approach if they were in the long or medium advert exposure duration
3.3.3.2 Simulator measures

SDLP

Figure 3.12 shows participants’ mean SDLP on approach to adverts and compared to control data across the factor of advert exposure duration.

The ANOVA performed on this data set, including control data, indicated that there was a main effect of advert type ($F_{(2,120)} = 150.63$, $p < 0.001$). There was also a main effect of advert exposure duration ($F_{(2,120)} = 118.79$, $p < 0.001$). An interaction effect was also identified ($F_{(4,240)} = 142.38$, $p < 0.001$). In the long exposure condition, there was very little difference between the control data set and the video advert condition but significant differences ($p < 0.005$) were found for both the medium and short conditions.

For the short duration, it was also found that SDLP was significantly higher when around both advert types. This indicates that any form of advert being present caused the driver’s lane position to become increasingly variable.

The planned contrasts performed on the data showed a significant difference between video and static advertising at all three durations ($p < 0.001$). The contrasts also showed that there was no significant change in SDLP across durations for static adverts. However, SDLP was significantly different for all comparisons of exposure duration for video adverts ($p < 0.01$) showing a trend of increasing lateral position variability as advertising duration decreases.

Summary

- Advert type and exposure duration affect a driver’s ability to maintain a consistent lane position
- Lane position variability was significantly increased in drivers approaching video adverts; this was when compared to both static adverts and control data
- This effect is not seen for video adverts visible for the long duration but is a significant effect is observed for static adverts at this position
Mean speed

Figure 3.13 shows participants’ mean speed on approach to adverts and compared to control data across the factor of advert exposure duration.

**Figure 3.13: Mean speed on approach to static and video adverts vs. control data across advert exposure duration**

The ANOVA comparing the data found a main effect of advert type ($F_{(2,120)} = 44.67, p < 0.001$) and advert exposure duration ($F_{(2,120)} = 13.88, p < 0.001$). There was also an interaction effect of advert type and exposure duration ($F_{(4,240)} = 73.08, p < 0.001$).

The planned contrasts show that control data was significantly different compared to video adverts with static advertising showing no difference at any duration. The largest difference between control and video data was during the medium condition ($p < 0.001$). The planned contrasts performed as part of the ANOVA indicated that there was a significant difference between the average speed of the video and static group in the long and medium exposure duration conditions ($p < 0.01$). This suggests that the static group maintained a higher average speed in the 100m approaching the advertising boards. From Figure 3.13, it is clear that the speed differential tended to be greatest for adverts presented at the medium exposure time. The contrasts also indicated that the difference seen in mean speed observed for short exposure duration adverts was not significantly different. In general, it seems that speed choice with static adverts is more similar to the control condition than that observed with video adverts.

**Summary**

- Advert type and exposure duration affect a driver’s speed choice
- When approaching video adverts of long or medium visibility durations, mean speed was significantly lower when compared to static adverts
- The lower mean speed suggests participants slowed to view the adverts
- Speed differential was greatest for video adverts in the medium exposure time condition
**Maximum speed**

Figure 3.14 shows participants’ maximum speed achieved on approach to adverts and compared to control data across the factor of advert exposure duration.

*Figure 3.14: Maximum speed on approach to static and video adverts vs. control data across advert exposure duration*

The ANOVA performed on data for maximum speed during the 100m prior to an advert indicated that there was a main effect of advert type ($F_{(2,120)} = 55.23, p < 0.001$). There was also a main effect of advert exposure duration ($F_{(2,120)} = 27.79, p < 0.001$), and an interaction effect ($F_{(4,240)} = 57.86, p < 0.001$).

Control data was shown to be significantly different from video data during the long and medium durations ($p < 0.01$ in both instances). For adverts at the short exposure time, there was a significant difference observed between static or video adverts when compared to the control data, with the video condition seeing higher speeds than both control and static advertising. Planned contrasts indicated that there was a significant difference between the video and static group in the long and medium conditions ($p < 0.01$) with participants achieving a higher maximum speed for static adverts.

**Summary**

- Advert type, and exposure duration affect a driver’s speed choice
- When approaching adverts of long or medium durations, the maximum speed achieved by drivers approaching video adverts was found to be significantly lower than around static adverts
- The lower maximum speed suggests participants slowed to view the adverts
**Standard deviation of speed**

Figure 3.15 shows the mean of the standard deviation of speed observed on approach to adverts and compared to control data across the factor of advert exposure duration.

The statistical analysis of data there was a main effect of advert type ($F_{(2,120)} = 27.98, p < 0.001$) and of advert exposure duration ($F_{(2,120)} = 11.25, p < 0.001$) and an interaction effect between the two ($F_{(4,240)} = 39.63, p < 0.001$). This result suggests that both factors influence drivers’ control of speed, with some combined effects of both advert type and duration being present in some cases. The planned contrasts performed as part of the analysis indicated that there were significant differences between video and control data in the medium condition and long condition ($p < 0.01$). There were also significant difference between control and static advertising groups during the long exposure condition ($p < 0.005$).

There was no significant difference between video and static advertising when the advertising duration was long. It is possible that drivers had difficulty differentiating video and static adverts from long distances or advert type did not affect how they attended to the advert at distance. In either case, a driver would be unlikely to change their behaviour at distance across the factor of advert type. However, when the advertising board was visible for a medium duration, there was a significant difference between video and static groups ($p < 0.001$). This indicates that when approaching video adverts, drivers showed a significantly higher variability in their speed. The planned contrast analysis also indicated there was a significant difference between video and static groups in the short visibility condition ($p < 0.05$), this is clearly seen in Figure 3.15.

**Summary**

- Advert type and exposure duration affect a driver’s ability to maintain a consistent speed
- When approaching video adverts, drivers showed a significantly higher variability in their speed for the medium and short exposure durations
• This may have been a consequence of slowing to view the adverts
• Video adverts affect a drivers’ ability to maintain a constant speed, especially in the medium duration condition

**Maximum deceleration rate**

Figure 3.16 shows the mean of the maximum deceleration rate observed on approach to adverts and compared to control data across the factor of advert exposure duration.

![Figure 3.16: Maximum deceleration rate on approach to static and video adverts vs. control data across advert exposure duration](image)

The results from the ANOVA analysis of this data shows there is a main effect of advert type \(F_{(2,120)} = 80.01, p < 0.001\), advert exposure duration \(F_{(2,120)} = 3.83, p = 0.024, 1-\beta=0.69\) and an interaction effect between the two \(F_{(4,240)} = 17.36, p < 0.001\). The contrast analysis performed on the data indicated there were significant differences between control braking behaviour and maximum deceleration rate when adverts were present.

In both the long and medium conditions there were significant differences between control data and data for both video and static adverts, suggesting that drivers slowed at a significantly higher rate when approaching advertising \(p < 0.001\). Video advertising was also significantly different from control behaviour in the short exposure condition \(p < 0.05\). Planned contrasts indicated there was no significant difference between the deceleration rates for video and static groups when approaching a long duration advert. However, there was a significant difference between the video and static adverts in the medium duration condition \(p < 0.01\). This suggests that the deceleration rate was significantly greater when on approach to a video advert and that the exposure duration influences whether this difference is significant.

**Summary**

• Advert type and exposure duration affects the deceleration rate chosen by a driver to stop if braking was required
Drivers approaching video adverts showed the highest deceleration rate in all three advert exposure durations.

The difference between video adverts and the other conditions examined was greatest in the medium advert exposure duration.

Results suggest that participants slowed to view the adverts, particularly video adverts at the medium exposure duration.

### 3.3.4 Advert position

The following subsections examine the effect of advert position on visual and driving behaviour.

#### 3.3.4.1 Eye movement measures

**Mean number of glances at adverts**

Figure 3.17 shows the mean number of glances made by participants on approach to static and video adverts compared across the factor of advert position.

![Figure 3.17: Mean number of glances at static and video adverts across advert position](image)

The repeated measures ANOVA performed on this data set revealed a significant main effect of advert type ($F_{1,72} = 13.26, p < 0.001$), and an interaction effect of advert type and position ($F_{2,144} = 12.96, p < 0.001$). This analysis has indicated that the type of advertisement used affects that number of glances a driver will make at the advertisement position. The results also suggest there is a link between advert type and where the advert position that influences visual behaviour.

The planned contrasts performed as part of the ANOVA indicated there was a significant difference between video and static adverts in all four positions ($p < 0.01$). This suggests that regardless of position, drivers make more glances to video adverts than to static adverts. The statistical tests indicate there are significant differences in the number of glances made to each position for video and static adverts. This suggests that
drivers make the greatest number of glances to advertising placed in all 3 positions, with significantly fewer glances to centre, left and then right advert positions.

**Summary**
- Advert type was found to have a significant effect on the number of times a driver will look at an advert
- Drivers looked at video adverts significantly more than static adverts, regardless of the position adverts were placed
- The results suggest that the number of glances made at adverts reduced when adverts were placed at the side of the road rather than directly over the carriageway or in all three positions

**Mean glance duration**

Figure 3.18 shows the mean duration of glances made by participants on approach to static and video adverts compared across the factor of advert position.

![Figure 3.18: Mean duration of glances at static and video adverts across advert position type](image)

Figure 3.18 shows that at all positions, mean glance duration was higher to video adverts. A repeated measures ANOVA indicated that there was a significant main effect of the advert type ($F_{(1,70)} = 15.06, p < 0.001$), and a main effect of advert position ($F_{(3,210)} = 57.47, p < 0.001$). These results therefore suggest that average glance duration is significantly influenced by advert type and advert position.

As part of the ANOVA, planned contrasts were conducted which indicated there was no difference in the mean glance duration for video and static adverts between the all 3 position and the centre position. However, there was a significant difference in the mean glance duration between video and static for adverts placed to the left ($p < 0.01$) or to the right ($p < 0.05$) of the road. This suggests that if advertising is placed in ‘all 3’ positions or over the centre the road, drivers will look at the boards significantly longer than if they are on the left or right of the road. However, a video advert on the left or
right of the road will be looked at for significantly longer than if a static advert is present in its place.

**Summary**

- Advert type was found to have a significant effect on glance duration
- Drivers looked at video adverts significantly more than static adverts when they were positioned on the left or right side of the road
- Advertising placed in ‘all 3’ positions or over the centre the road resulted in drivers looking at the adverts significantly longer than if they are placed at the side of the road

**Percentage time looking at adverts**

Figure 3.19 shows the mean percentage of time that participants spent looking at an advert on approach for static and video adverts compared across the factor of advert position.

![Figure 3.19: Mean percentage of time spent looking at static and video adverts across advert position type](image)

Statistical tests performed on the data in Figure 3.19 indicated a significant main effect of advert position ($F_{(3,210)} = 32.70$, $p < 0.001$). This suggests that advert position has a strong influence on advert viewing time on approach to an advert. The contrast analysis performed indicated that each position differed significantly from all others on this measure ($p < 0.01$).

Although there was no main effect of advert type reported by the ANOVA, the planned contrast tests revealed that there was a significant difference between video and static adverts for the ‘all 3’ ($p < 0.01$), left ($p < 0.005$) and right ($p < 0.05$) positions, indicating that video adverts tended to attract more attention when placed in most positions.

**Summary**

- Advert position had a significant effect on the proportion of time a driver spent looking at an advert when approaching a position
There was a significant difference between video and static adverts for the ‘all 3’, left and right positions.

Video adverts attract more attention when placed in three of the four positions.

3.3.4.2 Simulator measures

SDLP

Figure 3.20 shows the mean values for the standard deviation of lateral lane position on approach to static and video adverts compared across the factor of advert position.

![Figure 3.20: Mean SDLP on approach to static and video adverts across advert position type](image)

Figure 3.20 shows there is little difference in SDLP for static adverts across advert positions. The repeated measures ANOVA performed on this data revealed that there was a significant main effect of advert position ($F_{(6,180)} = 46.07, p < 0.001$), indicating that advert position affects SDLP. There were surprisingly high SDLP values recorded for the all 3 position under control conditions. It is possible that result is an artefact of drivers choosing to cut corners (whilst remaining within lane boundaries) when no adverts were present, resulting in deviation from the centre of the lane, thereby producing higher SDLP. Planned contrasts indicated a significantly higher SDLP between the video advert and static adverts or control conditions when advertising is placed in the centre, left and right position ($p < 0.001$).

Summary

- Advert type and position were found to affect a driver’s ability to maintain a consistent lane position.
- SDLP was significantly increased in drivers approaching video adverts; this was when compared to both static adverts and control data for three of the four positions.
- The greatest affect of video adverts on SDLP was seen in the left position.
Mean speed

Figure 3.21 shows the mean speed values observed on approach to static and video adverts compared across the factor of advert position.

The repeated measures ANOVA performed on data collected for mean speed during the trial shows a significant main effect of advert type ($F_{(2,120)} = 39.35$, $p < 0.001$) and advert position ($F_{(3,180)} = 30.21$, $p < 0.001$) and a significant interaction between the two ($F_{(6,360)} = 8.63$, $p < 0.001$). This again highlights that advert type and position affects measures of driving control.

Figure 3.21 indicates that for advert position, drivers tended to maintain higher mean speeds if adverts were not present and that drivers tended to adopt lower speeds when passing video adverts as compared to static adverts. Planned contrasts indicated that there was a significant difference between the control group and both advert groups in the all 3 condition, centre and right conditions ($p < 0.001$ in all cases). Static adverts and control data did not differ for the left position but there was a significant difference between mean speeds for control data against video adverts ($p < 0.05$).

Summary

- Advert type and position affected speed choice on approach to adverts
- Mean speed was always significantly lower with video adverts as compared to control data
- This suggests that drivers were attempting to mitigate perceived risk (caused by lack of attention to the driving situation) by lowering speed
- It may also mean that they slowed to view the adverts
**Maximum speed**

Figure 3.22 shows the maximum speed values observed on approach to static and video adverts compared across the factor of advert position.

![Figure 3.22: Mean of maximum speed values observed on approach to static and video adverts across advert position type](image)

A significant main effect of advert type ($F_{(2,120)} = 27.31, p < 0.001$) and advert position ($F_{(3,180)} = 30.21, p < 0.001$) was found. The ANOVA also indicated there was a significant interaction effect between advert type and advert position ($F_{(6,360)} = 17.49, p < 0.001$). This result indicates a similar pattern to that seen for mean speed.

Figure 3.22 shows drivers in the advert conditions tended to achieve a lower maximum speed on approach to adverts than drivers in comparable control regions. This was supported by the results of the planned contrasts conducted as part of the ANOVA, which indicated there were significant differences between the control data group and both advertising groups when adverts were placed in all 3 positions ($p < 0.05$), and when advertising was placed on the left and right hand side of the road ($p < 0.001$). Figure 3.22 suggests that the impact of video adverts on maximum speed appears particularly pronounced when adverts are placed to the left of the road.

**Summary**

- Advert type and affected maximum speed achieved on approach to adverts
- When approaching adverts in the left position, video adverts resulted in a significantly lower maximum speed when compared to static and control data values
- Lower maximum speeds suggest that drivers may have been attempting to mitigate perceived risk (caused by lack of attention to the driving situation) by lowering speed
- This may also suggest that drivers slowed to view the adverts – particularly video adverts presented to the left of the road
Standard deviation of speed

Figure 3.23 shows the mean of the standard deviation of speed values observed on approach to static and video adverts compared across the factor of advert position.

Examining standard deviation of speed, there was a significant main effect of advert type ($F(2,120) = 28.69, p < 0.001$). Results also showed a significant main effect of advert position ($F(3,180) = 6.11, p < 0.001$) and an interaction effect between the advert type used and advert position ($F(6,360) = 7.63, p < 0.001$). The results indicate that a drivers’ ability to maintain a smooth speed control is affected by the presence of adverts.

Figure 3.23 shows that drivers approaching adverts tended to show more speed variation than in the control condition. When examined further, the analysis indicated that in the ‘all 3’, centre and right conditions drivers had a significantly higher standard deviation in speed when adverts were present ($p < 0.001$). No significant differences were found when comparing control data to that for adverts placed to the right of the road ($p > 0.05$). The results clearly indicate that in three of the four positions, the presence of adverts has an effect on speed variation. In all four positions, speed variation was higher with static adverts than with video adverts.

Summary

- Advert type and position affect a driver’s ability to maintain a consistent speed
- Results indicate that speed variability was significantly higher when adverts were present in the all 3, centre and right placement conditions
- In three of the four positions, the presence of adverts has an effect on a drivers’ ability to maintain a consistent speed
- Speed variation tended to be slightly higher with static rather than video adverts
Maximum deceleration rate

Figure 3.24 shows the mean of the maximum brake position values observed on approach to static and video adverts compared across the factor of advert position.

Figure 3.24: Maximum deceleration rate on approach to static and video adverts vs. control data across advert position

The ANOVA performed on data for maximum deceleration rate showed there was a main effect of advert type ($F_{(2,120)} = 26.81, p < 0.001$), and an interaction between advert type and advert position ($F_{(6,360)} = 4.38, p < 0.001$). These findings indicate that the advert type being approached by a driver has a significant effect on maximum deceleration in the event the driver is required to brake and that this is influenced by the particular advert position.

When examining the data in more detail, Figure 3.24 clearly shows that for each position, control driving behaviour was characterised by significantly less deceleration. This was confirmed by a planned contrast analysis of the data, which indicated that in each position the difference in braking rate was significantly different from advert conditions ($p < 0.001$).

Summary

- Advert type and advert position affect deceleration rate
- Drivers approaching adverts showed a higher deceleration rate than in the control condition in all four advert positions
- When drivers approached advertising placed on the left side of the road their maximum deceleration rate was significantly higher for video adverts
- When advertising was placed over the centre of the road, or to the right side, drivers passing static adverts chose to slow their vehicle significantly quicker than any other group
3.3.5 **Perception of distraction/safety**

Following the simulator trials, participants were asked to complete a short questionnaire that was designed to examine how they felt about roadside adverts. The questions asked were intended to gauge opinion as to how distracting or safe they felt particular types of adverts were, rated on a scale from 0-10 (see Appendix B).

3.3.5.1 **Distraction by position**

Figure 3.25 shows how participants rated the level of distraction caused by adverts placed at each of the four locations used in the study (a score of 0 represented “Not at all distracted”; a score of 10 represented “highly distracted”).

![Figure 3.25: Mean subjective ratings of distraction across advert position](image)

Independent samples t-tests were conducted to compare the level of distraction caused and demonstrated that adverts placed at the left or right did not differ in their perceived level of distraction ($p = 0.41$). Similarly, the difference in mean distraction rating given to adverts place above the road or at all three positions only neared significance ($p = 0.076$). All other comparisons between positions were highly significant ($p < 0.001$ in each case). These results are somewhat at odds with the driving and visual behaviour comparisons which tended to show that adverts to the left were more distracting than those to the right.
3.3.5.2 Distraction by presentation type (video vs. static)

Figure 3.26 shows how participants rated the level of distraction caused by static or video adverts (a score of 0 represented “Not at all distracted”; a score of 10 represented “highly distracted”).

![Mean subjective rating of distraction caused by static or video adverts](chart.png)

**Figure 3.26: Mean subjective rating of distraction caused by static or video adverts**

Figure 3.26 shows that participants clearly believe that video adverts are more distracting than static billboards, supported by a highly significant t-test result ($p < 0.001$).
3.3.5.3 Safety by advert type

Figure 3.27 shows participants’ mean rating of how safe they felt the use of static/video adverts is (a score of 0 represented “Very unsafe”; a score of 10 represented “Very safe”).

![Figure 3.27: Mean safety rating given to static and video adverts (error bars show 95% confidence intervals)](image)

Again, there is a highly significant \((p < 0.001)\) difference between ratings for the static and video adverts, with video adverts being rated as very unsafe.

Participants were also asked to provide rating from 0 to 10 as to whether they felt video adverts would make safety “much worse” (0); “no change” (5); or “much better” (10). The mean score was 2.09 (SD = 1.54), suggesting that, having experienced driving in the presence of video adverts, participants felt safety would be negatively affected.

3.3.5.4 Comments

Appendix C shows a list of the free response comments provided by participants in response to the question: “Please give us any general comments you have about STATIC and VIDEO advertising billboards”. It can be seen that there are several comments alluding to increased distraction caused by video adverts, supporting the overall trend seen in the subjective results e.g.:

“Static you tend to just glance as where as the full motion you tend to watch for a lot longer, feels like you are made to look at it.”

“The static adverts didn’t distract me at all but the full motion videos definitely caught my attention.”

“I found the full motion video advertising billboards very distracting and these were losing my concentration on the road. Static billboards are not very distracting as nothing is moving in them.”
4 Discussion

4.1 Review of study aims

The purpose of this study was to quantify the distracting effects of billboard advertising on drivers when placed near a road in representative configurations similar to those found in the London area and as shown in ARC Outdoor Media Surveys (2005). Representative advertising boards were placed in a highly realistic ‘virtual’ London environment, displaying video and static advertising images. Participants in the study then drove through this environment and performance was assessed on the approach to such advert boards. As part of this study, advert position has been examined to evaluate which positions create the greatest distraction for a driver. This section of the report provides independent assessment of the findings of this study and makes a number of recommendations for further research. It also provides information and steps that could be taken to limit the distracting affects of advertising. To date, highway authorities and research groups have presented limited evidence demonstrating the distracting nature of advertising hoardings.

From the results gained from this study, the effects of each advert type relative to a situation where no advertising being present can be seen. The findings indicated there are a number of detrimental effects on driving performance when video adverts are present; when comparing performance to both static adverts and when no adverts are present. These effects are wide ranging and can influence four main areas of driving control (Figure 4.1). It appears that behaviour when adverts are present differs from that when it is absent, with video advertising causing a more pronounced effect on behaviour than static adverts. Speed control, braking and the variability of these vehicle control measures are greatly affected by adverts. Drivers also appear to be less able to maintain a consistent position within the lane in which they are travelling. There are also identifiable changes in driver performance relating to advert position. To a lesser extent, the amount of time a person can see the advertisements on the board also has been shown to influence driver distraction. The following sections discuss these findings in more depth.

4.2 The effect of advert type on driver performance

Statistical tests on data collected in trials (Section 3.3) indicated video adverts are significantly more distracting than the more traditional static adverts. There are also differences in driver visual behaviour included drivers making significantly more glances to video adverts and spending significantly longer with their eyes away from the road ahead, than when static adverts were similarly placed. This result suggests that the presence of moving images on an advertising board draws a driver’s attention towards the advert and away from the driving task and road. This finding is of little surprise; the human visual system has evolved to detect changes in the surroundings, thereby giving moving images an immediate advantage. That drivers’ visual attention was drawn away from the road to view video adverts more frequently and for longer is of concern in an urban area such as London with a relatively high density of vulnerable road users. A driver’s visual attention to the driving task is vital to minimise collision risk.

It has also been possible to examine the effect different types of advertising have on aspects of driving control. During the course of analysis, it became clear there were a number of significant effects of advert type on a driver’s ability to control speed. The first result of interest related to the average speed that a driver maintained during the course of passing advertising boards. Drivers approaching static adverts maintained a significantly higher speed during the 100m prior to an advert board, when compared to drivers passing video adverts. Coupled together with the earlier finding that video advertising boards were looked at significantly more than static boards, it can be suggested that drivers were in fact slowing down to look at the video advertising.
Initially this may appear an acceptable compromise, if a driver was to look at something unrelated to the task of driving, slowing down reduces the risk of causing a collision. However, while a reduction in maximum and average speed may reduce perceived collision risk, it does not produce a commensurate reduction in the actual collision risk. This is shown by the heavier braking and greater variation in lateral lane position observed in the presence of the video adverts. In terms of braking, the significant increase in deceleration rate suggests that drivers were distracted and braked later; requiring more force and urgency. This more violent braking could increase the chance of losing control of the vehicle when trying to avoid an object, vehicle or pedestrian.

This finding suggests that there are four key areas where driver distraction can affect the safe operation of the car. Figure 4.1 highlights the four areas in which there is evidence of a change in driver behaviour. These changes are fundamental to the safe control of the vehicle. The result that distraction caused by video adverts has such a strong effect on driver performance is of concern. There were three instances of simulated pedestrians being struck during the course of the trial, as part of the advertisement reaction tests; all three were during the approach to a video advert. This was a collision rate of 1/644 per advertising pass; in contrast there were no collisions while approaching a static advertising board.

![Figure 4.1: The identifiable changes in driver behaviour when distracted by video advertising](image)

4.3 The effect of advert exposure time on driver performance

Advert exposure time was examined by manipulating the position of structures ahead of adverts to control the duration over which the advert was visible. Results suggest that advert exposure time has a significant effect on driver behaviour and the effect is greatest on approach to a video advert. Examining glance duration, there was a significant difference between video and static advertising in both the medium and short exposure duration conditions. There was no significant difference between video and static conditions when a long duration advertising board was being approached. This shows that there is a greater distracting effect of video advertising when approaching a medium or short exposure advert. A driver may be able to scan a video advert at a long distance with less disruption. The results revealed significant differences in all three duration conditions, with drivers viewing video adverts for a significantly longer
percentage of time than with static adverts. The results show that a video advert of medium duration exposure was the most distracting condition.

If aspects of a driver’s visual performance have changed, driving control is likely to be affected and this was found to be the case. When examining variation in lateral lane position, static advertising caused no significant increase at any duration of advert exposure. In contrast, there was significantly increased variation in lateral lane position for the video group for medium and short exposure durations and a trend of increasing lateral variation as advertising duration decreased. This suggests that if there is less time for drivers to look at the video advertising board, their choice to look at the board may have led to a lack of lane position control. In a highly populated area and complex traffic environment such as London, good lane discipline is vital in avoiding collisions with other road users.

It is also clear from the results that elements of speed selection were affected, depending on both the type of advert and the duration of exposure. Results indicated a significant difference between the average speed of the video and static group in the long and medium duration conditions, with a tendency for higher speeds with static adverts. From Figure 3.13, it is clear that the difference in speed is greatest in the medium duration exposure condition. This result fits with the eye movement data to suggest that the driver is slowing down to view the advertising. This is only significant in the case of video advertising and is reflected in a decreased maximum speed in both long and medium exposure time conditions. This indicates that drivers passing static advertising maintained a significantly higher average and maximum speed compared to passing video advertising. As the approach to both medium and long adverts give the drivers the greatest chance of distraction (supported by eye movement data), it has been suggested that the reduction in speed is due a driver knowingly looking at the advert and slowing to reduce their perceived risk. However, when examining the type of advertising and the effect on car control, it was found that this also resulted in poor braking performance, thus mitigating the benefit of any reduction in speed.

Results indicated that while there were no significant differences between the deceleration rates for video and static groups when approaching a long duration advertising board, a significant difference was identified between video and static groups for medium exposure duration adverts with the mean deceleration rate for video adverts being significantly greater. This higher braking may either be due to drivers slowing to view the adverts or slowing to mitigate perceived risk whilst they view the adverts.

When examining the duration of advertising visibility it is clear that the condition causing the least detrimental effect on behaviour was the long exposure condition. In the study, this meant that the advertising was visible for around six seconds, thereby reducing the constraint on drivers to look at the advert for a continuous period. However, it appears that at each exposure duration condition, drivers were more distracted by video adverts than static advertising. These findings provide further evidence that video adverts significantly distract a driver beyond that observed with static adverts.

### 4.4 The effect of advert position on driver performance

A further aim of this study was to examine how advert position influences driver distraction. The results of this section revealed a number of different effects on driving performance based on advert position and type. When examining the pattern of results, two key patterns emerge. Firstly, the ‘all 3’ advert position was the most visually distracting condition, followed by the centre, left, and right positions. Secondly, superimposed on this pattern was a tendency for video adverts to attract more attention than static adverts at all positions. This is shown most clearly by Figure 3.17.

As previously discussed, the foundation of any distraction effect can be judged by the influence the advert has on a driver’s eye movements. However, such advertising would be further highlighted as a danger if it then provokes a detrimental change in the driver’s
control behaviour. The analysis conducted does indicate that driver’s vehicle control performance was affected by the type of advertising that they encountered.

A clear example of changes in behaviour based on advert position is shown in Figure 3.20 in which it can be seen that video adverts in the centre and right positions cause increases in variation in lateral lane position but video adverts positioned to the left cause an even more severe impairment. This supports the eye movement data; the greatest difference in mean glance duration between video and static advertising occurs when the advertisement is placed on the left side of the road.

As has been reported previously, mean speeds were typically lower when adverts were present. Comparing speed variability under control conditions with that observed for static and video adverts showed that drivers were less able to maintain a consistent speed when adverts were present for the ‘all 3’, centre and right advert positions. Surprisingly (given other results), speed variation tended to be slightly higher for static rather than video adverts.

4.5 Subjective opinions

Participants were asked to provide their views on their experience of driving through a simulated route with static and video adverts present. Their opinions were coherent with the objective measures provided by the eye tracker and driving simulator. Participants rate the ‘all 3’ advert position as most distracting, rating the centre, left, and right adverts as successively less distracting. This is consistent with the measures of visual distraction seen for the factor of advert position. Participants also gave a clear impression that they found video adverts more distracting than static adverts. Finally, were asked how safe they felt static and video adverts were. Participants gave a neutral response for static adverts and a clear negative response for video adverts suggesting they felt that road safety could be jeopardised by the introduction of video adverts. The novelty effect of seeing video adverts in the driving situation for the first time may be a factor in these results. However, it should be remembered if video adverts are to become more widespread, many drivers will have a first time viewing of a video advert and they are likely to be significantly more distracted on this occasion than in subsequent viewings.

4.6 Comparison to other driving impairments

An increase in variation in lateral lane position is not in itself necessarily the clearest indicator of driving impairment. However, when the changes can be compared with other types of driving impairment, a better understanding of the implications can be achieved. The increases in variation in lateral lane position, particularly at the short duration exposure time are consistent with a greatly increased tendency to drift into the offside lane or onto the nearside kerb, greatly increasing the risk of collision and/or injury. By comparison with other impairments tested on the simulator, cannabis has been shown to increase variation in lane position by 35% (Sexton, Tunbridge, Brook-Carter, Jackson, Wright, Stark, & Englehart, 2000) whilst trying to write and send a text message caused this measure to increase by 91% (Reed & Robbins, 2008). Consumption of alcohol to the legal limit caused some impairment to consistency of lateral lane position but failed to reach significance (Burns, Parkes, Burton, Smith & Burch, 2002). Although, the measures reported here were taken in a different driving environment and context, it is apparent that the impairment to performance when viewing video adverts is of a similar magnitude. Unlike, cannabis or alcohol, the detrimental effect of an advert is likely to be short-lived – limited to the time in which the driver has a clear view of the advert. However, the level of impairment that these adverts may cause drivers for each advert placed in the urban environment should be understood in this context.
4.7 Process by which advertising distraction affects driving performance

While examining the data collected in this study, it is clear there is a process at work when drivers are distracted by advertising. Examining the data, a logical process can be developed to depict this process. Figure 4.2 presents a process diagram which ties together the results found.

![Figure 4.2: Process that governs driver distraction by advertising](image)

The initial stages of distraction, by definition, require that the driver’s attention to be disrupted from the primary task (i.e. driving). It is possible to define a measure of distraction, as driving is a visuomotor task. Driving requires the driver to direct their gaze at the road ahead, and the increase in gaze towards advertising indicates eye movements can be used as a measure of distraction. In all cases, regardless of position or duration of advertising, the results showed that visual behaviour was significantly affected by the presence of adverts and that this appeared more pronounced for video adverts.

Any distraction from the main task has implications for the ability of the driver to control the vehicle in a safe manner. Estimates of distractions caused by irrelevant objects and features (e.g., pedestrians, parked cars and other objects near the road) near the roadway occur between 20% and 50% of the time (Green, 2002; Hughes and Cole, 1986; Land and Lee, 1994). This is compounded by the increased distraction caused by the presence of adverts, particularly when the advert contains moving images.

Wallace (2003) reviewed driver’s responses to adverts. This research suggested that a driver can be ‘overloaded’ with irrelevant information at critical times during a route. This study would provide support for this suggestion of an increased workload. Increased visual workload, in the form of watching video adverts, will result in a “secondary task” being formed. Performing a secondary task while driving (primary task), has been shown by previous research to affect car control performance. Studies have linked mobile phone conversations, texting and other distracting activities to reduced driver safety. In essence, video adverts create an additional load for a driver and as found in this study, performance in the driving task will be reduced. It is not possible to be certain how many of collisions are caused by static adverts. However, the results of this study suggest that if video adverts were to be used in an urban area there could be an increase in collisions due to driver distraction.

A driver’s ability to control a vehicle relies on their attention to the driving task. As a driver is distracted by advertising, it appears their ability to select an appropriate speed and control that speed is reduced. A consistent speed helps to maintain a high traffic flow, minimising congestion. It also helps reduce the risk of sudden braking or the need for other drivers to correct their speed. There are also implications for the increased braking severity seen when approaching video advertising. There is an increased risk of losing control of a vehicle under heavy braking and an increased risk of rear-end shunts. These changes in behaviour all appear to stem from the initial change in visual behaviour, and are in fact the driver’s attempt to manage the risk associated with looking at an advert a greater duration.
5 Conclusions

The purpose of this study was to determine the distracting nature of advertising placed near roads of a similar type to those found in the London area; specifically two types, video and static advertising. This study has also aimed to identify the relative effect of different advert positions based on real advert configurations used in London. Although simulation does not provide an exact replica of the situation observed with real driving, there are significant methodological, safety and price constraints that make studies of real world behaviour in relation to distraction by billboard advertising very difficult. In using the driving simulator at TRL, every effort was taken to ensure that this simulator study represented the London driving scene as accurately as possible. In addition, a number of experimental factors could be manipulated in a manner that is not possible in the real world, large volumes of accurate data could be collected, and participants were in complete safety at all times.

Through analysis of the experimental data, this study has provided useful insights into the differential effects of roadside billboard advertising on driver behaviour. The report has found significant effects on both drivers’ visual behaviour and driving performance when static and video adverts are present and that the video adverts seem more potent distractors than similarly placed static adverts. The results support and extend other studies of driver distraction by advertising (Crundall et al., 2006; Young and Mahfound, 2007). This report constitutes direct research into the area of driver distraction and has indicated that while affordable plasma and LED screens showing video advertising may be available, caution should be exercised in the use of this technology. While it is clear there are some effects of position and duration of exposure, the main finding is that video adverts provide a greater distraction than that currently caused by drivers approaching equivalent static adverts.
5.1 Further work

Numerous issues have been identified within this study that merit further investigation. Some examples are described below:

- **Review any further plans to use video advertising within the Greater London area**
  - This study suggests that the use of video based adverts result in a significant reduction in driving performance. This should be avoided in a dense urban environment where a driver’s attention is vital to avoiding collisions. There are alternatives to the video advertising boards, in the form of traditional poster boards. They provide less disruption to driver attention, and therefore less disruption to their driving skills.

- **Conduct a review of collisions around advertising within the Greater London area**
  - In addition to the findings of this report, we would recommend conducting a review of collisions that have occurred in London, around advertising. The aim of this review would be to identify any collision clusters, and also to identify any common factors that increase the risk of a collision. The research would provide planners with further evidence of areas that should not be populated with any further advertising, and may identify areas where advertising should be reduced. It may also provide a “risk checklist” that could be used to assess whether a planning application is appropriate; ensuring that advertising is not placed in an area where it may cause an unacceptable distraction for passing traffic.

- **Examine the feasibility of conducting an audit of current advertising**
  - The results of this study have highlighted the need to consider the placement and visibility duration of advertising boards. There is likely to be an increase in driver workload depending on the type of area a driver is travelling through, making the sites where advertising may be placed (or currently placed) key to driver safety. If the desire to implement roadside video advertising gains impetus, it would be advisable to identify areas where this type of advertising is not appropriate for use. These areas would be identified by certain criteria that would increase the workload on a driver.

- **Examine the effect of variation in advert density on driver performance**
  - This study used a relatively low density of static and video adverts. Consequently, there may have been a something of an ongoing novelty effect of each advertising board. It may be of interest to determine if this is reduced when a high density of adverts is used to replicate the situation if/when video advertising is more commonplace.

- **Examine the effect of advert size/content**
  - A key variable that was controlled in this study was the size of each advert. A new study could investigate the relative distraction effects of smaller/larger advertising boards.
  - Similarly, great effort was made to ensure the set of static and video adverts used were homogenously distracting to a wide range of drivers. It would be of interest to study the effect of very distracting adverts (targeted to a specific demographic) on driver behaviour relative to less distracting items.

- **Real world validation**
  - Whilst every effort was made to ensure that the simulator study was as lifelike as possible, it is clear that simulator driving is representative of real driving performance but not an exact replica. Confirmation of the validity of the
simulator results could be achieved by running validation studies on a test track or at a suitable on-road location.

Acknowledgements

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References


Appendix A  TRL CarSim

A.1 TRL Driving Simulator

TRL has successfully operated a driving simulator for more than 15 years and in that time the simulator has seen a number of different incarnations to keep pace with improvements in vehicle, projection, computing, and simulation technologies and as such is one of the most advanced simulators in the UK. The latest iteration uses a Honda Civic family hatchback (see Figure A.1). Its engine and major mechanical systems have been replaced by a sophisticated electric motion system that drives rams attached to the axles underneath each wheel. These impart limited motion in three axes (heave, pitch, and roll) and provide the driver with an impression of the acceleration forces and vibrations that would be experienced when driving a real vehicle. This significantly enhances the realism with which drivers approach the driving task and reduces the incidence of simulator sickness (a condition with symptoms similar to those of motion sickness) among participants. All control interfaces have a realistic feel and the manual gearbox can be used in the normal manner (automatic gears can be simulated).

Surrounding the simulator vehicle are large display screens onto which are projected the graphic images that represent the external visual environment to the driver. The level of environmental detail includes photo-realistic images of buildings, vehicles, signing, and markings, with terrain accurate to the camber and texture of the road surface. We have also recently added the capability to simulate night-time driving scenarios. The driving environment is projected at a resolution of 1280×1024 onto three forward screens to give the driver a 210º horizontal forward field of view. The presence of the two flat side screens adjacent to the driver gives a very strong impression of other vehicles travelling alongside of the vehicle. A rear screen provides a 60º rearward field of view, thus enabling normal use of all mirrors.

Surveillance video cameras are mounted in the car and participants can be recorded during their drive. There is also an intercom facility for communication between the...
vehicle and the control room. An in-car colour LCD display can also be used to give instructions or provide other task-related information.

More than one hundred autonomous traffic vehicles can be programmed to participate in the simulation. TRL has a library of different vehicle types to choose from including cars, trucks, buses, emergency vehicles, bicycles, and pedestrians. Each obeys specific driving rules to behave in a normal manner with respect to other traffic vehicles. However, these can be overridden causing them to perform specific manoeuvres e.g. emergency stop, sudden lane change etc. The autonomous vehicles also have dynamic properties of their own – they appear to pitch realistically under acceleration and braking, and vehicle graphics include body tilt and roll under braking, acceleration and turning; speed dependent rotating wheels and fully working brake, indicator, fog, and head lights. These provide additional cues to the driver and greatly enhance the realism of a scene. To generate scenarios with a heavy traffic load (> 1700 vehicles per lane per hour) we can generate a vehicle ‘swarm’. The swarm function allows us to define a region around the driver where vehicles will be placed and controlled. A vehicle moving out of the visible range of the driver is replaced by a new vehicle positioned to maintain the desired traffic density. This gives the impression of very high volume of traffic while maintaining the performance of the simulator.

A stereo sound system with speakers inside and outside the vehicle generates realistic engine, road, and traffic sounds to complete the representation of the driving environment. The software used to implement the simulation is called SCANeR II and was created by OKTAL to provide a flexible and powerful simulation with a highly advanced traffic model. It is employed by more than twenty research institutes across the globe and TRL leads the user group with access to OKTAL expertise for trial set-up and integration, if required.

The dynamics of the vehicle are modelled using a validated vehicle model that is used for product development by Renault. The model interprets the driver’s control inputs, relates them to the current vehicle status and computes a prediction of how a real vehicle would behave in the given circumstances. The system then responds to present to the driver its
optimal representation of how this behaviour would be perceived through the visual, sound, and motion sub-systems. The vehicle dynamics are updated at 100Hz whilst the visuals are refreshed at 60Hz so that the driver perceives a seemingly continuous driving experience. Data is then recorded relating to all control inputs made by the driver, including steering, pedals, gear, indicators; vehicle parameters such as speed, RPM; and parameters to assess behaviour in relation to other vehicles such as distance and time headways. The data recording rate is fully controllable dependent upon the trial demands, up to a rate of 100Hz.

The simulator also includes a full integrated SmartEye eye-tracking system for the analysis of driver visual behaviour. This system, in addition to being able to report the driver's gaze direction, is integrated with the 3D environment presented in the simulation, such that the eye-tracker can report in the simulator data the specific element on which the participant is fixating – a specific road sign, traffic light, the road ahead, or interior items such as the instrument panel or infotainment system. This dramatically improves the accuracy and efficiency of post-trial data analysis.

Participants for trials are recruited from a dedicated database of over 1000 members of the public. This comprises drivers from a wide range of ages and backgrounds, all of whom are familiar to TRL such that participants from particular demographic bands or driving experience/ability ratings can be selected to suit the trial requirements. The simulator facilities include a medical room for taking any physiological measures and trials management staff are trained in Good Clinical Practice. There is an interview room for questionnaire completion and debriefing and an information room for conducting computer based test or training tasks. Data management procedures are well established and compliant with the Data Protection Act 1998 to ensure security, confidentiality, and integrity of all records.
Appendix B  Questionnaire used in the trial

To be completed by TRL
Participant Number: ________________  Date of Trial: _____/_____/_________

Driving Simulator Study: URBAN DRIVING

SECTION A
DRIVER PROFILE

Note:

- All information on this form is confidential.
- It will be stored securely at TRL.
- No information will be used by other projects at TRL.
- No individuals will be identified.

A1. Name

A2. What was your age at your last birthday?

A3. Are you Male or Female? (please tick)

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
</table>

A4. How many years have you held a full driving licence?

A5. Approximately how many miles have you driven in the last year?

A6. What type of vehicle(s) do you drive? (tick all those that apply)

<table>
<thead>
<tr>
<th>Motorcycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
</tr>
<tr>
<td>Light Goods Vehicle</td>
</tr>
<tr>
<td>Heavy Goods Vehicle</td>
</tr>
</tbody>
</table>
### SECTION B
#### YOUR DRIVING

*(Please circle the number that you feel is most appropriate)*

**B1. In general, do you enjoy driving?**

<table>
<thead>
<tr>
<th>Completely dislike driving</th>
<th>Thoroughly enjoy driving</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**B2. On how many days do you drive in a typical week?**

<table>
<thead>
<tr>
<th>Never</th>
<th>Every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**B3. On average, how many days per month do you drive in an urban or built-up environment?**

**B4. In general, how calm do you feel when driving?**

<table>
<thead>
<tr>
<th>Very nervous</th>
<th>Very calm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**B5. In general, how calm do you feel when driving in an urban environment?**

<table>
<thead>
<tr>
<th>Very nervous</th>
<th>Very calm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
B1. Please tick the appropriate box that corresponds to the level of symptoms that you are experiencing **right now**.

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Slight</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>General discomfort</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>Fatigue</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>Headache</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4.</td>
<td>Eye strain</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5.</td>
<td>Difficulty focusing</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6.</td>
<td>Increased salivation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7.</td>
<td>Sweating</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8.</td>
<td>Nausea</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9.</td>
<td>Difficulty concentrating</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10.</td>
<td>Fullness of head</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11.</td>
<td>Blurred vision</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12.</td>
<td>Dizzy (eyes open)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.</td>
<td>Dizzy (eyes closed)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.</td>
<td>Vertigo*</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15.</td>
<td>Stomach awareness**</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.</td>
<td>Burping</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

* Vertigo is experienced as loss of orientation with respect to vertical upright.
** Stomach awareness is usually used to indicate a feeling of discomfort which is just short of nausea.
SECTION C
YOUR EXPERIENCE OF DRIVE 1
(Please circle the number that you feel is most appropriate)

C1. How calm did you feel after DRIVE 1?

<table>
<thead>
<tr>
<th>Very nervous</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Very calm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

C2. Please tick the appropriate box that corresponds to the level of symptoms that you were experiencing at their worst.

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Slight</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General discomfort</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Fatigue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Headache</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Eyestrain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Difficulty focussing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Increased salivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Sweating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Nausea</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Difficulty concentrating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Fullness of head</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Blurred vision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Dizzy (eyes open)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Dizzy (eyes closed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Vertigo*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Stomach awareness**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Burping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Vertigo is experienced as loss of orientation with respect to vertical upright.
** Stomach awareness is usually used to indicate a feeling of discomfort which is just short of nausea.
*** Visual flashbacks, illusion (motor), aftereffects reminiscent of reactions when in the simulator.
SECTION D
YOUR EXPERIENCE OF DRIVE 2

(Please circle the number that you feel is most appropriate)

D1. How calm did you feel after DRIVE 2?

<table>
<thead>
<tr>
<th>Very nervous</th>
<th>Very calm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

D2. Please tick the appropriate box that corresponds to the level of symptoms that you were experiencing at their worst.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>No</th>
<th>Slight</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General discomfort</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Fatigue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Headache</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Eyestrain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Difficulty focussing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Increased salivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Sweating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Nausea</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Difficulty concentrating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Fullness of head</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Blurred vision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Dizzy (eyes open)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Dizzy (eyes closed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Vertigo*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Stomach awareness**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Burping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Vertigo is experienced as loss of orientation with respect to vertical upright.
** Stomach awareness is usually used to indicate a feeling of discomfort which is just short of nausea.
SECTION E
YOUR EXPERIENCE OF DRIVE 3

(Please circle the number that you feel is most appropriate)

E1. How calm did you feel after DRIVE 3?

<table>
<thead>
<tr>
<th>Very nervous</th>
<th>Very calm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

E2. Please tick the appropriate box that corresponds to the level of symptoms that you were experiencing **at their worst**.

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Slight</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General discomfort</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. Fatigue</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Headache</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. Eyestrain</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. Difficulty focussing</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. Increased salivation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Sweating</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. Nausea</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. Difficulty concentrating</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. Fullness of head</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11. Blurred vision</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12. Dizzy (eyes open)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13. Dizzy (eyes closed)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14. Vertigo*</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15. Stomach awareness**</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16. Burping</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

* Vertigo is experienced as loss of orientation with respect to vertical upright.
** Stomach awareness is usually used to indicate a feeling of discomfort which is just short of nausea.
*** Dizzy (eyes open/eyes closed) reflects subject’s own subjective awareness of movement in the simulator.
SECTION F
YOUR EXPERIENCE OF DRIVE 4

(Please circle the number that you feel is most appropriate)

F1.  How calm did you feel after DRIVE 4?

<table>
<thead>
<tr>
<th>Very nervous</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
</table>

F2.  Please tick the appropriate box that corresponds to the level of symptoms that you were experiencing at their worst.

<table>
<thead>
<tr>
<th>No</th>
<th>Slight</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

1. General discomfort
2. Fatigue
3. Headache
4. Eyestrain
5. Difficulty focusing
6. Increased salivation
7. Sweating
8. Nausea
9. Difficulty concentrating
10. Fullness of head
11. Blurred vision
12. Dizzy (eyes open)
13. Dizzy (eyes closed)
14. Vertigo*
15. Stomach awareness**
16. Burping

* Vertigo is experienced as loss of orientation with respect to vertical upright.
** Stomach awareness is usually used to indicate a feeling of discomfort which is just short of nausea.
*** Visual flashbacks; illusions (not a) after-effects reminiscent of sensations when in the simulator.
SECTION G

G1. Please place a tick in the box next to each advertisement which you remember seeing during your drives in the simulator.

- Advertisement 1
- Advertisement 2
- Advertisement 3
G2. Each group of four images below and over the following pages shows the sequence of a full motion video advertisement. Please place a tick in the box next to each advertisement which you remember seeing during your drives in the simulator.

**Advertisement 1**

Video advertisement sequence inserted in this area (5 images)
Video advertisement sequence inserted in this area (5 images)
Advertisement 3

Video advertisement sequence inserted in this area (5 images)
Advertisement 4

Video advertisement sequence inserted in this area (5 images)
Video advertisement sequence inserted in this area (5 images)
Advertisement 6

Video advertisement sequence inserted in this area (5 images)
(Please circle the number that you feel is most appropriate)

G3. How distracting did you find advertising billboards placed to the left of the road?

<table>
<thead>
<tr>
<th>Not at all distracting</th>
<th>Highly distracting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

G4. How distracting did you find advertising billboards placed to the right of the road?

<table>
<thead>
<tr>
<th>Not at all distracting</th>
<th>Highly distracting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

G5. How distracting did you find advertising billboards placed above the road?

<table>
<thead>
<tr>
<th>Not at all distracting</th>
<th>Highly distracting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>
G6. How distracting did you find advertising billboards placed at the left and right sides of the road, and above the road?

<table>
<thead>
<tr>
<th>Not at all distracting</th>
<th>Highly distracting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

G7. How distracted do you think you would be by roadside billboards which display **STATIC** advertisements?

<table>
<thead>
<tr>
<th>Not at all distracted</th>
<th>Highly distracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

G8. How distracted do you think you would be by roadside billboards which display **FULL MOTION VIDEO** advertisements?

<table>
<thead>
<tr>
<th>Not at all distracted</th>
<th>Highly distracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

G9. How **SAFE** do you think the use of roadside billboards displaying **STATIC** advertisements is?

<table>
<thead>
<tr>
<th>Very unsafe</th>
<th>Very safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

G10. How **SAFE** do you think the use of roadside billboards displaying **FULL MOTION VIDEO** advertisements is?

<table>
<thead>
<tr>
<th>Very unsafe</th>
<th>Very safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>
G11. What difference to **SAFETY** do you think use of **FULL MOTION VIDEO** advertising billboards will make?

<table>
<thead>
<tr>
<th>Much worse</th>
<th>No change</th>
<th>Much better</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

G11. Please give us any general comments you have about **STATIC** and **FULL MOTION VIDEO** advertising billboards.

---

**End of Questionnaire**

Thank you very much for your participation in this study.
Appendix C  Participant comments on advertising

The following italicised text is the comments taken from the questionnaire made by participants in response to the statement: “Please give us any general comments you have about STATIC and FULL MOTION VIDEO advertising billboards”.

*Having full motion billboards left front and right is unneeded and you can be distracted by them a lot further down the road as they are very eye catching. They can’t have too much effect as I don’t remember what they were now. Static boards would be ok once in a while at safe areas.*

*Didn’t notice the billboards. I didn’t notice the contents of the full motion billboards. I guess I’m an advertiser’s nightmare!*  

*In my opinion static advertising billboards distract the driver because he stops giving attention to the roads to try reading the advertising billboards and the full motion ones are much worse too me as they have flash, video etc which are very distracted.*

*Static you tend to just glance as where as the full motion you tend to watch for a lot longer, feels like you are made to look at it.*

*The static adverts didn’t distract me at all but the full motion videos definitely caught my attention.*

*Static billboards are more distracting if they require you to read small print. Full motion billboards are very distracting as you tend to watch as much as you can before you pass them.*

*Static would be preferable and safer.*

*Although I noticed both, I tried not to be distracted by them so consequently I couldn’t really say generally what was being advertised. The only ones I felt vaguely acceptable were those with very simple graphics e.g. 2+4 adverts.*

*Full motion adverts were more distracting as they affected me earlier on, from a longer distance but I still looked at the static ones. The full motion adverts hold your attention for longer, and the changing lights are more distracting. Empty display boards are just as distracting as static ones.*

*Static: I think that they are less disturbing on motorways. Full motion video: Shouldn’t be allowed anywhere near roads.*

*Some static and some moving advertisements may be particularly eye-catching where they may, even if not aimed at the motorist, have a potential to create the impression of a pending hazard. Advertisements which show moving images more so, because they are less instantly dismissed as being truly static. I feel there is much excessive road*
signage which may fall into this category. My friend in Holland knows of a town where almost all the signage has been removed and the accident rate reduced!

I was distracted by the large white billboards displaying letters only because I have not seen the like before. Otherwise I tend not to notice ad boards. Note: this participant saw empty display boards with the ad codes on. Lena

I would imagine full motion video would be even more distracting at night time and especially to younger or less experienced drivers.

Static advertising billboards are not very distracting in singles and as long as not filling my area of vision. There are always the attraction to look to see what is advertised but I try not to look (hence I could not remember what was advertised). It is hard to ignore full motion advertising billboards and this was particularly dangerous when just behind some traffic lights. Those that are on both sides and above the road should be banned as they are very distracting and cannot be ignored! I tried not to look but the movement caught my eye and I could not avoid a quick glance which would be long enough to have an accident!

I did not notice the static boards at the side of the road at all. But I did find the full motion video very distracting. Particularly the lighter coloured advertisement.

I personally do not take a great deal of notice of static billboards motion video would distract me I think possibly making me feel sick.

During the drive I made an effort not to see distractions because of my awareness that I was on a test. But in real life I would ban them completely. They are a distraction to the driver.

Quite distracting in this simulation but don't tend to be used on the roads.

I found the full motion video advertising billboards very distracting and these were losing my concentration on the road. Static billboards are not very distracting as nothing is moving in them.

Other than legal, legitimate road signs giving instructions to motorists, advertising billboards of any sort should be kept away from the sides and above roads. Especially video signs as they could mentally confuse the eyesight and cause accidents.

Full motion video make you look at them and stop you from thinking about what is going on around you. Flashing images make you look at them - we think of flashing as a warning. Static boards you can look at like road signs and you normally recognise them without having to look longer at them. If you see them at all!
With static adverts you can possibly take in most of the image at a glance - whereas the
motion adverts require a lot more attention to follow sequences etc - therefore taking
attention from looking at road and pedestrians.

There’s enough to watch going on in everyday life, without extra things to watch on the
sideways and overhead. Static doesn’t distract as much as ex extra movement going on.

I really don’t find them distracting. I would have thought that I may have been
distracted by adverts featuring things that interest me. However on the evidence of this
simulation it appears I don’t notice them!

When above the road it becomes more tempting to look at the images/videos. When L or
R not so much so.

Static- would take a second glance if it was something that interested me. Didn’t take
eyes of road for longer than say looking at a pedestrian. Full motion - Very distracting,
wanted to see complete video. Was taking eyes off road for far too long. Would be good
in a traffic jam!!!....Maybe!

Static advertising billboards - Once you have looked briefly at it you’ve seen the entire
advertisement, there’s no need or compulsion to look again. Full motion billboards -
More distracting because you need to look longer to see the full advert.

Static boards are fine and you soon get used to the pictures anything else, including
static billboards that change adverts should only be seen at static junctions e.g. traffic
lights during rush hour. Thus when the road user can not be distracted from driving
safely.

Very used to seeing static advertising billboards so I didn't find theses a problem. Full
motion video billboards to tend to catch your eye and may distract your attention for a
few seconds.

Whilst driving in urban areas, there is a lot to distract the driver already. Adding motion
videos billboards into the equation makes it more likely a driver may miss something
that causes an accident. The traffic in town is slow enough now. Motion videos should be
placed where your full concentration can be applied and that is not when driving.

I spent more time looking at the video billboards than the static ones. I felt I was more
distracted by the videos than the static.

I tried to avoid looking at the billboards in general, but the full motion ones are more
difficult to avoid.

You lose concentration very easily with full motion video. Where they are placed on left,
centre and right seems to be the worst scenario. Static boards are better but not placed
at road junctions where concentration is of utmost safety.
I am aware that I pay very little attention to the static billboards, but was very drawn to the moving images especially the ones which were flashing and form quite a distance away I was distracted by trying to work out what the flashing was. However, since realising it was a billboard, I wasn't necessarily drawn to watching it further to find out what it was advertising.

I don't think that static billboards are too distracting unless they are particularly eye-catching. However, I think full motion video advertising ate the side of the road could be highly distracting and potentially dangerous.

Anything that distracts a driver from concentrating on the road ahead is a bad thing, but as the eyes are particularly drawn to motion whilst driving this makes full motion video adverts very dangerous indeed. Also, the brighter and more colourful the advert, the more distracting it becomes.

When I am driving I realise how easy it is to be distracted and try very hard not to be distracted. I found the motion advertising more distracting than static but made a conscious effort to ignore them. (Reflected by the fact that I have no recall of any of the advertisements in this questionnaire)! When you’re driving a vehicle in a busy urban area being distracted for even a short period of time can be catastrophic. I could see from the scenarios that it would have been easy for people to be distracted. The advertising was clearly aimed at motorists and I feel it is wrong for the media to be allowed to try and attract the motorist’s concentration on a "short film" motion advert.

Anything that takes the drivers attention away from the road for more than a few seconds like full motion video is a very bad idea. Static billboards are only glanced at and when you have seen them before you tend not to look. I remember the Wonderbra ads' and hearing reports of crashes! Sometimes not a good thing.
State, county, and municipal leaders across the U.S. are finding themselves with a new issue on their agendas: the latest generation of outdoor advertising signage, the digital billboard. Also known as LED or electronic billboards, dynamic signage, constantly variable signs, and other names, these signs are a whole new ballgame in outdoor advertising.

The digital technology features two major changes from the old "static" signage, which is graphics painted or printed on a surface. The image in the digital sign is displayed by a myriad of colored "lightbulbs" (light-emitting diodes, or LEDs, actually). So while the static sign is visible from daylight reflecting off it (or artificial lighting at night), the digital image shines out, akin to a television set. In the digital signs, the image is supplied to the sign by a computer; the image can be varied at will, right up to functioning as a Hi-Def television display. These two properties -- potential for both intense surface brightness and motion -- pose questions to safety and esthetics issues beyond those raised by the old static signs, and require new analysis by agencies tasked with regulating outdoor advertising.

It makes sense to start off this discussion by addressing the topic of digital billboards and the future. The large outdoor advertising companies have embraced this technology as the replacement for static signage; in their book, it is the technology which is here to stay. To quote a promotional video from the Trans-Lux company, "Nothing's as eye-catching as an electronic LED display. The brightly-lit text and graphics can be seen from hundreds of feet away, drawing the attention of everyone within view." Space on the electronic signs is marketed as being superior to that on static signs; it can cost as much or more to run your company's sign on the digital billboard as to rent a static one, even though your sign may only be shown a small percentage of the time on the digital display, alternating with as many as eight or more others. While the investment in a
digital sign is a large one (often quoted as $250,000 - $500,000), the anticipated return is great. Overhead costs are also cut for the advertising companies; when signs are designed, they no longer need to be printed, and then installed by a crew in the field; at the click of a computer mouse, the sign graphic is wired or radioed to the digital billboard for display. The companies in the multi-billion-dollar outdoor advertising field have a large financial incentive to change most outdoor signage from static to digital over the coming years.

Why is our coalition for responsible outdoor lighting discussing the subject of digital billboards? There are a few issues which directly involve questions of illumination which we address. The signs emit light into the nocturnal environment, potentially including residential and natural areas and the sky; they consume large amounts of electricity; their presence can affect public safety, most commonly by distracting drivers (which, after all, is the signs' precise intent and purpose). To understand these issues, and consider ordinances which should regulate the placement and operation of these signs, we need to understand the details of how the various effects are measured. Unfortunately, this is not common knowledge; state and local managers may not be familiar with principles and metrics which apply. Our intent in this paper is to provide some practical definitions, and cite sensible, logical and defensible levels of regulation.

**LUMINANCE**

Luminance is a measure of the perceived brightness of a surface. This differs from *illuminance*, which is a measure of the amount of light falling onto a surface. Luminance is a key measurement when analyzing surfaces which emit light, like a computer or television screen, or a digital billboard. Luminance, with this sort of light-emitting device, is controlled by the settings of the device itself. Illuminance is what allows us to see items which don’t emit light; light (illumination) coming from other sources reflects off the object, rendering it visible to us; illuminance is determined by the brightness and location of the external light source(s). But any object which we can see has a specific level of surface brightness or luminance. A computer screen turned up to high brightness puts out more light per square inch of its surface than when it is set to low; a piece of paper in the full sun reflects more light per square inch than one in candlelight. The two billboards in the photo above each present a certain surface brightness to the observer’s eye, whether they emit light like the digital one on the left, or reflect light like the "static" one on the right.

*Illuminance* (illumination) is usually measured in units of foot-candles or lux; *luminance* (surface brightness) is most often measured in *nits* or *candelas per square meter* (cd/m²), which are equivalent. (For further discussion of these units or any other technical terms used in this paper, see our website’s *Encyclopedia of Terms* page.)

Luminance plays a critical role in how a sign like a billboard interacts with the environment around it. During the daytime, a static billboard lit by the natural daylight
will appear to the eye to have a brightness which "fits in" with its surroundings; it will not cause excessive distraction because of an unusual level of luminance. (Perception studies show that having something in our field of vision which is either much brighter or darker than its surroundings causes an involuntarily shift of our vision to the object.) A digital sign which is set to a luminance level higher than that of the other objects around it, which are lit by daylight alone, can potentially draw a driver's eyes to the sign when they need to be looking elsewhere to safely operate their vehicle; levels can even be so high as to cause vision-disturbing glare.

The luminance level which a digital sign needs to be set at to be visible in the daylight is far above that needed at dusk or night. This effect can be seen with other luminous displays, such as on cellphones and laptop computers; brightness levels which seem high indoors are totally inadequate outside in the much brighter direct sunlight. The eye of the driver at night compensates for lower light levels by becoming more sensitive to light; it is even more easily distracted, dazzled, and even disabled by an overly luminous object than the daytime eye is.

SAFE AND SENSIBLE LIMITS FOR LUMINANCE

While an advertiser's desire might be to draw everyone's attention, for as long as possible, in the most potent methods possible, logic dictates that it is not in our best interest to have people who are at the moment operating motor vehicles (and hopefully practicing defensive driving, monitoring all the other vehicles and activity around, ahead, and behind their vehicle) be inordinately distracted from that task by advertising or anything else not related to safe driving. While this goal does not in itself dictate specific limits to the luminance level of electronic signs, it suggests a logical course for deriving such limits.

For daylight hours, the maximum luminance level for digital signage should be similar to what the luminance of an identical sign would be if it was printed out and installed on a static billboard. In other words, the digital sign would appear no brighter, no more intense, that the printed sign next to it, or the landscape surrounding it. In practice, setting a limit of 5000 nits (setting the sign's intensity so that an area on it displaying full-brightness white has no higher luminance than that figure) ends up delivering a surface brightness similar to landscape illuminated by sunlight.

At dusk and nighttime, a logical conclusion would be that new digital billboards do not need to operate at higher surface brightness than the static ones which they are replacing. The outdoor advertising industry has not, for decades, been telling its customers that their nighttime advertising is ineffective; quite the contrary. So, what could be the rationale for setting nighttime luminance limits which are higher than the brightness of the existing static signs? However, if such limits are not set, it seems that the advertising industry will be pushing the envelope out further and further, increasing the distractive effects of the digital signs, the potential disruption of visual perception, and the flooding of the surrounding neighborhoods with excess light.
The single photograph in the frame above, taken May 24, 2010, shows two adjacent billboards; the one in back (left) a static sign, lit from below by metal halide luminaires, which obviously has a lower surface brightness that the one in front (right), which is digital.

From independent surveys of static billboards, we have a good summary of levels of surface brightness that those signs are currently commonly operated at. A 2009 survey of static billboards in Arizona found that, out of 565 measured, 98% had a luminance of less than 150 nits, and 83% measured below 100 nits. A smaller 2008 survey in New York State found an average nighttime luminance of 124 nits for static billboards.

The IESNA Lighting Handbook recommends for “illuminated billboards and other large advertising panels”, illuminating such signs at night with 1000 lux in bright locations, and 500 lux for ones in dark surroundings. Assuming that a static billboard has a white face with a reflectance of 0.8, the luminance of such a billboard would be 250 nits in the setting (1000 lux) for brightly illuminated surroundings, and 125 nits in the low-light setting (500 lux illumination). Many digital billboards are mounted on tall masts, above the driver/viewer, so they appear to "hang in the sky"; at night, this would place them against that dark background, making the darker-surroundings setting appropriate.

**MEASURING LUMINANCE**

The Outdoor Advertising Association of America (the trade group of the billboard industry) hired Dr. Ian Lewin, CEO of Lighting Sciences, Inc. to write a report on "Digital Billboard Recommendations and Comparisons to Conventional Billboards". The report proposes both a set of sign brightness limits, and a methodology for estimating sign brightness. The report is widely cited by the billboard industry as the be-all, end-all of expert opinion on the matter of sign brightness and safety, but we find it to be notably flawed in several aspects.

Luminance can be directly measured with a special instrument called a luminance meter. It works much like a camera, focusing on the surface which one is determining the brightness of, and measuring that surface's light output per angular degree of area. Lewin suggests that these meters, which may cost several thousand dollars, are too expensive for local sign installers and regulators to obtain. Therefore, instead of direct measurement with a luminance meter (like the one shown on the right),
he suggests obtaining an approximate measurement by using a more common, generally less expensive *illuminance* light meter (as shown below). While the cost savings suggestion is laudable, the proposed indirect method contains several flaws when applied to real-world situations, leaving it, in our opinion, too lacking to use anywhere outside of the theoretical laboratory. Lewin's method involves positioning the observer with the light meter a known distance in front of the sign in question, and taking one measurement of all the light falling on the light meter while the sign is illuminated, and another reading while the sign is turned off. The difference between the two measurements should be the contribution of illuminance from the sign, and if you know the exact overall size of the sign, and just how far from the sign the measurements were taken, you can compute the approximate average surface brightness of the sign.

With a luminance meter, surface brightness can be measured from any (unspecified) distance, as long as the surface to be measured fills the field of view of the meter. With the indirect method, you need to know the distance precisely, and to use Lewin's "easy" table of calculation, the distance has to be a pre-set value, like 200 or 250 feet. In the real world, billboards are often located in hard to reach spots; 200’ in front might be a private property, a highway, a pond, etc. To measure the distance in most situations, a tape measure would not be practical; either a laser rangefinder or a precise GPS unit would be needed; purchasing that equipment would notably reduce the cost difference between the luminance and illuminance meters.

With the luminance meter, the brightness measurement can be taken in any condition of ambient light -- bright or cloudy day, dusk, or night. With the illuminance method, daytime light levels will overpower the light readings; separating out the contribution from the sign will be next to impossible to do to any level of accuracy. Finding this flaw in Lewin's proposal is not surprising, because he does not address the subject of limiting luminance during the daylight hours. When discussing digital billboard technology, this is a glaring omission (no pun intended). Current production models of LED displays can achieve surface brightness of over 13,000 nits\(^4\); this is intensely bright in the daylight, especially on overcast days. (As a comparison, the bright blue daytime sky ranges from around 5,000 to 7,000 nits in luminance.) We need to set limits for daytime sign luminance, too, and to be able to measure that performance.

With the luminance meter, the apparent surface brightness can be measured at any angle; this includes taking measurements directly from whatever areas of roadway where the sign will be in view. If the Lewin measurement is taken from the ground in front of the sign, that will often place the observer notably below the sign (billboards along roadways often being mounted high off the ground, especially those installed along elevated highways). The light emanating from digital billboards is somewhat directional; it is notably more intense along an axis extending out perpendicularly from the sign's face, and drops off in intensity as the angle away from that axis increases. The observer at ground level, often 30 feet or more below the lower edge of sign, will not be intercepting the most intense output of light.
The Lewin method requires manipulating the sign display, to take one reading with the sign on, and one with it off. This precludes the ability to independently measure sign luminance for code enforcement, because the sign operators will be choosing the luminance settings during the test. With a luminance meter, any sign can be checked for compliance at any time, without requiring the involvement of the sign owner/operator.

**LIGHT TRESPASS**

Light trespass is an issue related to the luminance of a light source, but it is generally measured in a different way. Instead of considering the surface brightness of the source (which needs to be regulated separately, as described above), trespass is looked at in terms of the level of illumination (illuminance) which the light source on one property shines onto another property. So for this value, we do look at foot-candles (or lux) of illuminance, generally at the property line of the property being trespassed upon; we do measure it directly with the illuminance light meter. (Illuminance trespass can also be calculated during engineering with computer modeling, by inputting the light output levels and pattern of the light source(s), and the physical layout of the properties involved.)

In his paper, Lewin uses the term "light trespass," but not in the way which it has normally been addressed in outdoor lighting regulation. He posits a set of distances away from the billboards at which to measure illuminance levels, rather than using the fairly standardized concept of property boundaries. His measurement points (at as far as 350' from the sign) might end up being on the same parcel which the sign in question is located on, or the next one over, or one beyond that. This points out a major difference between sign illumination and most other outdoor illumination; the later generally serves the purpose of illuminating the property it is installed on; the former (signs) are often intended expressly to illuminate (be seen from) adjoining properties, or across entire neighborhoods.

So, comparing the Lewin proposal for limiting "trespass" to the traditional concept of limiting light trespass is difficult. He arrives (through, I might add, what seems to be an elaborate use of cherry-picked logic) at a figure of 0.3 foot-candles as his recommended limit for nighttime trespass at his table of random distances out in front of various billboard sizes. This shouldn't be mistakenly equated with the location of a neighboring property; if there was 0.3 f.c. at 350', but a house was only 175' away, the trespass level to that house would be four times higher.

Trespass should be measured to property lines. Admittedly, this puts billboards at a disadvantage; it is not uncommon for them to be located on parcels which are barely larger than the footprint of the signs themselves. But why should they be allowed to light up adjacent properties any more than any other form of artificial illumination?

Some municipalities, townships, counties and states have light trespass regulations. For trespass on to properties with any residential class of zoning, a limit of 0.1 foot-candles is not uncommon. In Illinois, some jurisdictions which have the 0.1 f.c. limit include Barrington Hills, Crystal Lake, Elk Grove, Homer Glen, Mt. Prospect, Mt. Vernon, Naperville, Palatine, Park Ridge, Springfield, Urbana, and even Scott Air Force Base.
MOTION & DISTRACTION

Digital signs have the ability to display anything which a television or computer monitor can, including "moving images". It is obvious that a Panavision movie playing along side a highway would constitute a grossly unsafe distraction hazard for vehicle operators. The Outdoor Advertising Association of America has accepted that concept, and in its Code of Industry Practice now states that full-sized billboards should not feature animation, flashing lights, scrolling, or full-motion video. This self-imposed code of conduct is laudable, but is missing (at least) two key points.

First, they limit their suggestion to not use moving images to full-sized billboards only. It is fine with them if "street-sized" signs along the roadways in our busy towns and cities feature any sort of animation or television-like video. Apparently, they believe that roadway accidents caused by distraction only occur on highways.

Second, when one image changes to another on a sign within a person's field of view, the viewer's visual system perceives that change as motion, even though the two images themselves were "static." (This is how motion pictures operate; they present the viewer a series of static images, and the mind "sees" motion.) If there is one sign ahead of us, and it turns into another, what we perceive is a flash, and/or movement. So, paradoxically, the billboard companies say they won't operate flashing or moving billboards, but they cannot avoid those effects if they change the displayed images while we are watching. They also display ads which continue on multiple "frames," encouraging the viewer to stare at the sign for a prolonged time to see the next installment.

OTHER REAL-WORLD CONCERNS

In addressing the issue of sky glow (the "light pollution" which emptied the nighttime sky of most of its stars over our towns and cities over the past few decades), Lewin notes that most digital billboard units feature a set of louvers which limit the amount of light they project upwards. In reality, those louvers are installed to shade the light-emitting diodes from sunlight, to increase the contrast of the signs during the day and reduce solar heating. But, they do reduce the amount of light shining "up."

However, the light projection at lower angles above the horizontal is not impeded by the louvers. As described in the seminal paper "Lighting and Astronomy" by Luginbuhl, Walker & Wainscoat, light emitted between the horizontal and just 20° above it contributes much more to skyglow than light emitted at higher angles, and that low-angle light's effects are visible over a much broader area. So, the sunshade louvers built into many digital signs do little to minimize their impact on the night sky.

The outdoor advertisers like to point out some studies (most of which they commissioned) which show negligible traffic safety problems related to existing digital signage. But this is new technology; we don't have enough real-world data to make accurate judgments yet. There are vast numbers of billboards in the U.S. (the OAAA estimates 450,000), and only a tiny fraction have been converted to digital. Short-term analysis of that small percentage will not address the safety effect that large-scale, long
term installation will have. Picture an Illinois highway which already has a bewildering
display of billboards, like stretches of I-294 and I-55 near Chicago, with all of those
signs converted to digital, changing displays. Now picture it with all those displays
turned up to excessive brightness. Many of us can discern that such a situation would
pose increased driving hazards, without the need for a study, or for the accidents,
injuries and fatalities which might occur during the study period.

The big "selling point" which the outdoor advertising companies use is that the digital
signs may be used for posting Amber Alerts in real-time. This is a genuine public
service, and is lauded by many in law enforcement. However, operating roadside signs
every day and night at levels of brightness which makes them too highly distracting
could negate the public safety positives of Amber Alerts by increasing everyone's risk of
accident and injury in the vicinity.

We have heard some people suggest that there are other distraction hazards on the
roads which pose greater dangers, like drivers talking on cell phones, text messaging,
eating, reading, etc. Yes, those are obvious real hazards. But their existence does not
somehow make it logical that we should add even more distractions on the roadways of
this country. Over thirty thousand people die each year here in traffic accidents; this is a
horrible epidemic, and we need to be figuring out how to combat it, rather than
shrugging off safety concerns.

In the real world, once digital billboards are installed, most local regulatory agencies will
find it virtually impossible to ever remove them. If they were allowed by existing
regulations (or lack thereof) to be installed, even removal called for by a change in
those regulations will generally require condemnation procedures to be instituted; that
will entail the governmental body purchasing each offending sign from its owner. At a
quarter to a half of a million dollars per sign, this cost is not affordable to most local
governments, no matter how objectionable they or the citizens of the area have found
the signs to end up being, how the land usage in the areas around the signs has
changed over time, or if signs need to be removed because of road widening or other
civic projects.

SUMMARY

Our organization is not "anti-billboards". We believe that the residents of each
jurisdiction should decide what sort of outdoor advertising should be allowable in their
neighborhoods.

We are also not beholden in any way to the outdoor advertising industry, or any related
trades; we accept no contributions of any sort from these industries. Nor does our
organization or any of its board members stand to gain or lose anything of monetary
value based on the successes or failures of the outdoor advertising industry.

Our charter, as explained elsewhere across this website, is to speak as independent
advocates for safe, environmentally responsible outdoor illumination practices, including
a focused look at energy conservation. Filling that charter, we have studied the potential
real-world ramifications of digital sign technology, including a focus on practical
engineering (rather than vague theory) and on precedents which can be derived from other, well-established technology. Our recommendations for ordinances to govern the installation and operation of digital signage include the following:

- All digital signage visible from roadways (not just billboard-sized signs) should only be allowed to display non-animated images, and each image must be displayed ("dwell") for a minimum of ten seconds. Longer delay times should be set by local regulation as is needed in specific installations where distraction hazards are especially high.

- All self-luminous outdoor signs should be subject to surface luminosity limits, both during the daytime and nighttime hours. During the daytime, based on normal daylight illumination, a maximum limit of 5,000 nits will keep luminous signage balanced with the surrounding landscape. During the nighttime hours, a luminosity limit of 150 nits will provide a surface brightness for digital signs which is comparable to the nighttime signage which is widespread across this nation, and is in line with the sign illumination level recommendations of the Illuminating Engineering Society of North America (IESNA). If the nighttime luminance setting and limit is based on the sign in question being set to display full white, full brightness field, a limit as high as 200 nits for this method of calibration and testing is suitable. Incremental luminance limits between the nighttime limit and the full sunlight limit may also be specified for overcast or foggy days, or for dusk; or regulations may require an automatic control of sign luminance based on the ambient lighting condition, to throttle the sign luminance between the sunny-day and night maximums.

- Surface luminosity measurements should be made directly with a calibrated luminosity meter, following the instrument manufacturer's instructions. Readings should be taken from the area (generally of roadway) where the sign in question will be visible from, and which is closest to being directly in front of the sign (where the luminosity output is most focused).

- Outdoor signage should obey light trespass regulations. Into areas zoned for any type of residential occupation (including parks and preserves so zoned), a trespass limit of 0.1 foot-candles should be enforced, at the property line.

Considering the effect which large-scale outdoor signage may have on property values and quality of life issues, regulatory bodies should require public notification and allow public comment when sign permits are applied for, including requests to convert existing static billboards to digital.

Currently, some outdoor advertising companies are offering local regulators a "swap-out plan", where they will remove more than one square foot of existing static billboards for each square foot of replacement digital billboard. From an environmental perspective, such an overall reduction in illuminated signage could be an advance. But that only true if the new signage is no brighter, per square foot, than what it is replacing! Without regulation to enforce those operating parameters, digital signage may generate
negative environmental and safety impacts many orders of magnitude worse than the old signage it is poised to replace.

**UPDATES:**

Since this article was written, some good additional resources have become available. The article "Digital Signage and Philadelphia’s Green Future" by Gregory Young provides an excellent overview of digital signage, and focuses in depth on the substantial energy consumption by such signs -- tens of times larger than that of conventionally illuminated "static" signs.

An initial draft of the study "Digital LED Billboard Luminance Recommendations: How Bright Is Bright Enough?" by Luginbuhl, Israel, Scowen, Polakis & Polakis has been made available here for distribution; it covers many of the same issues addressed in this article, and includes substantial real-world measurement of existing sign illumination to provide a baseline in the discussion of brightness needs and limits.

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1 "Evaluation of Billboard Sign Luminances", Lighting Research Center, Rensselaer Polytechnic Institute, March, 2008  
4 “P20 Outdoor Full Color LED Display”, Shenzhen Only Optoelectronic Technology Co., Ltd. website, June, 2011  
From: Ken Hixon <kenhixon@pacbell.net>
Date: Tue, Oct 14, 2014 at 4:30 PM
Subject: Case Number: ENV-2013-1531 EIR - Academy Museum DEIR comment
To: luciralia.ibarra@lacity.org

Ms. Ibarra,

Attached below is a PDF containing my comments on the Academy Museum DEIR.

Thank you,

Ken

Ken Hixon
kenhixon@pacbell.net
323-935-7227

--
Luciralia Ibarra
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14 October 2014

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Re: Case Number: ENV-2013-1531 EIR  
Academy Museum DEIR  

Dear Ms. Ibarra,

The following are my comments on the Academy Museum Draft Environmental Impact Report. Although I am a Vice President of the Miracle Mile Residential Association, I offer these comments as an individual and a resident of the Miracle Mile for the past 28 years.

Film Premieres and Special Events.

The project includes three theaters with a combined seating capacity of up to approximately 1,350 persons: the 1,000-seat “Sphere” housing a state-of-the-art theater with a full stage and orchestra pit, as well as two other smaller theaters with a combined capacity of 350 persons.

As stated in the DEIR, the primary purpose and objective of the project is “...providing film screening and premieres in a state-of-the-art theater competitive with venues in size and amenities.” It is reasonable to assume that this statement refers to such prominent and active venues as the Chinese Theater, the El Captain, and the Cinerama Dome – and that the project intends to compete with these popular venues for major film premieres.

Throughout the DEIR an assortment of references are made to a broad variety of events that would take place at the project site, including: film premieres, Academy member and public film screenings, traveling shows, concerts, performances, cultural programing, spoken word productions, classes, video and press events, and film festivals – and that the attendance at these programs is anticipated to range for 100 to 1,325 attendees (not including staff).

The DEIR states that it is the intention of the Academy Museum to lease out these theaters for third-party purposes. Specific mention is made that the project is intended to “Provide for revenue-generating events that support sustainable
Museum operations, including but not limited to lease events such as movie premieres, film festivals, and occasional late night screenings, in a variety of locations on the Museum campus.”

In the DEIR [PDF-LIGHT-2; Special Event Lighting] mention is also made of HDTV (High Definition Television) broadcast of events – this obviously infers that the project and, specifically, its Piazza and Sphere theater would be built to accommodate the technical requirements of digital television production.

The passage below is from the DEIR and provides specific details about premiere screenings:

(3) Premiere Screenings

The Academy proposes to lease out the Main Theater and possibly the two smaller theaters for premiere screenings (“Premiere Screenings”) and other special events. These would be ticketed, invitation-only events for up to 1,350 attendees. Such events could be accompanied by a pre-event or post-event reception or seated dinner service for up to 1,000 attendees, to be held on-site within the ground-level Museum lobby and exhibit space. Special Event Dining Room, Rooftop Terrace, or the View Deck within the Sphere. Premiere Screenings may require up to approximately 200 additional support staff including security personnel, caterers, and Academy event planning and public relations staff, and custodians; lease events may require other support staff or vendors.

Approximately two Premiere Screenings or special events per week are anticipated throughout the year; Premiere Screenings would typically take place Monday, Tuesday, or Wednesday. As with Member Screenings, the majority of Premiere Screenings or special lease events would take place outside of normal Museum hours of operation, and Museum hours may be curtailed early to accommodate such events. Premiere Screenings and special lease events would typically have a 7:30 P.M. start time and end by 12:30 A.M., with campus vacation by 1:00 A.M.

The DEIR section below offers details on outdoor programming at the project:

The Project would include outdoor programming (“Outdoor Programming”), including Museum and Academy events. Outdoor Museum Programming may include, but would not be limited to, exhibitions, hands-on student activities, and lectures. Outdoor Academy Programming may include outdoor screenings, concerts, exhibits, or other events during May through October. Outdoor Programming events would take place on the Rooftop Terrace or on the Piazza. The Rooftop Terrace would accommodate up to 800 persons; outdoor events on the Piazza would normally accommodate up to 1,350 attendees, with occasional events with up to 2,500 attendees. The use of amplified sound in conjunction with all Outdoor Programming would conclude by 10:00 P.M. and Outdoor Programming without amplified sound would conclude by 12:30 A.M., with campus vacation completed by 1:00 A.M.

It is very apparent from the DEIR that the project, particularly its “Sphere” theater, is expressly designed and intended to function as a major special event center that will host a broad array of events, including television productions, concerts, plays, film screenings, and other productions. These events will draw many thousands of visitors to the project.

Although, the DEIR does specify that the Academy Museum “anticipates” that its “Sphere” theater will host two movies premieres or special events per week – or
104 events per year – given the tens-of-millions of dollars that the project is investing in its “Sphere” theater; and that it intends to pursue “revenue-generating events that support sustainable Museum operations;” its obvious eagerness to lease this venue to third parties; and the technical capabilities of this venue (which include an orchestra pit); it is logical to conclude that the “Sphere” will host far more than 104 special events per year. In fact, it could easily host the taping of television shows, live concerts, musical and theatrical performances, as well as film screenings. It is reasonable to assume that the project will be heavily promoted as a “for lease” special event venue – and that the total number of these special events could far exceed 104 per year.

Given the very late closing time of the project (1 AM and, on occasion, 3 AM) – and the large number of people that would be attracted to such major events – the negative impact of such a large number of “special events” on surrounding residential areas would be exponential.

Simply put, the DEIR underestimates the number of special events that would occur at the project site – particularly at its “Sphere” theater – in order to conceal its true impact on the community. The so-called “anticipated” two special events per week predicted in the DEIR is an obvious underestimation of the potential number of special events at the project.

Because the applicant neither places a limit on the number of special events per year nor indicates the maximum number of special events that the project could accommodate on an annual basis, the DEIR is inadequate and insufficient in that it prevents the public from measuring the full impact of the project on the surrounding communities.

**Special Event Coordination with Neighboring Museums.**

Although the DEIR touts that the project will devise a means of coordinating the planning of special events with the Los Angeles County Museum of Art [LACMA] to mitigate noise and traffic impacts. The terms of this coordination plan are not detailed in the DEIR and, hence, cannot be evaluated by the public. Absent the details of such a plan – and a means to enforce it – there will be no recourse for the community should this promised plan be inadequate or fail. Hence, this plan is not a CEQA mitigation and the DEIR is inadequate and insufficient in this aspect.

Also, the DEIR makes no mention of devising a similar plan of coordinating the planning of special events with the Petersen Automotive Museum, which is located on Wilshire Boulevard, directly across from the project site. Like the project, the Petersen frequently hosts special events and has a rooftop terrace where museum-related and leased events are held with amplified live or recorded music (events that are a frequent source of noise complaints from surrounding residents). The negative impact of uncoordinated special events at the Petersen and the project is not identified in the DEIR. CEQA requires that all negative
impacts from a proposed project by identified and mitigated. The absence of special events coordination plan between the project and the Petersen Museum would allow for unmitigated noise and traffic impacts. Hence, the DEIR is inadequate and insufficient.

**Noise.**

The following is quoted from the DEIR:

*Impact Statement NOISE-5: Project parking activities would not substantially increase existing noise levels at adjacent noise-sensitive receptors in the Project area. Therefore, impacts in this regard would be less than significant.*

The project proposes to utilize leased off-site parking for visitors in subterranean garages located in office buildings at 6100 Wilshire Boulevard and at 5900 Wilshire. The project will especially depend on these two off-site parking resources for nighttime special events – events that the DEIR acknowledges will not conclude until as late as 1 AM and, on occasion, 3 AM.

The motor court entrance to the garage at 6100 Wilshire Boulevard abuts an apartment building on Wilshire to the west and single-family homes on Warner Drive to the south. These adjacent homes and apartment building are noise-sensitive receptors. According to the DEIR, nighttime ambient noise levels were not measured at these locations and, hence, the noise impact of project parking activities at 6100 Wilshire Boulevard cannot be determined. Thus, *Impact Statement NOISE-5* is inaccurate and the DEIR is inadequate and insufficient.

There are two entrances/exits to the underground garage located at 5900 Wilshire: one on South Spaulding Avenue, a densely populated residential street, and the other on South Genesee Avenue, which is also a densely populated residential street – that includes a large low-income senior citizen apartment building. The multifamily residences on Spaulding and Genesee are noise-sensitive receptors. According to the DEIR, nighttime ambient noise levels were not measured at these locations and, hence, the noise impact of project parking activities at 5900 Wilshire Boulevard cannot be determined. Thus, *Impact Statement NOISE-5* is inaccurate and the DEIR is inadequate and insufficient.

**Digital Sign District.**

No mention of a “Sign District” was made in the initial report on this project. Hence, the public had no opportunity to submit comments or questions via scoping letters and then receive additional information or answers in the DEIR. The initial report should have been revised to include this significant change to the project and recirculated prior to the commencement of the DEIR. This is an error on the applicant’s part.
The digital signs and super-graphics proposed by the applicant would be a flagrant violation the *Miracle Mile Design Overlay Guidelines*. The CDO expressly prohibits moving, scrolling, and animated digital signs.

The applicant is attempting an “end run” around the provisions of the CDO by seeking to create a Sign District – but that too is illegal in that *per LAMC 13.11 C* a Sign District, as a Supplemental Use District, is prohibited from supplanting an existing Supplemental Use District, in this case the Miracle Mile CDO.

The DEIR does not address this conflict between Supplemental Use Districts in regards to the proposed Sign District versus an existing CDO, nor does it cite language from the Miracle Mile CDO prohibiting moving, scrolling, and animated digital signs. Hence, the DEIR purposely creates a mistaken and misleading impression on the public that the proposed Sign District would conform to existing ordinances, codes, and guidelines.

The proposed Sign District would also comprise the historic façade of the former May Company and potentially jeopardize aspects of its status as a landmark property. Altering, modifying, or obscuring the famous “perfume bottle” corner of the building to allow for the installation of a large “Oscar” shaped sign or emblem would also compromise its landmark status and/or historical designation(s).

The glare and distraction from the proposed digital signs and well-lit super-graphics would pose a grave safety risk to pedestrians, cyclists, and motorists.

The omission of any reference to *LAMC 13.11 C* and the fact that no mention of the Sign District was made in the initial project report are substantial flaws, hence, this DEIR is inadequate and insufficient.

**Conclusion.**

This DEIR is flawed, vague, inaccurate, and incomplete. The DEIR, as presently constituted, frustrates the ability of the public to fully understand all of the impact of the proposed project. **Hence, this DEIR is inadequate and insufficient. It must be corrected and recirculated to properly allow for public comment.**

Sincerely yours,

Ken Hixon

745 South Genesee Ave.
Los Angeles, CA 90036
kenhixon@pacbell.net
From: Evan Kaizer <ejkaizer@sieroty.com>
Date: Tue, Oct 14, 2014 at 2:34 PM
Subject: Academy Museum of Motion Pictures Project
To: luciralia.ibarra@lacity.org

Draft Environmental Impact Report (DEIR)
Case Number: ENV-2013-1531-EIR

Dear Ms. Ibarra,

The Sieroty Company Inc / Eastern Columbia Properties LP has a proud tradition of being in business over 100 years in Los Angeles. We have been a property owner and active community member in the Miracle Mile since 1935. The Sieroty Company / Eastern Columbia Properties began as a clothing and outfitting enterprise and transitioned from retail to become a real estate business over 50 years ago.

The Miracle Mile has undergone changes as well, transitioning from a retail district to the cultural and office workforce destination it is today. It’s one of the premier regional centers of Los Angeles, a city without a traditional single hub. Los Angeles is dependent on these regional centers to flourish. This Miracle Mile Center -- with the advent of The Purple Line will give residents and and the workforce needed mobility to move from one city center to another. There is one thing that we know for sure: The Miracle Mile will continue to evolve into an even more dynamic place than it is today. There can be no doubt that the Academy Museum of Motion Pictures will have a positive and dramatic impact on this neighborhood.

The proposed Academy Museum will join LACMA and other cultural institutions to become a visible and important flagship of the new Miracle Mile. It will bring new residents, new businesses and new visitors. Although CHANGE is hard for some, Los Angeles is a city in constant change. The Academy’s project needs to be embraced. With it, we will add new street life and create another architecturally important structure.
The May Company building is beautiful but has not been expertly maintained. Even since the Academy took over the space and began exhibiting, the building has been partially reborn. This process needs to be supported. Fairfax and Wilshire is truly one of Los Angeles' foremost intersections. The Academy's project is spot on to bring our neighborhood a true win-win. We get a fabulously important museum and worldwide draw -- thus further "selling" our great city, and the Academy; continues to wow, educate and entertain everyone who loves movies. And suffice it to say, with the Academy's efforts, a tired building can regain its rightful place as a true Icon of our City.

I commend the Academy for their effort in renovating and recreating this space. We support their commitment to the Miracle Mile.

Sincerely,

Evan Kaizer

Evan J. Kaizer
President & CEO
Sieroty Company Inc.
323-931-6022

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Please consider the environment before printing this e-mail.

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Luciralia Ibarra
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Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
Dear Ms. Ibarra,

I hope you are well. I am concerned about the future of the May Co. building. I am writing to share feedback on the signage component of the DEIR for the Academy Museum project in the Historic-Cultural Monument May Company Building (Case Number: ENV-2013-1531-EIR).

I am very concerned about the massive, unusual and obtrusive digital signage proposed for the exterior of the building. While I am OK with the outline of the Oscar logo, I am not OK about the illuminated five-story supergraphic signs on three of the building’s corners and the filling of its window bays.

Since 1939, the Streamline Moderne May Company building has stood at attention at the Western end of the Miracle Mile, a sculptural masterpiece of glittering gold and elegant black and white horizontals. It is a work of art. To wrap it so completely in digital signage would serve to make an Historic Cultural Monument nothing more than the armature for a billboard. This is an inappropriate and insensitive proposal that the Department of City Planning must discourage. The Academy Museum should use unobtrusive printed signage that does not overwhelm or architecturally transform its landmark building.

I beg you to preserve the beautiful architectural vista at Wilshire and Fairfax for the benefit of future generations of Angelenos and all lovers of the Streamline Moderne.

Thank you for your consideration, and best regards,
Laura Katz
From: Harrison Trust <harrisontrustlahs@gmail.com>
Date: Tue, Oct 14, 2014 at 11:49 AM
Subject: Academy of Motion Picture Museum
To: luciralia.ibarra@lacity.org

Attached please find my letter in support of the museum. Thank you for the opportunity to provide one.

--

Joyce Kleifield
Executive Director
Alice G. Harrison Memorial Trust
Los Angeles Senior High School
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City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
October 14, 2014

Luciralia Ibarra
Environmental Analysis Section
Department of City Planning
200 N. Spring Street, Room 750
Los Angeles, CA 90012
Email: luciralia.ibarra@lacity.org

Dear Ms. Ibarra:

As both a resident of the area and an advocate for the arts in public education I am compelled to write a letter in support of the proposed Academy Museum. Since its inception, the film industry has been synonymous with the city of Los Angeles. Yet there has been no outstanding museum here dedicated to preserving, presenting, and celebrating the art of filmmaking.

While the Academy Museum will provide for visitors to Los Angeles, it will also be a place for young Angelenos to learn about the main industry their city calls home, and to become creatively inspired. Unfortunately, many of the arts programs in LAUSD schools are underserved because of budget cuts. I see the new museum as a catalyst of inspiration for the next generation of actors, directors, costume designers, editors, cinematographers, and graphic artists.

The Academy has a strong track record demonstrating a commitment to educating and inspiring our youth. The amazing museum to be built at Wilshire and Fairfax will be a landmark educational tool for young Angelenos, and I hope you will join me in supporting their project.

Warmest regards,

Joyce Kleifield
Executive Director
The Harrison Trust
Los Angeles High School
From: Ivan Light <President@carthaycircle.org>
Date: Tue, Oct 14, 2014 at 11:41 AM
Subject: Academy Museum of Motion Pictures -- Case Number: ENV-2013-1531 EIR
To: Luciralia Ibarra <luciralia.ibarra@lacity.org>
Cc: Councilmember Paul Koretz <Paul.Koretz@lacity.org>, John Darnell <john.darnell@lacity.org>, James O'Sullivan <jamesos@aol.com>, Scott Epstein <sepstein@midcitywest.org>

Dear Ms. Ibarra:

Attached is the letter of the Carthay Circle Neighborhood Association commenting on the above referenced case.

Please send me a return email acknowledging its receipt.

Sincerely,

Ivan Light

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Ivan Light
President, Carthay Circle Neighborhood Association
6230 Wilshire Blvd. PMB 1153
Los Angeles, CA 90048
www.carthaycircle.org
Email: President@carthaycircle.org
Telephone: 323-939-9694

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Los Angeles, CA 90048
www.carthaycircle.org
October 14, 2014

Luciralia Ibarra
City of Los Angeles Department of City Planning
200 North Spring Street, Room 750
Los Angeles, CA 90012
Fax: (213) 978-1343
E-mail: luciralia.ibarra@lapd.org

Re: Case Number: ENV-2013-1531 EIR
___ Academy Museum of Motion Pictures (the “Project”)

Dear Ms. Ibarra:

The purpose of this letter is to express the serious concern of the Carthay Circle Neighborhood Association that if the Project is implemented as proposed it will have a material adverse impact on our neighborhood with respect to parking, traffic, light and glare, noise and overall quality of life.

The Carthay Circle neighborhood extends from the west side of Fairfax Boulevard to the west side of Schumacher Drive and from the north side of Olympic Boulevard to the north side of Warner Drive. It is an historic community dating from the 1920’s consisting mostly of owner occupied single family residences but also includes one and two story multi-family residences. The character of the neighborhood is strictly protected by being designated as an Historic Preservation Overlay Zone.

We incorporate by reference the submission made this date to you by the Miracle Mile Residential Association (the “MMRA Submission”) which discusses in detail the flaws, omissions, inconsistencies and inaccuracies in the Draft Environmental Impact Report for the Project (the “DEIR”) and requests that it be corrected and recirculated to allow for public comment. The Carthay Circle Neighborhood Association believes that the MMRA submission accurately and correctly points out the deficiencies in the DEIR and concurs with the views
expressed in the MMRA Submission and its conclusion that the DEIR needs to be corrected and recirculated to allow for public comment.

In addition, as set forth below, in the view of the Carthay Circle Neighborhood Association, the DEIR has failed to adequately address the impact of the Project on the Carthay Circle neighborhood and in particular on each individual street in the Carthay Circle neighborhood west of Fairfax Boulevard and South of Wilshire:

(1) Warner Drive, Del Valle Drive, Barrows Drive and San Vicente are in close proximity to the Project, and currently have no restricted parking at night or during weekends. They are the only residential streets—in any direction—adjacent to the Project that provide the opportunity for free parking. Yet no study was made of the impact that the Project would have on these streets.

(2) Although 8th Street is designated a “collector” street in the DEIR, Del Valle Drive was not discussed even though Del Valle feeds directly into 8th street and has a light at Fairfax making it a “collector” for traffic going to the Project and to parking areas east of Fairfax. This omission is most glaring, since Del Valle also has been designated as an alternate route by Los Angeles Fire Department for use by emergency vehicles.

(3) In light of the severe congestion that exists on all the major routes to the Project we believe the conclusion of the DEIR that drivers will not use every alternative route possible through the Carthay Circle community is patently unrealistic. With Google Maps, Waze and similar electronic traffic monitoring apps at their disposal, motorists will for sure cut-through our neighborhood streets seeking to avoid the gridlock that exists on the major routes. This is happening now without the Project — with the Project it will overwhelm our neighborhood.

(4) Our neighborhood streets south of San Vicente, including Commodore Sloat Drive, Hayes Drive, Moore Drive, Schumacher Drive and Foster Drive also currently have no restricted parking at night or during weekends and provide the opportunity for free parking, for tour buses and limousines to congregate and idle and for drivers to cut through seeking to avoid the heavily congested main streets leading to the Project. Yet no study was made of the impact that the Project would have on these streets.

(5) Currently, Fairfax Boulevard going north and south between Olympic and Wilshire Boulevards is horrendously congested at almost all times of the day. With thousands of more daily vehicle trips going to and from the Project and the increase in vehicle trips resulting from the building of the new Shalhevet campus and the new residential/retail development on the east side of Fairfax, north of Olympic, it is inevitable that the Carthay Circle streets will be used to avoid the gridlock on Fairfax and Wilshire, with North-South streets such as Crescent Heights (Carrillo), Foster Drive and Schumacher Drive inevitably experiencing a very large increase in traffic. Yet no study was made of the impact of the Project on these streets.

(6) We strongly oppose permitting the creation of a Digital Sign District that would allow for the installation of digital signs and super graphics in connection with the Project. Electronic displays with scrolling, flashing and moving images, are incompatible with
character of the surrounding residential neighborhoods as well as the other cultural institutions. To permit this would fundamentally change the character of the area from a cultural center into an extension of the Las Vegas strip.

(7) Noise and light abatement measures must be put in place to insure that the quality of life in the adjacent residential Carthay Circle community will not be adversely impacted by the Project's late night activities. The DEIR does not adequately assure that this will occur.

Furthermore, to permit the Project to be created within an area that has existing, heavily utilized cultural attractions that draw large crowds, that produce substantial traffic congestion and that have existing significant parking difficulties (which will increase further when the Metro station at Wilshire and Orange becomes operative) without requiring that the Project include the construction of a garage that would park hundreds of vehicles is a fundamental error. The Project, when it was proposed for an alternative location in the Hollywood area included the construction of a garage for more than 850 vehicles -- no less is needed for the proposed location at Wilshire and Fairfax.

Because of these deficiencies, the DEIR needs to be corrected and recirculated to allow for public comment. Merely correcting the issues in the DEIR without recirculation would not allow for public comment.

Respectfully submitted,

Dorothy Clark  
Chair, Carthay Circle Motion Picture Museum Committee  
Ivan Light  
President, Carthay Circle Neighborhood Association  
Email: President@carthavcircle.org

Cc: Councilmember Paul Koretz  
John Darnell  
James O'Sullivan  
Scott Epstein
Ms. Ibarra,

Please see attached comment letter from the homeowners and HOA board of 637 S. Fairfax Ave., Los Angeles, CA 90036 regarding:

ENV-2013-1531-EIR
State Clearinghouse Number: 2013051086
Council District: 4
Community Plan Area: Wilshire
Project Location: 6067 Wilshire Boulevard, Los Angeles, CA 90036

Please do not hesitate to contact me if you have any questions.

Regards,

Guy

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Guy Lipa
guylipa@gmail.com
(310) 435-7359

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Luciralia Ibarra
City Planner
Major Projects
10/4/2014

RE: Le Melange HOA Comments on ENV-2013-1531-EIR

ENV-2013-1531-EIR
State Clearinghouse Number: 2013051086
Council District: 4
Community Plan Area: Wilshire
Project Location: 6067 Wilshire Boulevard, Los Angeles, CA 90036

The following are comments from Le Melange Home Owners Association, located at 637 S. Fairfax Ave., Los Angeles, CA 90036, (directly across the street from the site of the proposed Academy Museum of Motion Pictures).
To whom it may concern:

The board representing the homeowners of 637 S. Fairfax Ave., Los Angeles, CA 90036 is enthusiastic about the proposed project and what it represents for the future of our community and neighborhood in the way of investment, neighborhood amenities, and the revitalization of the currently neglected intersection of Wilshire and Fairfax. However, we do have certain concerns we would like to officially voice about the construction process and ongoing operations of the proposed museum.

The EIR summary page states that based on the analysis contained in this DEIR, implantation of the project would result in “significant and unavoidable operational traffic impacts and cumulative construction noise impacts.” Other issues addressed in the Draft EIR include, aesthetics, air quality, cultural resources, geology, soils, hazards and hazardous materials, hydrology and water quality, land use, noise, project construction and operation, public service (police and fire, and transportation and parking) neighborhood intrusion, access, and parking. The board shares these concerns and is looking forward to the mitigation requirements associated with this projects that this DEIR process will produce.

As the most directly adjacent residential neighbor of the proposed project, we do have unique concerns that we feel deserve consideration.

Having lived through the process of construction of Levitating Mass, our building endured significant exposure to construction pollution including dust that made its way into our building through our air-condition systems (HVAC), this dust also caused significant browning of the exterior of the building at a far more accelerated rate than had previously been seen, as well as additional maintenance required for our HVAC systems. The construction also caused significant noise impacts associated with elevated truck trips and general construction related noise.

Current, city ordinance 41.40 LAMC- Construction-Noise, allows construction Monday through Friday from 7:00 AM to 9:00PM and Saturdays and Holidays between 8:00 AM and 6:00 PM, no construction is allowed on Sunday. During Levitating Mass construction the ordinance was almost always adhered to, however, as the nearest adjacent residential community, with many people who regularly work from home and with young children in the building the effects on quality of life were significant. Multiple years of continuous construction noise from 7:00 AM to 9:00 PM with no mitigation represents a significant burden on quality of life of our homeowners, including our ability to work from home and our children’s ability to sleep and study. This is without compounding the construction pollution noise that will come with additional construction at the Petersen Automotive Museum and with the Purple Line Extension.

In addition to noise, dust, traffic, we are also concerned about glare and light pollution based on materials used. In some instances the building is purposed to be approximately 100 ft from homeowner’s bedroom windows and as can be learned from the construction of Disney Hall, materials and exterior lights can have a significant effect on nearby residential.
In conclusion we are supportive of what a project of this kind represents for the future of our neighborhood and community as a whole, but can only support the project if certain mitigations and concerns are addressed:

1. Construction noise
2. Construction pollution
3. Wear and Tear on building (air condition unites, building exterior)
4. Light and glare pollution
5. Traffic mitigation, parking, neighborhood intrusion plans

Sincerely,

The board and homeowners of Le Melange - 637 S. Fairfax Ave., Los Angeles, CA 90036

Please contact Guy Lipa at guylipa@gmail.com or (310) 435-7359 with any comments or concerns.
Dear Ms. Ibarra,

Thank you for the opportunity to comment. My name is Doug Long and I live on Blackburn Avenue, a few short blocks away from the Academy Motion Pictures Museum project. I am writing to express my support for the project as I believe it will bring positive change for the neighborhood. Before I make specific statements on why I support the project, I want to provide a little background on why I live in this area and what I love about it.

Los Angeles is the second largest city in the United States. I live here because I love city life and all it has to offer. My residential neighborhood is a quiet and enjoyable place with a unique character. My street is safe and pleasant, and my neighbors are friendly and welcoming. I also live directly next to the Grove and Farmers Market, a stone’s throw away from the Miracle Mile, and short walking distance to the Beverly Center, Beverly Connection, and the West 3rd Street restaurant corridor. All of these destinations create impacts on the surrounding neighborhoods. A minority of these impacts are negative, without a doubt. What some fail to recognize is that the vast majority of these impacts are positive. While my street is safe, charming, and pleasant, there is no way I would have moved here had my immediate surroundings been other than that. I love the amazing cultural, entertainment, shopping, and dining attractions in the immediate area. While charming and lovable, my neighborhood is not unique in Los Angeles – it’s one of many pristine neighborhoods ideally located directly adjacent to the places that make Los Angeles so amazing.

Just this week I had a good friend visit me from Dallas, TX. He couldn’t get over how incredible the walkability and array of different attractions within my area. We visited museums, restaurants, bars, stores, etc. I was a proud resident to see an out of towner’s reaction to where I live. And it’s all because of all the neighborhood has to offer. His response was "I need to visit more often.” I have friends who live in other less attractive areas of Los Angeles, who tell me how much they want to live where I live. And it’s all because of great things like the Academy Museum project.

The Academy Museum will further expand the amazing offerings on the Miracle Mile as well as in Los Angeles more broadly. Will impacts be created as a result of transforming a little-used building into a world-class
museum? No doubt. No one likes construction and growing pains, and as the traffic study states, trips will be added to the grid. Will the benefit to the surrounding neighborhoods as a result of the new museum far outweigh any negative impacts? Also no doubt. I can’t think of a better place for a movie museum than as an anchor to the cultural center of Los Angeles, the home of the film industry. In the near future, a subway stop directly across from the museum, which will make it one of the easiest places to get to in LA without a car.

The biggest impact I perceive in the area is traffic. This is something not unique to Mid City and the Miracle Mile, and an issue that requires systemic fixes rather than small-minded thinking. I’ve reviewed the traffic study, and was happy to learn that the traffic impacts that will be created are not severe. The vast majority of museum trips occur when traffic is lightest, making any trip additions less impactful on me and my neighbors.

I’m excited to have such a renowned Los Angeles institution and cultural concept as a neighbor – many new residential developments and well as office developments are changing the face of the neighborhood. This has not necessarily been a bad thing, but I’m glad the Academy is building a museum at this site and providing its neighbors with a new iconic building that will compliment and add to the great neighborhood we have.

Sincerely,

Doug

Doug Long
7961 Blackburn Ave
Los Angeles, CA 90048

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Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
From: Miracle Mile Chamber <info@miraclemilechamber.org>
Date: Tue, Oct 14, 2014 at 10:28 AM
Subject: RE:6001-6067 Wilshire Blvd. (Academy Museum of Motion Pictures)
To: luciralia.ibarra@lacity.org

Luci,

Please find attached the Miracle Mile Chamber's letter of recommendation/commendation for this project.

Thank you.

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Meg McComb
Executive Director
Miracle Mile Chamber of Commerce
Office: 323.964.7100 EXT 0
VM: 323.964.5454

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Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343

Dear Luci,

The Miracle Mile Chamber of Commerce works to promote the Miracle Mile district as a burgeoning cultural and business center. Acting as both a resource and advocate, the M.M.C.C. works closely with local businesses, cultural organizations, government agencies, the area's schools and neighborhood associations. From the ancient La Brea Tar Pits to the new Grove shopping center, the Miracle Mile District offers something for everyone. We enjoy the exciting architectural styles of the past 100 years, the small shops that line our boulevards, and a wide choice of great restaurants.

The Miracle Mile is home to the largest concentration of world-class museums in Southern California, and they make the Miracle Mile the amazing place that it is today. The landmark May Co Building, long underutilized after the department store went out of business in the '90s, is the ideal site for a new museum. With The Academy of Motion Picture Arts and Sciences on board to develop a new state-of-the-art museum dedicated to the craft of filmmaking, I can't think of a better location than on the Miracle Mile and in the historic May Co Building.

The new $300-million museum will have positive economic impacts on the construction industry, the local community, and the city as a whole. With the Purple Line coming to the Miracle Mile, the area will be even more vibrant and energized than it is today. The Chamber has reviewed the EIR, and we believe the area has the infrastructure in place to support such a project. The Academy has set a leading example in working with us and the other Miracle Mile museums to plan and coordinate both construction and operations to ease impacts as much as possible.

We look forward to welcoming the Academy Museum as the newest addition to an already amazing lineup of cultural institutions that call the Miracle Mile home.

Sincerely,

Meg McComb
Executive Director, Miracle Mile Chamber of Commerce
Miracle Mile Chamber of Commerce
From: William Morris <wmor007@hotmail.com>
Date: Tue, Oct 14, 2014 at 2:26 PM
Subject: Signs at LACMA
To: "luciralia.ibarra@lacity.org" <luciralia.ibarra@lacity.org>

ENV 2013 1531 EIR:
We who live in Los Angeles and have the privilege of enjoying our museums do not wish to see them turned into an advertising venue looking like the "Japanese Ginza". This would trash the neighborhood and demean the dignity of the classic architecture. Please be respectful of the wishes of the patrons.
Sincerely,
Mr. & Mrs W. Morris

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Luciralia Ibarra
City Planner
Major Projects
Department of City Planning
200 N. Spring Street, Rm 750
Los Angeles, CA 90012
Ph: 213.978.1378
Fx: 213.978.1343
This email got sent to me instead of you.

-------- Forwarded message --------
From: Adam Villani <adam.villani@lacity.org>
Date: Thu, Sep 11, 2014 at 3:35 PM
Subject: Fwd: Academy Museum of Motion Pictures ENV-2013-1531-EIR
To: Luciralia Ibarra <luciralia.ibarra@lacity.org>

-------- Forwarded message --------
From: Chris Nichols <nixols@yahoo.com>
Date: Thu, Sep 11, 2014 at 2:46 PM
Subject: Academy Museum of Motion Pictures ENV-2013-1531-EIR
To: "adam.villani@lacity.org" <adam.villani@lacity.org>

Re: Academy Museum of Motion Pictures

ENV-2013-1531-EIR  State Clearinghouse Number: 2013051086
Council District: 4  Community Plan Area: Wilshire
Project Location: 6067 Wilshire Boulevard, Los Angeles, CA 90036

Dear Mr. Villani,

I am writing to express my disagreement with the EIR for this project. The 1946 addition should be considered a historic resource. It was planned at the same time, by the same architects, and used the same materials as the original building. I believe the same standards being applied to the South elevation should be applied to the entire building, this is an extraordinary building and a top tier landmark.

Thank you.
Chris Nichols