Emily Gates
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FRONT BRAKE LIGHT

The automobile is a complex system in which humans play an important role. Driving is largely a "visual task"[1]- when vision is obstructed, due to darkness, alcohol, fatigue or impairment an automobile cannot correctly operate on its own. People act as the sensory component of the automobile system and are needed to detect stimuli from the environment, process it and act on it accordingly. Problems in the human-car-environment system occur when stimuli from the environment are below the range of human detection and/or when humans have dulled or distracted their ability to receive and respond to such stimuli. Close to 40,000 fatal automobile accidents occur each year and of those close to 5,000 involve pedestrians or bicycles.[2] Currently drivers react to stimuli in their environment, plan their actions and use visual blinkers, headlights and brake lights to create a visual environment for other drivers to react upon. One component that seems to have been left out of the human-automobile- environment system is the human aspect of the environment- that is the people walking, running, bicycling and jogging in the same environment an automobile is navigating. Nowhere is this dual human factor more evident than on a college campus or in a large city where there a lot of busy intersections. The mode of transportation used to get around campuses and cities is as diverse as the people that reside there, and the person/automobile conflict comes to a head at the intersection. The automobile is currently equipped to provide other drivers with visual information but its not- as I will argue- well enough equipped to provide pedestrians and bicyclers with the visual information they need to safely and most efficiently navigate the

[1] D. Alfred Owens and Michael Sivak, "The Role of Reduced Visibility in Nighttime Road Fatalities," University of Michigan Industry Affiliation Program for Human Factors in Transportation Safety, November 1993
[2] Bureau of Transportation Statistics, "Table 2.1 Transportation Fatalities by Mode," US Department of Transportation Research and Innovative Technology Administration, 2002 http://www.bts.gov/publications/national_transportation_statistics/2002/html/table_02_01.htm

intersection. I propose that front brake lights would function for pedestrians in much the same way that back brake lights function for drivers. Considering both human elements in the automobile-user-environment system front brake lights ergonomically fit the visual, cognitive and anthropometric dimensions of human perception- making them an important consideration in automobile design.

Collisions between pedestrians and automobiles represent the highest percentage of nighttime crashes.[3] A pedestrian is 4.1 times more likely to be involved in a fatal accident at night than during the day.[4] The greatest contributor to crashes that occur during dark is the limited visibility.[5] Visibility is the function of human visual performance, illumination of the environment, type of target being viewed, characteristic of light signals and characteristics of the vehicle.[6] The more conspicuous an object the greater the chance it will be detected and the greater the likelihood it will be detected earlier.[7] Therefore to increase visibility, the design of automobile lighting should operate to increase the conspicuousness of both pedestrians and of the automobile itself. I propose that the addition of front brake lights would increase the conspicuity of a vehicle, making a vehicle more visible by increasing the illumination of the car, lighting up the surrounding environment, making it easier to a person to see when a car is breaking, creating a distinct visual signal and empowering pedestrians with the visual stimuli needed to make smarter choices about crossing the road. Placing the front brake light in a triangular formation as depicted in figure 1 and figure 2 increases visibility by separating the

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[3] Sullivan and Flannagan, "Assessing the Potential Benefit of Adaptive Headlighting using Crash Databases" University of Michigan Industry Affiliation Program for Human Factors in Transportation Safety (1999)

[4] Sullivan and Flannagan, "Characteristics of Pedestrian Risk in Darkness," University of Michigan Industry Affiliation Program for Human Factors in Transportation Safety (November 2001)

[5] Kåre Rumar, "A Worldwide Perspective on Future Automobile Lighting," University of Michigan Industry Affiliation Program for Human Factors in Transportation Safety (November 2001)

[6] Ibid.

[7] Jan Theeuwes and Johan Alferdinck, "The Effectiveness of Side Marker Lamps: An Experimental Study," *Accid. Anal. and Prev.* 29, No. 2 (1997): 235.-245

flashing signal light (brake light) from the steady background of the headlights.[8] Using a flashing brake light, like the current back brake lights of cars depicted in figure 3, present the greatest convey the most visual information when contrasted with steady background lights, such as the constant lights of headlights.[9] Theeuwes and Alferdinck (1997) found the addition of *side* blinker lights on automobiles increased the conspicuity of vehicles making them visible and visible quicker than cars without side blinkers due the increased area of light they presented to the viewer.[10] I hypothesize that if side blinkers increase conspicuity the additional light from front brake lights would further increase a vehicle's conspicuity.

Information is the reduction of uncertainty.[11] Front brake lights present pedestrians, bicyclers and other drivers with information not already available in vehicle design. By providing feedback in the form of visual stimuli as to the time and rate of braking, front brake lights convey information to pedestrians that reduces the uncertainty as to whether a car has seen them and is braking or not breaking. This information then enables pedestrians, bicycles and drivers to make a decision and act accordingly to the visual information presented to them. Sanders and McCormick (1993) define compatibility as the degree to which relationships match human expectations.[12] Arranging front brake lights in a configuration similar to back break lights, such as depicted in figure 1 and 2, makes learning what the light is signally faster, contributes to faster reaction times and reduces the number of errors in signal detection.[13] A triangle light more closely resembles information people already have about automobile lighting, because many back lights are arranged this way, therefore the addition of front brake lights would be easy for young and old pedestrians to discern.

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[8] Mark S. Sanders and Ernest J. McCormick, *Human Factors in Engineering and Design.* McGraw-Hill Inc., 1993, 151
[9] Ibid.
[10] Ibid.
[11] Ibid., 48
[12] Ibid., 302
[13] Ibid.

Red is the stereotypical color used in most warning lights.[14] Because brake lights would shine when drivers were braking, making a front brake light red in color is counterintuitive to popular perceptions about warning lights. Back brake lights are red because they warn other drivers when the car in front of them is braking, so that they too may brake. Front break lights however would be used most by people crossing in front of the path of a car and would be warned only by the absence of the light that the car is not going to stop. When the light does go off the people crossing are not warned but rather informed that it is safe to cross the street, therefore I feel the front brake light of a car should be a color other than red. I propose a green or yellow light would be best, as following red, these colors were associated with the fastest reaction times when signal-to-background contrast is low.[15] Because more and more automobiles have continuous headlights the signal (brake light) to the background (headlight) is low and brake lights that were green or yellow would contrast the white lights of headlights[16] and increase the likelihood of a response.

The normal line of sight is 15º below the horizon and the most effective visual field forms an oval around this line of sight.[17] The response times to light presented in the visual field are the lowest for stimuli presented around 10º around the line of sight.[18] In darkness the human eye's ability to see decreases significantly.[19] Visual acuity degrades with low lighting, and the ability for the eye to adjust to darkness decreases such that depth, distance, size, shape and motion become difficult to discern.[20] Front brake lights could accommodate for the human limitations of the visual system by providing illumination levels high enough to allow drivers to

[14] Ibid. 152
[15] Ibid., 149
[16] Ibid.
[17] Ibid., 469
[18] Ibid., 470
[19] Owens and Sivak, "The Role of Reduced Visibility in Nighttime Road Fatalities"
[20] Ibid.

see pedestrians as well as pedestrians to see cars. Placing brake lights on the front of cars places them in the line of sight of pedestrians, bikers and other drivers as shown in figure 4. Because bikers and pedestrians in wheelchairs are significantly shorter than standing pedestrians a front brake light placed on the top of the car would limit the likelihood of a pedestrian being too short to see over the hood of the car, as shown in figure 4 and figure 5.[21]

Front brake lights make ergonomic sense for all parties involved at an intersection. On college campus students, faculty and staff are under high stress, have different cultural ideals for who has the "right of way," are distracted by cell phones, friends or music or as Shinar (1984) found, greatly overestimate the ability of drivers to see them and stop in time.[22] At night on college campuses, the visibility of pedestrians and/or can be further impaired by alcohol. For the visual, cognitive and anthropometric dimensions of the human body, front break lights that are yellow or green in color and are mounted in a triangle arrangement to the headlights, would greatly improve the human-environment-automobile fit. In 1971, Post and Mortimer asked subjects about their feelings of front brake lights, and found that respondents thought they would be a good addition to vehicle design.[23] Despite this research and several variations of a front brake lighting system found patented on-line ,there is no or very little literature about existing front brake lighting systems and I cam across no plans or discussion of this system in current automobile models.

90% of the information used to drive comes from visual input.[24] Yet very little of the design of today's automobiles is designated to the safety of the humans outside of the car. Visual

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[21] City of Toronto, *Accessibility Design Guidelines,* Diversity Management and Community Engagement, April 2004: 90
[22] David Shinar, "Actual versus estimated nig ht-time pedestrian visibility," *Ergonomics* 27, 8 (1984): 863-871
[23] D.V. Post and R.G. Mortimer, "Subjective Evaluation of the Front-Mounted Braking Signal," Highway Safety Research Institute The University of Michigan (1971)
[24] Owens and Sivak, "The Role of Reduced Visibility in Nighttime Road Fatalities"

displays help to enhance people's situational awareness.[25] Front brake lights provides information for the various "zones of interest"[26] associated with the busy intersections most commonly found on college campuses and in cities. They provide information about the situation of the machine, they provide information to the operator concerning the cars around them and most importantly they provide information to the people outside of the vehicle-conveying information to pedestrians that helps them make an informed decision for action. Not every street can have a crossing guard and humans cannot be 100% aware and error free in every situation-I propose front brake lights as an ergonomic addition to the automobile in an effort to put a STOP to unnecessary pedestrian confusion, injury and fatality.

[25] Sanders and McCormick, 152
[26] Ibid.

Figure 1

Figure 2

Figure 3

Figure 4

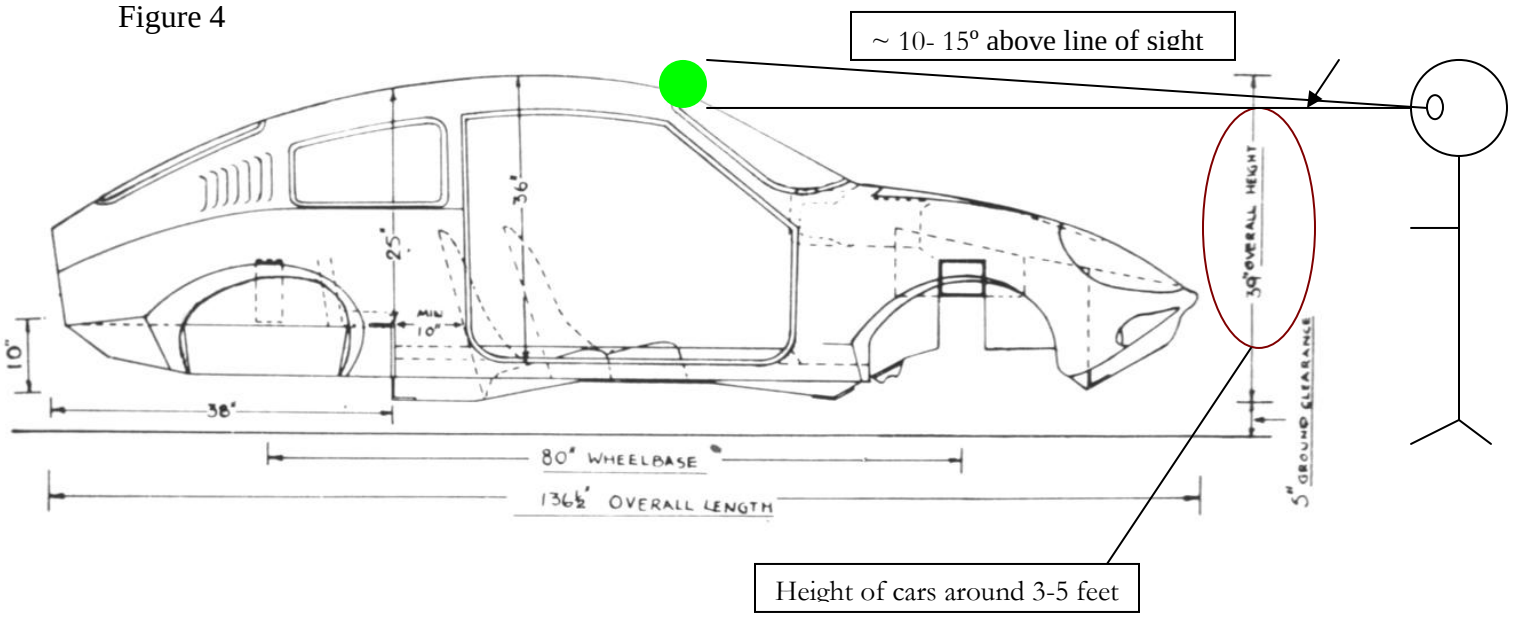
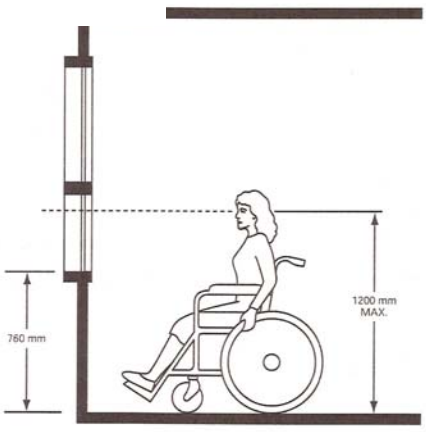


Figure 5



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