

Technical Memorandum
HuF-TM-1

April 8, 1971

SUBJECTIVE EVALUATION OF THE
FRONT-MOUNTED BRAKING SIGNAL

D.V. Post and R.G. Mortimer
Highway Safety Research Institute
The University of Michigan
Ann Arbor 48105

Technical Memorandum
HuF-TM-1
April 8, 1971

SUBJECTIVE EVALUATION OF THE FRONT-MOUNTED BRAKING SIGNAL

D.V. Post and R.G. Mortimer
Highway Safety Research Institute
The University of Michigan

SUMMARY

The concept of a braking signal visible from the front of an automobile was subjectively evaluated by means of a concept Survey and usage Questionnaire.

Thirty-six Surveys were distributed to persons who were not familiar with the front brake signal concept. The 18 respondents to this survey indicated that, generally, they thought the front brake light concept had merit, although half of them said that they would not be willing to buy a front brake lamp.

Seventeen Surveys were completed by persons who used a front brake lamp on their personal car for a period of one month. These persons also thought that the front brake light concept had merit, but were no more willing to buy a front brake lamp.

Seventeen Questionnaires were completed by the users of the front brake lamp who also received the Surveys. The questionnaire results indicated that spontaneous, purposeful communication occurred.

INTRODUCTION

At the present time vehicles are equipped with headlamps, parking lamps, and turn signal lamps at the front to provide illumination, marking and direction signaling. At the rear, vehicles are equipped with lamps for these same functions, and, in addition, with stop lamps. The concept of a stop signal to be indicated at the front has received some informal discussion but there have not been any studies conducted to evaluate such a signal.

A forward-facing stop signal may be able to provide useful information to drivers in overtaking, lane changing and other situations. At the same time the signal has some ambiguity and could lead to dangerous driver or pedestrian actions if it is not interpreted in an advisory manner.

The present study is a preliminary investigation of the attitudes of drivers to a front braking signal.

METHOD

Phase 1 consisted of distributing Surveys to 36 Highway Safety Research Institute personnel. An attempt was made to obtain a male/female balance and a wide dispersion of employee levels. These persons were all ascertained to have no knowledge of the forward brake signaling concept and completed the Survey based solely on the information contained therein. Completed Surveys were received from 18 persons.

The Survey consisted of 14 questions regarding light signaling concepts with emphasis on a front located, forward projecting foot-on-brake signal. This Survey is shown in Table 1.

Phase 2 consisted of installing the "front brake light" on the personal vehicles of 17 HSRI personnel chosen as above. The subjects agreed to have the unit installed for a minimum of one month and to complete a questionnaire at the end of the trial period (there were several refusals). At the end of the trial period the subjects were initially given the first five Survey questions and then the Questionnaire (6 Ss). The responses to these five questions induced the addition of 9 more items to the Survey. The remaining subjects (11 Ss) then were given the whole 14 item Survey and asked to complete the Questionnaire.

The Questionnaire consisted of 17 questions and 6 information items. The questions and three of the information items directly relate to the front brake light. The Questionnaire is shown in Table 2.

The lamps used in Phase 2 were "Driver Communication Signal" lamps manufactured by Disco Research, Inc. They are the size and shape of an interior rearview mirror. The lamp is designed to be mounted on the windshield, between the windshield and the rearview mirror, by means of an adhesive border. It is wired to the normal rear brake lamp wiring or the brake switch. The unit operates simultaneously with the rear brake lamps. Light is provided by means of two No-211 bulbs. These bulbs and their reflector project light forward through a slotted sunscreen and an amber plastic lens and the windshield.

RESULTS

The scoring of all forms was done in terms of frequency, as the total number (N) of responses was too small to justify use of percentages. Likewise, the variability of the number of respondents for individual questions was large as respondents tended to answer only when they thought they understood the question and had a comment to make. The miscellaneous category among the tabled responses represents responses which were not directly relevant to the question at hand.

The 18 subjects who filled out Surveys without ever having seen a forward brake signal produced the results shown in Table 1. The following are some of the more interesting findings. Five subjects felt that such a signal would be useful in indicating emergencies involving oncoming traffic on a two-lane road. The majority of subjects thought that such a signal concept had liabilities in several areas, such as: creating confusion, distraction, and over-confidence. Only 3 of 17 (17%) would be willing to purchase such an item, with 4 others being potential purchasers.

Nearly everyone thought that a forward, foot-on-brake, signal could be helpful, especially at night. Their preference was for a red grille-mounted light. Most of the subjects also thought that it would be helpful to know "how hard" someone is braking. Eight subjects thought that increasing the lighted area proportional to brake pressure would be more useful than a foot-on-brake signal, while 3 disagreed. Ten of 17 subjects (57%) indicated that they would install a foot-on-brake front brake signal if it were sent as a free sample.

The Survey results of the 17 subjects who drove for the trial period with a "front brake light" are indicated in Table 2. The users also thought that the concept had some merit along with several liabilities, such as: creating confusion, distraction, and false intent messages. They saw the indication of two-lane emergencies involving oncoming traffic as less important and pedestrian warning as more important than did the non-users. Their preference was for an amber windshield signal as opposed to the previous group's preference for a red grille signal--indicating that they were impressed with the signaling unit that was installed in their automobiles. Of this group, 5 of 11 (45%) would be willing to purchase such an item as compared to only 17% of the non-users. The majority thought that it was important to know if oncoming drivers were braking, especially at night. The majority of subjects thought that it would be helpful to know "how hard" someone is braking. Three thought that increasing light area with brake pressure would be more useful than a foot-on-brake signal, while 1 disagreed. Seven of 11 subjects (59%) indicated that they would install a foot-on-brake front brake signal if it were sent as a free sample.

The Questionnaire responses from the 17 users of the "front brake light" are given in Table 3. The majority of subjects remained conscious of the presence and operation of the unit during most of the trial period. They were not more secure with the

unit and were not convinced that it should be a standard item, even though they felt that it did increase communication to others.

Subjects reported that the signal was noticed by pedestrians, drivers approaching, drivers ahead in the same direction, and drivers approaching at 90°. The majority of the subjects thought that the purpose of the signal was to "help drivers know what other drivers are doing" and about one-half of the subjects indicated that they had used their signal light via the brake pedal to "purposely communicate to others."

Three subjects thought that the daytime brightness was "bright enough" while six thought that it was "inadequate." Most of the subjects did not think that daytime distraction or confusion was a problem. Four subjects thought that the nighttime brightness was "too bright" while one said that it was "plenty bright enough" and six reported it to be "adequate." Six subjects reported nighttime distraction while four reported confusion.

Most of the subjects indicated that they do not rest their foot on the brake pedal when driving and did not ever notice the red light indicate that they were riding the brake.

Most of the subjects reported that there were no particular conditions which affected their perception of the front brake light. However, a few subjects reported that darkness increased the signal's apparent brightness, that rain caused light reflection and scatter, and that sunlight reduced the signal's visibility.

When asked for comments and suggestions two lines of thought predominated. One group stressed the need for public education and information about the forward brake signal, and the other thought that such a device was of minimal value unless proven to be useful and costworthy.

DISCUSSION

The preference of the non-users was for a red-colored grille located "front brake light." This preference was apparently modified by use of the forward brake signaling unit as users indicated a preference for an amber light located on the windshield. It is evident that persons unfamiliar with the forward brake signaling concept did not consider the amber color and windshield location to be obviously appropriate. Thus, a conflict exists between initial preference and the effects of exposure to an alternative color and location. It should be noted that at one time blue was considered an appropriate color for a front brake light (Fisher and Bostwick, 1968).

The following propositions are supported by the data:

1. Drivers desire more driver intent and driver state information.
2. Drivers may use more self-initiated signaling if the appropriate devices were available.

The majority of non-user and user respondents thought that it would be helpful to know that someone's foot was on the brake pedal, especially at night. Also, the majority of user respondents thought that the primary purpose of the signal was to increase driver communication rather than affect accident rate, traffic flow, or driver security. Additional support for the propositions above is derived from the fact that the front brake light was used by about 50% of the user group to "purposefully communicate to others."

The daytime brightness of the particular lamp used was deemed inadequate by the majority of the user subjects. It should be noted that the need for dual (day/night) intensity signal lights has been substantiated (Mortimer, 1970). However, the majority of users indicated that it was more important to receive a braking signal at night due to the lack of visual vehicular cues.

The need for public education regarding the function of the "front brake light" and the need for proof of its utility were primary concerns expressed by the unit's users.

CONCLUSIONS

1. Some subjects felt that the front brake signal had some utility as a means of increasing inter-driver or driver-pedestrian communication.

2. The findings of this preliminary investigation suggest that a more comprehensive evaluation is warranted.

3. Objective evidence should be provided that a front brake signal will provide a greater margin of vehicular safety.

4. A study should be conducted using test vehicles to determine how this added signal will affect the performance of other drivers and pedestrians. For example, a driver whose vehicle is not slowing down may tap the brake pedal when approaching an intersection and find cars pulling out dangerously close in front of him, because the other drivers assumed that he would make a right turn.

5. If such a signal should be found to be valuable it would probably be necessary to conduct a public education campaign to explain its function.

REFERENCES

Fisher, P.M. and Bostick, R.E. Colored Signal Lights: Their History, Development, and Speculation. Color Engineering, 1968, 6, No. 1, pp. 28-33.

Mortimer, R.G. Automotive Rear Lighting and Signaling Research. Final Rept., Contract FH-11-6936, U.S. Dept. of Transportation, Highway Safety Research Inst., Univ. of Michigan, Report HuF-5, 1970.

TABLE I

SURVEY OF NON-USERS

The following questions pertain to a device called a front brake light; such a device gives a forward signal from the front of a vehicle when the driver's foot is on the brake pedal. Thus, such a device lights simultaneously with the rear brake lights and can be seen from any position forward of the device including positions ahead of and on either side of the vehicle.

1. Do you think the concept of a front-facing and front-mounted brake signal has merit? If so, why?

15=Yes. It will provide a signal that will be useful in indicating the following: two-lane on-coming emergencies, driver intentions at intersections (especially the four-way stop types), state of the vehicle, pedestrian warning, and driver intentions during merging and lane change maneuvers.
3=No. There are too many varieties of front-of-vehicle lights on the roadways now. It is more important to see the car ahead brake than the one behind.
2. In what situations do you think such a signal would be useful and in what manner would it be helpful?

8-Indicating stopping intentions at intersections.
5-Indicating emergencies involving on-coming cars on two-lane roads.
3-Indicating via the rearview mirror the actions of the driver behind you.
2-None.
1-Pedestrian warning.
6-One response recorded for each of six miscellaneous categories.
3. Do you think the concept of a front-facing front-mounted brake signal has liabilities? If so, why?

12=Yes. 6=No. See "Yes" responses per category below.

6-It will cause confusion.
3-It will cause distraction.
2-Overconfidence in the signal may result in "second guessing" of drivers intentions.
2-Its failure could present an unexpected hazard.
4. In what situations do you think such a signal would be disadvantageous and in what manner would it be a drawback?

2-None.
3-It may be confusing.
4- It may falsely represent a driver's intentions.
4-It may cause a diversion of attention.
4-One response recorded for each of four miscellaneous categories.
5. What location and color do you think such a signal should have? Why? Possibilities for location are on the grille, on the windshields behind the rearview mirror, and within other lights. Possible colors are red, amber, green and white. Other possibilities can be mentioned.

7-Grille
6-Windshield
1-Roof-line
8-Red
3-Amber
1-Green
1-White

6. Would you be willing to buy a front brake light as an additional safety item for your car?
- 3=Yes
10=No
2-If it was shown to be safer, I would.
2-If the cost was reasonable, I would.
7. Would it be helpful to you to know that someone's foot is on the brake?
- 17=Yes
0=No
1=Miscellaneous
8. Would a "foot on brake" signal be useful when compared to nighttime cues like a vehicle's "apparent speed?"
- 8=Yes
5=No
4=Miscellaneous
9. Would a "foot on brake" signal be useful when compared to daytime cues like a vehicle's "apparent speed?"
- 7=Yes
4=No
6=Miscellaneous
10. Do you think a front brake light signal is a more necessary device during daylight or darkness? Why?
- 11=Night
2=Day
1=Both
2=Neither
1=Miscellaneous
11. Would it be helpful to you to know how hard someone is braking?
- 13=Yes
4=No
12. Would an increasing light area corresponding to amount of braking pressure be more useful as a front brake light than a "foot on brake" signal? Why? Please explain!
- 8=Yes
3=No
6=Miscellaneous
13. Would a forward facing velocity display be a useful signal? Why? Please explain!
- 3=Yes
4=No
10=No response or miscellaneous response
14. At this point if a front brake light was sent to you as a free sample, would you install it (time 30-60 min.), have it installed, or neither?
- 10=Yes. Install it or have it installed.
4=No
2=If it was explained to other drivers, I would install it.
1=Miscellaneous

TABLE II
 SURVEY OF USERS
 (6 S Had Q 1-5 Only)

The following questions pertain to a device called a front brake light; such a device gives a forward signal from the front of a vehicle when the driver's foot is on the brake pedal. Thus, such a device lights simultaneously with the rear brake lights and can be seen from any position forward of the device including positions ahead of and on either side of the vehicle.

1. Do you think the concept of a front-facing and front-mounted brake signal has merit? If so, why?
 - 11=Yes. It will provide a useful signal for freeway driving, pedestrians, and oncoming and following traffic.
 - 3=No. No reasons given.

2. In what situations do you think such a signal would be useful and in what manner would it be helpful?
 - 7-Intersection
 - 1-two-lane emergency
 - 4-Driver behind
 - 5-Pedestrian
 - 2-Miscellaneous

3. Do you think the concept of a front-facing and front-mounted brake signal has liabilities? If so, why?
 - 12=Yes. 2=No. See "Yes" responses per category below.
 - 4-Confusion
 - 3-Distraction
 - 1-Failure
 - 3-False intent
 - 1-Miscellaneous

4. In what situations do you think such a signal would be disadvantageous and in what manner would it be a drawback?
 - 0-None
 - 3-Confusion
 - 3-False intent
 - 4-Diversion (distraction)
 - 2-Miscellaneous

5. What location and color do you think such a signal should have? Why? Possibilities for location are on the grille, on the windshield behind the rearview mirror, and within other lights. Possible colors are red, amber, green and white. Other possibilities can be mentioned.

7-Windshield	4-Red
4-Grille	7-Amber
1-Roof line	0-Green
1-Miscellaneous	1-White
	1-Miscellaneous

6. Would you be willing to buy a front brake light as an additional safety item for your car?
 - 5=Yes
 - 5=No

7. Would it be helpful to you to know that someone's foot is on the brake?
- 9=Yes
1=No
8. Would a "foot on brake" signal be useful when compared to nighttime cues like a vehicle's "apparent speed?"
- 6=Yes
1=No
9. Would a "foot on brake" signal be useful when compared to daytime cues like a vehicle's "apparent speed?"
- 5=Yes
3=No
10. Do you think a front brake light signal is a more necessary device during daylight or darkness? Why?
- 4-Night
0-Day
5-Both
11. Would it be helpful to you to know how hard someone is braking?
- 6=Yes
5=No
12. Would an increasing light area corresponding to amount of braking pressure be more useful as a front brake light than a "foot on brake" signal? Why? Please explain!
- 4=Yes
1=No
13. Would a forward-facing velocity display be a useful signal? Why? Please explain!
- 4=Yes
4=No
14. At this point if a front brake light was sent to you as a free sample, would you install it (time 30-60 min), have it installed, or neither?
- 7=Yes. Install it or have it installed.
3=Neither.

TABLE III
FBL - QUESTIONNAIRE

1. Were you conscious of the physical structure of the light?
3=Never
4=Only at first
2=For several days
6=For most of the trial period
2=For all of the trial period
2. Were you conscious of the light's use--
0=Only in daytime
4=Only at night
12=In both day and night
1=Never
3. I felt more secure when driving using the light, than previous to its installation. Circle: True or False.
4=True
13=False
4. I think every car should have one. Circle: True or False.
7=True
10=False
5. Did you notice a small red light on the front brake light?
Circle: Yes or No
14=Yes
3=No
6. What do you think was the purpose of the small red light, if you noticed it?
13=It is to indicate the operation of the front brake signal.
1=Don't know.
3=Didn't notice.

PLEASE COMPLETE THIS PAGE BEFORE CONTINUING

7. Do you feel that the light increased communication to others?
Circle: Yes or No.
10=Yes
6=No
1=Not sure
8. Did other people notice the front brake light? Circle: Yes or No. If yes, check all numbers corresponding to people who noticed the light.
15=Yes. 2=No. See "Yes" responses per category below.
12-1. Pedestrians
10-2. Drivers approaching in oncoming lane
7-3. Drivers approaching at 90° (intersections and driveways)
9-4. Drivers ahead of you in your lane going the same direction
4-5. Drivers making left turns in front of you
2-6. Drivers making right turns in front of you
1-7. Drivers merging
4-8. Drivers yielding

9. Why do you think or know that people in the groups checked noticed the light?

Their expressions, actions and sometimes questions indicated that the light had caught their attention.

10. Was the purpose of the front brake light to--

- 5-1. Reduce accidents
 - 3-2. Increase traffic flow
 - 16-3. Help drivers know what other drivers are doing
 - 3-4. Make drivers feel more secure in traffic.
 - 5. Other (please state here)--
 - 2-to let pedestrians know that drivers are stopping.
- PLEASE COMPLETE THIS PAGE BEFORE CONTINUING

11. Did you ever (check those that apply)

- 2-1. Refrain from braking to avoid the forward indication of braking
- 0-2. Come near to a collision because of the light
- 8-3. Use your brake purposely to communicate to others
- 0-4. Avoid having a collision because of the light
- 5. Disconnect or think about disconnecting your light for any particular situation -- please specify
 - 1-to stop gas station attendants from detaining me by asking so many questions.

12. What do you think of the daytime effectiveness of the front brake light in regard to--

- 1. Distraction
 - 2. Confusion
 - 3. Brightness
- 7-Distraction may be a problem.
4-Confusion may be a problem.
9-The lamp's brightness is inadequate.

13. What do you think of the nighttime effectiveness of the front brake light in regard to--

- 1. Distraction
 - 2. Confusion
 - 3. Brightness
- 9-Distraction is a problem.
7-Confusion is a problem.
12-The lamp is too bright.

14. Did you ever notice the small red light indicate that you were "riding the brake?" If so, circle whether Day or Night.

- 3=Yes. Both day and night.
12=No.

PLEASE COMPLETE THIS PAGE BEFORE CONTINUING

15. Did you notice any particular weather or lighting conditions which affected the front brake light or your perception of it? If so, explain.

- 7=None
- 4=Glare
- 3=Rain
- 5=Darkness
- 2=Sunlight

16. Who drove your car occasionally during the front brake light trial period?

17. Any comments and/or suggestions?

- 4=Public education is a must for successful application of this device.
- 4=This device must be proven to be useful and must be inexpensive.

A. Vehicle make, model and year--

B. Equipped with seat belts? _____ Shoulder harness? _____

C. Do you use the seat belts? _____ Shoulder harness? _____

D. Is the vehicle an automatic or manual shift? _____

E. Do you ever rest your foot on or against the brake pedal when driving?

- 2=Yes. In stop and go driving.
- 15=No.

PLEASE COMPLETE THIS PAGE BEFORE CONTINUING

F. Are you more inclined to purchase options which will reduce your chance of having an accident or options which will increase your chance of surviving accidents with minimal injury?

- 6-Options which will increase my chance of surviving accidents with minimal injury.
- 3-Options which will reduce my chance of having an accident.
- 3-Both choices are equally attractive.

Appendix A
USER INSTRUCTIONS

The light which will be installed in your car is a "windshield front brake lite." This light will be connected to your brake switch such that it goes on when your brake lights go on. It will operate automatically and in no way interferes with your brake, lights, or battery and electrical system. The light unit is shaped like your rear view mirror, and is approximately the same size. It attaches to your windshield behind the rear view mirror by means of an adhesive border and can be easily installed and removed. I would like to install the light on your car for about ten days driving time, after which I will call you to arrange a removal time for the unit. I hope that you will want to try this "completely unique experience."

Please keep this sheet on your dash or other accessible place so that you can check the appropriate time intervals that the car is put in use. Record one check for each vehicle trip.

Thank you.

DRIVER'S LOG

Times Driven	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.
To Work (7-8 a.m.)														
Morning														
Noon														
Afternoon														
To Home (5-6 p.m.)														
Even. (Before Dk.)														
Night (After Dark)														

Times Driven	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.
To Work (7-8 a.m.)														
Morning														
Noon														
Afternoon														
To Home (5-6 p.m.)														
Even. (Before Dk.)														
Night (After Dark)														

P.S. An evaluative questionnaire will be provided after the trial period.

