# A10 / STUDY 3 - TEST INSTRUCTIONS

Before we begin, I would like you to become familiar with this vehicle. Please adjust your seat, steering wheel, and mirrors so that you are comfortable and prepared to drive. Please make sure that your seat belt is securely fastened

Our session today will be conducted on this test track which is closed to all other traffic during the session. This study is being conducted jointly by General Motors and Ford. That is why we are having you drive a Ford Taurus today. The passengers that will be in the car with you are (Test Driver Name) who is a trained General Motors Proving Ground test driver and myself. And I will be giving you directions as we go through the testing session.

The purpose of this study is to examine the distance a driver normally follows the vehicle ahead under a variety of conditions. The conditions will be at speeds ranging from 30 to 60 mph. This information will be used to understand how to design a feature for cars that would automatically adjust the distance between your vehicle and the vehicle ahead. This feature will be used to enhance the cruise control feature on an automobile.

There will be a total of four segments to your session today. During these segments you will be asked to follow the lead car at your normal following distance. The lead car will be travelling at 30, 40, 50, or 60 mph. At each of these four speeds, you will follow the lead vehicle at your normal following distance for approximately 15 minutes. This driving period will allow the computerized distance control feature to “learn” how you like to drive normally. After this learning period, you will drive with the vehicle’s cruise control system and the new distance control feature controlling the vehicles speed and following distance. After experiencing the distance control feature at each speed we will ask you questions regarding your preferences about the system.

At no time during the session are we going to ask you perform any unsafe driving actions. In addition, we would like you to know that there are a number of precautions we have taken to ensure your safety today. Your test-driver passenger (Name), has access to passenger-side brakes in the event of an emergency. Also, the vehicle you are following is constructed of a “soft” material that is designed to not cause injury to other vehicles or their occupants when struck. All of our procedures have been designed with safety as the top priority.

Do you have any questions so far?

# A11 / STUDY 3 - NAME THE SYSTEM QUESTIONNAIRE

The purpose of this research is to understand how to properly design a feature that would reduce one common type of accident. This accident type occurs when a driver is following another car on a straight road, and then crashes into the back end of that car.

Now that you have some idea about what such a feature would be like, we would like your opinion about what to name the feature. Listed below are names that have been proposed for the new system. When picking the name, please keep in mind that this feature is not designed to detect pedestrians, and this feature would occasionally alert or warn the driver under conditions that pose no threat to the driver.

Please choose three names that you think would be good choices. Number your choices 1 (best), 2 (second best), and 3 (third best).

_____ Forward Collision Warning System

_____ Forward Collision Alert System

_____ Forward Crash Warning System

_____ Forward Crash Alert System

_____ Front-end Collision Warning System

_____ Front-end Collision Alert System

_____ Rear-end Collision Warning System

_____ Rear-end Collision Alert System

# A12 / STUDY 4-SUBJECT INFORMATION LETTER

Dear Participant,

Last year (between mid-August and mid-October) you participated in a research project that was conducted at the Milford Proving Grounds in Milford, Michigan. That project examined driver's braking maneuvers, and is one of a continuing program of research being conducted by Ford and GM. You are now being asked to participate in research that will examine the distance a driver normally follows the vehicle ahead under a variety of situations. The data from this study will provide us with an essential building block for understanding how to design a feature for cars that would automatically adjust the distance between your vehicle and the vehicle ahead. This feature can be thought of as an enhancement to the cruise control feature, which is offered to enhance driver's comfort in many current vehicles.

As a test participant, you will drive a real car at speeds ranging from 30-60 mph. As a safety precaution, the object you will be driving behind is an "artificial" rear-end of a vehicle. This "artificial car" will be towed about 40 feet (or one and one half car lengths) behind a real car. You will be asked to simply follow this artificial car at your normal following distance under a variety of conditions. The passenger in the car you will be driving will be a trained General Motors Milford Proving Ground test driver. The test driver will have access to passenger-side brakes and will override your braking in the event it becomes necessary. If you do collide with the lead vehicle, you should know that the artificial car is constructed of a material such that, if struck, it is designed not to cause injury to either the test participant or researchers. During the testing you will be asked to complete a questionnaire about your experience. At no time will you be asked to perform any unsafe driving actions.

You must have a valid, unrestricted, U.S. drivers license (except for corrective eye glasses), have a minimum of 2 years driving experience, be 20 years of age or older, have normal hearing and vision (with correction allowed), be able to drive an automatic transmission vehicle without assistive devices or special equipment, be able to give informed consent, and not be under the influence of alcohol, drugs, or any other substances (e.g., antihistamines) which may impair your ability to drive.

In addition you must not have a history of heart condition or prior heart attack, lingering effects of brain damage from stroke, tumor, head injury, or infection, epileptic seizures in the past 12 months, shortness of breath or chronic medical therapy for respiratory disorders, a history of motion sickness, a history of inner ear problems, dizziness, vertigo, or balance problems, diabetes for which insulin is required, chronic migraine or tension headaches, or be pregnant. You must not have used alcohol, drugs, or any other substances (e.g., antihistamines) which will impair your ability to drive for a period of no less than 24 hours prior to participation.

**Risks:** There are some risks and discomforts to which you expose yourself in volunteering for this research. This includes the risk of an accident normally associated with driving and braking a vehicle in response to a stopped or slowing lead vehicle. Unlike in normal driving, this stopped or slowing lead vehicle will be an artificial vehicle attached to a collapsible beam, and your

passenger will be a trained General Motors Milford Proving Ground test driver. This test driver will have access to passenger-side brakes and will override your braking in order to avoid collisions with the artificial car. If an accident does occur, the experimenters will arrange medical transportation to the Milford Proving Ground Medical facility. You will be required to undergo examination by medical personnel there. You will be responsible for making arrangements for payment of subsequent treatment.

**Benefits**: There are no direct benefits to you from this research other than compensation for your time and effort. However, by participating in this study, you are lending your experience as a driver to research aimed at understanding how to properly design a feature for cars which would automatically adjust the distance between a driver's vehicle and the vehicle ahead. You will not be informed as to the results of this study.

**Payment**: You will be paid $150 for participation in this study. The study will take about 2-2 ½ hours. Payment will be made by check at the time of participation.

**Withdrawal:** Participation in this study is voluntary. You may withdraw at anytime, for any reason, without penalty. Should you withdraw, you will still be paid in full.

**Confidentiality**: The data gathered in this study will be treated with anonymity. Shortly after you have participated, your name will be separated from your data and it will be given a number. Only the Principle Investigator will have access to this coding information. Your name will not appear in any reports or papers written about the project. Any videotapes of the data, which will include video of the your head and face, will be kept until they are no longer needed. Confidentiality of this video information will be protected.

The researchers hope that you will agree to participate in this study. If you have any questions, please feel free at any time to ask the experimenter.

Once you have had your questions answered, please let the experimenter know whether you are interested in participating in this study. If you are willing to participate, the experimenter will ask you some questions to ensure that your background and experience match our research needs. If it is determined that you qualify to participate, you will be asked to read and sign an Informed Consent Form before you can actually participate in the study.

# A13 / STUDY 4 - INFORMED CONSENT

I, _____, agree to participate in research aimed at understanding how to properly design a feature for cars which would automatically adjust the distance between a driver's vehicle and the vehicle ahead.

1. You are being asked to volunteer to be a subject in a research project whose purpose and description are contained in the Information Letter. The purpose of this research program is to understand how to properly design a feature for cars that would automatically adjust the distance between a driver's vehicle and the vehicle ahead. As a test participant, you will drive a real car at speeds ranging from 30-60 mph. As a safety precaution, the object you will be driving behind is an "artificial" rear-end of a vehicle. This "artificial car" will be towed about 40 feet (or one and one half car lengths) behind a real car. You will be asked to simply follow this artificial car at your normal following distance under a variety of conditions. The passenger in the car you will be driving will be a trained General Motors Milford Proving Ground test driver. The test driver will have access to passenger-side brakes and will override your braking in the event it becomes necessary. If you do collide with the lead vehicle, you should know that the artificial car is constructed of a material such that, if struck, it is designed not to cause injury to either the test participant or researchers. During this testing, you will be asked to complete a questionnaire about your experience. At no time will you be asked to perform any unsafe driving actions.

There are some risks and discomforts to which you expose yourself in volunteering for this research. These include the risk of an accident normally associated with driving and braking a vehicle in response to a stopped or slowing lead vehicle. Unlike in normal driving, this stopped or slowing lead vehicle will be an artificial vehicle attached to a collapsible beam, and your passenger will be a trained General Motors Milford Proving Ground test driver. This test driver will have access to passenger-side brakes and will override your braking in order to avoid collisions with the artificial car.

3. The following precautions will be taken during your drive:

The experimenter will always be present in the test vehicle and will monitor your driving. They will ask you to discontinue participation if they feel the risks are too great to continue. However, as long as you are driving the research vehicle, it remains your responsibility to drive in a safe, legal manner.

The front seat experimenter will have an override brake pedal.

The vehicle is equipped with a driver-side airbag and anti-lock brakes. Air bags inflate with great force, faster than the blink of an eye. If you're too close to an inflating air bag, it could seriously injure you. Safety belts help you keep in position before and during a crash. You should always wear your safety belt, even with air bags. You will be required to wear your lap and shoulder belt system during this test anytime the car is moving. You should sit as far back as possible while still maintaining control of the vehicle.

The vehicle is equipped with a fire extinguisher and first-aid kit. The lead vehicle has a cellular phone.

If an accident does occur, the experimenters will arrange medical transportation to the Milford Proving Ground Medical facility. You will be required to undergo examination by medical personnel in the emergency room. You will be responsible for making arrangements for payment of the expenses of such treatment.

Trained medical personnel will be immediately accessible by phone at all times during testing.

4. The data gathered in this study will be treated with anonymity. Shortly after you have participated, your name will be separated from your data and it will be given a number. Only the Principle Investigator will have access to this coding information. Your name will not appear in any reports or papers written about the project. Any videotapes of the data, which will include video of your head and face, will be kept until they are no longer needed. Confidentiality of this video information will be protected. It is possible that, should you be involved in an accident during testing that the researchers will have to release your data on your driving in response to a court order.

5. You will be paid $150 for participation in this study. The study will take about 2-2 ½ hours. Payment will be made by check at the time of participation.

There are no direct benefits to you from this research other than payment. However, by participating in this study, you are lending your experience as a driver to research aimed at understanding how to properly design a feature for cars which would automatically adjust the distance between a driver's vehicle and the vehicle ahead. You will not be informed as to the results of this study.

7. By agreeing to participate, you certify that you possess a valid, unrestricted, U.S. drivers license (except for corrective eye glasses), have a minimum of 2 years driving experience, be 20 years of age or older, have normal hearing and vision (with correction allowed), are able to drive an automatic transmission vehicle without assistive devices or special equipment, are able to give informed consent and are not under the influence of alcohol, drugs, or any other substances (e.g., antihistamines) which may impair your ability to drive. You also certify that you do not have a history of heart condition or prior heart attack, lingering effects of brain damage from stroke, tumor, head injury, or infection, epileptic seizures in the past 12 months, shortness of breath or chronic medical therapy for respiratory disorders, a history of motion sickness, a history of inner ear problems, dizziness, vertigo, or balance problems, diabetes for which insulin is required, chronic migraine or tension headaches, or are pregnant. Additionally, you have not used alcohol, drugs, or any other substances (e.g., antihistamines) which will impair your ability to drive for a period of no less than 24 hours prior to participation.

8. The experimenters will answer any question that you might have about this project and you should not sign this informed consent form until you are satisfied that you understand all of the previous descriptions and conditions. You may contact the principal investigator at the following address and telephone number:

**Raymond J. Kiefer, Ph.D.**
**CAMP**
**Discovery Centre**
**39255 Country Club Drive**
**Suite B-30**
**Farmington Hills, MI 48331**
**(248) 848-9595 ext. 15**

9. If information becomes available which might reasonably be expected to affect your willingness to continue participating in this study, this information will be provided to me.

10. Participation in this study is voluntary. You may withdraw from this study at any time, and for any reason, without penalty. Should you withdraw, you will still be paid in full.

11. By signing this form you certify, to the best of your knowledge, you have no physical ailments or conditions which could either be further aggravated or adversely affected by participation in this study.

I have read and understand the scope of this research program and I have no other questions at this time. I understand that I am free to ask questions at any time. I hereby give my consent to participate, but I understand that I may stop at anytime, if I choose to do so.

Participant:

Name:_____

Address:_____

Telephone:_____

Signature:_____ Date:_____

Researcher:

Signature:_____ Date:_____

# A14 / STUDY 4 - PART 1 TEST INSTRUCTIONS

Before we begin, I would like you to become familiar with this vehicle. Please adjust your seat, steering wheel, and mirrors so that you are comfortable and prepared to drive. Please make sure that your seat belt is securely fastened.

Our session today will be conducted on this test track which is closed to all other traffic during the session. This study is being conducted jointly by General Motors and Ford. That is why we are having you drive a Ford Taurus today. The passengers that will be in the car with you are (Test Driver Name) who is a trained General Motors Proving Ground test driver and myself. And I will be giving you directions as we go through the testing session.

The purpose of this study is to examine the distance a driver normally follows the vehicle ahead under a variety of conditions. The conditions will be at speeds ranging from 30 to 60 mph. This information will be used to understand how to design a feature for cars that would automatically adjust the distance between your vehicle and the vehicle ahead. This feature will be used to enhance the cruise control feature on an automobile.

There will be a total of four segments to your session today. During these segments you will be asked to follow the lead car at your normal following distance. The lead car will be traveling at either 30, 40, 50, or 60 mph. At each of these four speeds, you will follow the lead vehicle at your normal following distance for approximately 15 minutes. This driving period will allow the computerized distance control feature to "learn" how you like to drive normally. After this learning period, you will drive with the vehicle's cruise control system and the new distance control feature controlling the vehicle speed and following distance. After experiencing the distance control feature at each speed we will ask you questions regarding your preferences about the system.

At no time during the session are we going to ask you perform any unsafe driving actions. In addition, we would like you to know that there are a number of precautions we have taken to ensure your safety today. Your test-driver passenger (Name), has access to passenger-side brakes in the event of an emergency. Also, the vehicle you are following is constructed of a "soft" material that is designed to not cause injury to other vehicles or their occupants when struck. All of our procedures have been designed with safety as the top priority.

Do you have any questions so far?

# A15 / STUDY 4 - PART 2 TEST INSTRUCTIONS

We would like now to go over the instructions for the rest of the study. The real purpose of this study is to understand both when and how to present crash warning information to drivers. Throughout the test, you will be asked to brake in response to crash alerts while approaching the lead "artificial" car. This lead car will be moving. The lead car will be traveling either at 30, 45, or 60 mph. You should follow the lead vehicle, maintaining your normal following distance just as you did before. Please accelerate in a comfortable, quick manner to reach your normal following distance. The lead car driver will brake with various braking intensities throughout the test, ranging from normal braking to relatively hard braking.

It is extremely important that you keep your foot on the accelerator and maintain a steady speed until the crash alert is presented. Once the crash alert is presented, please quickly move your foot from the accelerator to the brake, and brake the car to a complete stop such that you do not collide with the lead "artificial car". Please brake the car in any way you are comfortable and that you feel is appropriate to avoid colliding with the artificial car. Once again, it is extremely important that you keep your foot on the accelerator and maintain a steady speed until the crash alert occurs.

The test driver will have access to passenger-side brakes. When necessary, the test driver will override your braking to avoid collisions with the lead car. Should this occur, please do not be concerned of frustrated, just do the best you can.

If you now have any questions about the test, please do not hesitate to ask.

# A16 / THE TIME-COURSE OF THE BRAKE PULSE ALERT

**Table 1 The Time-Course of the Brake Pulse Alert Using 7 Samples at Each Speed With the Highest and Low Values Removed at Each Speed to Reduce Effect of Extreme Values**

| Brake Pulse Measure | Speed | | | | | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | 30 mph | | 45 mph | | 60 mph | | | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Time between alert criterion violation and start of pulse (sec) | 0.34 | 0.07 | 0.26 | 0.03 | 0.31 | 0.12 | 0.30 | 0.08 |
| Time between alert criterion violation and attaining -0.10 g's due to pulse (sec) | 0.42 | 0.07 | 0.37 | 0.02 | 0.43 | 0.09 | 0.41 | 0.07 |
| Time between alert criterion violation and attaining -0.20 g's due to pulse (sec) | 0.49 | 0.07 | 0.47 | 0.06 | 0.54 | 0.07 | 0.50 | 0.07 |
| Time between alert criterion violation and attaining peak deceleration level due to pulse (sec) | 0.60 | 0.08 | 0.53 | 0.00 | 0.60 | 0.07 | 0.58 | 0.06 |
| Time between alert criterion violation and end of pulse (sec) | 0.91 | 0.08 | 0.87 | 0.02 | 0.93 | 0.12 | 0.90 | 0.08 |
| Peak deceleration value attained due to brake pulse (g) | 0.26 | 0.01 | 0.23 | 0.01 | 0.23 | 0.02 | 0.24 | 0.02 |

**Table 2 Time-Course of the Brake Pulse Alert Using All 7 Samples at Each Speed**

| Brake Pulse Measure | Speed | | | | | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | 30 mph | | 45 mph | | 60 mph | | | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Time between alert criterion violation and start of pulse (sec) | 0.38 | 0.16 | 0.27 | 0.05 | 0.31 | 0.13 | 0.32 | 0.12 |
| Time between alert criterion violation and attaining -0.10 g's due to pulse (sec) | 0.46 | 0.17 | 0.37 | 0.03 | 0.43 | 0.12 | 0.42 | 0.12 |
| Time between alert criterion violation and attaining -0.20 g's due to pulse (sec) | 0.53 | 0.16 | 0.47 | 0.06 | 0.53 | 0.11 | 0.51 | 0.12 |
| Time between alert criterion violation and attaining peak deceleration level due to pulse (sec) | 0.64 | 0.16 | 0.53 | 0.02 | 0.60 | 0.09 | 0.59 | 0.11 |
| Time between alert criterion violation and end of pulse (sec) | 0.95 | 0.17 | 0.88 | 0.06 | 0.92 | 0.14 | 0.92 | 0.13 |
| Peak deceleration value attained due to brake pulse (g) | 0.26 | 0.02 | 0.23 | 0.02 | 0.24 | 0.02 | 0.24 | 0.02 |

# A17 / DETAILED BREAKDOWN OF DRIVERS' RESPONSES

**Table 3 Detailed Breakdown of Drivers' Responses to the Alert Noticeability Questionnaire for Study 3 and Study 4 (Study 4 shown in parentheses)**

| Post-Surprise Trial Question and Driver's Response | Crash Alert Type | | | | |
|---|---|---|---|---|---|
| | **HHDD + Non-Speech** | **HHDD Flashing + Non-Speech** | **HHDD + Speech** | **HUD + Non-Speech** | **HHDD + Non-Speech + Br. Pulse** |
| *If the driver noticed visual alert?* Yes | 5/12 (3/12) | 8/12 (10/12) | 3/12 | 10/12 | 4/12 |
| *What color was the indicator?* | | | | | |
| Red, Orange, or Amber for HHDD | 4/12 (3/12) | 5/12 (7/12) | 2/12 | | 4/12 |
| Blue or Green for HUD | | | | 9/12 | |
| *Where was indicator located?* (Correct) | 3/12 (2/12) | 5/12 (7/12) | 1/12 | 9/12 | 1/12 |
| *Were there letters or a picture, or letter and picture on the indicator?* | | | | | |
| Letters Only | 1/12 (0/12) | 1/12 (1/12) | 0/12 | 3/12 | 2/12 |
| Picture Only | 0/12 (1/12) | 0/12 (2/12) | 0/12 | 1/12 | 0/12 |
| Letter + Picture | 0/12 (2/12) | 2/12 (1/12) | 0/12 | 4/12 | 0/12 |
| *If you saw letters, what word or words did they spell?* "Warning" | 1/12 (2/12) | 2/12 (1/12) | 0/12 | 5/12 | 1/12 |
| *If you saw a picture, please draw or describe the picture?* | | | | | |
| Star (part correct) | 0/12 | 0/12 | 0/12 | 1/12 | 0/12 |
| Arrows + Star | 0/12 | 0/12 | 0/12 | 1/12 | 0/12 |
| Other | 0/12 (3/12) | 2/12 (3/12) | 0/12 | 3/12 | 0/12 |
| *If the driver noticed the auditory alert?* Yes | 12/12 (12/12) | 12/12 (12/12) | 11/12 | 12/12 | 11/12 |
| *What was the type of sound you noticed?* (Correct) | 12/12 (12/12) | 12/12 (12/12) | 11/12 | 12/12 | 11/12 |
| *Please describe the sound.* Tone | 12/12 (12/12) | 12/12 (12/12) | N/A. | 12/12 | 11/12 |
| *Please say the word.* "Warning" | N/A. | N/A. | 10/12 | N/A. | N/A. |
| *If driver noticed the brake pulse alert?* Yes | N/A. | N/A. | N/A. | N/A. | 12/12 |
| *Please describe sensation.* | N/A. | N/A. | N/A. | N/A. | |
| Braking | | | | | 1/12 |
| Jerk | | | | | 1/12 |
| Vehicle Hesitation | | | | | 4/12 |
| Like ABS | | | | | 1/12 |
| Bump | | | | | 2/12 |
| Pulse-like sensation-related description provided, however, unlike the descriptions provided above, drivers were unsure of source of sensation | | | | | 3/12 |