U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

DOT HS 808 (TBD) **September, 2000**

Preliminary Studies in Haptic Displays for Rear-End Collision Avoidance System and Adaptive Cruise Control System Applications

Dependent Variable: TOTSTOP, Best Model with Test Participant Effects, Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	2984.88737307	2984.88737307	28.52	0.0001
X2	1	2456.35100323	2456.35100323	23.47	0.0001
X3	1	1177.25693889	1177.25693889	11.25	0.0017
X4	1	690.18508889	690.18508889	6.59	0.0140
X5	1	70.84467222	70.84467222	0.68	0.4154
X6	1	3161.73567230	3161.73567230	30.21	0.0001
X7	1	5.22227500	5.22227500	0.05	0.8244
Error	41	4291.65743535	104.67457159		
Corrected Total	48	21037.46611020			

R-Square	C.V.	Root MSE	TOTSTOP Mean
0.795999	13.20759	10.23105916	77.46346939

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	76.34777778	22.39	0.0001	3.41035305
X1	-9.89412187	-5.34	0.0001	1.85282276
X2	-8.77407627	-4.84	0.0001	1.81124328
X3	16.17444444	3.35	0.0017	4.82296754
X4	12.38444444	2.57	0.0140	4.82296754
X5	3.96777778	0.82	0.4154	4.82296754
X6	-30.04837840	-5.50	0.0001	5.46737492
X7	1.15969651	0.22	0.8244	5.19200470

Dependent Variable: TOTSTOP,Best Model without Test Participant Effects, Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	4678.62800817	4678.62800817	16.56	0.0002
X2	1	3916.81564649	3916.81564649	13.86	0.0005
Error	46	12999.20451994	282.59140261		
Corrected Total	48	21037.46611020			

R-Square	C.V.	Root MSE	TOTSTOP Mean
0.382093	21.70114	16.81045516	77.46346939

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	79.12853405	32.67	0.0001	2.42187599
X1	-12.18335333	-4.07	0.0002	2.99424307
X2	-10.95158512	-3.72	0.0005	2.94164249

Dependent Variable: BRKSTOP, 'Best' Model with Test Participant Effects, Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	1156.76089798	1156.76089798	15.44	0.0003
X2	1	755.24455923	755.24455923	10.08	0.0028
X3	1	769.75800556	769.75800556	10.28	0.0026
X4	1	504.34880000	504.34880000	6.73	0.0131
X5	1	52.94205000	52.94205000	0.71	0.4054
X6	1	3255.86173151	3255.86173151	43.47	0.0001
X7	1	0.61906441	0.61906441	0.01	0.9280
Error	41	3070.92297646	74.90056040		

R-Square	C.V.	Root MSE	BRKSTOP Mean
0.788667	13.60969	8.65451099	63.59081633

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	63.20555556	21.91	0.0001	2.88483700
X1	-6.15935280	-3.93	0.0003	1.56731328
X2	-4.86519212	-3.18	0.0028	1.53214097
X3	13.07888889	3.21	0.0026	4.07977560
X4	10.58666667	2.59	0.0131	4.07977560
X5	3.43000000	0.84	0.4054	4.07977560
X6	-30.49237391	-6.59	0.0001	4.62488346
X7	-0.39928445	-0.09	0.9280	4.39194623

Dependent Variable: BRKSTOP, 'Best' Model without Test Participant Effects, Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	2229.83746924	2229.83746924	9.37	0.0037
X2	1	1599.36570250	1599.36570250	6.72	0.0127
Error	46	10947.62003816	237.99173996		

R-Square	C.V.	Root MSE	BRKSTOP Mean
0.246613	24.25976	15.42698091	63.59081633

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	64.70588233	29.11	0.0001	2.22255937
X1	-8.41093323	-3.06	0.0037	2.74782154
X2	-6.99816707	-2.59	0.0127	2.69954990

APPENDIX F

”BEST” RESPONSE SURFACE MODELING RESULTS FOR NO DISTRACTION CONDITION

F.1 "BEST" RESPONSE SURFACE MODELING RESULTS FOR NO DISTRACTION CONDITION

Note: In all models provided below,

X1 = coded variable for Jerk Rate
- -1 signifies 0. 08 g/s
- 0 signifies 0.20 g/s
- +1 signifies 0.32 g/s

X2 = coded variable for Duration
- -1 signifies 0.25 seconds
- 0 signifies 0.65 seconds
- +1 signifies 1.0 second

X3 through X7, when used, are binary (0, 1) indicator variables for Subject Effects (i.e., effects attributable to variation among the test participants or subjects).

Dependent Variable: ACCELRT, 'Best' Model with Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	0.49337194	0.49337194	12.94	0.0009
X3	1	0.34742290	0.34742290	9.11	0.0045
X4	1	0.03373378	0.03373378	0.88	0.3528
X5	1	0.00810000	0.00810000	0.21	0.6475
X6	1	0.01111441	0.01111441	0.29	0.5924
X7	1	0.00455625	0.00455625	0.12	0.7315
Error	38	1.44870878	0.03812392		

R-Square	C.V.	Root MSE	ACCELRT Mean
0.467934	33.66439	0.19525346	0.58000000

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	0.5760273475	8.32	0.0001	0.06919939
X1	-.1382187803	-3.60	0.0009	0.03842188
X3	0.3054012239	3.02	0.0045	0.10116733
X4	-.0893606809	-0.94	0.3528	0.09499761
X5	-.0450000000	-0.46	0.6475	0.09762673
X6	0.0609039206	0.54	0.5924	0.11279782
X7	-.0337500000	-0.35	0.7315	0.09762673

Dependent Variable: ACCELRT,'Best' Model without Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	0.52809191	0.52809191	10.35	0.0025
Error	43	2.19470809	0.05103972		

R-Square	C.V.	Root MSE	ACCELRT Mean
0.193952	38.95168	0.22591973	0.58000000

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	0.5985784314	17.52	0.0001	0.03416980
X1	-.1393382353	-3.22	0.0025	0.04331813

Dependent Variable: MAXPEDF,‘Best’ Model with Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	1026.98572238	1026.98572238	2.53	0.1199
X2	1	3466.03764190	3466.03764190	8.55	0.0059
X3	1	7805.44199872	7805.44199872	19.27	0.0001
X4	1	13100.32356406	13100.32356406	32.33	0.0001
X5	1	3447.15765625	3447.15765625	8.51	0.0060
X6	1	16097.18438114	16097.18438114	39.73	0.0001
X7	1	1861.70675625	1861.70675625	4.60	0.0387
Error	37	14990.71702654	405.15451423		

R-Square	C.V.	Root MSE	MAXPEDF Mean
0.828694	15.18662	20.12845037	132.54066667

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	149.3447672	20.87	0.0001	7.15616270
X1	6.3792082	1.59	0.1199	4.00677462
X2	11.4926544	2.92	0.0059	3.92928972
X3	-45.8412399	-4.39	0.0001	10.44402604
X4	-55.7803227	-5.69	0.0001	9.80957863
X5	-29.3562500	-2.92	0.0060	10.06422518
X6	73.3871770	6.30	0.0001	11.64274978
X7	-21.5737500	-2.14	0.0387	10.06422518

Dependent Variable: MAXPEDF,‘Best’ Model without Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	7965.12461585	7965.12461585	4.43	0.0412
X2	1	5765.44620115	5765.44620115	3.21	0.0804
Error	42	75435.81926650	1796.09093492		

R-Square	C.V.	Root MSE	MAXPEDF Mean
0.137961	31.97533	42.38031306	132.54066667

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	128.2759829	19.64	0.0001	6.53010221
X1	17.2819189	2.11	0.0412	8.20653520
X2	14.7032093	1.79	0.0804	8.20653520

Dependent Variable: TOTSTOP, ‘Best’ Model with Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	3249.33480058	3249.33480058	39.90	0.0001
X2	1	3018.42336892	3018.42336892	37.06	0.0001
X3	1	3971.01992975	3971.01992975	48.76	0.0001
X4	1	255.11310461	255.11310461	3.13	0.0850
X5	1	71.99522500	71.99522500	0.88	0.3532
X6	1	2414.16408742	2414.16408742	29.64	0.0001
X7	1	18.16890625	18.16890625	0.22	0.6395
Error	37	3013.33987601	81.44161827		

R-Square	C.V.	Root MSE	TOTSTOP Mean
0.863594	11.11571	9.02450100	81.18688889

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	79.51149160	24.78	0.0001	3.20843365
X1	-11.34701956	-6.32	0.0001	1.79641954
X2	-10.72491326	-6.09	0.0001	1.76167953
X3	32.69705504	6.98	0.0001	4.68253252
X4	7.78406395	1.77	0.0850	4.39808085
X5	4.24250000	0.94	0.3532	4.51225050
X6	-28.42029721	-5.44	0.0001	5.21997496
X7	2.13125000	0.47	0.6395	4.51225050

Dependent Variable: TOTSTOP,‘Best’ Model without Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	6212.10300766	6212.10300766	18.79	0.0001
X2	1	3051.61454492	3051.61454492	9.23	0.0041
Error	42	13883.66523515	330.56345798		

R-Square	C.V.	Root MSE	TOTSTOP Mean
0.371525	22.39451	18.18140418	81.18688889

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	84.64810066	30.22	0.0001	2.80145235
X1	-15.26212480	-4.34	0.0001	3.52065199
X2	-10.69696351	-3.04	0.0041	3.52065199

Dependent Variable: BRKSTOP, 'Best' Model with Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	835.36827322	835.36827322	18.81	0.0001
X2	1	1561.18511770	1561.18511770	35.16	0.0001
X3	1	1898.27293343	1898.27293343	42.75	0.0001
X4	1	336.97974860	336.97974860	7.59	0.0091
X5	1	43.95690000	43.95690000	0.99	0.3262
X6	1	2454.10071468	2454.10071468	55.27	0.0001
X7	1	17.32640625	17.32640625	0.39	0.5360
Error	37	1642.77229219	44.39925114		

R-Square	C.V.	Root MSE	BRKSTOP Mean
0.873719	9.827422	6.66327631	67.80288889

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	66.51706516	28.08	0.0001	2.36895978
X1	-5.75338665	-4.34	0.0001	1.32639353
X2	-7.71313464	-5.93	0.0001	1.30074311
X3	22.60668759	6.54	0.0001	3.45736656
X4	8.94626817	2.75	0.0091	3.24734054
X5	3.31500000	1.00	0.3262	3.33163815
X6	-28.65440624	-7.43	0.0001	3.85418934
X7	2.08125000	0.62	0.5360	3.33163815

Dependent Variable: BRKSTOP,'Best' Model without Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X1	1	2381.34187203	2381.34187203	10.67	0.0022
X2	1	1750.63841884	1750.63841884	7.84	0.0077
Error	42	9376.44079554	223.24859037		

R-Square	C.V.	Root MSE	BRKSTOP Mean
0.279224	22.03668	14.94150563	67.80288889

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	70.14308642	30.47	0.0001	2.30223781
X1	-9.44945042	-3.27	0.0022	2.89327716
X2	-8.10203106	-2.80	0.0077	2.89327716

APPENDIX G

TEST PARTICIPANT CONSENT FORM

G.1 TEST PARTICIPANT CONSENT FORM

Title of Study: **Haptic Display Study No. 1b**

Study Description: Rear-end crashes are among the most common types of crashes. Research is under way into ways to use sensors and computer technology to detect potential crash hazards and warn a driver in time to avoid such hazards. Various auditory displays (tones) and visual displays (lights) have been proposed as rear-end crash warning displays. However, it may also be possible to warn the driver by a display that is felt rather than seen or heard. One type of 'felt' display is called active steering. In this display, a computer vibrates the steering wheel for very brief period of time to alert the driver of a possible hazard ahead. This vibration serves only as an alert; it does not provide steering input to the vehicle or affect its trajectory.

Haptic display systems are those which use tactile means to provide the driver with information. Haptic displays being developed for use in cars and trucks can be used in lieu of auditory or visual displays to call the driver's attention to urgent information. Such systems allow a driver to receive information without diverting his eyes from the roadway, and use this information to perform the driver's primary job of safely controlling the vehicle. The National Highway Traffic Safety Administration (NHTSA) is conducting research to measure the effects on driver performance of using such display methods. One area of research is the effect on driver behavior and performance when these displays advise drivers in a car following situation that their time headway to a lead vehicle has fallen below a predetermined limit.

As a participant, you will be shown a haptic display system, and oriented on the actions you are to take when the display occurs. The display system in this study, referred to as Active Steering, is a proposed method of alerting a driver to an imminent crash with a vehicle or object ahead of them. Active Steering provides a brief steering wheel vibration to alert the driver of a need to brake the vehicle. As soon as you perceive an active steering event, bring the vehicle to a controlled stop. We will measure the elapsed time from display presentation to brake application.

The purpose of today's testing is to help determine what might be the most appropriate type of Active Steering Display. You will be driving an instrumented vehicle on the TRC Skid pad at a speed of 45 mph. You will be driving under conditions where you are working on a distracting in-vehicle task and under conditions where you are only driving. **From time to time, an active steering event will be presented. As soon as you perceive an active steering event, bring the vehicle to a controlled stop.** You will then be asked to rate the particular presentation of active steering in terms of appropriateness as a warning. The rating scales will be presented to you later in this session. Do you have any questions about the intent of the study and the procedure?

You will also receive training on how to complete destination entry tasks with a commercially available route guidance system. The experimenter will show you a set of "target" destinations that you are to write down on individual 4x6 index cards so that you will be able to use them for destination entry during practice as well as while driving on the TRC skid pad. You will have an opportunity to practice entering destinations with the system in a parked vehicle and ask any questions you wish of the experimenter.

The experimenter will accompany you during all testing. During testing, you will be asked to wear protective headphones to shield you from potentially distracting sounds. These headphones contain speakers through which you will hear modified ocean sounds to mask any remaining unwanted noise. The ride-along experimenter will be responsible for all radio communications with the control tower and other test units. You will be asked to drive a series of laps in an assigned lane on the TRC skid pad. When you are not in a turnaround loop, the ride-along experimenter will ask you to maintain a speed of 45 mph. Periodically, the haptic display system will signal you to apply the vehicle's brakes. This signal can be expected to vary slightly with each occurrence, but will always be characterized by a brief, automatic vibration of the vehicle's steering wheel. This vibration will not affect your ability to steer and control the vehicle. After you have then applied the brakes, the experimenter will ask you a series of questions about the appropriateness of the display as a warning. As the headphones may make it difficult to hear the experimenter, he will show you cards containing lists of descriptions of the display's appropriateness, from which you will be asked to choose that which matches your opinion. After the experimenter records your responses, you will continue with the next trial and rating. The ride-along experimenter will also periodically hand you a 4x6 index card with a destination written on it, a signal that you are to enter that destination into the route guidance system, WHEN AND IF YOU BELIEVE IT IS SAFE TO DO SO GIVEN THE CURRENT DRIVING CONDITIONS ON THE SKID PAD. The experimenter may sometimes ask you to begin a destination entry task, then subsequently determine that it is not necessary to complete that task. After you have completed a series of laps, you will return to Building 60. The complete series of orientations and trials will take approximately four hours.

You, as the driver of the test vehicle, are responsible for maintaining safety at all times. Do not perform any task which you believe would be unsafe. Remember, you must be the final judge of whether or when to work on a task or make a response. Do you have any questions?

It is very important to always remember that you, as the driver, are in control of the vehicle and you must be the final judge on when or whether to respond to any request or engage in any task. You should follow a request or prompt or complete a task or maneuver only when, in your judgement, it is safe and convenient to do so. The ride-along experimenter will not be able to insure safety; you as the driver are responsible for that. Remember, safety while driving on the skid pad is your primary responsibility. Complete requests only when and if you believe it is safe to do so.

Risks: While driving for this study, you will be subject to all risks normally associated with driving on the TRC skid pad plus any additional risks associated with completing in-vehicle tasks while driving. There are no known physical or psychological risks associated with participation in this study beyond those indicated.

Be aware that accidents can happen any time when driving. You remain responsible for your driving during this testing. If the ride-along experimenter should make a request, or the display prompt an action, you are not to do it unless you judge it is safe to do so.

Benefits: This testing will provide data on driver behavior, performance judgements, and preferences regarding the haptic display presented. This data will provide a scientific basis for guiding recommendations on standards for haptic display systems in the future.

Confidentiality: The data recorded on you will be analyzed along with data gathered from other test participants during this testing. Your name will not be associated with any final report, publication, or other media that might arise from this study. However, your video-recorded likeness (in video or still photo formats created from the video) and engineering data from you specifically may be used for educational and research purposes. A waiver of confidentiality for permission to use the video and engineering data (including data or images derived from these sources) is included for you to sign as part of this form. It is not anticipated that you will be informed of the results of this study.

Informed Consent: By signing below, you agree that participation is voluntary and you understand and accept all terms of this agreement. **You have the option of not performing any requested task at any time during the test without penalty.**

Compensation: Should you agree to participate in this testing, it will be considered part of your normal work day activities. There is no special compensation associated with participation in the test.

Principal Investigator: Contact Dr. Louis Tijerina (TRC) or Dr. Riley Garrott (NHTSA VRTC) if you have questions or comments regarding this study. They may be reached at the address and phone number given below:

Vehicle Research and Test Center
10820 SR 347
East Liberty, OH 43319
Phone: (937) 666-4511

Disposition of Informed Consent: The VRTC will retain a signed copy of this Informed Consent form. A copy of this form will also be provided to you.

INFORMED CONSENT:

I, _________________________, UNDERSTAND THE TERMS OF THIS AGREEMENT AND VOLUNTARILY CONSENT TO PARTICIPATE.

______________________________ ____________

Signature Date

______________________________ ____________

Witness Date

WAIVER OF CONFIDENTIALITY:

I, ________________________, grant permission, in perpetuity, to the National Highway Traffic Safety Administration (NHTSA) to use, publish, or otherwise disseminate the video (including still photo formats derived from the video) and engineering data collected about me in this study for educational, outreach, and research purposes. I understand that such use may involve widespread distribution and may involve dissemination of my likeness in video or still photo formats, but will not result in release of my name or other identifying personal information.

______________________________ ____________

Signature Date

______________________________ ____________

Witness Date

APPENDIX H

SKID PAD INSTRUCTIONS FOR ACTIVE STEERING STUDY

H.1 HAPTIC DISPLAY STUDY 1B: ACTIVE STEERING STUDY

INSTRUCTIONS FOR SKID PAD

(To be read upon arrival at the skid pad).

You will be driving the instrumented vehicle on the TRC Skid pad at a speed of 45 mph except when directed otherwise by the experimenter (me). You will be driving under conditions where you are only driving and sometimes when you are both driving and entering in a destination on the route guidance system in the instrumented vehicle.

From time to time, an active steering event will be presented. That is, the steering wheel will be vibrated by a computer for a brief period of time. As soon as you perceive an active steering signal, apply the brakes as quickly as possible, bringing the vehicle to a controlled stop. Afterwards, you will be asked to rate the active steering event in terms of its appropriateness as a warning display using a rating scale (Show them the rating scale cards).

Do the best you can to complete the destination entry tasks. If a display occurs during a destination entry task, follow the normal procedure and, as soon as you perceive a pulse braking event, bring the vehicle to a controlled stop. You do not need to complete the destination entry task

Remember that you, as the driver of the test vehicle, are responsible for maintaining safety at all times. Do not perform any task which you believe would be unsafe. Remember, you must be the final judge of whether or when to work on a task or make a response. Do you have any questions?”

APPENDIX I

SUBJECTIVE RATING SCALES FOR ACTIVE STEERING DISPLAYS

I.1 SUBJECTIVE RATING SCALES FOR ACTIVE STEERING DISPLAYS

The test participants answered the subjective assessment question below after each detected active steering display event after having brought the vehicle to a complete stop:

Vibration:

Please judge the vibration of the haptic event as a warning display on the following 3-point scale:

3 ___Too slow
2 ___About right
1 ___Too fast

Strength:

Please judge the strength of the haptic event as a warning display on the following 3-point scale:

3 ___Too weak
2 ___About right
1 ___Too strong

Duration:

Please judge the duration of the haptic event as a warning display on the following 3-point scale:

3 ___Too short
2 ___About right
1 ___Too long

APPENDIX J

”BEST” RESPONSE SURFACE MODELING RESULTS FOR DISTRACTION CONDITION

J.1 "BEST" RESPONSE SURFACE MODELING RESULTS FOR DISTRACTION CONDITION

Note: In all models provided in this Appendix, the following coding scheme is used:

X1 = coded variable for Active Steering Display Frequency
- -1.9 signifies 4 Hz
- -1 signifies 6 Ha
- 0 signifies 8 Hz
- +1 signifies 10 Ha
- +1.9 signifies 12 Hz

X2 = coded variable for Active Steering Display Amplitude
- -1.9 signifies 1.0 Nm
- -1 signifies 1.2 Nm
- 0 signifies 1.6 Nm
- +1 signifies 1.8 Nm
- +1.9 signifies 2.2 Nm

X2 = coded variable for Active Steering Display Duration
- -1.9 signifies 0.50 seconds
- -1 signifies 0.74 seconds
- 0 signifies 1.00 seconds
- +1 signifies 1.26 seconds
- +1.9 signifies 1.50 seconds

X4 through X8, when used, are binary (0, 1) indicator variables for Subject Effects (i.e., effects attributable to variation among the test participants or subjects).

Dependent Variable: ACCELRT, Best Model with Test Participant Effects, Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X2	1	0.02668332	0.02668332	6.34	0.0137
X3	1	0.01595323	0.01595323	3.79	0.0549
X4	1	0.01875000	0.01875000	4.46	0.0378
X5	1	0.00768000	0.00768000	1.83	0.1803
X6	1	0.00065333	0.00065333	0.16	0.6945
X7	1	0.01633333	0.01633333	3.88	0.0521
X8	1	0.01633333	0.01633333	3.88	0.0521

R-Square	C.V.	Root MSE	ACCELRT Mean
0.290597	14.60313	0.06485413	0.44411111

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	0.4593333333	27.43	0.0001	0.01674526
X2	-.0170937363	-2.52	0.0137	0.00678664
X3	-.0132172580	-1.95	0.0549	0.00678664
X4	-.0500000000	-2.11	0.0378	0.02368138
X5	-.0320000000	-1.35	0.1803	0.02368138
X6	-.0093333333	-0.39	0.6945	0.02368138
X7	-.0466666667	-1.97	0.0521	0.02368138
X8	0.0466666667	1.97	0.0521	0.02368138

Dependent Variable: ACCELRT, Best Model without Test Participant Effects, Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X2	1	0.02668332	0.02668332	5.23	0.0246
X3	1	0.01595323	0.01595323	3.13	0.0804

R-Square	C.V.	Root MSE	ACCELRT Mean
0.087697	16.07742	0.07140160	0.44411111

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	0.4441111111	59.01	0.0001	0.00752639
X2	-.0170937363	-2.29	0.0246	0.00747180
X3	-.0132172580	-1.77	0.0804	0.00747180

Dependent Variable: BRAKERT(Brake Reaction Time), Distraction Condition

No statistically significant models were found as a function of the active steering display variables of Frequency, Amplitude, or Duration. Individual differences among test participants accounted for approximately 49% of the variability in maximum pedal force. The remaining 51% of response variation is due to unknown sources of variability or random variation.

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X4	1	0.03536333	0.03536333	3.75	0.0561
X5	1	0.10800000	0.10800000	11.46	0.0011
X6	1	0.00616333	0.00616333	0.65	0.4210
X7	1	0.31827000	0.31827000	33.76	0.0001
X8	1	0.11781333	0.11781333	12.50	0.0007

R-Square	C.V.	Root MSE	BRAKERT Mean
0.485834	12.73996	0.09709266	0.76211111

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	0.8306666667	33.13	0.0001	0.02506922
X4	0.0686666667	1.94	0.0561	0.03545323
X5	-.1200000000	-3.38	0.0011	0.03545323
X6	-.0286666667	-0.81	0.4210	0.03545323
X7	-.2060000000	-5.81	0.0001	0.03545323
X8	-.1253333333	-3.54	0.0007	0.03545323

Dependent Variable: MAXPEDF (Maximum Pedal Force), Distraction Condition

No statistically significant models were found as a function of the active steering display variables of Frequency, Amplitude, or Duration. Individual differences among test participants accounted for approximately 68% of the variability in maximum pedal force. The remaining 32% of response variation is due to unknown sources of variability or random variation.

Dependent Variable: MAXPEDF, Test Participant Effects Only Model, Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X4	1	1970.73075000	1970.73075000	4.57	0.0354
X5	1	11359.58043000	11359.58043000	26.35	0.0001
X6	1	2098.19307000	2098.19307000	4.87	0.0301
X7	1	23104.09505333	23104.09505333	53.59	0.0001
X8	1	1461.89121333	1461.89121333	3.39	0.0691

R-Square	C.V.	Root MSE	MAXPEDF Mean
0.682086	16.59407	20.76269891	125.12122222

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	130.1733333	24.28	0.0001	5.36090581
X4	-16.2100000	-2.14	0.0354	7.58146570
X5	-38.9180000	-5.13	0.0001	7.58146570
X6	-16.7260000	-2.21	0.0301	7.58146570
X7	55.5026667	7.32	0.0001	7.58146570
X8	-13.9613333	-1.84	0.0691	7.58146570

Dependent Variable: TOTSTOP (Total Stopping Distance), Distraction Condition

No statistically significant models were found as a function of the active steering display variables of Frequency, Amplitude, or Duration. Individual differences among test participants accounted for approximately 81% of the variability in total stopping distance. The remaining variation in total stopping distance appears attributable to unknown sources of variability or random variation.

Dependent Variable: TOTSTOP, Test Participant Effects Only Model, Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X4	1	425.40736333	425.40736333	6.62	0.0118
X5	1	10.76403000	10.76403000	0.17	0.6833
X6	1	3546.66387000	3546.66387000	55.21	0.0001
X7	1	16056.84675000	16056.84675000	249.95	0.0001
X8	1	204.88533333	204.88533333	3.19	0.0777

R-Square	C.V.	Root MSE	TOTSTOP Mean
0.814483	9.631559	8.01493361	83.21533333

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	96.87733333	46.81	0.0001	2.06944696
X4	-7.53133333	-2.57	0.0118	2.92663996
X5	-1.19800000	-0.41	0.6833	2.92663996
X6	-21.74600000	-7.43	0.0001	2.92663996
X7	-46.27000000	-15.81	0.0001	2.92663996
X8	-5.22666667	-1.79	0.0777	2.92663996

Dependent Variable: BRKSTOP (Brake Stopping Distance), Distraction Condition

No statistically significant models were found as a function of the active steering display variables of Frequency, Amplitude, or Duration. Individual differences among test participants accounted for approximately 81% of the variability in brake stopping distance. The remaining variation in brake stopping distance appears attributable to unknown sources of variability or random variation.

Dependent Variable: BRKSTOP, Test Participant Effects Only Model, Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X4	1	482.08225333	482.08225333	8.59	0.0043
X5	1	10.52576333	10.52576333	0.19	0.6660
X6	1	3587.88288000	3587.88288000	63.94	0.0001
X7	1	11777.83788000	11777.83788000	209.90	0.0001
X8	1	98.35541333	98.35541333	1.75	0.1891

R-Square	C.V.	Root MSE	BRKSTOP Mean
0.800984	10.74008	7.49073882	69.74566667

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	81.73800000	42.26	0.0001	1.93410045
X4	-8.01733333	-2.93	0.0043	2.73523108
X5	1.18466667	0.43	0.6660	2.73523108
X6	-21.87200000	-8.00	0.0001	2.73523108
X7	-39.62800000	-14.49	0.0001	2.73523108
X8	-3.62133333	-1.32	0.1891	2.73523108

APPENDIX K

”BEST” RESPONSE SURFACE MODELING RESULTS FOR NO DISTRACTION CONDITION

K.1 "BEST" RESPONSE SURFACE MODELING RESULTS FOR NO DISTRACTION CONDITION

Note: In all models provided in this Appendix, the following coding scheme is used:

X1 = coded variable for Active Steering Display Frequency
- -1.9 signifies 4 Hz
- -1 signifies 6 Ha
- 0 signifies 8 Hz
- +1 signifies 10 Ha
- +1.9 signifies 12 Hz

X2 = coded variable for Active Steering Display Amplitude
- -1.9 signifies 1.0 Nm
- -1 signifies 1.2 Nm
- 0 signifies 1.6 Nm
- +1 signifies 1.8 Nm
- +1.9 signifies 2.2 Nm

X2 = coded variable for Active Steering Display Duration
- -1.9 signifies 0.50 seconds
- -1 signifies 0.74 seconds
- 0 signifies 1.00 seconds
- +1 signifies 1.26 seconds
- +1.9 signifies 1.50 seconds

X4 through X8, when used, are binary (0, 1) indicator variables for Subject Effects (i.e., effects attributable to variation among the test participants or subjects).

Dependent Variable: ACCELRT, Best Model with Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X2	1	0.09452304	0.09452304	15.77	0.0002
X4	1	0.14840333	0.14840333	24.76	0.0001
X5	1	0.01875000	0.01875000	3.13	0.0806
X6	1	0.01728000	0.01728000	2.88	0.0933
X7	1	0.13333333	0.13333333	22.24	0.0001
X8	1	0.01976333	0.01976333	3.30	0.0730

R-Square	C.V.	Root MSE	ACCELRT Mean
0.392572	19.45874	0.07742417	0.39788889

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	0.3273333333	16.37	0.0001	0.01999083
X2	-.0321725799	-3.97	0.0002	0.00810203
X4	0.1406666667	4.98	0.0001	0.02827131
X5	0.0500000000	1.77	0.0806	0.02827131
X6	0.0480000000	1.70	0.0933	0.02827131
X7	0.1333333333	4.72	0.0001	0.02827131
X8	0.0513333333	1.82	0.0730	0.02827131

Dependent Variable: ACCELRT, Best Model without Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X2	1	0.09452304	0.09452304	11.48	0.0011

R-Square	C.V.	Root MSE	ACCELRT Mean
0.115399	22.80546	0.09074038	0.39788889

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	0.3978888889	41.60	0.0001	0.00956488
X2	-.0321725799	-3.39	0.0011	0.00949550

Dependent Variable: BRAKERT, 'Best' Model with Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X2	1	0.26035234	0.26035234	18.08	0.0001
X4	1	0.78732000	0.78732000	54.66	0.0001
X5	1	0.03400333	0.03400333	2.36	0.1282
X6	1	0.01408333	0.01408333	0.98	0.3256
X7	1	0.00341333	0.00341333	0.24	0.6277
X8	1	0.02640333	0.02640333	1.83	0.1794

R-Square	C.V.	Root MSE	BRAKERT Mean
0.610082	15.90540	0.12001511	0.75455556

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	0.7180000000	23.17	0.0001	0.03098777
X2	-.0533946562	-4.25	0.0001	0.01255894
X4	0.3240000000	7.39	0.0001	0.04382332
X5	-.0673333333	-1.54	0.1282	0.04382332
X6	0.0433333333	0.99	0.3256	0.04382332
X7	-.0213333333	-0.49	0.6277	0.04382332
X8	-.0593333333	-1.35	0.1794	0.04382332

Dependent Variable: BRAKERT,'Best' Model without Test Participant Effects, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X2	1	0.26035234	0.26035234	8.17	0.0053

R-Square	C.V.	Root MSE	BRAKERT Mean
0.084915	23.66391	0.17855735	0.75455556

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	0.7545555556	40.09	0.0001	0.01882160
X2	-.0533946562	-2.86	0.0053	0.01868507

Dependent Variable: MAXPEDF (Maximum Pedal Force), No Distraction Condition

No statistically significant models were found as a function of the active steering display Frequency, Amplitude, or Duration. All variation in maximum pedal force appears unrelated to the active steering variables at the levels tested in this study. Individual differences among test participants accounted for approximately 81% of the variability in maximum pedal force. The remaining variation in is maximum pedal force is associated with unknown sources of variability or random variation.

Dependent Variable: MAXPEDF Test Participant Effects Only Model, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X4	1	424.35363000	424.35363000	1.50	0.2242
X5	1	3061.91621333	3061.91621333	10.82	0.0015
X6	1	1905.94581333	1905.94581333	6.73	0.0112
X7	1	50555.53803000	50555.53803000	178.63	0.0001
X8	1	532.22832000	532.22832000	1.88	0.1739

R-Square	C.V.	Root MSE	MAXPEDF Mean
0.813037	13.79903	16.82298614	121.91422222

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	111.5973333	25.69	0.0001	4.34367634
X4	7.5220000	1.22	0.2242	6.14288599
X5	-20.2053333	-3.29	0.0015	6.14288599
X6	-15.9413333	-2.60	0.0112	6.14288599
X7	82.1020000	13.37	0.0001	6.14288599
X8	8.4240000	1.37	0.1739	6.14288599

Dependent Variable: TOTSTOP (Total Stopping Distance), No Distraction Condition

No statistically significant models were found as a function of the active steering display Frequency, Amplitude, or Duration. All variation in total stopping distance appears unrelated to the active steering variables at the levels tested in this study. Individual differences among test participants accounted for approximately 85% of the variability in maximum pedal force. The remaining variation in total stopping distance is associated with unknown sources of variability or random variation.

Dependent Variable: TOTSTOP Test Participant Effects Only Model, No Distraction Condition

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X4	1	416.93952000	416.93952000	10.27	0.0019
X5	1	3.01467000	3.01467000	0.07	0.7859
X6	1	558.31788000	558.31788000	13.75	0.0004
X7	1	10510.15701333	10510.15701333	258.90	0.0001
X8	1	53.38668000	53.38668000	1.32	0.2547

R-Square	C.V.	Root MSE	TOTSTOP Mean
0.845721	7.816582	6.37144346	81.51188889

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	88.49666667	53.79	0.0001	1.64509963
X4	7.45600000	3.20	0.0019	2.32652220
X5	-0.63400000	-0.27	0.7859	2.32652220
X6	-8.62800000	-3.71	0.0004	2.32652220
X7	-37.43466667	-16.09	0.0001	2.32652220
X8	-2.66800000	-1.15	0.2547	2.32652220

Dependent Variable: BRKSTOP (Brake Stopping Distance), No Distraction Condition

No statistically significant models were found as a function of the active steering display Frequency, Amplitude, or Duration. All variation in total stopping distance appears unrelated to the active steering variables at the levels tested in this study. Individual differences among test participants accounted for approximately 87% of the variability in maximum pedal force. The remaining variation in is brake stopping distance force is associated with unknown sources of variability or random variation.

Source	DF	Type III SS	Mean Square	F Value	Pr > F
X4	1	16.81505333	16.81505333	0.60	0.4400
X5	1	1.16033333	1.16033333	0.04	0.8390
X6	1	776.63232000	776.63232000	27.80	0.0001
X7	1	9438.74456333	9438.74456333	337.85	0.0001
X8	1	57.07681333	57.07681333	2.04	0.1566

R-Square	C.V.	Root MSE	BRKSTOP Mean
0.866032	7.742548	5.28563989	68.26744444

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	76.02066667	55.70	0.0001	1.36474635
X4	1.49733333	0.78	0.4400	1.93004280
X5	0.39333333	0.20	0.8390	1.93004280
X6	-10.17600000	-5.27	0.0001	1.93004280
X7	-35.47533333	-18.38	0.0001	1.93004280
X8	-2.75866667	-1.43	0.1566	1.93004280

APPENDIX L

TEST PARTICIPANT CONSENT FORM

L.1 TEST PARTICIPANT CONSENT FORM

Title of Study: **Haptic Display Study No. 2**

Study Description: Rear-end crashes are among the most common types of crashes. Research is under way into ways to use sensors and computer technology to detect potential crash hazards and warn a driver in time to avoid such hazards. Various auditory displays (tones) and visual displays (lights) have been proposed as rear-end crash warning displays. However, it may also be possible to warn the driver by a display that is felt rather than seen or heard. One type of 'felt' display is called a Pulse Braking Display. The brakes are applied for very brief period of time to alert the driver of a possible hazard ahead.

Haptic display systems are those which use tactile means to provide the driver with information. Haptic displays being developed for use in cars and trucks can be used in lieu of auditory or visual displays to call the driver's attention to urgent information. Such systems allow a driver to receive information without diverting his eyes from the roadway, and use this information to perform the driver's primary job of safely controlling the vehicle. The National Highway Traffic Safety Administration (NHTSA) is conducting research to measure the effects on driver performance of using such display methods. One area of research is the effect on driver behavior and performance when these displays advise drivers in a car following situation that their time headway to a lead vehicle has fallen below a predetermined limit; that is, that a collision with the vehicle ahead may be imminent.

As a participant, you will be shown a haptic display system, and oriented on the actions you are to take when displays occur. The display system in this study, referred to as Pulse Braking, is a proposed method of alerting a driver to an imminent crash with a vehicle or object ahead of them. The purpose of the display is to alert the driver that he may need to apply the vehicle's brakes. In order to alert the driver to a need for braking action, Pulse Braking provides a brief brake application to achieve a predetermined rate or level of deceleration. The brakes are then automatically released; subsequent braking action is the responsibility of the vehicle driver. The deceleration effected by the display itself is minimal and insufficient to prevent most impending collisions. To stop the vehicle, the driver must apply the brakes.

The purpose of today's testing is to help determine what might be the most appropriate type of Pulse Braking Display. You will be driving an instrumented vehicle on the TRC Skid pad at a speed of 42 mph. You will be driving under conditions where you are working on a distracting in-vehicle task, the entry of a destination into a route guidance system. During your drive, you will be following another vehicle, known as the lead vehicle, in the same lane at usually the same speed. The lead vehicle is actually an artificial automobile being towed by a real automobile. You will be asked to maintain a constant time headway of two seconds to the artificial automobile ahead. **Your vehicle is equipped with a computer-controlled cruise control system to aid you in maintaining the desired time headway to the moving lead vehicle. You will not normally need to adjust the cruise control or throttle position, unless you feel it necessary in the interest of safety. Braking the vehicle to slow or stop it remains your responsibility. From time to time, this artificial automobile will rapidly decelerate to a stop. Neither the artificial automobile nor the vehicle towing it will have functioning brake lights. Often a pulse braking event will be presented to**

warn you that the artificial automobile is stopping. A pulse braking event may also occur even though the artificial automobile ahead is maintaining a constant speed; in this case it is not necessary for you to stop. <u>As soon</u> as you perceive that the artificial automobile ahead is decelerating to a stop, your job is to avoid a collision by bringing your vehicle to a controlled stop. You will then be asked to rate the particular level of pulse braking event, if applicable, in terms of appropriateness as a warning. The rating scales will be presented to you later in this session. Do you have any questions about the intent of the study and the procedure?

You will also receive training on how to complete destination entry tasks with a commercially available route guidance system. The experimenter will show you a set of "target" destinations that you are to write down on individual 4x6 index cards so that you will be able to use them for destination entry during practice as well as while driving on the TRC skid pad. You will have an opportunity to practice entering destinations with the system in a parked vehicle and ask any questions you wish of the experimenter.

The experimenter will accompany you during all testing. During testing, you will be asked to wear protective headphones to shield you from potentially distracting sounds. These headphones contain speakers through which you will hear modified ocean sounds to mask any remaining unwanted noise. The ride-along experimenter will be responsible for all radio communications with the control tower and other test units. The ride-along experimenter will also periodically hand you a 4x6 index card with a destination written on it, a signal that you are to enter that destination into the route guidance system, **WHEN AND IF YOU BELIEVE IT IS SAFE TO DO SO GIVEN THE CURRENT DRIVING CONDITIONS ON THE SKID PAD.** The experimenter may sometimes ask you to begin a destination entry task, then subsequently determine that it is not necessary to complete that task. You will be asked to drive a series of laps in an assigned lane on the TRC skid pad. On the straight sections of the skid pad, the ride-along experimenter will ask you to maintain a speed of 42 mph. Periodically, the artificial automobile ahead of you will decelerate to a stop. The haptic display system may provide a pulse braking display to warn that the vehicle ahead is stopping. This display will often but not always be associated with the deceleration of the artificial automobile ahead. The haptic display can be expected to vary slightly with each occurrence, but will always be the characterized by a brief, automatic application and release of the vehicle's brakes. The Pulse Braking event will not affect your ability to control your vehicle, and will, in and of itself, have little effect upon your vehicle's speed. After you have applied the brakes and brought the vehicle to a controlled stop, if appropriate, the experimenter will ask you a series of questions about the appropriateness of the display as a warning. As the headphones may make it difficult to hear the experimenter, he will show you cards containing lists of descriptions of the display's appropriateness, from which you will be asked to choose that which matches your opinion. After the experimenter records your response, you will continue with the next trial and rating. After you have completed a series of laps, you will return to Building 60. The complete series of orientations and trials will take approximately four hours.

You, as the driver of the test vehicle, are responsible for maintaining safety at all times. Do not perform any task which you believe would be unsafe. Remember, you must be the final judge of whether or when to work on a task or make a response. The haptic displays serve only as a warning to decelerate or stop -- the vehicle, you must apply the brakes as in any other car. Do you have any questions?"

It is very important to always remember that you, as the driver, are in control of the vehicle and you must be the final judge on when or whether to respond to any request or engage in any task. You should follow a request or prompt or complete a task or maneuver only when, in your judgement, it is safe and convenient to do so. The ride-along experimenter will not be able to insure safety; you as the driver are responsible for that. Remember, safety while driving on the skid pad is your primary responsibility. Complete requests only when and if you believe it is safe to do so.

Risks: While driving for this study, you will be subject to all risks normally associated with driving on the TRC skid pad plus any additional risks associated with completing in-vehicle tasks while driving. There are no known physical or psychological risks associated with participation in this study beyond those indicated.

Be aware that accidents can happen any time when driving. You remain responsible for your driving during this testing. If the ride-along experimenter should make a request, or the display prompt an action, you are not to do it unless you judge it is safe to do so.

Benefits: This testing will provide data on driver behavior, performance judgements, and preferences regarding the haptic display methods presented. This data will provide a scientific basis for guiding recommendations on standards for haptic display systems in the future.

Confidentiality: The data recorded on you will be analyzed along with data gathered from other test participants during this testing. Your name will not be associated with any final report, publication, or other media that might arise from this study. However, your video-recorded likeness (in video or still photo formats created from the video) and engineering data from you specifically may be used for educational and research purposes. A waiver of confidentiality for permission to use the video and engineering data (including data or images derived from these sources) is included for you to sign as part of this form. It is not anticipated that you will be informed of the results of this study.

Informed Consent: By signing below, you agree that participation is voluntary and you understand and accept all terms of this agreement. **You have the option of not performing any requested task at any time during the test without penalty.**

Compensation: Should you agree to participate in this testing, it will be considered part of your normal work day activities. There is no special compensation associated with participation in the test.

Principal Investigator: Contact Dr. Louis Tijerina (TRC) or Dr. Riley Garrott (NHTSA VRTC) if you have questions or comments regarding this study. They may be reached at the following address and phone number:

Vehicle Research and Test Center
10820 SR 347
East Liberty, OH 43319
Phone: (937) 666-4511

Disposition of Informed Consent: The VRTC will retain a signed copy of this Informed Consent form. A copy of this form will also be provided to you.

INFORMED CONSENT:

I, ________________________, UNDERSTAND THE TERMS OF THIS AGREEMENT AND VOLUNTARILY CONSENT TO PARTICIPATE.

______________________________ ____________

Signature Date

______________________________ ____________

Witness Date

WAIVER OF CONFIDENTIALITY:

I, _______________________, grant permission, in perpetuity, to the National Highway Traffic Safety Administration (NHTSA) to use, publish, or otherwise disseminate the video-tape (including still photo formats derived from the videotape) and engineering data collected about me in this study for educational, outreach, and research purposes. I understand that such use may involve widespread distribution and may involve dissemination of my likeness in videotape or still photo formats, but will not result in release of my name or other identifying personal information.

______________________________ ____________

Signature Date

_____________________________ ____________

Witness Date

APPENDIX M

MONO-PULSE BRAKING STUDY 3: SKID PAD INSTRUCTIONS

M.1 MONO-PULSE BRAKING STUDY 3: SKID PAD INSTRUCTIONS

INSTRUCTIONS FOR SKID PAD

The object you will be driving behind is an “artificial” rear-end of a car. This artificial car is not equipped with working brake lights/stop lamps. You will be asked to follow the artificial car at a distance to be indicated by the experimenter (me). You will be instructed to engage the cruise control and a computer will then maintain the following distance and adjust your vehicle speed as necessary. A third car will be following your vehicle.

From time to time, the lead vehicle will brake to a complete stop. A pulse braking event may be presented to warn you that the lead vehicle is coming to a complete stop. That is, your brakes will be applied by a computer for a brief period of time. It is also possible that the pulse braking event may be presented even if the lead vehicle is not braking. As soon as you notice that the lead vehicle is braking to a stop, bring your vehicle to a controlled stop. Failure to bring the vehicle to a controlled stop may result in a collision with the artificial lead vehicle. Afterwards, you will be asked whether or not you noticed a pulse braking event. If so, you may be asked to rate the pulse braking event in terms of its timing and appropriateness as a warning display using a rating scale format. (Show them the rating scale card).