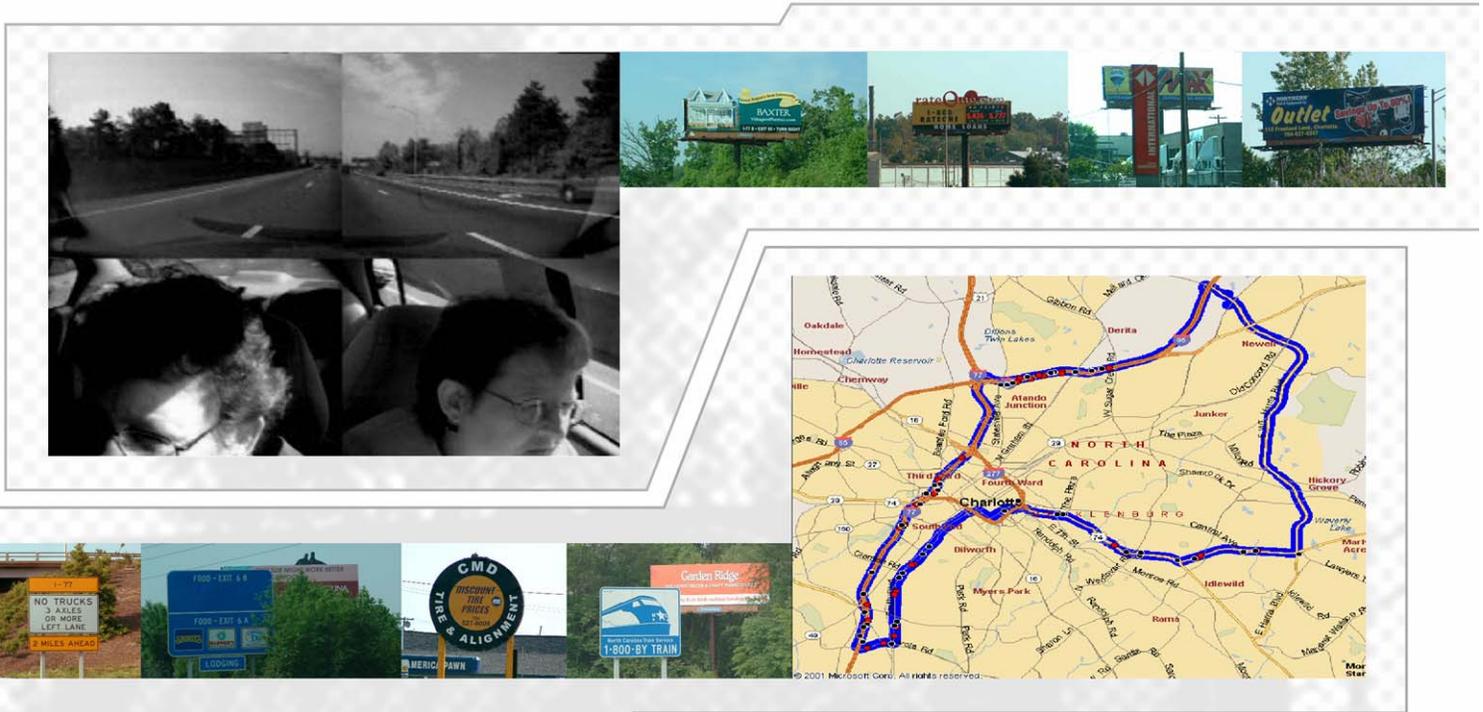


Driving Performance in the Presence and Absence of Billboards

EXECUTIVE SUMMARY

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By Suzanne E. Lee, Erik C. B. Olsen, and Maryanne C. DeHart



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Introduction

The current project was undertaken to determine whether there is any change in driving behavior in the presence or absence of billboards. Several measures of eyeglance location were used as primary measures of driver visual behavior. Additional measures were included to provide further insight into driving performance--these included speed variation and lane deviation. The overall conclusion from this study is that the presence of billboards does not cause a change in driver behavior in terms of visual behavior, speed maintenance, or lane keeping. A rigorous examination of individual billboards that could be considered to be the most visually attention-getting demonstrated no relationship between glance location and billboard location. Driving performance measures in the presence of these specific billboards generally showed less speed variation and lane deviation. Thus, even in the presence of the most visually attention-getting billboards, neither visual behavior nor driving performance changed.

Methods

Participants in this study drove a vehicle equipped with cameras in order to capture the forward view and two views of the driver's face and eyes. The vehicle was also equipped with a data collection system that would capture vehicle information such as speed, lane deviation, GPS location, and other measures of driving behavior. The video and other data were linked by use of a common time numbering system, and all data were collected at the rate of 10 times per second.

Thirty-six drivers participated in the study. Participants were unaware of the focus of the study on billboards; they were told that the purpose of the study was to examine natural driving behavior, which was also true. The drivers were a diverse group in terms of age, gender, income, education, and ethnicity. They were all familiar with at least some segments of the test route, which was a 35-mile loop route in Charlotte, North Carolina. The route included both interstate and surface streets, and it was mostly urban and suburban in nature. A total of 30 billboard sites along the route were selected with assistance from a Charlotte, North Carolina outdoor advertising company and representatives from the Outdoor Advertising Association of America (OAAA). The route included billboards of various sizes, on both sides of the road, and on both interstates and surface streets. In addition, six comparison sites (e.g., logo signs, on-premises signs, etc.) and six baseline sites (i.e., no visual elements such as buildings or signs present) were included for comparison purposes.

Participants were oriented to the study and the experimental vehicle before they began driving the route. After a short practice route with the experimenter, each participant drove the route unaccompanied and with the assistance of route directions mounted on the dashboard. Data were collected unobtrusively by using hidden sensors. The data were then stored on compact disks for later analysis. After returning to the starting point, drivers completed a demographic and driving questionnaire and were then paid a token amount in appreciation for their time.

The experiment was designed so that the elements of participant age (younger/older), participant gender (male/female), side of road (left/right), and type of site (billboard, comparison, or baseline) were equally represented. Several measures were used to determine whether driver

behavior varied during the 7-seconds preceding the billboard site (as compared to other types of sites). These included measures of visual behavior (eyeglance locations of forward, left, and right) and driving performance (lane deviation and speed variation). The measures were statistically analyzed in terms of the controlled elements of site type, age, gender, and route, as well as by road type and familiarity. An additional analysis examined visual and driving performance in the presence of certain high-profile billboards that might be expected to be the most attention-getting along the route.

The eyeglance data were analyzed by four trained data analysts who used a customized software package. The software used GPS location data for site, route, and vehicle identification on an electronic road map. Glances were analyzed down to a tenth of a second, in terms of both length of glance and glance locations. Analysis of vehicle speed and lane position variability was accomplished with a computerized post-processing procedure on the raw data file. Each analyzed event was 7 seconds long.

With 36 participants and 42 sites, there were 1,512 events available for analysis from approximately 54 hours of data collection. A small amount of data was lost due to sensor outages, sun angle, and lane changes, leaving 1,481 events for eyeglance analysis and 1,394 events for speed and lane position analysis. Altogether, 103,670 video frames were analyzed and 10,895 glances were identified. There were 97,580 data points in the speed and lane position data set.

Questionnaire Results

The average participant age was 25 years for younger drivers and 56 years for older drivers. On average, drivers had completed 14 years of education (high school plus two years of college). For marital status, 78% of participants were single or married, while 14% were divorced and 8% widowed. Over 61% of drivers were European (Caucasian) and 39% of drivers had an African American, Native American, or Multi-racial background. Seventy-two percent of drivers reported an annual income of less than \$49K. All drivers were familiar with the roadway system in Charlotte, North Carolina and most drivers both lived and worked there.

Analysis of the questionnaire results revealed that the most common items that caught drivers' attention during the route were traffic, other drivers, road signs, and highway signs, as well as construction, landmarks, landscaping, and buildings. Only 25% of drivers indicated that billboards caught their attention during the drive. Upon further discreet inquiry, these drivers indicated that they either tended to look at billboards in general or at specific billboards that caught their attention.

Other questions asked drivers to indicate what was memorable about the drive or what they noticed about other drivers. Most comments involved traffic, construction, the weather, or aggressive driving by other drivers. Many drivers indicated that they typically also performed other activities while driving, such as listening to music, talking on a cell phone, eating, drinking, smoking cigarettes, or talking to passengers. The last question asked drivers to reiterate the purpose of the study; all of the drivers indicated that the study was designed to examine natural driving behavior, which is what they had been told at the beginning.

Visual Behavior Results

The visual behavior results indicate that billboards do not differ from comparison sites such as logo boards, on-premises advertisements, and other roadside items. The analysis of eyegance patterns provided insight as to whether drivers displayed more active glance performance when passing billboards. Glances were analyzed in terms of number of glances, average duration of glances, and total duration of glances for each of three site types: billboard, baseline, and comparison sites. Billboard sites did not differ significantly from the comparison sites for left-forward glances, but did differ from baseline sites. There were also a difference in terms of left-forward total glance duration; billboard and comparison sites had significantly longer left-forward total glance durations than baseline sites, but did not differ from one another. There were no differences for the average glance durations in any direction between three site types. Out of nine visual performance measures, there were no cases for which the billboard site type differed significantly from the comparison site type, and only two cases for which both billboard and comparison sites differed from baseline sites.

In terms of side of road, age, or familiarity, no differences were found for eyegance behaviors, and there was only one difference for gender. Females displayed longer average and total right-forward glance durations across all site types; this difference, although significant, was relatively small in terms of magnitude and does not appear to have any practical significance.

Not surprisingly, there were significant differences for road type, with surface streets showing a more active glance pattern than interstates. More glances were observed in all directions on surface segments, as compared to interstate segments. The average and total center forward glance durations were longer for the interstate segments; in most cases, the right- and left-forward average and total glance durations were shorter on the interstate than on surface streets. In most cases, surface road sites have more signs, buildings, and other features closer to the side of the road, so it is not surprising that drivers would look at locations other than center forward while driving in these areas.

Speed Variability Behavior Results

Speed maintenance behavior did not differ in the presence of billboards as compared to comparison and baseline sites. Significant differences were found for side of road, familiarity, and road type; however, from a practical perspective, differences were small. Sites on the right were associated with less speed variation than those on the left. Drivers also exhibited less speed variation for sites rated as familiar. The largest difference was in terms of road type--sites on the interstate had less speed variability than did sites on the surface streets.

Lane Deviation Behavior Results

Lane maintenance behavior did not differ in the presence of billboards as compared to comparison and baseline sites. Lane position analysis revealed differences only for side of road. For sites on the left side of the road, lane position varied by 10 inches during the 7-second segment, as compared to 7.5 inches for sites on the right side. These differences, although significant, are within the expected range of deviation.

Specific Board Analysis Results

An analysis of specific boards was performed to determine: 1) how specific billboards compared to other billboards as well as specific baseline and comparison sites in terms of eyeglance and driving performance measures, and 2) how the eyeglance measures corresponded to the placement of the billboards (left or right) in relation to the road. By choosing the four billboards that might be expected to draw the most glances, as well as two more ordinary boards, and comparing their results to all other sites, it became obvious that the selected billboards did not change visual performance. Some billboard sites seemed to have a more active glance pattern than others, but this was most likely due to road type differences, since the glance directions at these sites did not correspond to the side of the road where the billboards were situated.

Study Parameters

This study was conducted in a specific city chosen to be representative of mid-sized U.S. cities. The route was chosen to include both urban and suburban sections (and some sections were close to rural in nature). The billboards in Charlotte, North Carolina are generally situated close to the side of the road, therefore placing the boards within the forward-view of the participants for a longer period of time than if they were further offset from the road. Both the setting (urban/suburban/rural) and the billboard offsets were typical of most billboard locations found in the U.S. For each of the above-mentioned parameters, every attempt was made to conduct a balanced, representative study for which the results could be generalized to other cities and routes.

One limitation of this study was that there were few electronic boards along the route, so no conclusions can be drawn regarding driver behavior in the presence of this type of billboard. All three of the electronic billboards available on the route were included, however, for a total of 10% of the sampled billboards. Future research into this topic should focus on routes with a greater number of available electronic billboards so that an electronic/non-electronic analysis can be conducted.

Conclusions

The overall conclusion from this study is that the presence of billboards does not cause a change in driver behavior, in terms of visual behavior, speed maintenance, or lane keeping. A rigorous examination of individual billboards that could be considered to be the most visually attention-getting demonstrated no relationship between glance location and billboard location. Driving performance measures in the presence of these specific billboards generally showed less speed variation and lane deviation. Thus, neither visual behavior nor driving behavior changes, even in the presence of the most visually attention-getting billboards.