Increasing Speed Estimation Accuracy Through Daytime Headlight Usage

Ryan Pletcher

Stockton University

22 March 2018

speed by an average of 20 percent. Passengers were asked to make a judgement of the speed at

vehicle speed from films made from the driver's perspective and were able to estimate both the speed they would travel if they were driving, and the speed the vehicle was traveling in the film. The use of recorded footage to act as a surrogate for putting a subject behind the wheel of a vehicle is capable of providing accurate and valid data.

Current Study

The current study seeks to analyze the impact of headlight usage during daylight conditions on the estimation of oncoming vehicle speed. As there has been l

Method

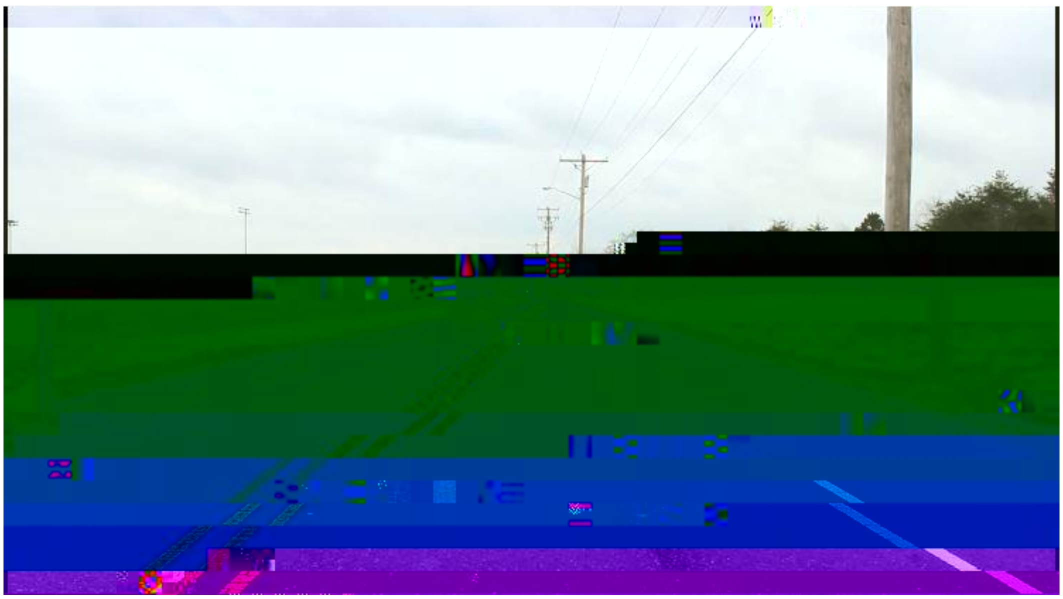
Participants

Sixty-four Stockton University undergraduate psychology students participated in the experiment (51 females, 13 males; *M (SD)* age = 22.44 (6.55) years old).

All participants were provided course credit as compensation for participating in the study.

Materials

Participants were asked to record their estimations of speed in miles per hour on a paper form. Participants were tested in a laboratory setting in front of a computer, where they watched 60 video clips of the experimental car without sound. The experimental car was a grey Kia Soul. The clips depicted the experimental car driving in the opposite lane on a two-lane road toward the camera. See Figure 1 for an illustration of the scenery and vehicle used in the clips. In each set of videos, the experimental car remained at a constant speed throughout the duration of the clip. There are five clips in each set of videos that differ based on the speed the vehicle is moving: 25, 30, 35, 40, and 45 miles per hour. There are four sets of clips. In Set A, the experimental car traveled 500 feet with its headlights off, and in Set B, the experimental car traveled 500 feet with its headlights on. In Set C, the experimental car traveled for 5 seconds (183.33, 220, 256.67, 293.33, and 330 feet for each speed, respectively) with its headlights off, and in Set D, the experimental car traveled for 5 seconds with its headlights on. Sets A & B comprise the distance standardization set, where Sets C & D comprise the time standardization set. The duration of the videos in the distance standardization set were 14.64, 12.36, 10.74, 9.52, and 8.58 seconds, respectively, and the duration of the videos in the time standardization set were fixed at 5 seconds. Two different constants were used in order to improve the validity of the study. The distance standardization set held distance traveled constant at the expense of changing clip times, which presented a timing confound. Conversely, the time standardization set held time constant at the expense of changing clip distances, which created a distance confound. The inclusion of both types of standardization in this experiment assisted in determining if the confounding variables of time and distance affected subjects' speed estimations.



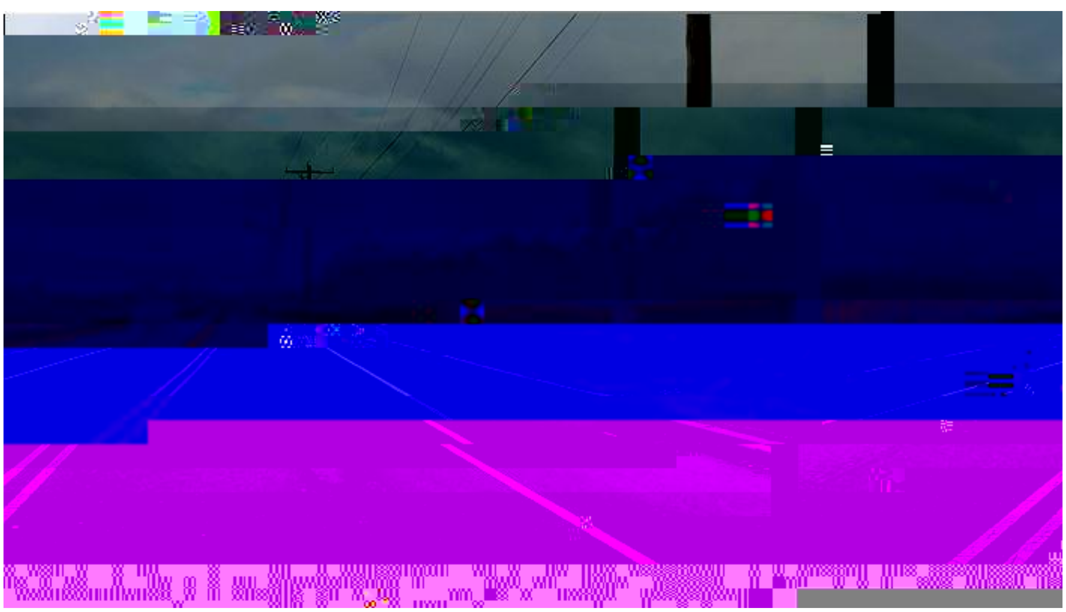


Figure 1.

Images from the video clips. The top image depicts the headlight condition, where the bottom picture depicts the no headlight condition.

Procedure

Participants signed a consent form, and then watched 60 clips of a vehicle travelling toward the camera in the opposite lane to imitate an oncoming vehicle. Participants estimated the speed of the vehicle by recording their estimates on the computer

headlight conditions in trials with distance standardization. For all other speeds, participants underestimated the speed of cars significantly more in the headlight off condition than in the headlight on condition.

Graph 1. Mean errors in speed estimation by speed for headlights on and headlights

increased. Graph 3 displays the mean errors in estimation across five speeds for both standardization conditions.

Graph 3. Mean errors in speed estimation by speed for distance standardization and time standardization.

Discussion

In summary of the results previously described, individuals estimated speed to be greater when headlights were on than when headlights were off, on average when condensing the two standardization groups. This was true for all speeds above 25 miles per hour. For all speeds above 35 miles per hour, this effect remained relatively constant in magnitude, again on average

contrast would be supported by an additional study in which the luminance of the headlights in the test vehicle was variable. If the contrast generated by headlights is truly a factor in increasing speed estimation accuracy, higher luminance values for the headlights should produce an increase in estimation accuracy.

There are additional questions raised by the findings of this study. One interesting effect worth noting is that of standardization. It was found that individuals made underestimation errors consistent with the results of the Conchillo and colleagues (2006) and Schutz and colleagues (2015) studies in trials where the distance the car traveled was held constant. For the trials where time was held constant, there was an inflation of estimated speed error which decr5.15 Tm0 g0 G[(c)4(hu)-9(tz)-7

Considering this, distance standardizations appear to be the most ecologically valid method for testing speed estimation errors, supported by the results of the present study as well as the findings of both Conchillo and colleagues (2006) and Horswill and colleagues (2005).

Limitations

Due to the field-based nature of this experiment, the footage collected c considerations. With regard to passing behaviors, one future study might attempt to examine whether headlight usage in oncoming vehicles leads to fewer passing attempts or to fewer failed passing attempts in a lab simulation, to better ascertain the possible applications of the present research.

References

Bar-Gera, H., Shinar, D. (2005). The tendency of drivers to pass other vehicles. *Transportation Research Part F: Traffic Psychology and Behaviour*, *8*, 429-439.

Brooks, R., Rafat, M. (2015). Simulation of driving in low-visibility conditions: Does stereopsis improve speed perception? *Perception, 44,* 145-156.

Cœugnet, S., Miller, H., Anceaux, F., Naveteur, J. (2013). How do time pressured drivers estimate speed and time? *Accident Analysis & Prevention*, *55*, 211-218.

Conchillo, A., Recarte, M., Nunes, L., Ruiz, T. (2006). Comparing speed estimations from a moving vehicle in different traffic scenarios: Absence versus presence of traffic flow. *Spanish Journal of Psychology, 9*(1), 32-37.

Evans, L. (1970). Automobile speed estimation using movie-film simulation. *Ergonomics, 13*.

Schütz, A., Billino, J., Polin, P., Khanh, T., Gegenfurtner, K. (2015). Robust underestimation of speed during driving: A field study. *Perception*, *44*, 1356-1370.