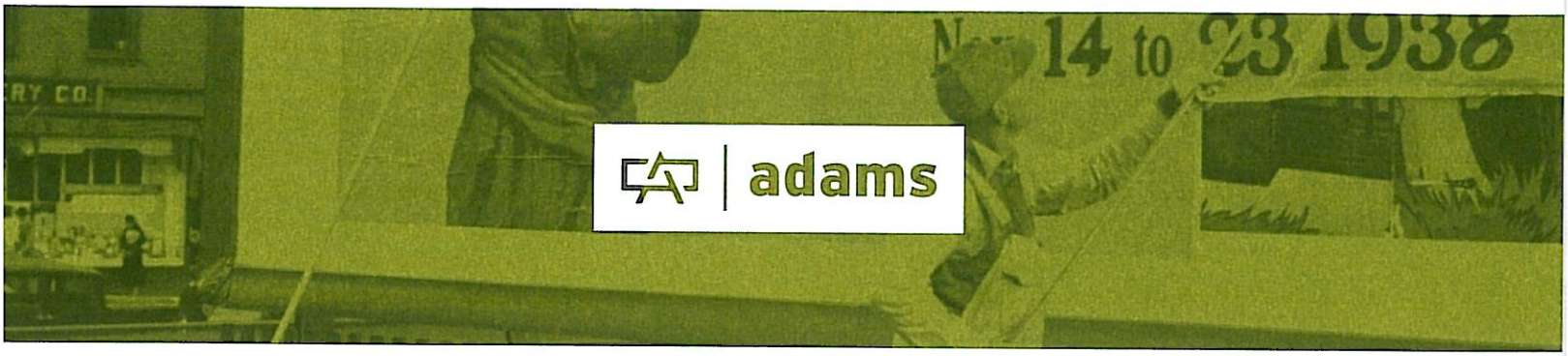
734.327.8999 | adamsoutdoor.com | 880 james l. hart parkway, ypsilanti, mi 48197



Wendy Rampson
Planning Manager
City of Ann Arbor
301 E. Huron Street
Ann Arbor, MI 48107

March 28, 2018

RE: SAFETY STUDIES

Wendy;

Enclosed please find summaries from three studies conducted regarding distractions and digital billboards. Each of these studies concludes that digital billboards are safety neutral. If you would like the entire reports, please let me know.

We would request that these summaries be included along with the other materials we have submitted for the Council packet.

Thanks,

Mitch

Mitchell Gasche
Real Estate Manager
Adams Outdoor Advertising
880 James L Hart Parkway
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Driving Performance and Digital Billboards

EXECUTIVE SUMMARY OF FINAL REPORT

Prepared for:

Foundation for Outdoor Advertising Research and Education

By:

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and

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Virginia Tech

1872

TRANSPORTATION INSTITUTE

Center for Automotive Safety Research

March 22, 2007

EXECUTIVE SUMMARY

The most notable findings from this study are as follows:

- Eyeglance results showed that there were no differences in the overall glance patterns between digital billboards, conventional billboards, comparison events, and baseline events during the daytime.
- Drivers did not glance more frequently in the direction of digital billboards than in the direction of other event types during the daytime.
- Drivers took longer glances in the direction of digital billboards and comparison sites than in the direction of conventional billboards and baseline sites during the daytime.
- An analysis of glances lasting longer than 1.6 seconds indicated that these longer glances were distributed evenly across the digital billboards, conventional billboards, comparison events, and baseline events during the daytime
- The nighttime results indicate that digital billboards and comparison events may be associated with more active glance patterns, as well as with more frequent and longer glances towards the digital billboards and comparison events.
- For the post-drive questionnaire, 42% of drivers mentioned billboards as one of the top five items that caught their attention; note that drivers did not know this was billboard study.
- In an open-ended question, three drivers mentioned billboards as the single most memorable item on the trip, and two referred specifically to the digital billboards as being memorable.

The motivation for the current study was to examine driver performance in the presence of digital billboards, as compared to other driving locations without them. There is a long history of studying billboards in the context of traffic safety but, although the research record covers many years (1951 until the present), it is lacking in volume and is primarily focused on conventional billboards. There were a few epidemiological studies performed in the early 1950's examining traffic accidents in the presence and absence of billboards; however, much of this early work was methodologically flawed. After a long gap in research, there were a few additional studies in the 1960's through the 1980's, none of which demonstrated that billboards are unsafe. More recent studies conducted in Canada have shown that there may be changes in driver behavior associated with video billboards (those with full motion), but those studies do not address the digital billboards of interest in the current study (with a static message that changes instantaneously without special effects).

Traffic accident analysis techniques have improved in recent years with the creation and maintenance of national crash databases. A careful examination of these databases shows that distraction caused by billboards fails to show up in any of the accident databases as an accident cause. Likewise, an examination of numerous driver distraction studies demonstrates that billboards fail to show up as a cause of driver distraction. The overall conclusion from all past research is that conventional billboards in general have not been shown to cause traffic accidents or change driver behavior. However, the question of whether digital billboards change driver behavior in some way cannot be answered by these previous studies; this is the motivation for the current study.

The current study was conducted in Cleveland, OH to assess the effects, if any, of digital billboards on driver behavior and performance. The study was conducted following the model of a previous study conducted in Charlotte, NC that showed no measurable effects of conventional billboards on eyeglance patterns, speed maintenance, or lane keeping. Thirty-six drivers were recruited with males and females equally represented; they were also equally divided by age (older: 50-75, younger: 18-35). Participants drove an instrumented vehicle on their own (without an experimenter in the vehicle) on a 50-mile loop route in the daytime along some of the interstates and surface streets in Cleveland. Participants were not informed about the true purpose of the experiment, and were told that the purpose was to help understand the way people drive in a natural environment. Along the route, participants encountered the following items:

- 5 digital billboards (all that were available on the route). The digital billboards were the standard bulletin size (14 ft x 48 ft) and the copy changed instantaneously every eight seconds (there were no special effects during the transition).
- 15 conventional billboards (similar to those studied in the Charlotte study).
- 12 comparison sites (similar to items you might encounter in everyday driving; comparable to digital billboards in terms of visual activity/attractiveness, including on-premises signs [some with digital elements], logo placards, landmark buildings, and murals).
- 12 baseline sites (sites with no signs).

After the drive, participants completed a questionnaire regarding which types of items and activities they had noticed along the route. Participants were paid a nominal amount for their participation. Twelve participants returned for a nighttime session to explore the potential effects of the digital billboards at night.

The eight seconds leading up to the events of interest were then analyzed in terms of eyeglance patterns, speed maintenance behavior, and lane keeping behavior. With 36 participants and 44 sites, there were 1,584 events available for analysis from approximately 63 hours of data collection. A small amount of data was lost due to cell phone use, sensor outages, sun angle, and vehicle stoppages, leaving 1,540 events for eyeglance analyses. Altogether, 124,740 video frames were analyzed and 10,073 individual glances were identified. The speed data were filtered to remove events as described above, and then further filtered to remove low speed events, leaving 1,494 events in this dataset, with 121,014 data points. The lane position dataset was further filtered to remove events indicating a possible lane change or lane position sensor failure (often due to poor lane markings). After filtering, there were 1,188 events remaining in the lane position dataset, with 96,228 data points.

In terms of demographics, the average age was 28 years for younger drivers and 59 years for older drivers. Most had completed high school, but few had attended college. All participants lived in the Cleveland area, and were familiar with at least some parts of the route. For the post-drive questionnaire, 42% of drivers mentioned billboards as one of the top five items that caught their attention (out of 18 choices). In a later open-ended question, three drivers mentioned billboards as the single most memorable item on the trip, and two referred specifically to the digital billboards as being memorable. By way of contrast, only 25% of drivers in the Charlotte study checked off billboards in their top five list (of 18 choices), and none mentioned billboards as being the most memorable aspect of the trip. Recall that drivers did not know that the purpose

of the study was to examine performance in the presence of billboards; in fact, they did not know that the study had anything to do with billboards.

Eyeglance results showed that there were no differences in the overall glance patterns (percent eyes-on-road and overall number of glances) between event types (digital billboard, conventional billboard, comparison events, and baseline events). Drivers also did not glance more frequently in the direction of digital billboards than in the direction of other event types. However, drivers did take longer glances in the direction of digital billboards and comparison sites than in the direction of conventional billboards and baseline sites. Given that three of the comparison sites had digital components, the similar eyeglance findings for these two event types are not surprising. An analysis of glances lasting longer than 1.6 seconds showed no obvious differences in the distribution of these longer glances across event types.

There were differences in speed maintenance, with conventional billboards showing greater variation in speed than digital billboards. However, this was thought to be the result of a road type interaction, given that all of the digital billboards were on interstates. When only interstate events were considered in the analysis, there were no significant differences in speed maintenance across event types. There was a trend towards poorer lane keeping performance for digital billboards and conventional billboards; however, this trend failed to reach significance.

A smaller exploratory study was also conducted at nighttime using a slightly shortened route. Given that the digital signs being studied were intrinsically illuminated, this was felt to be an important first step in determining whether there are driver performance differences in the presence of these signs under different levels of ambient illumination. Twelve drivers were used, again divided equally by age and gender. All of the nighttime drivers had previously driven the route during the daytime and were thus somewhat familiar with the route (so were unlikely to get lost or go off route). The nighttime study was exploratory in nature with fewer data points, so these data were examined descriptively rather than analyzed statistically (due to lack of statistical power).

Four eyeglance measures were examined for the nighttime data: eyes-on-road percent, overall glance frequency, mean glance duration in the direction of an event, and mean number of glances in the direction of an event. The eyes-on-road measure showed that digital billboards and comparison events tended to have less eyes-on-road time at nighttime than either baseline events or conventional billboards. The overall glance frequency was also higher in the presence of digital billboards and comparison events than in the presence of baseline events and conventional billboards. These two findings taken together show a more active glance pattern at nighttime in the presence of these two event types. The mean glance duration for glances in the direction of an event also showed higher values for digital billboards and comparison events. Finally, the mean number of glances in the direction of an event also showed digital billboards and comparison events as having higher values than either baseline events or conventional billboards. Taken together, these four findings indicate that digital billboards and comparison events *may* result in more active glance patterns overall, as well as more frequent and longer glances towards the digital billboards and comparison events at nighttime.

Two driving performance measures were examined for the nighttime data: standard deviation of speed and standard deviation of lane position. The standard deviation of speed appeared to be higher in the presence of both conventional and digital billboards than for baseline and comparison events. Lane keeping also showed a trend towards greater lane deviations in the presence of both digital billboards and conventional billboards.

The luminance values of many of the billboards, comparison events, and baseline events were also measured at nighttime. The digital billboards had noticeably higher luminance values than any of the other event types, even though their luminance was automatically reduced at night. This probably explains some of the driver performance findings in the presence of the digital billboards. The overall ranking of luminance by event (digital billboards were the highest, followed in order by comparison events, conventional billboards, and baseline events) closely mirrors the rankings of many of the performance measures for both daytime and nighttime, including eyeglance, speed maintenance, and lane keeping.

The overall conclusion, supported by both the eyeglance results and the questionnaire results, is that the digital billboards seem to attract more attention than the conventional billboards and baseline sites (as shown by a greater number of spontaneous comments regarding the digital billboards and by longer glances in the direction of the billboards). The comparison events, 25% of which included signs with digital components, showed very similar results to the digital billboards. Thus, there appears to be some aspect of the digital billboards and comparison events that holds the driver's attention, once the driver has glanced that way. This is most likely the result of the intrinsic lighting of these signs, which is noticeable even during the daytime. Drivers may also have maintained longer glances towards the digital billboards in the hopes of catching the next message (knowing that the message changes periodically). Although exploratory in nature, the nighttime results were very similar to the daytime results, with indications of degraded driving performance for digital billboards and comparison events.

These particular LED billboards were considered safety-neutral in their design and operation from a human factors perspective: they changed only once every eight seconds, they changed instantaneously with no special effects or video, they looked very much like conventional billboards, and their luminance was attenuated at night. It is thus quite likely that digital signs with video, movement, higher luminance, shorter on-message duration, longer transition times, and special effects would also be related to differences in driver behavior and performance. Because of the lack of crash causation data, no conclusions can be drawn regarding the ultimate safety of digital billboards. Although there are measurable changes in driver performance in the presence of digital billboards, in many cases these differences are on a par with those associated with everyday driving, such as the on-premises signs located at businesses. Conventional billboards were shown both in the current study and in the Charlotte study to be very similar to baseline and comparison events in terms of driver behavior and performance; thus, the design of digital billboards should be kept as similar as possible to conventional billboards.

TANTALA ASSOCIATES, LLC
CONSULTING ENGINEERS

AN UPDATE OF A STUDY OF THE RELATIONSHIP BETWEEN DIGITAL BILLBOARDS AND TRAFFIC SAFETY IN CUYAHOGA COUNTY, OHIO

SUBMITTED TO

THE FOUNDATION FOR OUTDOOR ADVERTISING
RESEARCH AND EDUCATION (FOARE)
1850 M STREET, NW, SUITE 1040
WASHINGTON, DC 20036-5821

BY

MICHAEL WALTER TANTALA, P.E.
ALBERT MARTIN TANTALA, SR., P.E.

SUBMITTED ON

NOVEMBER 18, 2009

TANTALA ASSOCIATES, LLC
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AN UPDATE OF A STUDY OF THE RELATIONSHIP BETWEEN DIGITAL BILLBOARDS AND TRAFFIC SAFETY IN CUYAHOGA COUNTY, OHIO

Key points:

- Eight years of accident data comparison
- Seven digital boards on Interstate Routes with eight second dwell times
- Data shows no statistically significant increase in accident rates
- Driver Age (young/elderly) is a neutral factor
- Time of day (daytime/nighttime) is a neutral factor

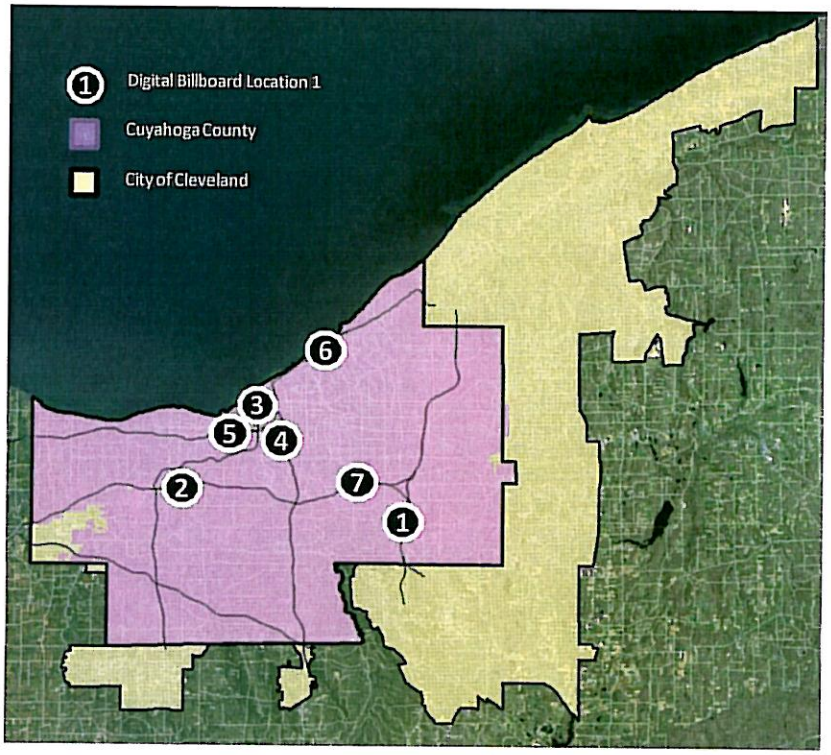

Figure 1.
Digital Billboard locations in Cuyahoga County, Ohio and within the City of Cleveland

Eight years of data ...

... no statistically significant relationship with the occurrence of accidents ...

... age of drivers and time of day are neutral factors.

OVERVIEW

This 2009 study is an update of our 2007 study of the statistical relationship between digital billboards and traffic safety in Cuyahoga County, Ohio. This study revisits the same seven digital billboards in Ohio for longer periods of time and looks more closely at comparisons of specific attributes within accident reports, including comparisons of driver age (young/elderly) and time of day (daytime/nighttime).

This 2009 study examines and compares **eight years of traffic accident data** near seven digital billboards in Ohio. This eight-year comparison more than doubles the three-year study period in 2007. This study analyzed traffic and accident data along Interstate Routes I-77, I-90, I-271, and I-480 and near seven existing, digital billboards (see Figure 1). The seven billboards have eight-second dwell times, were converted to digital from conventional format in July 2005 and collectively have traffic volumes as much as 335 million vehicles per year. The study uses official data as collected, compiled and recorded independently by the Ohio Department of Transportation. Over eight years, this accident data represents approximately 46,000 accidents on Interstate Routes within the County and 360,000 accidents on all roads within the County.

Temporal (*when and how frequently*) and spatial (*where and how far*) statistics were summarized near billboards within multiple vicinity ranges within 0.2, 0.4, 0.6, 0.8, and 1.0 miles upstream and downstream of the billboards.

The overall conclusion of this study is that **digital billboards in Cuyahoga County have no statistically significant relationship with the occurrence of accidents.**

This study reinforces the findings of our original study for longer periods of time with a robust eight years of data. This study also finds that the **age of drivers (younger/elderly) and the time of day (daytime/nighttime) are neutral factors** which show no increase in accident rates near the digital billboards in Cuyahoga County.

This conclusion is based on the Ohio Department of Transportation's own data and an objective statistical analysis; **the data shows no increase in accident rates.**

TANTALA ASSOCIATES, LLC
CONSULTING ENGINEERS

A STUDY OF THE RELATIONSHIP BETWEEN DIGITAL BILLBOARDS AND TRAFFIC SAFETY IN HENRICO COUNTY AND RICHMOND, VIRGINIA

SUBMITTED TO

THE FOUNDATION FOR OUTDOOR ADVERTISING
RESEARCH AND EDUCATION (FOARE)
1850 M STREET, NW, SUITE 1040
WASHINGTON, DC 20036-5821

BY

MICHAEL WALTER TANTALA, P.E.
ALBERT MARTIN TANTALA, SR., P.E.

ON

29 NOVEMBER 2010

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A STUDY OF THE RELATIONSHIP BETWEEN DIGITAL BILLBOARDS AND TRAFFIC SAFETY IN HENRICO COUNTY AND RICHMOND, VIRGINIA

KEY POINTS

- More than 7 years of accident data comparisons
- Ten locations with 14 digital billboard faces with 10 second duration times
- Data show no statistically significant increase in accident rates, using before and after comparisons and using an Empirical Bayes Method Analysis for the actual and predicted comparisons
- Comparisons of driver age (young/elderly) and time of day (daytime/nighttime) are neutral factors

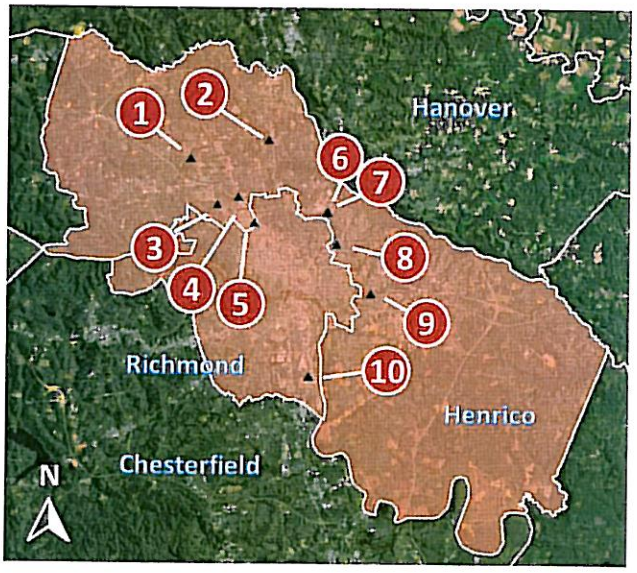

Figure 1.
Digital Billboard Locations analyzed in Henrico County and Richmond, Virginia

TOC

More than 7 years of data ...

... no statistically significant relationship with the occurrence of accidents ...

... 10-second duration times ...

OVERVIEW

The purpose of this study is to **examine the statistical relationship between digital billboards and traffic safety in Henrico County and Richmond, Virginia.** This study analyzes traffic and accident data along routes near **10 locations with 14 digital billboard faces** (see Figure 1) with traffic volumes on roads collectively representing approximately 154 million vehicles per year. The study uses official data as collected, complied and recorded independently by municipal police departments, Henrico County and the Virginia Department of Transportation.

The study includes more than **seven years of accident data** representing approximately 40 thousand accidents near ten locations in Richmond and Henrico County. The billboards were converted to digital format between 2006 and 2009 and allow periods of comparison as long as 7.3 years (88 months).

Temporal (*when and how frequently*) and spatial (*where and how far*) statistics are summarized near billboards within multiple vicinity ranges as large as one-half mile for areas that are upstream and downstream of the billboards. Subsets of daytime and nighttime accidents and driver age are analyzed for before and after comparisons.

Additionally, an Empirical Bayes Method (EBM) analysis is performed to estimate the number of accidents that could statistically be expected without the introduction of digital signs. This method is the basis of the safety analysis and science-based, predictive models introduced within the 2010 *Highway Safety Manual* of the American Association of State Highway Official (AASHTO, Reference 14). This report establishes benchmarks for the basis of accident records at pre-digital locations and also uses other comparison sites in Henrico County and Richmond.

The overall conclusion of the study is that **the digital billboards in Richmond, Virginia have no statistically significant relationship with the occurrence of accidents.** This study also finds that the age of drivers (younger/elderly) and the time of day (daytime/nighttime) are neutral factors which show no significant increase in accident rates near the digital billboards. These conclusions are based on Police Department data and an objective statistical analysis; **the data show no significant increase in accident rates.**