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Appendices for NHTSA Technical Report

Assessing the Feasibility of Vehicle-Based Sensors to Detect Alcohol Impairment

TABLE OF CONTENTS

APPENDIX A: PHONE QUANTITY, FREQUENCY, VARIABILITY (QFV)

Phone QFV Screening

6/10/2009

When you have wine, how often do you have as many as:

Wine	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	Check columns: modal check	Check columns: check sum
5 – 6 glasses						0	0
3 - 4 glasses						0	0
1 – 2 glasses						0	0

3b

When you have beer, how often do you have as many as:

Beer	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum
5 – 6 cans						0	0
3 – 4 cans						0	0
1 – 2 cans						0	0

4b

When you have spirits, how often do you have as many as:

Liquor (Spirits)	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum
5 – 6 drinks						0	0
3 – 4 drinks						0	0
1 – 2 drinks						0	0

5b

How often do you have...

Frequency Table	Wine	Beer	Liquor (Spirits)	Any kind of alcoholic drink	Check sum
3 or more times a day					0
2 times a day					0
Nearly every day					0
3-4 times per week					0
Once or twice per week					0
2-3 times a month					0
About once a month					0
Less than once a month but at least once a year					0
Never					0

Check Sums OK	Error With Frequency Table!
	Non-Drinker

The National Advanced Driving Simulator
at The University of Iowa

6/10/2009

Q-F-V Scoring

CHART II
Q-V CLASS

Q-V CLASS	MODAL QUANTITY	MAXIMUM QUANTITY
1	5-6	5-6
2	3-4	5-6 less than half the time
3	3-4	5-6 once in awhile
4	no mode	5-6 less than half the time
5	3-4	3-4
6	1-2	5-6 less than half the time
7	No mode	5-6 once in awhile
8	1-2	5-6 once in awhile
9	1-2	3-4 less than half the time
10	1-2	3-4 once in awhile
11	1-2	1-2

CHART II

Q-F-V CLASS

Enroll ONLY individuals who are classified as a moderate or heavy drinker as defined below.

Q-F-V CLASS	FREQUENCY (maximum frequency of <u>any</u> beverage	Q-V CLASS
Heavy drinkers	Three or more times a day	1-11
	Twice a day	1-9
	Every day or nearly every day	1-8
	3-4 times a week	1-5
	1-2 times a week	1-4
	2-3 times a month	1
Moderate drinkers	Twice a day	10-11
	Every day or nearly every day	9-10
	3-4 times a week	6-9
	1-2 times a week	5-9
	2-3 times a month	2-8
	About once a month	1-6

Phone QFV Screening

6/10/2009

When you have wine, how often do you have as many as:

Wine	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum
5 – 6 glasses			X			0	1
3 - 4 glasses		X				1	1
1 – 2 glasses				X		0	1

3b

When you have beer, how often do you have as many as:

Beer	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum
5 – 6 cans					X	0	0
3 – 4 cans					X	0	0
1 – 2 cans					X	0	0

4b

When you have spirits, how often do you have as many as:

Liquor (Spirits)	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum
5 – 6 drinks				X		0	1
3 – 4 drinks			X			0	1
1 – 2 drinks		X				1	1

5b

Check columns

How often do you have...

Frequency Table	Wine	Beer	Liquor (Spirits)	Any kind of alcoholic drink	Check sum
3 or more times a day					0
2 times a day					0
Nearly every day	X			X	2
3-4 times per week					0
Once or twice per week					0
2-3 times a month					0
About once a month			X		1
Less than once a month but at least once a year					0
Never		X			1

Check Sums OK	Frequency Table OK
	Heavy Drinker

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at The University of Iowa

6/10/2009

APPENDIX B: SCENARIO SPECIFICATIONS DOCUMENT

THE UNIVERSITY OF IOWA

SPECIFICATIONS DOCUMENT

NHTSA_IMPACT Task2 Scenario Specification

Document ID: N08-007
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Date: June 2008

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LIST OF ACRONYMS

BAC	Blood Alcohol Concentration
CO	Contract Officer
COTR	Contract Officer's Technical Representative
g/dL	gram per deciliter
IRB	Institutional Review Board
OEM	Original Equipment Manufacturer
NADS	National Advanced Driving Simulator
NHTSA	National Highway Traffic Safety Administration
PI	Principal Investigator
PM	Program Manager
SDM	Simulator Development Module
SOW	Statement of Work
UI	The University of Iowa
USDOT	United States Department of Transportation
TOM	Task Order Manager

1 SCENARIO/EXPERIMENT OVERVIEW

1.1 Introduction

The IMPACT study consists of three equivalent scenarios. Each scenario consists of a total of 19 events, and the estimated time of driving is about 25 minutes. Each scenario has urban, interstate, and rural settings.

1.2 Common Performance Measures

Each scenario is analyzed by computing common as well as scenario-specific performance measures. Scenario-specific measures are described within the individual scenario event descriptions, and the common measures are listed below.

Table 1 Definitions of dependent measures

Category	Dependent Measure	Source	Description
Lateral control			
Input	Standard deviation of steering wheel position		Standard deviation of mean steering wheel position
	Velocity of steering wheel		Mean absolute velocity in degrees per minute
	Jerk of steering wheel		Mean absolute derivative of acceleration
	Steering error		Deviation from Taylor series approximation
	Steering wheel reversals	Mark Savino's thesis	Change from the negative (clockwise movement) to a positive (counterclockwise) rotational velocity OR the change from a positive rotational velocity to a negative rotational velocity. Absolute value of rotational velocity exceeds 3.0 degrees per second
	Intersection turn signal use	(Crancer, Dille, Delay, Wallace, & Haykin, 1969)	Number of times participant used turn signal for left turn at light and right turn at stop sign
	Highway turn signal use	(Crancer et al., 1969)	Ratio of lane changes while using turn signal in comparison to all lane changes
	Transition turn signal use	(Crancer et al., 1969)	Number of times participant used turn signals in transitions
Output	Mean lane position	Triggs, & Redman, 1999)	Mean position in the lane relative to the center (positive to the right of center, negative to the left)
	Standard deviation of lane position	(Gawron & Ranney, 1988; Ramaekers, Robbe, & O'Hanlon, 2000)	Standard deviation of mean lane position
	Standard deviation of lane position from center	(Harrison, 2005)	Standard deviation of lane position from center of the lane
	Time to line crossing		Mean absolute(s) toward lane boundary participant is headed toward lateral position/lateral velocity
	Proportion of time		Percentage of time TLC is less than 2

Category	Dependent Measure	Source	Description
	TLC < 2 sec		seconds for each lane boundary
	95% TLC		[5th] Percentile TLC
	Exponentially weighted moving average of lane position		Mean lane position and previous few graphed over entire drive
	Lateral acceleration		Change in velocity in lateral direction
	Number of center line crossings		Number of times any part of the vehicle crossed the center line
	Number of right line crossings		Number of times any part of the vehicle crossed the right line
	Frequency of lane changes		Frequency per minute of when entire car switches from one lane to the other
Longitudinal control			
Input	Accelerator holds		Percentage of time accelerator position is constant
	Velocity of accelerator position		Velocity of changing accelerator position
	Jerk of accelerator position		Derivative of acceleration
	Standard deviation of accelerator position		Standard deviation of mean accelerator position
	Mean brake force		Mean brake force applied
	Standard deviation of brake force		Standard deviation of mean brake force
Output	Mean speed		Mean speed
	Standard deviation of speed	(Arnedt, Wilde, Munt, & MacLean, 2001; Gawron & Ranney, 1988)	Standard deviation of mean speed
	Deviation from Posted Speed Limit	(Arnedt, 2001)	Standard deviation of speed relative to posted speed limit
	Exponentially weighted moving average of speed		Mean speed and previous few, graphed over entire drive
	Time to collision (TTC)		Distance between front bumper of participant's vehicle and the rear bumper of the vehicle in front divided by the difference in the two vehicles'

Category	Dependent Measure	Source	Description
			velocities
	Time headway		Distance between front bumper of participant's vehicle and the rear bumper of the vehicle in front divided by the velocity of the participant's vehicle
	Variation in time headway		SD of time headway
	Did participant stop? (left turn, yellow light)		Minimum velocity
	Stopping location		Location of front bumper when vehicle reached zero velocity
Event contingent			
	Time gap accepted	(Leung & Starmer, 2005)	Distance between the two vehicles divided by the speed of the second vehicle
	Time between brake release and gap		The amount of time between when participant releases the brake and the front car's rear bumper (car in front in gap chosen) is in line with participant's car's front bumper. Positive relates to releasing brake before gap is available, negative equates to after.
	Time headway when centers of vehicles are in line		Time headway of second car in gap when center of participant's vehicle is in line with the center of the second car in gap
	Amount of time between initial stop to midpoint though intersection		Amount of time between first full stop and when midpoint of participant's vehicle is in line with midpoint of second car in gap
	Decision time	(Leung & Starmer, 2005)	Amount of time it took for participant to react to stimulus (ie: yellow light)
	Number of traffic control violations	(Macdonald, Mann, Chipman, & Anglin-Bodrug, 2004)	Number of times participant violated traffic laws (speed limit, driving through red light, etc)
	Number of collisions	(Flanagan, Strike, Rigby, & Lochridge, 1983)	Number of times participant's vehicle collided with another object

Category	Dependent Measure	Source	Description
	Near misses		Number of times participant's vehicle came within 2 feet of another object
	Near misses	(Neale, 2002) 100 car study	Number of times a conflict situation requiring a rapid, severe evasive maneuver to avoid a crash occurred during the event
	Degree of conflict	(Neale, 2002) 100 car study	Minimum time to contact
Smoothness: applicable to acceleration, lane change	Delay time	(Ogata, 1997)	Time at which half settling (speed, lane position, etc.) is reached; see Figure 1
	Rise time	(Ogata, 1997)	Time at which first reaches settling lane position, etc.); see Figure 1
	Peak time	(Ogata, 1997)	Time the maximum (speed, lane position, etc.) occurs at; see Figure 1
	Max overshoot	(Ogata, 1997)	The difference between the maximum and the settling lane position, etc); see Figure 1
	Settling time	(Ogata, 1997)	The amount of time required for the lane position, to stay within a bounded allowable tolerance; see Figure 1
	How well it fits the model (Robertson, 1996)		Correlation between model and performance of participant
Eye movement			
Micro-movements	~~Horizontal gaze nystagmus~~	~~**NHTSA 2002~~	~~Distance from center the jerkiness starts (in degrees?)~~
	Smooth pursuit velocity	(Katoh, 1988)	Velocity of smooth pursuit eye movements
	Smooth pursuit duration	(Moskowitz, Ziedman, & Sharma, 1976)	Time taken to smooth pursuit from one location to another
	Smooth pursuit frequency	(Moskowitz et al., 1976)	Number of smooth pursuit movements per second
	Smooth pursuit maximum velocity	(Stapleton, Guthrie, & Linnoila, 1986)	Maximum velocity of smooth pursuit eye movements
	Smooth pursuit gain	(Fetter & Buettner, 1990)	Cumulative amplitude of smooth pursuit (subtracts away saccades) divided by the amplitude of the stimulus (%)

Category	Dependent Measure	Source	Description
Statistical distribution	Standard deviation of gaze	(Victor, 2005)	Combine horizontal and vertical gaze position components using Pythagorean theorem
	Another standard deviation of gaze	(Recarte, Nunes, 2000)	SD of horizontal gaze distribution * SD of vertical gaze distribution
	Gaze kurtosis		The extent to which a frequency distribution is concentrated about its mean: "peakedness"
	Dwell duration	(Moskowitz et al., 1976)	Total time the participant focused on a particular object
	Frequency of rear view mirror glances	(Recarte & Nunes, 2000)	Frequency of participant's glances at rear view mirror
	Frequency of side mirror glances		Frequency of participant's glances at side mirrors
	Frequency of speedometer glances	(Recarte & Nunes, 2000)	Frequency of participant's glances at speedometer
Event contingent	Glance direction (glance to hazards)		Number of times participant did not look at critical features or focused on unnecessary features
	Head movement		Number of times participant did not look at critical features or focused on unnecessary features
	Timing of participant looking at side mirror?		Amount of time between looking at mirror and taking action
	Timing of participant looking at rear view mirror?		Amount of time between looking at mirror and taking action
	Glance frequency at particular object		Number of times per minute participant glanced at particular object
Driver physical state			
Postural stability	Pressure output (global and local)		Sum of pressures across all pressure points
	Pressure and force over time		Distance between peak pressure points over time
	Pressure point mapping		Location of peak pressure points
Eye blink	PERCLOS	(Hayami, 2002)	Percent eye closure
	Eye blink frequency	(Beideman & Stern, 1977)	Number of blinks per minute

Category	Dependent Measure	Source	Description
	Eye blink duration	(Beideman & Stern, 1977)	Duration of eye blinks
Combined measures			
	Correlation between road curvature and eye movements	(Chattington, Wilson, Ashford, & Marple-Horvat, 2007)	Correlation between road curvature and eye movements
	Correlation between eye movements and steering		Correlation between eye movements and steering
	Correlation between steering and road curvature		Correlation between steering and road curvature
	Correlation between eye movements and SDLP		Correlation between eye movements and SDLP
	Correlation between head turn and steering wheel movement		Correlation between head turn and steering wheel movement

Table 2 Dependent measures by event

		Events																		
		Urban (1)						Highway (2)						Rural (3)						
	Dependent measure	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	7
Lateral control																				
Input	SD of steering wheel position		■	■	■		■	■	■	■	■	■	■		■	■	■	■	■	
	Velocity of steering wheel	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	
	Jerk of steering wheel	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	
	Steering error		■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	
	Steering wheel reversals		■	■	■		■	■				■			■	■	■	■	■	
	Intersection turn signal use					■								■						
	Highway turn signal use									■	■	■								

		Events																		
		Urban (1)						Highway (2)						Rural (3)						
	Dependent measure	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	7
	Transition turn signal use	■						■	■				■					■		■
Output	Mean lane position		■	■	■		■	■		■	■	■			■	■	■		■	
	SD of lane position		■	■	■		■			■		■			■	■	■		■	
	SD from center		■	■	■		■			■		■			■	■	■		■	
	Time to line crossing (TLC)		■	■	■	■	■	■		■	■	■			■	■	■		■	
	Proportion of time TLC<2s		■	■	■	■	■	■		■	■	■			■	■	■		■	
	95% TLC		■	■	■	■	■	■		■	■	■			■	■	■		■	
	Exponentially weighted moving average of lane position		■	■	■	■	■	■		■	■	■			■	■	■		■	
	Lateral Acceleration					■			■	■	■	■	■							
	Number of center line crossings		■	■	■		■	■		■	■	■			■	■	■	■	■	
	Number of right line crossings		■	■	■		■	■		■	■	■			■	■	■	■	■	
	Frequency of lane changes									■	■	■								
Longitudinal																				
Input	Accelerator holds		■	■	■		■	■		■		■			■	■	■	■	■	
	Velocity of accelerator position	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
	Jerk of accelerator position	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
	SD of accelerator position	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
	Mean brake force	■			■	■		■	■	■	■	■	■	■				■		
	SD of brake force				■	■		■	■	■	■	■	■	■				■		
Output	Mean speed		■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	
	SD of speed		■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	
	Exponentially weighted moving average of speed		■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	
	Time to collision (TTC)					■			■	■	■									

		Events																		
		Urban (1)						Highway (2)						Rural (3)						
	Dependent measure	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	7
	Time headway																			
	Variation in time headway																			
	Did participant stop?																			
Event Contingent																				
Traffic related	Time gap accepted																			
	Decision time																			
	Number of traffic control violations																			
	Number of collisions																			
	Near misses																			
	Degree of conflict																			
Smoothness	Delay time																			
	Rise time																			
	Peak time																			
	Max overshoot																			
	Settling time																			
	How well it fits the model																			
Eye movement																				
Micro movements	Horizontal gaze nystagmus																			
	Smooth pursuit velocity																			
	Smooth pursuit duration																			
	Smooth pursuit frequency																			
	Smooth pursuit maximum velocity																			
	Smooth pursuit gain																			
Statistical distribution	SD of gaze																			
	Gaze kurtosis																			
	Dwell duration																			
	Frequency of rear view mirror glances																			

		Events																		
		Urban (1)						Highway (2)						Rural (3)						
	Dependent measure	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	7
	Frequency of side mirror glances																			
	Frequency of speedometer glances																			
Event Contingent	Glance direction																			
	Had movement																			
	Timing of participant looking at side mirror																			
	Timing of participant looking at rear view mirror																			
	Glance frequency at particular object																			
Driver physical state																				
Postural stability	Pressure output (global and local)																			
	Pressure and force over time																			
	Pressure point mapping																			
Eye blink	PERCLOS																			
	Eye blink frequency																			
	Eye blink duration																			
Combined measures																				
	Correlation between road curvature and eye movements																			
	Correlation between eye movements and steering																			
	Correlation between Steering and Road Curvature																			
	Correlation between eye																			

		Events																		
		Urban (1)						Highway (2)						Rural (3)						
	Dependent measure	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	7
	movements and SDLP																			
	Correlation between head turn and steering wheel movement																			

1.3 Logstream Descriptions

A logstream is a data variable that can be set by the scenario. This is usually used to express in the data stream that the subject has reached a specific location or that a specific event has occurred.

1.3.1 Logstream 1: Event Count

Logstream 1 indicates a sequential count of scenario events from beginning to end. Since the order of events is different for the three equivalent scenarios, this number does not always correspond to the same scenario event.

1.3.2 Logstream 2: Event ID

Logstream 2 indicates the current active scenario event; each event has a unique ID that remains the same for each event across all three equivalent drives. The ID is 3 digits in length. The digit in the hundreds place is 1 for urban events, 2 for interstate events, and 3 for rural events. For example, for the second urban event, Logstream 2 is set to 102.

1.3.3 Logstream 3: Temporal Event Data

Logstream 3 indicates the occurrence of sub-events that have a temporal reference to the position of the subject vehicle or other objects or events in the scenario event. For example, information relating to the timing of stoplights is recorded in this logstream. The specific sub-events are described in the specification of each scenario event.

1.3.4 Logstream 4: Spatial Event Data

Logstream 4 indicates the occurrence of sub-events that have a spatial reference to the position of the subject vehicle or other objects or events in the scenario event. For example, this logstream will change when the subject vehicle is 500 ft from an intersection. The specific sub-events are described in the specification of each scenario event.

1.3.5 Logstream 5: Road Sub-Section

Logstream 5 indicates the current road section type. A value of:

- 11 indicates the participant is on an urban commercial segment
- 12 indicates the participant is on an urban residential segment
- 13 indicates the participant is on an urban section without parking
- 14 indicates the participant is leaving the residential section
- 21 indicates the participant is on an interstate entrance ramp
- 22 indicates the participant is on the interstate
- 23 indicates the participant is on the exit ramp
- 31 indicates the participant is on the rural lit segment
- 32 indicates the participant is on the rural unlit segment
- 33 indicates the participant is on the rural gravel segment
- 34 indicates the participant is on the driveway segment

1.4 Embed Audio

During the drive the participants will have prerecorded audio instructions played to them. The audio instructions will provide the participant with landmark-based navigational instructions. The restart instructions are played at the start of a "restart" drive. A restart drive is required if the participant misses a turn or makes an incorrect turn. The drive is restarted, and the participant is placed a short distance before the turn that was missed. The instruction number is the audio instruction that matches the value in the SCC_Audio_Trigger cell in the DAQ file.

Instruction Number	Title	Audio Message	Location Played
301	Start Drive	Drive until you see the Shell gas station and then turn left at the intersection.	125 ft after the participant pulls out.
302	Urban Portion	Continue driving and take Interstate 30 South.	Shortly after beginning of Urban Event 106: Urban Curves
313	Distraction 1	At this time, please turn on the CD player, select track 17, then track 9, then press off.	As soon asparticipant gets within 5 seconds headway to the first heavy truck; no later than approximately 6500 ft from the end of the on-ramp
314	Distraction 2	At this time, please turn on the CD player, select track 2, then track 15, then press off.	Approximately 10000 ft from the end of the on-ramp

Instruction Number	Title	Audio Message	Location Played
315	Distraction 3	At this time, please turn on the CD player, select track 6, then track 11, then press off.	Approximately 15000 ft from the end of the on-ramp
303	Interstate 37	Drive to the Highway 94 exit and continue towards Carbondale.	Start of Interstate Event 205: Interstate Curves
304	Rural	Continue on Highway 94 and bear to the right after passing Earl's service station.	375 ft after start of Rural Event 302: Lighted Rural
305	Destination	Your destination is the first residence on the right.	Start of Rural Event 306: Gravel Rural
306	Stop	You have reached your destination.	75 ft after entrance to driveway in Rural Event 307: Driveway
7	Restart 1	On the green light, drive until you see the Shell gas station and then turn left at the intersection.	The first intersection before Urban Event 105: Left Turn
322	Restart 2	Continue driving and take Interstate 30 South.	500 ft before Interstate Event 201: Turn On Ramp
323	Restart 3	Drive to the Highway 94 exit and continue towards Carbondale.	Interstate Event 206: Exit Ramp
324	Restart 4	Continue on Highway 94 and bear to the right after passing Earl's service station	Immediately after hairpin curve in Rural Event 304: Dark Rural
325	Restart 5	Continue on Highway 94 and bear to the right after passing Earl's Service Station.	500 ft before Rural Event 305: Gravel Transition

1.5 In-cab Instructions

The following instructions are given to the participants after they have been seated in the simulator cab and before they begin to drive.

1.5.1 Simulator motion

"The simulator is moving towards its start position. During this time you may hear rumbling and feel vibrations. This is perfectly normal. There are microphones in the cab so the simulator operator can hear you at all times. If for any reason you wish to stop driving, please let us know. The operator can bring you to a stop in just a few seconds."

This file is a recorded message that is played by the control room experimenter as the simulator is moving to the starting position.

1.5.2 Practice drive

"Your first drive will be a practice drive. It is designed to help you get used to the simulator. During this drive you should become familiar with driving at the various posted speed limits and recognizing traffic control devices. When it is time to begin, instructions will tell you to merge into traffic. Onboard navigational instructions will provide directions to the interstate. A recording will tell you when it is time to stop. Do you have any questions?" The ride-along experimenter reads these instructions before the start of the drive.

1.5.3 Data Collection Drive

"The main drive will start shortly. Remember to listen to the on-board instructions carefully. If you have any uncertainty about navigating during the drive, please ask. When the scenery comes on, please press on the brake, shift into drive and merge into traffic when it is safe to do so. Do you have any questions at this time?" (In-cab researcher responds to questions). The ride-along experimenter reads these instructions before the start of the drive.

2 SCENARIOS

This section describes the layout of the scenarios for this study. A scenario consists of several driving segments that combine to form an experimental drive. All scenarios in this study have three distinct driving segments in the following order: urban, interstate, and rural. The order of these segments remains the same in all scenarios. Only the order of the events within the segments changes between scenarios. Although the order of events changes between scenarios, the scenario is designed to remain similar in duration and comprises the same tiles. The urban section comprises three different versions of buildings, gas stations, and different rotations. The interstate and rural sections differences are related to curve direction and radii of curve. The table below illustrates the differences across the scenarios.

	Scenario 1	Scenario 2	Scenario 3
1st Urban Intersection	1 (rotation:0)	2 (rotation: 90)	3 (rotation: 180)
2nd Urban Intersection	2 (rotation: 90)	3 (rotation: 0)	1 (rotation: 180)
3rd Urban Intersection	3 (rotation: 0)	2 (rotation: 90)	1 (rotation: 180)
1st Freeway Curve	Left (4500)	Left (4500)	Right (3100)
2nd Freeway Curve	Right (3100)	Right (3100)	Left (4010)
3rd Freeway	Right (4010)	Left (4010)	Left (4500)
1st Rural Curve	Left (2100)	Right (2100)	Left (2100)
2nd Rural Curve	Right (456)	Left (456)	Right (456)
3rd Rural Curve	Left, Right (hill) (2446 total)	Left, Right (hill) (2446 total)	Left (3850)
4th Rural Curve	Left (3850)	Right (3850)	Left, Right (hill) (2446 total)

Figure 1 Road networks for Scenarios 1, 2, and 3 (counterclockwise from top)

The spatial and logical constraints require that the order of most events remains the same between scenarios. Those events that are different have been marked in gray in Table 3.

Table 3 Scenario event orders

Event	Scenario 1	Scenario 2	Scenario 3
1	Urban Event 101: Pull Out	Urban Event 101: Pull Out	Urban Event 101: Pull Out
		Urban Event 111: Urban Drive	Urban Event 111: Urban Drive
2	Urban Event 102: Urban Drive	Urban Event 103: Green Light	Urban Event 105: Left Turn
3	Urban Event 103: Green Light	Urban Event 102: Urban Drive	Urban Event 102: Urban Drive
4	Urban Event 104: Yellow Light Dilemma	Urban Event 105: Left Turn	Urban Event 103: Green Light
5	Urban Event 105: Left Turn	Urban Event 104: Yellow Light Dilemma	Urban Event 104: Yellow Light Dilemma
6	Urban Event 106: Urban Curves	Urban Event 106: Urban Curves	Urban Event 106: Urban Curves
7	Interstate Event 201: Turn On Ramp	Interstate Event 201: Turn On Ramp	Interstate Event 201: Turn On Ramp
8	Interstate Event 202: Merge On	Interstate Event 202: Merge On	Interstate Event 202: Merge On
9	Interstate Event 203:	Interstate Event 203:	Interstate Event 203:
10	Interstate Event 204: Merging Traffic	Interstate Event 204: Merging Traffic	Interstate Event 204: Merging Traffic
11	Interstate Event 205: Interstate Curves	Interstate Event 205: Interstate Curves	Interstate Event 205: Interstate Curves
12	Interstate Event 206: Exit Ramp	Interstate Event 206: Exit Ramp	Interstate Event 206: Exit Ramp
13	Rural Event 301: Turn Off Ramp (Transitional)	Rural Event 301: Turn Off Ramp (Transitional)	Rural Event 301: Turn Off Ramp (Transitional)

Event	Scenario 1	Scenario 2	Scenario 3
14	Rural Event 302: Lighted Rural	Rural Event 302: Lighted Rural	Rural Event 302: Lighted Rural
15	Rural Event 303: Transition to Dark Rural	Rural Event 303: Transition to Dark Rural	Rural Event 303: Transition to Dark Rural
16	Rural Event 304: Dark Rural	Rural Event 304: Dark Rural	Rural Event 304: Dark Rural
17	Rural Event 305: Gravel Transition	Rural Event 305: Gravel Transition	Rural Event 305: Gravel Transition
18	Rural Event 306: Gravel Rural	Rural Event 306: Gravel Rural	Rural Event 306: Gravel Rural
19	Rural Event 307: Driveway	Rural Event 307: Driveway	Rural Event 307: Driveway

2.1 Practice Drive

This scenario allows participants the opportunity to get familiar with the simulator and the study drive route. It comprises an urban section, an interstate ramp, and interstate driving. The drive begins in the urban area where participants are instructed to turn left at the first intersection and then listen to the navigational instructions provided. The practice route uses the same database as Scenario 1, with the exception of taking a different exit ramp.

2.2 Scenario 1

This scenario has three segments as shown in Figure 2. Each segment is shown in more detail in Figure 3, Figure 4, and Figure 5. Each figure is accompanied with a table that provides more detailed information about the duration and length of each event within the segment. It should be noted that the elevation throughout the scenario is the same with two exceptions: the exit ramp the participant takes and a curve in the rural segment. More detail is provided later.

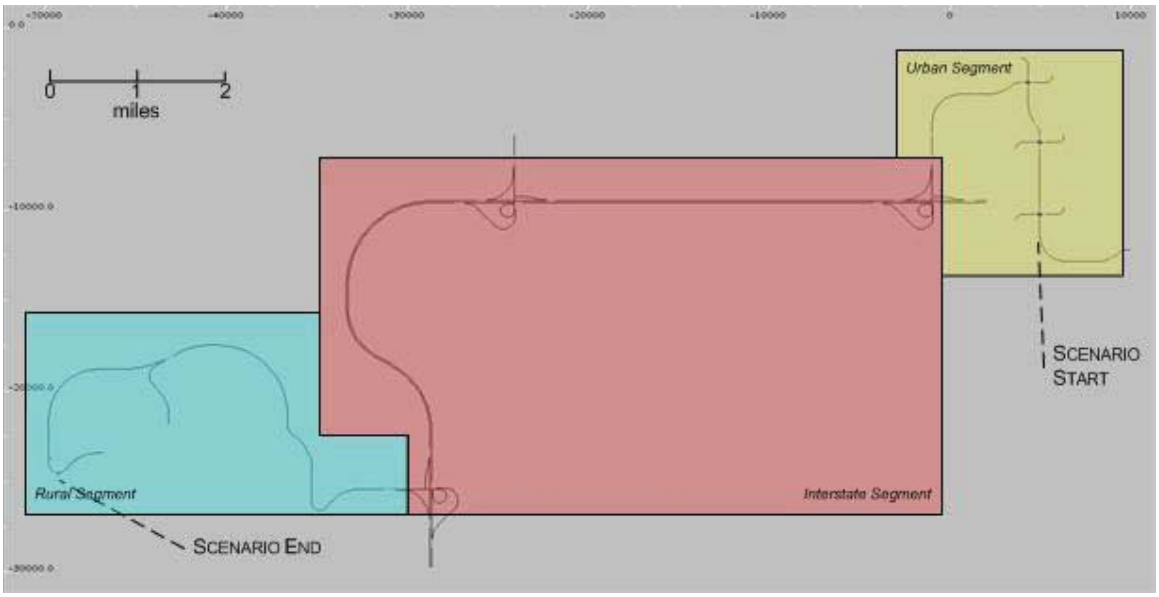


Figure 2 Scenario 1 road network

2.2.1 Urban Segment

The participant begins the urban portion of the scenario at the pullout event (location 101). The participant then continues through the events through the urban section (marked in yellow) toward the interstate segment.

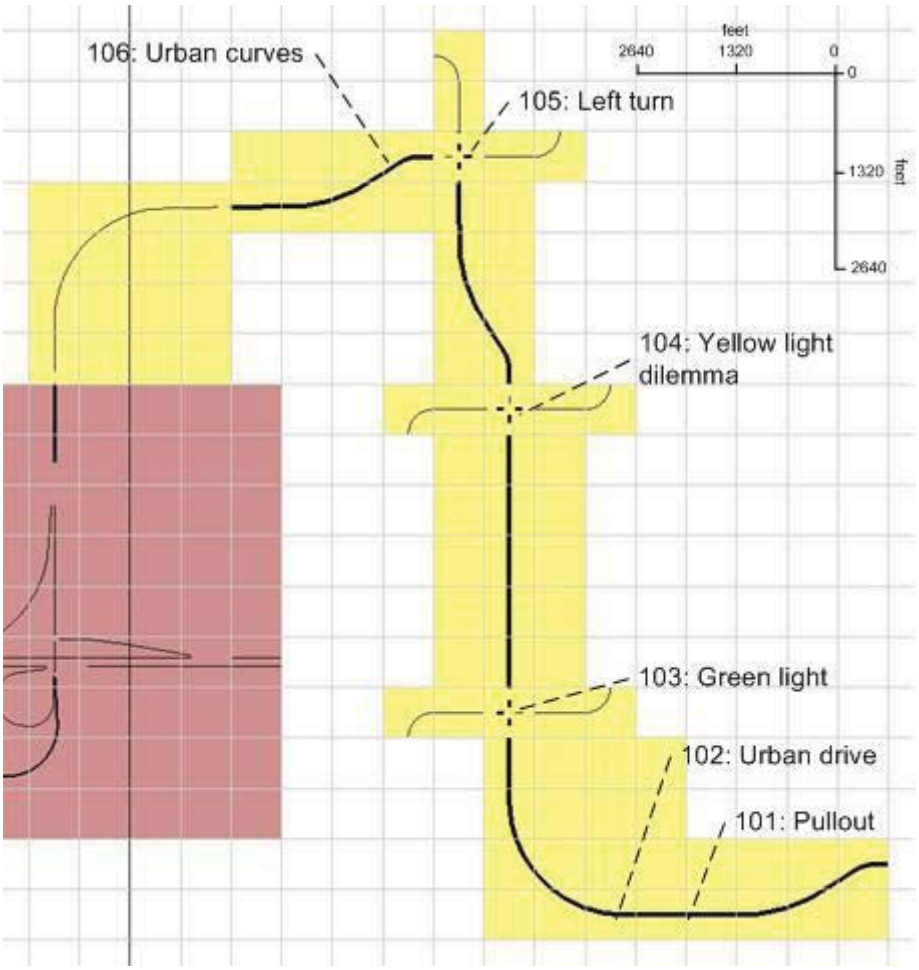


Figure 3 Segment 1, urban events

Table 4 indicates the distance required for each event and the approximate length of time that it takes a participant to traverse this segment at the posted speed limits. The urban events are designed to work at speeds from 15 to 45 mph.

Table 4 Scenario 1, urban segment times and distances

Event	Assumed Speed (mph)	Actual Distance (feet)	Cumulative Distance (feet)	Actual Time (minutes)	Cumulative Time (minutes)
101: Pull Out	15	270	270	0.20	0.20
102: Urban Drive	25	3670	3940	1.67	1.79
103: Green Light	25	3970	7910	1.80	3.60
104: Yellow Dilemma	25	3450	11360	1.57	5.16
105: Left Turn	25	890	12250	0.40	5.57
106: Urban Curves	30, 45 for last 400’	7310	19560		
Total		**19300**		**8.31**	

2.2.2 Interstate Segment

Following the urban segment, the participant takes the on-ramp to get on the interstate.

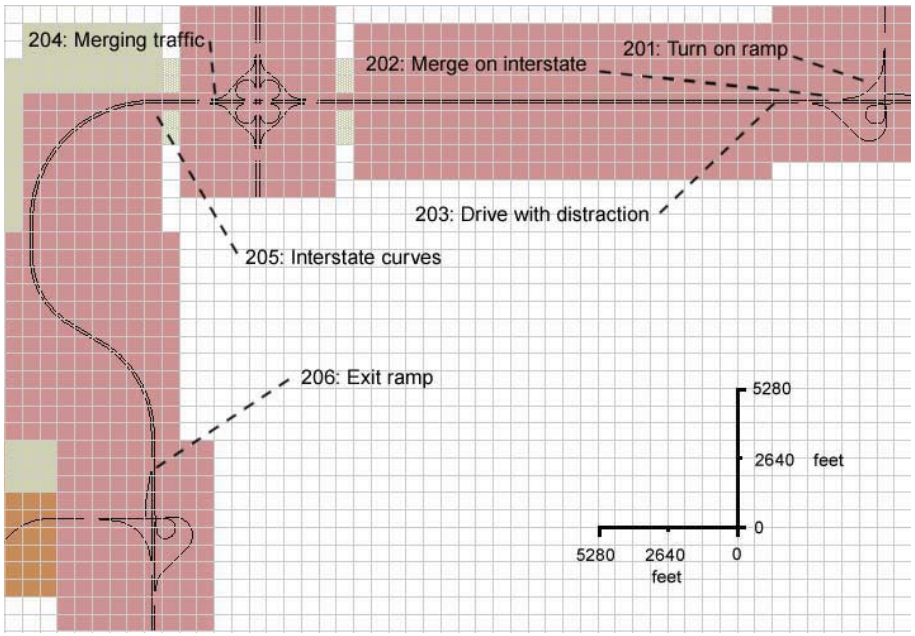


Figure 4 Segment 2, interstate events

Table 5 indicates the distance required and the approximate length of time that it takes a participant to traverse this segment at posted speed limits.

Table 5 Scenario 1, interstate segment times, and distances

Event	Assumed Speed (mph)	Actual Distance (feet)	Cumulative Distance (feet)	Actual Time (minutes)	Cumulative Time (minutes)
201: Turn On Ramp	25	1000	1000	0.45	0.45
202: Merge On	45	3500	4500	0.88	1.34
203: Drive with Distraction	70	18000	22500	2.96	4.30
204: Merging Traffic	70	6100	28600	0.99	5.29
205: Interstate Curves	70	19300	47900	3.13	8.43
206: Exit Ramp	35	1500	49400	0.49	8.91
Total		**49400**		**8.91**	

2.2.3 Rural Segment

Following the interstate segment, the participant takes the off-ramp to exit the interstate and takes a right turn at the intersection to turn toward the rural portion of the scenario.

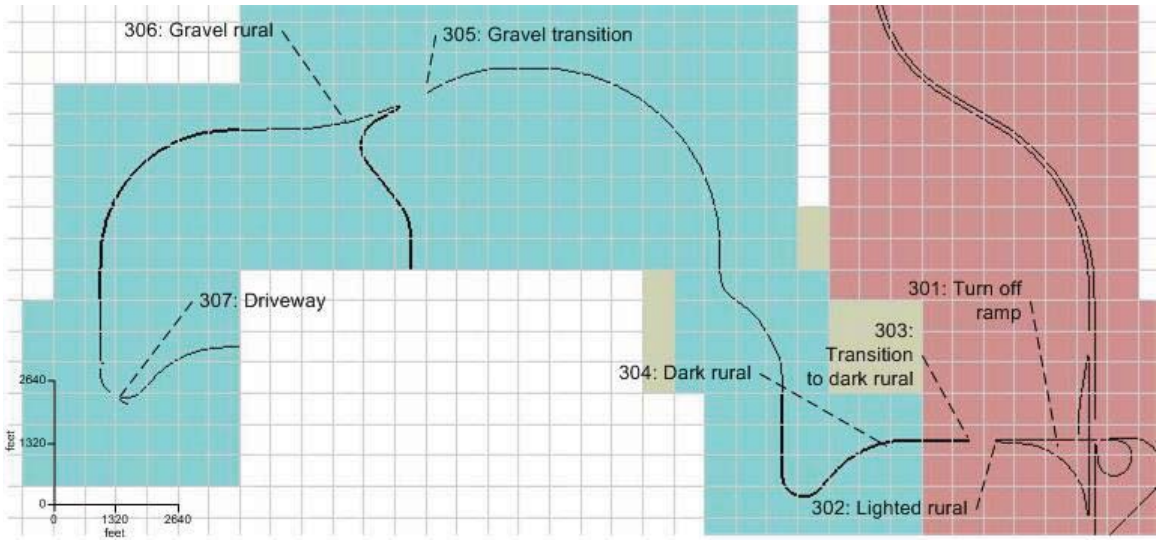


Figure 5 Segment 3, rural events

Table 6 indicates the distance required and the approximate length of time that it takes a participant to traverse this segment at posted speed limits.

Table 6 Scenario 1, rural segment times, and distances

Event	Assumed Speed (mph)	Actual Distance (feet)	Cumulative Distance (feet)	Actual Time (minutes)	Cumulative Time (minutes)
301: Turn Off Ramp	30	1500	1500	0.5	0.5
302: Lighted Rural	55	750	2250	0.15	0.65
303: Transition to Dark	55	1500	3750	0.30	0.95
304: Dark Rural	55	14510	18260	3	4
305: Gravel Transition	55	2420	20680	0.5	4.5
306: Gravel Rural	45	5940	26620	1.5	6
307: Driveway	15	660	27280	0.5	6.5
Total		**27280**		**6.5**	

2.3 Scenario 2

The segments for this scenario are shown in Figure 6.

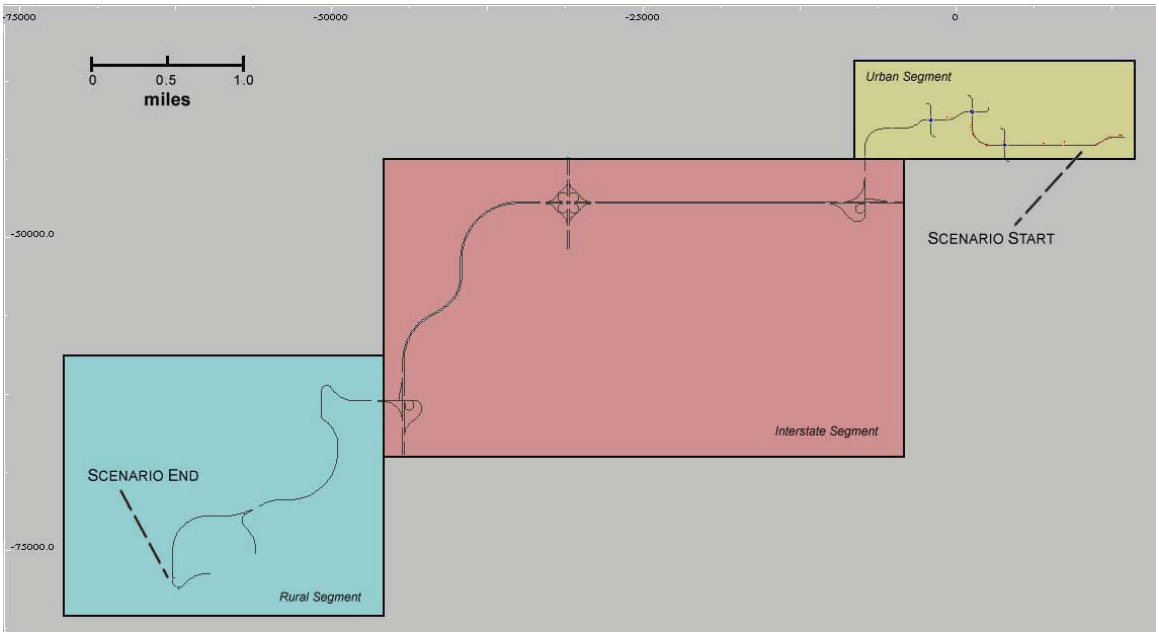


Figure 6 Scenario 2 road network

2.4 Scenario 3

The segments for this scenario are shown in Figure 7.

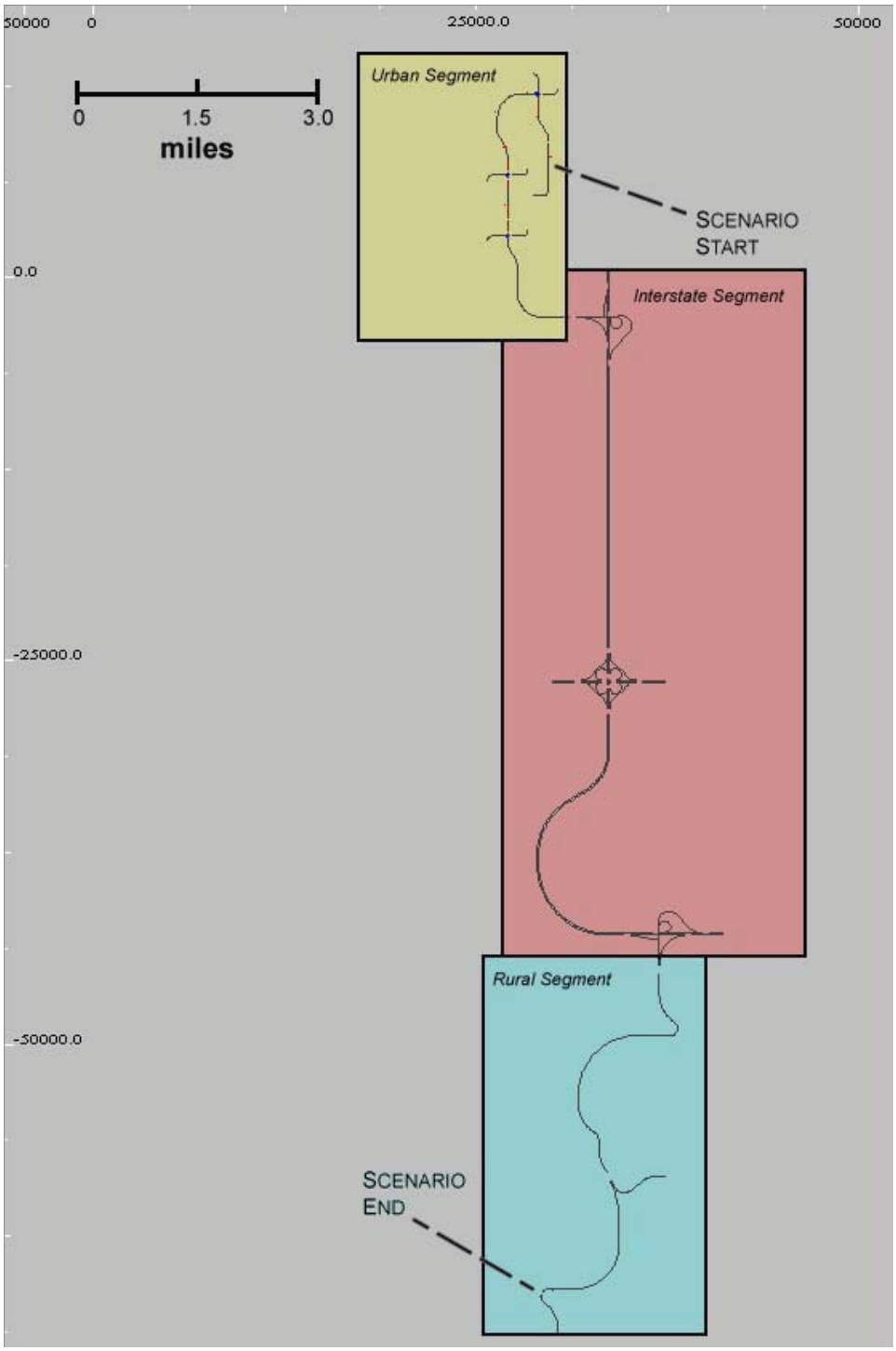


Figure 7 Scenario 3 road network

3 EVENT SPECIFICATION

This section describes each event in detail. The order of the events will change across the three scenarios.

3.1 Urban Event 101: Pull Out

The vehicle is parallel parked along the side of the road. The participant will start the drive by pulling out onto a main road and driving in the same direction. The participant is pulling out into traffic with intermittent gaps. The gaps will vary in distance, and the participant will have to decide when to pull out.

URBAN EVENT 101: PULL OUT	
RATIONALE	The assumption is that the participant is driving home at night after being at a bar. The drive starts from a parking spot parallel to the driving lane on an urban street. There are cars in front and behind the driver's vehicle. He must look for traffic in the rear and pull out when it is clear. There is no FARS rationale for this, but it represents a typical situation for a drinking driver and presents some challenges for an impaired driver--judging the distance from the car in front and in the rear and pulling out onto the street when traffic is clear from behind. Police blotters are filled with complaints by citizens of damage to their cars while they were parked. Many impaired drivers strike these cars and then leave the scene. This is a judgment situation for the driver and comes in the first scenario event. Drivers can easily leave this parking spot when sober. When impaired at .08 BAC, it may present a challenge.
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 660 Road type (lanes, surface): 2 driving lanes with on-road parking Speed limit (in mph): 25 Curvature: none Intersection type: none Time of day/date: night
PREPARATION	The simulation starts; the participant is parked in parking lane 21.5 ft behind one vehicle and 137 ft in front of a second vehicle. A series of cars pass the participant in the driving lane at varying gaps; the first gap that is presented is short (The participant waits for a reasonable gap between cars to pull out)
START CONDITIONS	Start of Simulation
ACTUAL EVENT	The simulation starts; logstream 1 is incremented, logstream 2 is set to 101, logstream 3 is set to 0, logstream 4 is set to 1, logstream 5 is set to 11. A series of cars is created behind the participant at the start of the drive. The cars are located approximately 60, 200, 465, and 1000 ft (CG to CG) behind the participant in the driving lane. The participant pulls out once a reasonable gap has presented itself. (The participant waits for a reasonable gap.) (The participant pulls out into the driving lane.) After participant has pulled out, a vehicle parked behind the driver pulls out into the driving lane. After the participant crosses the back of the first parked car, logstream 4 is set to 100 Approximately 125 feet after the driver pulls out of the parking lane, instruction #1 is played.

URBAN EVENT 101: PULL OUT			
END CONDITIONS	The participant has pulled out into traffic and is 250 feet from the initial start location.		
CLEANUP	None		
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Length of gaps	E101_gap_d_X (where X is the gap number, 1-6)	ft
	Length of gaps	E101_gap_t_X (where X is the gap number, 1-6)	Sec
	Vehicle creation distance from subject	E101_vehX_create_d (where X is passing vehicle 1-6)	ft
	Distance to vehicle parked in front of subject	E101_front_veh_d	ft
	Distance to vehicle parked behind subject	E101_rear_veh_d	ft
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Pull-out time (time from start of simulation until participant passes rear of forward parked car)	E101_pullout_t	sec
	Time to finish accelerating (time from pull out until absolute value of acceleration averaged over 1 sec is less than a TBD threshold)	E101_acc_done_t	sec
	Distance to finish accelerating (time from pull out until absolute value of acceleration averaged over 1 sec is less than a TBD threshold)	E101_acc_done_d	ft
	Steering angle (min and max)	E101_steer_min E101_steer_max	deg
	Pulls forward (check to make sure participant does not put vehicle into reverse and back up before pulling out)	E101_pull_forward	binary 1=yes, 0 = no
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Number of head turns to left before pulling out (threshold angle that defines a turn needs TBD)	E101_head_turn	count
	Number of glances at side mirror before pulling out (definition TBD once we have eye data)	E101_side_mirror	count
	Number of glances at rear mirror before pulling out (definition TBD once we have eye data)	E101_rear_mirror	binary 1=yes, 0 = no
	Time from last glance (head turn, side mirror, or rear mirror) until pullout	E101_last_glance	sec
	Gap participant takes	E101_gap_taken E101_gap_taken_d	number ft

URBAN EVENT 101: PULL OUT			
		E101_gap_taken_t	sec
	Collision	E101_collision	binary 1=yes, 0 = no
	Collision object	E101_collision_obj	Text descriptor of object
	Turn signal use	E101_turn_signal	Binary 1=yes, 0 = no
	Smoothness of lane change	E101_smooth_lat	
	Smoothness of acceleration	E101_smooth_long	
	Degree of conflict		
	Velocity of steering wheel	E101_steer_vel	
	Jerk of steering wheel	E101_steer_jerk	
	Velocity of accelerator position	E101_accel_vel	
	Jerk of accelerator position	E101_accel_jerk	
	SD of accelerator position	E101_accel_sd	
	Pressure output (global and local)	E101_out_pres	
	Pressure and force over time	E101_force_pres	
	Pressure point mapping	E101_map_pres	
	PERCLOS	E101_perclos	
	Eye blink frequency	E101_blink_freq	
	Eye blink duration	E101_blink_dur	
	Percent in center based on median location of gaze	E101_cent_base	
	Correlation between head turn and steering wheel movement	E101_headturn_wheel	
	Number of collisions	E101_num_col	
	Near misses	E101_num_miss	
	Degree of conflict	E101_deg_conflict	
	Delay time	E101_delay_time	
	Rise time	E101_rise_time	
	Peak time	E101_peak_time	
	Max overshoot	E101_over_max	

URBAN EVENT 101: PULL OUT			
	Settling time	E101_set_time	
	How well it fits the model	E101_model_fit	
	Smooth pursuit velocity	E101_smpur_vel	
	Smooth pursuit duration	E101_smpur_dur	
	Smooth pursuit frequency	E101_smpur_freq	
	Smooth pursuit maximum velocity	E101_smpur_maxvel	
	Smooth pursuit gain	E101_smpur_gain	
	SD of gaze	E101_gaze_sd	
	Gaze kurtosis	E101_gaze_kurt	
	Dwell duration	E101_dwell_time	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Time from last glance (head turn, side mirror, or rear mirror) until pullout	E101_last_glance	sec
	Gap participant takes	E101_gap_taken E101_gap_taken_d E101_gap_taken_t	number ft sec
	Mean accelerator position		
	Time from last glance (head turn, side mirror, or rear mirror) until pullout		
	Smoothness of lane change		
	Smoothness of acceleration		

- Jerk of accelerator position
- Jerk of steering wheel position
- Velocity of accelerator position
- Smoothness of lane change
- Over- or undershoot in lane position relative to nominal pullout maneuver
- Time from last glance (head turn, side mirror, or rear mirror) until pullout
- Max overshoot

- Minimum TTC to following vehicle during pullout
- Minimum TTC to parked vehicle ahead
- Relationship to passing vehicle as pullout

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when pulling out of a parking space are: time from last glance until pulling out, how close the vehicle came to another moving vehicle, the smoothness of pulling out, max overshoot, and jerk and velocity of accelerator position. As a person pulls out of the parking space, looking for other traffic is essential to safe driving and is something that alcohol-impaired drivers tend to ignore**. The smoothness of lane change and max overshoot go hand in hand in the way a person pulls out of the parking space as unimpaired drivers will get into the lane fairly quickly and impaired drivers will have to adjust their position before settling on an adequate location (Stuster, 1997). Jerk and velocity of accelerator position look at how smoothly the participant pulled out of the parking space in a longitudinal perspective. Alcohol-impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997).

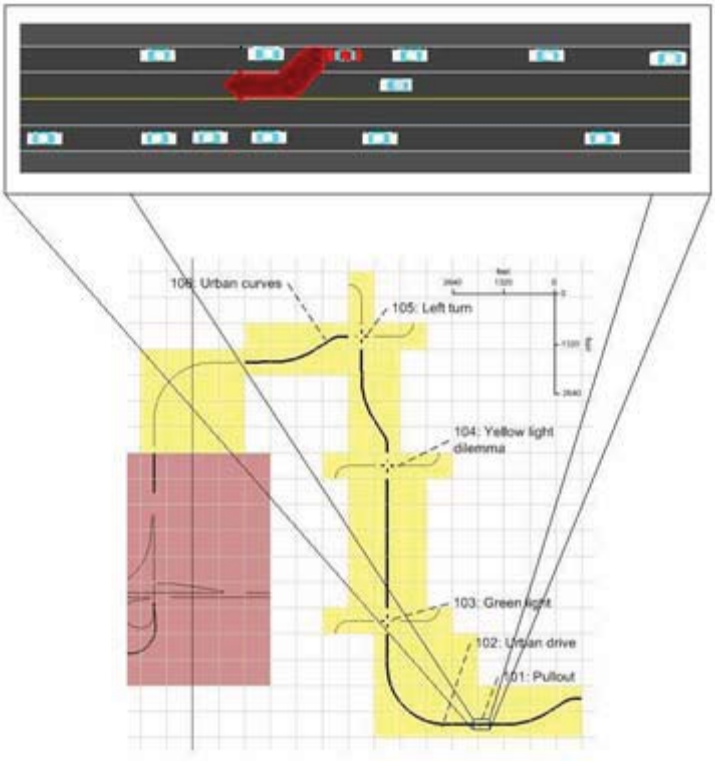


Figure 8 Participant pulling out: participant is driving the red vehicle

3.2 Urban Event 111: Urban Drive

The main street onto which the participant will have pulled out is relatively narrow, with cars parked on both sides of the road. This event exists only in drives 2 and 3. This section was added to give the participant space to get up to speed before the second event in the drive. There is oncoming traffic and traffic behind and in front of the participant.

<table>
<tr><th colspan="4">URBAN EVENT 111: URBAN DRIVE</th></tr>
<tr><td>RATIONALE</td><td colspan="3">This involves driving on a narrow urban road with parked cars on both sides and oncoming traffic about once every 10 seconds. FARS rationale includes over-representations in nighttime conditions on a dark but lighted road which is two lanes and undivided with oncoming traffic (over-representation of driving over center line). Impaired drivers also tend to drive too fast for these conditions.</td></tr>
<tr><td>ROAD NETWORK REQUIREMENTS</td><td colspan="3">Overall length/distance needed to support event (in feet): 4620
Road type (lanes, surface): 2 driving lanes with on-road parking
Speed limit (in mph): 25
Curvature: 90 deg turn, radius of 1100 ft
Intersection type: none
Time of Day/Date: night</td></tr>
<tr><td>PREPARATION</td><td colspan="3">The participant drives on a narrow urban road with parking on both sides of the street and oncoming traffic approximately once per 10 seconds
(The participant is traveling 25 miles per hour)</td></tr>
<tr><td>START CONDITIONS</td><td colspan="3">End of previous event</td></tr>
<tr><td>ACTUAL EVENT</td><td colspan="3">Logstream 1 is be incremented, logstream 2 is set to 111, logstream 5 is set to 100
(The participant is traveling 25 miles per hour)
A lead vehicle is approximately 6 seconds ahead of the participant with a minimum speed of 15 and a maximum speed of 50, and maximum acceleration rate of 4.9 meters per second squared, and maximum deceleration of -0.68 meters per second squared.
A series of oncoming cars is created ahead of the participant at around one per 10 seconds; a few cars are behind the participant.
(The participant does not cross the center line.)</td></tr>
<tr><td>END CONDITIONS</td><td colspan="3">The participant is 500 ft from the next intersection.</td></tr>
<tr><td>CLEANUP</td><td colspan="3">None</td></tr>
<tr><td rowspan="4">EVENT CONTINGENCY
(VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)</td><td>DESCRIPTION</td><td>IDENTIFIER</td><td>UNITS</td></tr>
<tr><td>Participant has finished accelerating from parking space before start of this event.</td><td>E101_acc_done</td><td>binary
1=yes, 0 = no</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

URBAN EVENT 111: URBAN DRIVE			
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Minimum time headway to lead vehicle	E102_ttc_t_min	sec
	Maximum time headway to lead vehicle	E102_ttc_t_max	sec
	Oncoming traffic every 10 seconds	E102_oncoming_freq	avg. sec between cars
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Speed (average, min, and max)	E102_sp_avg E102_sp_min E102_sp_max	Mph
	Speed entering and leaving curve	E102_sp_init E102_sp_end	Mph
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Lane Position	E102_lp_avg	Ft
	SD of lane position (relative to mean lane position)	E102_lp_sd	Ft
	SD of lane position (relative to center of lane)	E102_lpn_sd	Ft
	Speed	E102_sp_avg	Mph
	Speed (relative to posted or assumed speed limit)	E102_spn_avg	Mph
	SD of speed (during “steady state”) relative to mean speed	E102_sp_sd	Mph
	SD of speed (during “steady state”) relative to posted speed limit	E102_spn_sd	Mph
	Number of center line crossings (any part of the car leaves the lane)	E102_center_cross	Count
	Number of right line crossings (any part of the car leaves the lane)	E102_right_cross	Count

URBAN EVENT 111: URBAN DRIVE			
	Did participant glance toward hazard X (hazards are described and numbered in 3.21)?	E102_haz_glance_X	binary 1 = yes, 0 = no
	Steering wheel reversals	E102_steer_rev	
	SD of steering wheel position	E102_steer_sd	
	Velocity of steering wheel	E102_steer_vel	
	Jerk of steering wheel	E102_steer_jerk	
	Steering error	E102_steer_error	
	Time to line crossing (TLC)	E102_tlc	
	Proportion of time TLC>2s	E102_tlc_2	proportion
	95% TLC	E102_tlc_95	
	Accelerator holds	E102_accel_holds	
	Velocity of accelerator position	E102_accel_vel	
	Jerk of accelerator position	E102_accel_jerk	
	SD of accelerator position	E102_accel_sd	
	Glance frequency at particular object	E102_freq_glance	
	Pressure output(global and local)	E102_out_pres	
	Pressure and force over time	E102_force_pres	
	Pressure point mapping	E102_map_pres	
	PERCLOS	E102_perclos	
	Eye blink frequency	E102_blink_freq	
	Eye blink duration	E102_blink_dur	
	Percent in center based on median location of gaze	E102_cent_base	
	Correlation between road curvature and eye movements	E102_eye_curve	
	Correlation between steering and road curvature	E102_steer_curve	
	Correlation between eye movements and SDLP	E102_eye_sdlp	
	Number of collisions	E102_num_col	
	Near misses	E102_num_miss	
	Smooth pursuit velocity	E102_smpur_vel	
	Smooth pursuit duration	E102_smpur_dur	

URBAN EVENT 111: URBAN DRIVE			
	Smooth pursuit frequency	E102_smpur_freq	
	Smooth pursuit maximum velocity	E102_smpur_maxvel	
	Smooth pursuit gain	E102_smpur_gain	
	SD of gaze	E102_gaze_sd	
	Gaze kurtosis	E102_gaze_kurt	
	Dwell duration	E102_dwell_time	
	Frequency of side mirror glances	E102_glance_freq_side	
	Frequency of speedometer glances	E102_glance_freq_speed	
	Glance direction	E102_glance_dir	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	SD of lane position		
	SD of speed		
	Steering wheel reversals		
	Number of center line crossings		
	Number of right line crossings		

3.3 Urban Event 102: Urban Drive

The main street onto which the participant will have pulled out is relatively narrow, with cars parked on both sides of the road. There is oncoming traffic and traffic behind and in front of the participant.

URBAN EVENT 102: URBAN DRIVE	
RATIONALE	This involves driving on a narrow urban road with parked cars on both sides and oncoming traffic about once every 10 seconds. FARS rationale include over-representations in nighttime conditions on a dark but lighted road which is two lanes and undivided with oncoming traffic (over-representation of driving over center line). Impaired drivers also tend to drive too fast for these conditions.

URBAN EVENT 102: URBAN DRIVE			
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 4620 Road type (lanes, surface): 2 driving lanes with on-road parking Speed limit (in mph): 25 Curvature: 90 deg turn, radius of 1100 ft Intersection type: none Time of Day/Date: night		
PREPARATION	The participant drives on a narrow urban road with parking on both sides of the street and oncoming traffic approximately once per 10 seconds (The participant is traveling 25 miles per hour)		
START CONDITIONS	End of previous event		
ACTUAL EVENT	Logstream 1 is be incremented, logstream 2 is set to 102, logstream 5 is set to 100 (The participant is traveling 25 miles per hour) A lead vehicle is approximately 6 seconds ahead of the participant with a minimum speed of 15 and a maximum speed of 50 and a maximum acceleration rate of 4.9 meters per second squared, and maximum deceleration of -0.68 meters per second squared. A series of oncoming cars is created ahead of the participant at around one per 10 seconds; a few cars are behind the participant. (The participant does not cross the center line.)		
END CONDITIONS	The participant is 500 ft from the next intersection.		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
	Participant has finished accelerating from parking space before start of this event.	E101_acc_done	binary 1=yes, 0 = no
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Minimum time headway to lead vehicle	E102_ttc_t_min	sec
	Maximum time headway to lead vehicle	E102_ttc_t_max	sec
	Oncoming traffic every 10 seconds	E102_oncoming_freq	avg. sec between cars

URBAN EVENT 102: URBAN DRIVE			
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Speed (average, min, and max)	E102_sp_avg E102_sp_min E102_sp_max	Mph
	Speed entering and leaving curve	E102_sp_init E102_sp_end	Mph
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Lane Position	E102_lp_avg	Ft
	SD of lane position (relative to mean lane position)	E102_lp_sd	Ft
	SD of lane position (relative to center of lane)	E102_lpn_sd	Ft
	Speed	E102_sp_avg	Mph
	Speed (relative to posted or assumed speed limit)	E102_spn_avg	Mph
	SD of speed (during "steady state") relative to mean speed	E102_sp_sd	Mph
	SD of speed (during "steady state") relative to posted speed limit	E102_spn_sd	Mph
	Number of center line crossings (any part of the car leaves the lane)	E102_center_cross	Count
	Number of right line crossings (any part of the car leaves the lane)	E102_right_cross	Count
	Did participant glance toward hazard X (hazards described and numbered in 3.21)?	E102_haz_glance_X	binary 1 = yes, 0 = no
	Steering wheel reversals	E102_steer_rev	
	SD of steering wheel position	E102_steer_sd	
	Velocity of steering wheel	E102_steer_vel	
	Jerk of steering wheel	E102_steer_jerk	
	Steering error	E102_steer_error	
	Time to line crossing (TLC)	E102_tlc	

URBAN EVENT 102: URBAN DRIVE			
	Proportion of time TLC>2s	E102_tlc_2	proportion
	95% TLC	E102_tlc_95	
	Accelerator holds	E102_accel_holds	
	Velocity of accelerator position	E102_accel_vel	
	Jerk of accelerator position	E102_accel_jerk	
	SD of accelerator position	E102_accel_sd	
	Glance frequency at particular object	E102_freq_glance	
	Pressure output(global and local)	E102_out_pres	
	Pressure and force over time	E102_force_pres	
	Pressure point mapping	E102_map_pres	
	PERCLOS	E102_perclos	
	Eye blink frequency	E102_blink_freq	
	Eye blink duration	E102_blink_dur	
	Percent in center based on median location of gaze	E102_cent_base	
	Correlation between road curvature and eye movements	E102_eye_curve	
	Correlation between steering and road curvature	E102_steer_curve	
	Correlation between eye movements and SDLP	E102_eye_sdlp	
	Number of collisions	E102_num_col	
	Near misses	E102_num_miss	
	Smooth pursuit velocity	E102_smpur_vel	
	Smooth pursuit duration	E102_smpur_dur	
	Smooth pursuit frequency	E102_smpur_freq	
	Smooth pursuit maximum velocity	E102_smpur_maxvel	
	Smooth pursuit gain	E102_smpur_gain	
	SD of gaze	E102_gaze_sd	
	Gaze kurtosis	E102_gaze_kurt	
	Dwell duration	E102_dwell_time	
	Frequency of side mirror glances	E102_glance_freq_side	
	Frequency of speedometer glances	E102_glance_freq_speed	

URBAN EVENT 102: URBAN DRIVE			
	Glance direction	E102_glance_dir	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	SD of lane position		
	SD of speed		
	Steering wheel reversals		
	Number of center line crossings		
	Number of right line crossings		

- SD of lane position (relative to mean lane position)
- SD speed (relative to mean)

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when going through a green lighted intersection are: SDLP and SD speed relative to mean speed. One of the most widely thought of behaviors of alcohol-impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). The same has been shown for variation in speed which can be measured by SD speed (Arnedt et al., 2001; Gawron & Ranney, 1988).

3.4 Urban Event 103: Green Light

The participant continues to drive down the narrow street with cars parked on both sides of the road with oncoming traffic and traffic behind the participant. The participant encounters an intersection with a green traffic light.

URBAN EVENT 103: GREEN LIGHT	
RATIONALE	This scenario involves approaching an intersection where the light is green. The driver must drive through the intersection (no turns) with oncoming traffic. There is no specific FARS rationale for this, but it could involve some lane maintenance problems and some judgment problems that are described in the DWI Detection Guide.

URBAN EVENT 103: GREEN LIGHT			
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 3080 Road type (lanes, surface): 2 driving lanes with on-road parking Speed limit (in mph): 25 Curvature: none Intersection type: 4 way Time of Day/Date: night		
PREPARATION	The participant approaches an intersection; the light is green (The participant is traveling 25 miles per hour)		
START CONDITIONS	The participant is 500 feet from the intersection		
ACTUAL EVENT	When the participant is 500 feet from the intersection, logstream 1 is incremented, logstream 2 is set to 103, logstream 4 is set to 1 When the participant is 250 feet from the intersection, logstream 4 is set to 2 As the participant crosses the stop line, logstream 4 is set to 3 The participant drives through the intersection, the light is green, and the participant experiences oncoming traffic (The participant does not turn at the intersection) (The participant is traveling 25 miles per hour) Once the participant passes the stop line on the far side of the intersection, logstream 4 is set to 100		
END CONDITIONS	The participant is 500 feet from the next intersection		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Distance from start of event to intersection	E103_start_d	ft
	Distance from 250 ft logstream change to intersection	E103_250_d	ft
	Scenario cars from left/right don't enter intersection		
	Any oncoming cars go through light		
	Oncoming traffic (on average once every 6 sec)	E103_oncoming_freq	avg. sec between cars
ASSUMED DRIVER	DESCRIPTION	IDENTIFIER	UNITS

URBAN EVENT 103: GREEN LIGHT			
BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	SV goes through light	E103_go_thru	binary 1=yes, 0 = no
	Speed (average, min, and max) as participant approaches intersection	E103_sp_avg E103_sp_min E103_sp_max	mph
	Brake press	E103_brake_press	binary 1=yes, 0 = no
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Frequency of glances to own traffic light	E103_glance_freq_light	glances/sec
	Frequency of glances to cross traffic light	E103_glance_freq_cross_light	glances/sec
	Frequency of glances to traffic on left	E103_glance_freq_left	glances/sec
	Frequency of glances to traffic on right	E103_glance_freq_right	glances/sec
	Did participant glance toward hazard X (hazards TBD)?	E103_haz_glance_X	binary 1 = yes, 0 = no
	Lane Position	E103_lp_avg	ft
	SD of lane position relative to mean lane position	E103_lp_sd	ft
	SD of lane position relative to center of lane	E103_lpn_sd	ft
	Speed	E103_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E103_spn_avg	mph
	SD of speed relative to mean speed	E103_sp_sd	mph
	SD of speed relative to posted speed limit	E103_spn_sd	mph
	Number of center line crossings	E103_center_cross	count
	Number of right light crossings	E103_right_cross	count
	Head Turn		Binary 1=yes 0=no
	SD of steering wheel position	E103_steer_sd	
	Velocity of steering wheel	E103_steer_vel	
	Jerk of steering wheel	E103_steer_jerk	

URBAN EVENT 103: GREEN LIGHT			
	Steering error	E103_steer_error	
	Steering wheel reversals	E103_steer_rev	
	Time to line crossing (TLC)	E103_tlc	
	Proportion of time TLC>2s	E103_tlc_2	proportion
	95% TLC	E103_tlc_95	
	Accelerator holds	E103_accel_holds	
	Velocity of accelerator position	E103_accel_vel	
	Jerk of accelerator position	E103_accel_jerk	
	SD of accelerator position	E103_accel_sd	
	Glance frequency at particular object	E103_freq_glance	
	Pressure output(global and local)	E103_out_pres	
	Pressure and force over time	E103_force_pres	
	Pressure point mapping	E103_map_pres	
	PERCLOS	E103_perclos	
	Eye blink frequency	E103_blink_freq	
	Eye blink duration	E103_blink_dur	
	Percent in center based on median location of gaze	E103_cent_base	
	Correlation between road curvature and eye movements	E103_eye_curve	
	Correlation between steering and road curvature	E103_steer_curve	
	Correlation between eye movements and SDLP	E103_eye_sdlp	
	Number of collisions	E103_num_col	
	Near misses	E103_num_miss	
	Smooth pursuit velocity	E103_smpur_vel	
	Smooth pursuit duration	E103_smpur_dur	
	Smooth pursuit frequency	E103_smpur_freq	
	Smooth pursuit maximum velocity	E103_smpur_maxvel	
	Smooth pursuit gain	E103_smpur_gain	
	SD of gaze	E103_gaze_sd	
	Gaze kurtosis	E103_gaze_kurt	

URBAN EVENT 103: GREEN LIGHT			
	Dwell duration	E103_dwell_time	
	Frequency of side mirror glances	E103_glance_freq_side	
	Frequency of speedometer glances	E103_glance_freq_speed	
	Glance direction	E103_glance_dir	
	Head movement	E103_head_mov	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	SD of lane position relative to mean		
	SD of speed relative to mean		
	SD of speed relative to posted		
	Steering wheel reversals		

- SD of lane position (relative to mean lane position)
- SD speed (relative to mean)

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when going through a green lighted intersection are: SDLP and SD speed relative to mean speed. One of the most widely thought of behaviors of alcohol-impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). The same has been shown for variation in speed which can be measured by SD Speed (Arnedt et al., 2001; Gawron & Ranney, 1988).

3.5 Urban Event 104: Yellow Light Dilemma

The participant approaches an intersection; the light is green. The light turns yellow at a time when the participant must decide if whether to stop or drive through the intersection.

URBAN EVENT 104: YELLOW LIGHT DILEMMA	
RATIONALE	In this segment, the driver approaches a 4-way intersection with oncoming traffic. When the driver is 4.00 seconds from the stop line at the intersection, the signal turns yellow. The light turns red after 3.0 seconds. The driver either stops or drives through the intersection risking going through a red light. This is the yellow light dilemma. There is no particular FARS rationale for this (except clearly running the red light), however, several DWI detection cues could arise: e.g., stopping problems, slow response to traffic signal, lane maintenance, etc.
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 4620 Road type (lanes, surface): 2 driving lanes with on-road parking Speed limit (in mph): 25 Curvature: S-curve after intersection, radius of 365 ft entry, 1460 exit Intersection type: 4-way Time of Day/Date: night
PREPARATION	The participant approaches a 4-way intersection with oncoming traffic (The participant is traveling 25 miles per hour) When the participant is 4.00seconds from the stop line, the light turns yellow (The participant either stops at the stop line or drives through the intersection) The light turns red after 3.0 seconds (The participant has either stopped or cleared the intersection) If participant stops, the vehicle from the right turns right (Scenario 1). Vehicle from left (Scenarios 2 and 3) passes through the intersection (The participant remains in stopped position.) The light turns green. (If the participant stopped at the intersection, they then accelerate forward)
START CONDITIONS	The participant is 500 feet from the intersection

URBAN EVENT 104: YELLOW LIGHT DILEMMA			
ACTUAL EVENT	When the participant is 500 feet from the traffic light, logstream 1 is incremented, logstream 2 is set to 104, logstream 4 is set to 1 (The participant is traveling 25 miles per hour.) When the participant is within 250 feet of the intersection, logstream 4 is set to 2 When the participant's time to arrival is 4.00 seconds from the stop line, the light turns yellow, and logstream 3 is set to 1 (Some participants go through the intersection without stopping and some stop.) As the participant crosses the stop line, logstream 4 is set to 3 (The participant does not turn at the intersection) The light is set to red after 3.0 seconds, based on: (http://www.ct.gov/dot/lib/dot/Documents/dpublications/Capacity_Analysis_&_Signal_Timing.pdf) **Y = t + V/(2a+2Ag)** Where: **Y =** yellow clearance interval in seconds **t =** reaction time (no reaction time assumed in pilot) **V** = 85% percentile approach speed in ft/sec or m/sec (40 mph used) **a** = deceleration rate of a vehicle (use 10 ft/sec/sec) **A** = acceleration due to gravity (32.2 ft/sec/sec) **g** = percent grade in decimal form (+ for upgrade, - for downgrade) (0 used) - Calculate the yellow clearance interval to the nearest 0.1 second. -Do not use a yellow clearance interval of less than 3 seconds. When the light turns red, logstream 3 is set to 2. After a delay of .5 seconds from the light turning red, the light turns green for the cross traffic. A vehicle in the cross street on the participant's travels across the intersection (go straight). Another vehicle in the cross street on the participant's right makes a right turn onto the same street and travels the same direction as the participant. Logstream 3 is set to 3 The light turns yellow for the cross traffic 15 seconds after turning green, and logstream 3 is set to 4 (The participant drives through the intersection) 3 seconds after the yellow light, all the lights is turned red. Logstream 3 is set to 5 0.5 seconds after the all red state, the light changes to green for the participant, logstream 5 is set to 6. When the participant has passed through the intersection, logstream 4 is set to 100. Logstream 3 is set to 0, and the sequence changing the logstreams based on the current light pattern is stopped.		
END CONDITIONS	The participant is 500 feet from next intersection.		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS

SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Distance from start of event to intersection	E104_start_d	ft
	Distance from 250 ft marker to intersection	E104_250_d	ft
	Time to arrive at stop line when light changes to yellow (should be 3.16 seconds)	E104_change_to_yellow	sec
	Time after yellow until light changes to red (should be 3 sec after yellow light)	E104_change_to_red	sec
	Others lead scenario car to go through yellow Y/N		
	Scenario cars from left and right behave as specified		
	Any oncoming cars go through light		
	Oncoming traffic every 30 seconds	E104_oncoming_freq	avg. sec between cars
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Speed (average, min, and max) as participant approaches intersection	E104_sp_avg E104_sp_min E104_sp_max	mph
	Go through light	E104_complete_stop	binary 1=yes, 0 = no
	Accelerator release	E104_accel_release	binary 1=yes, 0 = no
	Brake press	E104_brake_press	binary 1=yes, 0 = no
	Acceleration (greater than some threshold value TBD)	E104_accelerate	binary 1=yes, 0 = no
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Frequency of glances to traffic light	E104_glance_freq_light	glances/sec
	Frequency of glances to traffic on left	E104_glance_freq_left	glances/sec
	Frequency of glances to traffic on right	E104_glance_freq_right	glances/sec
	Did participant glance toward hazard X (hazards TBD)?	E104_haz_glance_X	binary 1 = yes, 0 = no
	Lane Position	E104_lp_avg	ft
	SD of lane position relative to mean lane position	E104_lp_sd	ft
	SD of lane position relative to center	E104_lpn_sd	ft
	Speed	E104_sp_avg	mph

	Speed (relative to posted or assumed speed limit)	E104_spn_avg	mph
	SD of speed	E104_sp_sd	mph
	SD of speed relative to posted speed limit	E104_spn_sd	mph
	Number of center line crossings	E104_center_cross	count
	Number of right light crossings	E104_right_cross	count
	Decision time (time from fixation on light until release or depression of accelerator)	E104_decison_t	sec
	Stopping location (relative to stop line, negative value means before line)	E104_stop_pos	ft
	Smoothness of deceleration	E104_smooth_decel	
	Smoothness of acceleration	E104_smooth_acc	
	Dwell time		
	SD of steering wheel position	E104_steer_sd	
	Velocity of steering wheel	E104_steer_vel	
	Jerk of steering wheel	E104_steer_jerk	
	Steering error	E104_steer_error	
	Steering wheel reversals	E104_steer_rev	
	Time to line crossing (TLC)	E104_tlc	
	Proportion of time TLC>2s	E104_tlc_2	proportion
	95% TLC	E104_tlc_95	
	Mean Brake Force		
	Accelerator holds	E104_accel_holds	
	Velocity of accelerator position	E104_accel_vel	
	Jerk of accelerator position	E104_accel_jerk	
	SD of accelerator position	E104_accel_sd	
	Mean brake force	E104_brake_avg	
	SD of brake force	E104_brake_sd	
	Decision time	E104_dec_time	
	Glance frequency at particular object	E104_freq_glance	
	Pressure output(global and local)	E104_out_pres	
	Pressure and force over time	E104_force_pres	
	Pressure point mapping	E104_map_pres	

	PERCLOS	E104_perclos	
	Eye blink frequency	E104_blink_freq	
	Eye blink duration	E104_blink_dur	
	Percent in center based on median location of gaze	E104_cent_base	
	Correlation between road curvature and eye movements	E104_eye_curve	
	Correlation between steering and road curvature	E104_steer_curve	
	Correlation between eye movements and SDLP	E104_eye_sdlp	
	Number of collisions	E104_num_col	
	Near misses	E104_num_miss	
	Delay time	E104_delay_time	
	Rise time	E104_rise_time	
	Peak time	E104_peak_time	
	Max overshoot	E104_over_max	
	Settling time	E104_set_time	
	How well it fits the model	E104_model_fit	
	Smooth pursuit velocity	E104_smpur_vel	
	Smooth pursuit duration	E104_smpur_dur	
	Smooth pursuit frequency	E104_smpur_freq	
	Smooth pursuit maximum velocity	E104_smpur_maxvel	
	Smooth pursuit gain	E104_smpur_gain	
	SD of gaze	E104_gaze_sd	
	Gaze kurtosis	E104_gaze_kurt	
	Dwell duration	E104_dwell_time	
	Frequency of side mirror glances	E104_glance_freq_side	
	Frequency of speedometer glances	E104_glance_freq_speed	
	Glance direction	E104_glance_dir	
	Head movement	E104_head_mov	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE	DESCRIPTION	IDENTIFIER	UNITS
	SD of lane position relative to mean		
	Mean brake force		

ALGORITHM)	Number of center line crossings		
	Number of right line crossings		

- RT to yellow light onset (after accelerator release or brake pedal depressed)
- SD of lane position (relative to mean lane position)
- Hover time (after accelerator release, time not depressing either pedal, sum across time to catch multiple)

The major variables to take into consideration when comparing an alcohol impaired driver and an unimpaired driver when encountering a yellow light dilemma are: reaction time and SDLP. One of the most widely thought of behaviors of alcohol impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). Reaction time has been known to be affected by alcohol long before research was being done on alcohol and driving (Liguori, D'Agostino, Dworkin, Edwards, & Robinson, 1999; Maylor, Rabbitt, James, & Kerr, 1990; Strayer, Drews, & Crouch, 2006). Provided the participant reacts to the yellow light, this variable should be sensitive to alcohol impairment.

3.6 Urban Event 105: Left Turn

The participant passes through an intersection with a green traffic light on an urban two-lane road with parked vehicles in the right lane, oncoming traffic, and traffic behind the participant. The participant turns left at this intersection and has to wait for a gap in oncoming traffic to make the turn.

Urban Event 105: Left Turn	
RATIONALE	This scenario involves the participant approaching a 4-way intersection with a green light (they will have received landmark based instruction telling them to turn at the light). The driver must wait until oncoming traffic clears to make the turn. There is no specific FARS rationale for this, but it does involve judgment and is a typical maneuver in a drive home from a bar. This could involve some driving cues that indicate impairment (from NHTSA's DWI Detection Guide): e.g., turning with a wide radius, misjudgment of the oncoming vehicle speed, turning too fast, too sharp or in a jerky manner.
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 3300 Road type (lanes, surface): 2 driving lanes with on-road parking Speed limit (in mph): 25 mph Curvature: none Intersection type: 4-way, no dedicated left turn lane Time of Day/Date: night

Urban Event 105: Left Turn			
PREPARATION	The light is green at the intersection with oncoming traffic; the participant pulls into the intersection (The participant attempts to make a left turn) A series of gaps in oncoming traffic is presented to the participant (the participant waits for a gap of appropriate length) The participant makes a left turn at the intersection		
START CONDITIONS	Distance 500 ft from the stop line of the intersection		
ACTUAL EVENT	There are five oncoming vehicles at the intersection waiting for the red light to turn green. When the participant is 21 seconds from the intersection, an additional stream of cars at various gaps (gap times specified below) is created in the oncoming lane, approaching the red light. When the lead car of the oncoming traffic stream is 650 feet from the intersection, the light turns green and logstream 3 is set to 80. Also at the same time, a car is created in the inner lane of the cross street on the left (with respect to the driver); this car will restrict the participant's path as they execute left turn maneuver. The lead vehicle in front of the participant will continue on straight through the intersection without turning. When the participant is 500 feet from the intersection , logstream 1 is incremented, logstream 2 is set to 105, and logstream 4 is set to 1 When the participant is 250 feet from the intersection, logstream 4 is set to 2 When the participant crosses the stop line, logstream 4 is set to 3 At the intersection, 8 gaps of varying size is presented to the participant in this order (gap size is approximate): 4 seconds, 2 seconds, 3 seconds, 4.2 seconds, 6.7 seconds, 5.7 seconds, 8.2 seconds, and 10.2 seconds. After these gaps, no more cars appear. (The participant has stopped at the intersection and is attempting to make a left turn) Once the participant has made the left turn, logstream 3 is set to 0, logstream 4 is set to 100, logstream 5 is set to 12 (The participant has made a left turn at the intersection)		
END CONDITIONS	Driver has completed left hand turn and is 266 ft beyond the intersection.		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
	The light turns from green to red (Logstream 3 set to 80 to reflect this change) before the end of the previous event.		
SCENARIO	DESCRIPTION	IDENTIFIER	UNITS

Urban Event 105: Left Turn			
PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	Light turns green at 11.5 sec TTA (time to arrival to intersection)	E105_change_to_green	binary 1=yes, 0 = no
	Length of gaps	E105_gap_d_X (where X is the gap number, 1 to 8)	ft
	Length of gaps	E105_gap_t_X (where X is the gap number, 1 to 8)	sec
	Other scenario cars in front go through light		
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Speed (average, min, and max) as participant approaches intersection	E105_sp_avg E105_sp_min E105_sp_max	mph
	Turn left	E105_nav_error	binary 1=yes, 0 = no
	Accelerator release	E105_accel_release	binary 1=yes, 0 = no
	Brake press	E105_brake_press	binary 1=yes, 0 = no
	Mean brake force		
	Complete stop before turn (min speed less than 1 mph)	E105_complete_stop	binary 1=yes, 0 = no
	Stop distance from stop line	E105_stop_pos	ft
	Lane position at stop	E105_stop_lp	ft
	Heading at stop (relative to original direction of travel)	E105_stop_hdng	deg
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Head turn (threshold angle that defines a turn needs TBD)	E105_head_turn	count
	Turn signal use	E105_turn_signal	binary 1=yes, 0 = no
	Time from stop until turn begins (when vehicle heading has rotated 90 deg)	E105_turn_start_t	sec
	Gap participant takes	E105_gap_taken_d E105_gap_taken_t	ft sec
	Size of gap taken relative to size of previous gaps		

Urban Event 105: Left Turn			
	Time distance of following vehicle in gap when participant releases brake and begins turn	E105_gap_t_start	sec
	TTC of oncoming vehicle when vehicle heading has rotated to 90 deg	E105_gap_t_turn	sec
	Time to complete turn (gap clearance time)	E105_turn_t	sec
	Overshoot (distance from center of lane to vehicle center when vehicle heading has rotated to 90 deg)	E105_overshoot	ft
	Lateral acceleration (max during turn)	E105_lat_acc_max	ft/s^2
	Frequency of glances to the light	E105_glance_freq_light	glances/sec
	Did participant glance toward hazard X (hazards TBD)?	E105_haz_glance_X	binary 1 = yes, 0 = no
	Smoothness of deceleration	E105_smooth_decel	
	Smoothness of acceleration	E105_smooth_acc	
	Velocity of steering wheel	E105_steer_vel	
	Jerk of steering wheel	E105_steer_jerk	
	Steering error	E105_steer_error	
	Intersection turn signal use	E105_turn_sig	
	Time to line crossing (TLC)	E105_tlc	
	Proportion of time TLC>2s	E105_tlc_2	proportion
	95% TLC	E105_tlc_95	
	Velocity of accelerator position	E105_accel_vel	
	Jerk of accelerator position	E105_accel_jerk	
	SD of accelerator position	E105_accel_sd	
	Mean brake force	E105_brake_avg	
	SD of brake force	E105_brake_sd	
	Time gap accepted	E105_time_gap	
	TTC to oncoming vehicle during turn	E105_ttc	
	Glance frequency at particular object	E105_freq_glance	
	Pressure output(global and local)	E105_out_pres	
	Pressure and force over time	E105_force_pres	
	Pressure point mapping	E105_map_pres	

Urban Event 105: Left Turn			
	PERCLOS	E105_perclos	
	Eye blink frequency	E105_blink_freq	
	Eye blink duration	E105_blink_dur	
	Percent in center based on median location of gaze	E105_cent_base	
	Correlation between eye movements and steering	E105_eye_steer	
	Number of collisions	E105_num_col	
	Near misses	E105_num_miss	
	Degree of conflict	E105_deg_conflict	
	Delay time	E105_delay_time	
	Rise time	E105_rise_time	
	Peak time	E105_peak_time	
	Max overshoot	E105_over_max	
	Settling time	E105_set_time	
	How well it fits the model	E105_model_fit	
	Smooth pursuit velocity	E105_smpur_vel	
	Smooth pursuit duration	E105_smpur_dur	
	Smooth pursuit frequency	E105_smpur_freq	
	Smooth pursuit maximum velocity	E105_smpur_maxvel	
	Smooth pursuit gain	E105_smpur_gain	
	SD of gaze	E105_gaze_sd	
	Gaze kurtosis	E105_gaze_kurt	
	Dwell duration	E105_dwell_time	
	Frequency of side mirror glances	E105_glance_freq_side	
	Frequency of speedometer glances	E105_glance_freq_speed	
	Glance direction	E105_glance_dir	
	Head movement	E105_head_mov	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Mean accelerator position		

Urban Event 105: Left Turn			

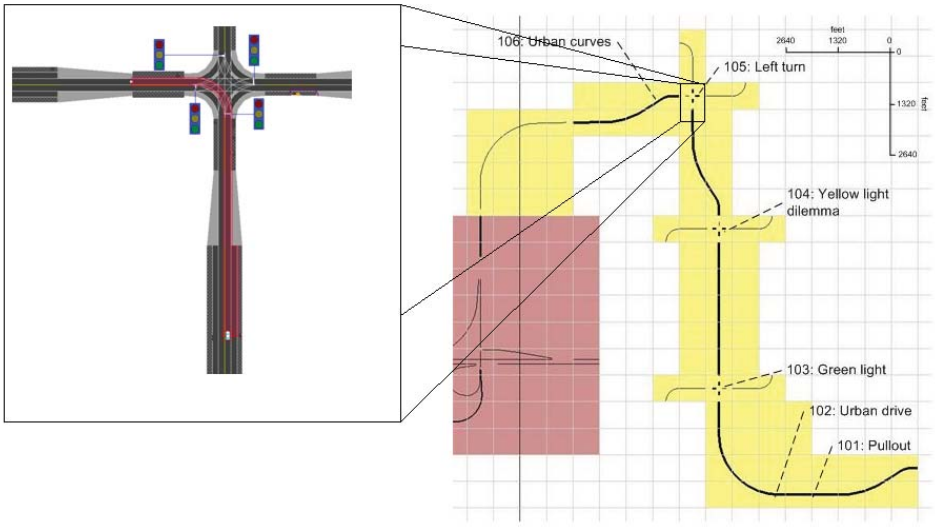


Figure 9 Left turn

- Jerk of accelerator position
- Velocity of accelerator position
- Smoothness of lane change
- Max overshoot
- Velocity of steering wheel
- Jerk of steering wheel

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when turning left are: the smoothness of pulling out, max overshoot, and jerk and velocity of accelerator position. The smoothness of lane change and max overshoot go hand in hand in the way a person pulls out of the parking space as unimpaired drivers will get into the lane fairly quickly and impaired drivers will have to adjust their position before settling on an adequate location (Stuster, 1997). Jerk and velocity of accelerator position look at how smoothly the participant pulled out of the parking space in a longitudinal perspective. Alcohol-impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997).

3.7 Urban Event 106: Urban Curves

The participant drives through a series of three curves of mixed radius of curvature (non-steady radius). The entrances of the curves is blinded (the participant's view of the rest of the curve is obstructed).

URBAN EVENT 106: URBAN CURVES			
RATIONALE	This event involves navigating a series of curves on an urban two-lane road with cars parked on both sides and oncoming traffic approximately once every 30 seconds. The FARS rationale is the over-representation of impaired driving fatal crashes on curves, at non-junctions and on two-lane roadways. FARS driving-related factors that are over-represented for impaired participants could also come into play in this scenario: e.g., steering only as a crash avoidance maneuver, running off the road, failure to keep in proper lane, driving too fast for conditions.		
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 7920 Road type (lanes, surface): 2 driving lanes with on-road parking Speed limit (in mph): 30 increasing to 45 mph for last 400 ft Curvature: Blind mixed radius (S-curve with 365 ft radius entry, 1460 ft radius exit; 90 deg curve with 1100 ft radius) Intersection type: None Time of Day/Date: Night		
PREPARATION	Just after the start of the event, instruction #2 is played, instructing the participant to turn onto the interstate The participant navigates a series of curves The participant experiences oncoming traffic once per 30 seconds on average Towards the end of the event the speed limit changes from 30 mph to 45 mph.		
START CONDITIONS	Finished Left Turn onto Urban Residential Section		
ACTUAL EVENT	Logstream 1 is incremented, Logstream 2 is set to 106 (The participant is driving 25 mph.) (The participant stays in their lane.) Instruction #2 is played, instructing the participant to turn onto the interstate The participant experiences oncoming traffic once per 30 seconds on average. (The participant maintains a speed of 25 miles per hour) When parking lane ends, logstream 5 is set to 13 (after corridor). Approximately 1000 feet from the end of the curve there is a 45 mph speed limit sign. When the driver is 850 feet before the sign, logstream 5 is set to 14.		
END CONDITIONS	Start of Next Event		
CLEANUP	None		
EVENT CONTINGENCY	DESCRIPTION	IDENTIFIER	UNITS
	NONE		

URBAN EVENT 106: URBAN CURVES			
(VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)			
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Oncoming traffic every 30 seconds	E106_oncoming_freq	avg. sec between cars
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Speed (average, min, and max)	E106_sp_avg E106_sp_min E106_sp_max	mph
	Lane position	E106_lp_avg	
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Lane position	E106_lp_avg	ft
	SD of lane position relative to mean lane position	E106_lp_sd	ft
	SD of lane position relative to center of lane	E106_lpn_sd	ft
	Speed	E106_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E106_spn_avg	mph
	SD of speed relative to mean speed	E106_sp_sd	mph
	SD of speed relative to posted speed limit	E106_spn_sd	mph
	Number of center line crossings	E106_center_cross	count
	Number of right line crossings	E106_right_cross	count
	Glance(s) to speed limit sign(s)	E106_glance_sign_X	

URBAN EVENT 106: URBAN CURVES			
	SD of steering wheel position	E106_steer_sd	
	Velocity of steering wheel	E106_steer_vel	
	Jerk of steering wheel	E106_steer_jerk	
	Steering error	E106_steer_error	
	Steering wheel reversals	E106_steer_rev	
	Time to line crossing (TLC)	E106_tlc	
	Proportion of time TLC>2s	E106_tlc_2	proportion
	95% TLC	E106_tlc_95	
	Accelerator holds	E106_accel_holds	
	Velocity of accelerator position	E106_accel_vel	
	Jerk of accelerator position	E106_accel_jerk	
	SD of accelerator position	E106_accel_sd	
	Glance frequency at particular object	E106_freq_glance	
	Pressure output(global and local)	E106_out_pres	
	Pressure and force over time	E106_force_pres	
	Pressure point mapping	E106_map_pres	
	PERCLOS	E106_perclos	
	Eye blink frequency	E106_blink_freq	
	Eye blink duration	E106_blink_dur	
	Percent in center based on median location of gaze	E106_cent_base	
	Correlation between road curvature and eye movements	E106_eye_curve	
	Correlation between steering and road curvature	E106_steer_curve	
	Correlation between eye movements and SDLP	E106_eye_sdlp	
	Correlation between eye movements and steering	E106_eye_steer	
	Correlation between head turn and steering wheel movement	E106_headturn_wheel	
	Number of collisions	E106_num_col	
	Near misses	E106_num_miss	
	Smooth pursuit velocity	E106_smpur_vel	
	Smooth pursuit duration	E106_smpur_dur	

URBAN EVENT 106: URBAN CURVES			
	Smooth pursuit frequency	E106_smpur_freq	
	Smooth pursuit maximum velocity	E106_smpur_maxvel	
	Smooth pursuit gain	E106_smpur_gain	
	SD of gaze	E106_gaze_sd	
	Gaze kurtosis	E106_gaze_kurt	
	Dwell duration	E106_dwell_time	
	Frequency of side mirror glances	E106_glance_freq_side	
	Frequency of speedometer glances	E106_glance_freq_speed	
	Glance direction	E106_glance_dir	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	SD of lane position relative to mean		
	SD of speed relative to mean		
	SD of speed relative to posted		
	Mean Speed		
	Number of center line crossings		
	Number of right line crossings		
	Steering wheel reversals		

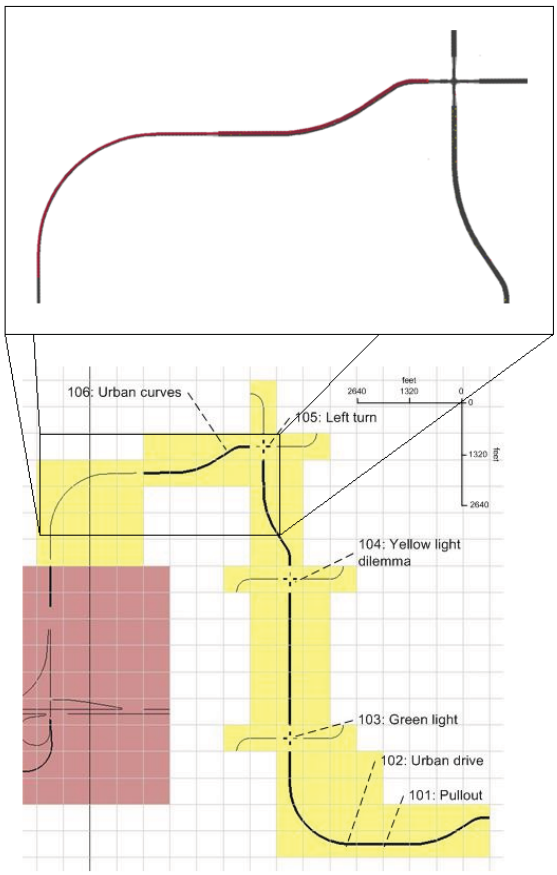


Figure 10 Urban Curves

- SD of lane position (relative to mean lane position)
- Speed (relative to posted or assumed speed limit)
- SD of speed (during "steady state") relative to mean speed
- Eye gaze distribution measures

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when driving down a road are: SDLP, SD speed, and speed relative to the posted or assumed speed limit. One of the most widely thought of behaviors of alcohol-impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). The same has been shown for variation in speed which can be measured by SD speed (Arnedt et al., 2001; Gawron & Ranney, 1988). A standard set of qualitative behaviors for police to follow mentions that alcohol-impaired drivers tend to drive slower than the speed limit by more than 10 mph (Stuster, 1997).

3.8 Interstate Event 201: Turn On Ramp

The participant turns onto the interstate on-ramp; the turn is gentle. This ends the urban section of the drive.

INTERSTATE EVENT 201: TURN ON RAMP (TRANSITIONAL)			
RATIONALE	This event involves turning onto a ramp for transition to an interstate highway. The rationale for this event is that impaired drivers will often make driving errors such as missing a turn, inappropriate speed, or over/undershooting a turn. Some DWI detection cues could occur: e.g., turning with a wide radius, signaling intentions, accelerating and decelerating.		
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 1100 Road type (lanes, surface): 2 driving lanes Speed limit (in mph): 25 Curvature: Gentle curve to the right Intersection type: Interstate onramp Time of Day/Date: night lit		
PREPARATION	The participant turns onto the entrance ramp (The participant correctly turns onto the ramp, and does not continue on straight)		
START CONDITIONS	The participant is 500 feet from the beginning of the on ramp		
ACTUAL EVENT	When the participant is 500 feet from the highway on ramp, logstream 1 is incremented, logstream 2 is set to 201, logstream 4 is set to 1 (The participant remembers the navigation instructions given at the end of the last turn)		
END CONDITIONS	When the participant crosses onto the on ramp		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS

INTERSTATE EVENT 201: TURN ON RAMP (TRANSITIONAL)			
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Participant does not take ramp	E201_nav_error	binary 1=yes, 0 = no
	Initial speed (speed at beginning of event)	E201_sp_init	mph
	End speed (speed at end of event)	E201_sp_mavgnd	mph
	Accelerator release	E201_accel_release	binary 1=yes, 0 = no
	Brake press	E201_brake_press	binary 1=yes, 0 = no
	Acceleration (mean over entire event)	E201_acc_avg	ft/s^2
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Turn signal use	E201_turn_signal	binary 1=yes, 0 = no
	Smoothness of transition onto ramp (longitudinal)	E201_smooth_long	
	Smoothness of transition onto ramp (lateral)	E201_smooth_lat	
	SD of steering wheel position	E201_steer_sd	
	Velocity of steering wheel	E201_steer_vel	
	Jerk of steering wheel	E201_steer_jerk	
	Steering error	E201_steer_error	
	Steering wheel reversals	E201_steer_rev	
	Head movement		binary 1=yes, 0=no
	Lane position	E201_lp_avg	ft
	Time to line crossing (TLC)	E201_tlc	
	Proportion of time TLC>2s	E201_tlc_2	proportion
	95% TLC	E201_tlc_95	
	Accelerator holds	E201_accel_holds	
	Number of center line crossings	E201_center_cross	count
	Number of right light crossings	E201_right_cross	count
	Velocity of accelerator position	E201_accel_vel	

INTERSTATE EVENT 201: TURN ON RAMP (TRANSITIONAL)			
	Jerk of accelerator position	E201_accel_jerk	
	SD of accelerator position	E201_accel_sd	
	Mean brake force	E201_brake_avg	
	SD of brake force	E201_brake_sd	
	Speed	E201_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E201_spn_avg	mph
	Glance frequency at particular object	E201_freq_glance	
	Pressure output(global and local)	E201_out_pres	
	Pressure and force over time	E201_force_pres	
	Pressure point mapping	E201_map_pres	
	PERCLOS	E201_perclos	
	Eye blink frequency	E201_blink_freq	
	Eye blink duration	E201_blink_dur	
	Percent in center based on median location of gaze	E201_cent_base	
	Correlation between eye movements and SDLP	E201_eye_sdlp	
	Correlation between head turn and steering wheel movement	E201_headturn_wheel	
	Number of collisions	E201_num_col	
	Near misses	E201_num_miss	
	Delay time	E201_delay_time	
	Rise time	E201_rise_time	
	Peak time	E201_peak_time	
	Max overshoot	E201_over_max	
	Settling time	E201_set_time	
	How well it fits the model	E201_model_fit	
	Smooth pursuit velocity	E201_smpur_vel	
	Smooth pursuit duration	E201_smpur_dur	
	Smooth pursuit frequency	E201_smpur_freq	
	Smooth pursuit maximum velocity	E201_smpur_maxvel	
	Smooth pursuit gain	E201_smpur_gain	

INTERSTATE EVENT 201: TURN ON RAMP (TRANSITIONAL)			
	SD of gaze	E201_gaze_sd	
	Gaze kurtosis	E201_gaze_kurt	
	Dwell duration	E201_dwell_time	
	Frequency of side mirror glances	E201_glance_freq_side	
	Frequency of speedometer glances	E201_glance_freq_speed	
	Glance direction	E201_glance_dir	
	Head movement	E201_head_mov	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Mean brake force		
	Mean accelerator position		
	Steering wheel reversals		

- Jerk of accelerator position
- Velocity of accelerator position
- Velocity of steering wheel
- Jerk of steering wheel

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when turning onto a ramp are: jerk and velocity of accelerator position and jerk and velocity of steering wheel position. Jerk and velocity of accelerator position look at how smoothly the participant pulled out of the parking space in a longitudinal perspective. Alcohol-impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997). The jerk and velocity of the steering wheel position look at how smoothly the participant turned onto the ramp. Research has shown that alcohol impairs a person's ability to maintain lateral control (Calhoun et al., 2005).

3.9 Interstate Event 202: Merge On

The participant will merge onto the interstate.

Interstate Event 202: Merge On			
RATIONALE	This event involves merging onto the interstate highway from the ramp. This interchange is required to provide a transition to the higher-speed interstate environment. Despite the fact that there is not a conflict situation when entering the roadway, the geometry of the interchange would require the driver to scan the visual environment to confirm this. Additionally, it provides data on driver acceleration switching between speed limits. There is no specific FARS data on which this event is based.		
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 3960 Road type (lanes, surface): Asphalt entrance ramp Speed limit (in mph): 45 (suggested) Curvature: 1100 ft radius Intersection type: on ramp		
PREPARATION	The participant approaches the interstate. (The participant is accelerating up to highway speeds) The participant merges onto the interstate (The participant safely merges without an accident.)		
START CONDITIONS	When the participant enters the on-ramp		
ACTUAL EVENT	Logstream 1 is incremented, logstream 2 is set to 202, logstream 4 is set to 0, logstream 5 is set to 21 The participant approaches the interstate; when the participant is approximately one third of the way down the onramp, a tractor trailer is created in the right lane of the interstate approximately 2300 feet ahead of the participant, a second truck will be created 1000 feet behind this truck (on the highway, not on the on-ramp). Both of these trucks will be traveling 10 miles per hour slower than the participant while the participant is on the ramp. After subject enters the interstate, the tractor trailers travel at 45 mph. Logstream 4 is set to 1. (The participant is accelerating) (The tractor trailer stays in right lane and maintains speed.) When participant begins to merge onto the interstate, logstream 4 is set to 2. (The participant safely merges onto the interstate.) Once the participant has merged onto the highway, logstream 4 is set to 100; logstream 5 is set to 22.		
END CONDITIONS	Participant merges onto the highway		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS

Interstate Event 202: Merge On			
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Participant is able to successfully merge onto the highway	E202_merge_success	binary 1=yes, 0 = no
	Average acceleration	E202_acc_avg	ft/s^2
	Accelerator pedal variability	E202_accel_sd	proportion of range
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Turn signal use	E202_turn_signal	binary 1=yes, 0 = no
	Lateral acceleration	E202_lat_acc	ft/sec^2
	Smoothness of transition off ramp (longitudinal)	E202_smooth_long	
	Smoothness of transition off ramp (lateral)	E202_smooth_lat	
	SD of steering wheel position	E202_steer_sd	
	Velocity of steering wheel	E202_steer_vel	
	Jerk of steering wheel	E202_steer_jerk	
	Steering error	E202_steer_error	
	Lane position	E202_lp_avg	ft
	Time to line crossing (TLC)	E202_tlc	
	Velocity of accelerator position	E202_accel_vel	
	Jerk of accelerator position	E202_accel_jerk	
	SD of accelerator position	E202_accel_sd	

Interstate Event 202: Merge On			
	Mean brake force	E202_brake_avg	
	SD of brake force	E202_brake_sd	
	Speed	E202_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E202_spn_avg	mph
	Time to collision (TTC)	E202_ttc	
	Time gap accepted	E202_time_gap	
	Timing of participant looking at rear view mirror	E202_rear_look	
	Glance frequency at particular object	E202_freq_glance	
	Pressure output(global and local)	E202_out_pres	
	Pressure and force over time	E202_force_pres	
	Pressure point mapping	E202_map_pres	
	PERCLOS	E202_perclos	
	Eye blink frequency	E202_blink_freq	
	Eye blink duration	E202_blink_dur	
	Percent in center based on median location of gaze	E202_cent_base	
	Correlation between eye movements and SDLP	E202_eye_sdlp	
	Correlation between head turn and steering wheel movement	E202_headturn_wheel	
	Number of collisions	E202_num_col	
	Near misses	E202_num_miss	
	Degree of conflict	E202_deg_conflict	
	Delay time	E202_delay_time	
	Rise time	E202_rise_time	
	Peak time	E202_peak_time	
	Max overshoot	E202_over_max	
	Settling time	E202_set_time	
	How well it fits the model	E202_model_fit	
	Smooth pursuit velocity	E202_smpur_vel	
	Smooth pursuit duration	E202_smpur_dur	
	Smooth pursuit frequency	E202_smpur_freq	

Interstate Event 202: Merge On			
	Smooth pursuit maximum velocity	E202_smpur_maxvel	
	Smooth pursuit gain	E202_smpur_gain	
	SD of gaze	E202_gaze_sd	
	Gaze kurtosis	E202_gaze_kurt	
	Dwell duration	E202_dwell_time	
	Frequency of side mirror glances	E202_glance_freq_side	
	Frequency of speedometer glances	E202_glance_freq_speed	
	Glance direction	E202_glance_dir	
	Head movement	E202_head_mov	
	Timing of participant looking at side mirror	E202_side_time	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Mean brake force		
	Mean accelerator position		
	Lateral acceleration		

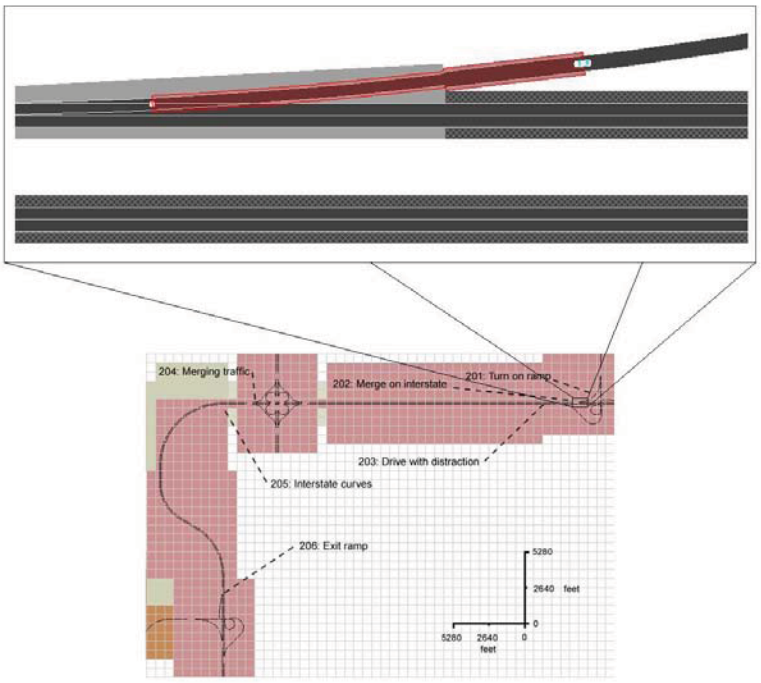


Figure 11 Merging onto highway

- Look for oncoming traffic
- Jerk of accelerator position
- Velocity of accelerator position
- Smoothness of merge on
- Max overshoot
- SDLP on ramp
- SD of acceleration to highway speed

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when merging onto a highway are: time from last glance until merging on, the smoothness of changing lanes, max overshoot, and jerk and velocity of accelerator position. As a person merges onto a highway, looking for other traffic is essential to safe driving and is something that alcohol-impaired drivers tend to ignore**. The smoothness of lane change and max overshoot go hand in hand in the way a person pulls out of the parking space, as unimpaired drivers will get into the lane fairly quickly and impaired drivers will have to adjust their position before settling on an adequate location (Stuster, 1997). Jerk and velocity of accelerator position look at how smoothly the participant pulled out of the parking space in a longitudinal perspective. Alcohol-impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997).

3.10 Interstate Event 203: Drive with Distraction

The participant drives on a straight section of interstate with two slow-moving trucks in the driving lane and a relatively slow-moving passenger car in the passing lane. The driver will also be instructed to interact with the CD player during this event.

INTERSTATE EVENT 203: DRIVE WITH DISTRACTION	
RATIONALE	Once the participant has merged onto the interstate, there will be a slow moving truck ahead of the driver that will maintain 45 mph. The posted speed limit of the interstate is 70 mph but with a posted truck speed limit of 65 mph. At three times during this section the driver will be instructed to interact with the CD player by turning it on and switching tracks. There is no specific FARS rationale for this event; however, it could involve a number of cues from NHTSA's DWI Detection Guide: e.g., following too close, unsafe lane change, weaving and failure to signal intentions. Some risk taking could take place when the drivers are impaired.
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 19712 Road type (lanes, surface): 2-lane interstate Speed limit (in mph): 70 mph for passenger vehicles, 65 mph for trucks Curvature: none Intersection type: none Time of Day/Date: night lit
PREPARATION	A pair of tractor-trailers are created in the previous event ahead of the participant traveling 10 miles per hour slower than the participant with a minimum speed of 35 mph. Once the driver has finished merging onto the freeway the tractor-trailers will change their speed to 45 miles per hour. When the participant is at 6500, 10000, and 15000 they will be instructed to interact with the CD player. Before the participant reaches the first off ramp, a passenger vehicle will be created 1200 feet ahead of the driver in the passing lane. In drives 1 and 2, the vehicle will be created when the driver is 500 feet from the start of the exit-ramp; in drive 3, the vehicle will be created when the participant is 2850 feet from the exit ramp. The passenger vehicle will be traveling at 66% of the participant's speed; this will encourage the participant change lanes into the right lane to pass the passenger vehicle.
START CONDITIONS	200 feet past the on ramp.
ACTUAL EVENT	The participant has merged onto the interstate. Logstream 1 is incremented, logstream 2 is set to 203, and Logstream 4 is set to 1. When the participant is within 5.0 seconds headway to the first heavy truck or no later than approximately 6500 ft from the end of the on-ramp. SCC_Audio_Trigger is set to 313, playing the instructions for the 1st CD interaction task: "At this time – please turn on the CD player - select track 13 - then press off." When the participant is approximately 10000 ft from the end of the on-ramp. SCC_Audio_Trigger is set to 314, playing the instructions for the 2nd CD interaction task: "At this time – please turn on the CD player - select track 8 - then press off." When the participant is approximately 15000 ft from the end of the on-ramp. SCC_Audio_Trigger is set to 315, playing the instructions for the 3rd CD interaction task: "At this time – please turn on the CD player - select track 3 - then press off." When the participant is 500 feet from the end of the off-ramp in driver 1&2, and 2850 for drive 3, a car is created in the passing lane 1200 feet ahead of the participant. It will be traveling 66% of t the participants speed. Logstream 4 will be set to 3

INTERSTATE EVENT 203: DRIVE WITH DISTRACTION			
END CONDITIONS	The participant is 100 ft before the overpass.		
CLEANUP	none		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Trucks and passenger vehicle maintain speed		
	Trucks and passenger vehicle maintain lane		
	Trucks turn off exit ramp	E203_exit_X (X is truck number, 1 to 2)	binary 1=yes, 0 = no
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Driver passes first truck		binary 1=yes, 0=no
	Driver passes second truck		binary 1=yes, 0=no
	Driver passes car		binary 1=yes, 0=no
	Driver performs CD task as instructed	By observation	
ALCOHOL IMPAIRMENT INDICATORS	DESCRIPTION	IDENTIFIER	UNITS
	Average distance from SV to truck	E203_hdwy_avg_d	ft
	Number of lane changes during following	E203_lane_change_ct	count

INTERSTATE EVENT 203: DRIVE WITH DISTRACTION			
(MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	Lane position	E203_lp_avg	ft
	Head movement (during lane change if any)		binary 1=yes, 0=no
	SD of lane position from mean	E203_lp_sd	ft
	SD of lane position from center	E203_lpn_sd	ft
	Turn signal use	E203_turn_signal_ct	binary 1=yes, 0 = no
	Time to collision	E203_ttc_min E203_ttc_obj	sec name of obj
	Smoothness of lane changes		
	SD of steering wheel position	E203_steer_sd	
	Velocity of steering wheel	E203_steer_vel	
	Jerk of steering wheel	E203_steer_jerk	
	Steering error	E203_steer_error	
	Highway turn signal use	E203_highwayturn_sig	
	Proportion of time TLC>2s	E203_tlc_2	proportion
	95% TLC	E203_tlc_95	
	Lateral Acceleration	E203_lat_acc	ft/sec^2
	Accelerator holds	E203_accel_holds	
	Number of center line crossings	E203_center_cross	count
	Number of right light crossings	E203_right_cross	count
	Frequency of lane changes	E203_freq_lane	count
	Velocity of accelerator position	E203_accel_vel	
	Jerk of accelerator position	E203_accel_jerk	
	SD of accelerator position	E203_accel_sd	
	Mean brake force	E203_brake_avg	
	SD of brake force	E203_brake_sd	
	Speed	E203_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E203_spn_avg	mph
	Timing of participant looking at rear view mirror	E203_rear_look	

INTERSTATE EVENT 203: DRIVE WITH DISTRACTION			
	Glance frequency at particular object	E203_freq_glance	
	Pressure output(global and local)	E203_out_pres	
	Pressure and force over time	E203_force_pres	
	Pressure point mapping	E203_map_pres	
	PERCLOS	E203_perclos	
	Eye blink frequency	E203_blink_freq	
	Eye blink duration	E203_blink_dur	
	Percent in center based on median location of gaze	E203_cent_base	
	Correlation between road curvature and eye movements	E203_eye_curve	
	Correlation between steering and road curvature	E203_steer_curve	
	Correlation between eye movements and SDLP	E203_eye_sdlp	
	Correlation between eye movements and steering	E203_eye_steer	
	Correlation between head turn and steering wheel movement	E203_headturn_wheel	
	Number of collisions	E203_num_col	
	Near misses	E203_num_miss	
	Degree of conflict	E203_deg_conflict	
	Delay time	E203_delay_time	
	Rise time	E203_rise_time	
	Peak time	E203_peak_time	
	Max overshoot	E203_over_max	
	Settling time	E203_set_time	
	How well it fits the model	E203_model_fit	
	Smooth pursuit velocity	E203_smpur_vel	
	Smooth pursuit duration	E203_smpur_dur	
	Smooth pursuit frequency	E203_smpur_freq	
	Smooth pursuit maximum velocity	E203_smpur_maxvel	
	Smooth pursuit gain	E203_smpur_gain	
	SD of gaze	E203_gaze_sd	
	Gaze kurtosis	E203_gaze_kurt	

INTERSTATE EVENT 203: DRIVE WITH DISTRACTION			
	Dwell duration	E203_dwell_time	
	Frequency of side mirror glances	E203_glance_freq_side	
	Frequency of speedometer glances	E203_glance_freq_speed	
	Glance direction	E203_glance_dir	
	Head movement	E203_head_mov	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	Timing of participant looking at side mirror	E203_side_time	
	DESCRIPTION	IDENTIFIER	UNITS
	SD of lane position relative to mean		
	Headway		
	Variation in headway		

- SD of lane position from mean
- Smoothness of lane changes
- Time headway (if participant actually follows the trucks for any length of time, which is fairly unlikely because of the speed of the trucks)
- Max overshoot
- SD of speed (during "steady state") relative to mean speed

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when driving on a highway with other traffic are: SDLP, SD speed, and smoothness of lane changes, as well as maximum overshoot and time headway. SDLP has been shown to increase significantly when drivers are under the influence of alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). The same has been shown for variation in speed, which can be measured by SD speed (Arnedt et al., 2001; Gawron & Ranney, 1988). The smoothness of lane change and max overshoot go hand in hand in the way a person pulls out of the parking space, as unimpaired drivers will get into the lane fairly quickly and impaired drivers will have to adjust their position before settling on an adequate location (Stuster, 1997). When drivers are alcohol-impaired, they tend to follow more closely behind a lead vehicle than if they weren't impaired (Strayer et al., 2006).

3.11 Interstate Event 204: Merging Traffic

The participant will approach a second interchange. A passenger vehicle will start to merge onto the interstate; the merge onto the interstate is timed to cause a conflict in the driving lane with the participant. This means the participant will have to either change speed or lane in order to allow the other car to merge if they are in the driving lane. The passenger car will merge onto the interstate, but shortly thereafter will pull of onto the shoulder.

INTERSTATE EVENT 204: MERGING TRAFFIC	
RATIONALE	This scenario will involve the driver approaching an interchange with a vehicle merging about 500 feet ahead of the on-ramp. The driver should keep a relatively constant speed. The FARS rationale is the over-representation of impaired drivers in fatal crashes being the striking vehicles on high speed roads. DWI detection cues that could be observed include the driver's reaction to the merge: swerving, varying speed, unsafe lane change.
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 5720 Road type (lanes, surface): 2-lane interstate Speed limit (in mph): 70 mph for passenger vehicles, 60 mph for trucks Curvature: none Intersection type: Highway Interchange Time of Day/Date: Night
PREPARATION	The participant approaches a "clover leaf" interchange. A slow-moving vehicle in the passing lane from the previous event encourages the participant to pass on the right and places the participant in the driving lane. A vehicle merges onto the highway so as to create a conflict situation with the participant if they are in the driving lane. (The participant is in the driving lane) After the merging vehicle has driven in the driving lane for a short distance, it brakes and pulls off to the side of the road.
START CONDITIONS	The participant is 1070 feet before center of clover leaf interchange (merging car will come on first ramp) or between the two over passes (merging car will come on second ramp).
ACTUAL EVENT	The participant approaches a "clover leaf" interchange. (The participant is in the driving lane after passing the slow moving vehicle). The vehicle merging onto the highway is created, logstream 1 is incremented, logstream 2 is set to 204, logstream 4 is set to 1. The merging vehicle enters the driving the lane of the interstate from the last entrance ramp for scenarios 1&2, for scenario 3 the vehicle enters from the 1st on-ramp. After a short distance the merging vehicle starts to decelerate with brake lights; logstream 4 is set to 2. The merging car pulls off onto the right shoulder and brakes to a stop. Once the participant has passed the location where the merging vehicle has or will stop, logstream 4 is set to 100.
END CONDITIONS	500 ft before start of curves
CLEANUP	None

INTERSTATE EVENT 204: MERGING TRAFFIC			
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Lateral distance between SV and blocker car at time merging car crosses onto interstate	E204_blocker_lat_d	ft
	Bumper-to-bumper distance between SV and blocker car at time merging car crosses onto interstate	E204_blocker_long_d	ft
	Time SV passes blocker car relative to merging car crossing onto interstate (negative = prior)	E204_blocker_pass_t	sec
	Scenario vehicles do not drive through one another	E204_DO_col_ct E204_DO_col_tx	count of DOs that collide with each other during event names of DOs that collide
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Which lane the participant is in at start of event	E204_lane_init	binary 1=right, 2=left
	Accelerator release	E204_accel_release	binary 1=yes, 0 = no
	Brake press	E204_brake_press	binary 1=yes, 0 = no
	Lane change (driver moves over for merging car)	E204_lane_change	binary 1=yes, 0 = no
	Correlation between steering and road curvature	E204_steer_curve	
	Correlation between eye movements and SDLP	E204_eye_sdlp	

INTERSTATE EVENT 204: MERGING TRAFFIC			
	Correlation between eye movements and steering	E204_eye_steer	
	Correlation between head turn and steering wheel movement	E204_headturn_wheel	
	Number of collisions	E204_num_col	
	Near misses	E204_num_miss	
	Degree of conflict	E204_deg_conflict	
	Delay time	E204_delay_time	
	Rise time	E204_rise_time	
	Peak time	E204_peak_time	
	Max overshoot	E204_over_max	
	Settling time	E204_set_time	
	How well it fits the model	E204_model_fit	
	Smooth pursuit velocity	E204_smpur_vel	
	Smooth pursuit duration	E204_smpur_dur	
	Smooth pursuit frequency	E204_smpur_freq	
	Smooth pursuit maximum velocity	E204_smpur_maxvel	
	Smooth pursuit gain	E204_smpur_gain	
	SD of gaze	E204_gaze_sd	
	Gaze kurtosis	E204_gaze_kurt	
	Dwell duration	E204_dwell_time	
	Frequency of side mirror glances	E204_glance_freq_side	
	Frequency of speedometer glances	E204_glance_freq_speed	
	Glance direction	E204_glance_dir	
	Head movement	E204_head_mov	
	Percent in center based on median location of gaze	E204_cent_base	
	Timing of participant looking at side mirror	E204_side_time	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Mean brake force		
	Mean accelerator position		

INTERSTATE EVENT 204: MERGING TRAFFIC			

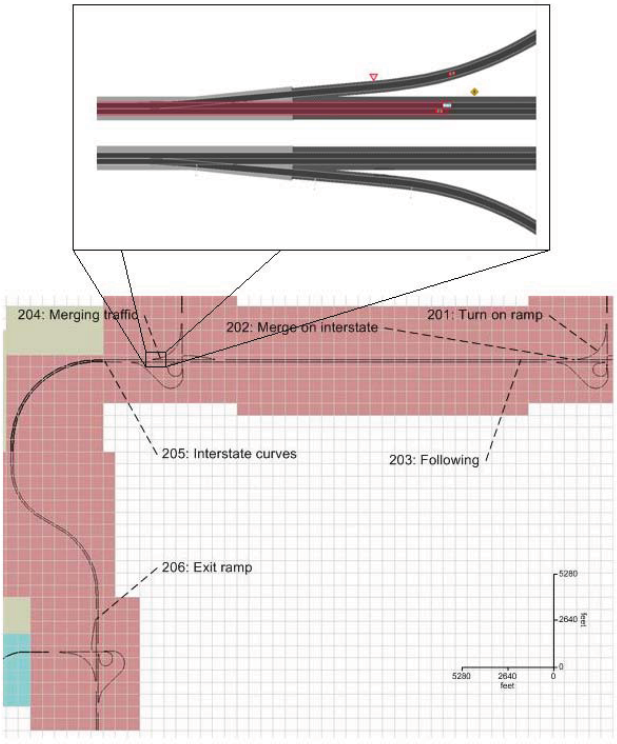


Figure 12 Merging Traffic

- Look for oncoming traffic
- Jerk of accelerator position
- Velocity of accelerator position
- Smoothness of lane change
- Max overshoot

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when encountering traffic merging onto a highway are: time from last glance until merging on, the smoothness of pulling changing lanes, max overshoot, and jerk and velocity of accelerator position. As a person merges onto a highway, looking for other traffic is essential to safe driving and is something that alcohol-impaired drivers tend to ignore**. The smoothness of lane change and max overshoot go hand in hand in the way a person pulls out of the parking space, as unimpaired drivers will get into the lane fairly quickly and impaired drivers will have to adjust their position before settling on an adequate location (Stuster, 1997). Jerk and

velocity of accelerator position look at how smoothly the participant pulled out of the parking space from a longitudinal perspective. Alcohol-impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997).

3.12 Interstate Event 205: Interstate Curves

The participant will navigate a series of three curves on the interstate.

INTERSTATE EVENT 205: INTERSTATE CURVES			
RATIONALE	This scenario will involve a series of three curves the driver must negotiate on the interstate with light traffic. The FARS rationale is the over-representation of impaired driving fatal crashes on curves on dark but lighted roads. DWI detection cues that could occur include: weaving, drifting out of lane, almost striking an object, varying speed, and straddling a lane line.		
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 20020 Road type (lanes, surface): Asphalt 2-lane interstate Speed limit (in mph): 70 mph for passenger vehicles, 65 mph for trucks Curvature: 3 curves (radii of 3350, 2250, and 2925 ft) Intersection type: none Time of Day/Date: night lit		
PREPARATION	The participant navigates a series of three curves on the interstate. Audio instruction #3 plays, instructing the participant to get off at the next exit. (The participant is able to keep the vehicle on the road)		
START CONDITIONS	500 feet before the start of the first curve		
ACTUAL EVENT	Logstream 1 is incremented, logstream 2 is set to 205 The participant navigates a series of three curves on the interstate. Audio instruction number 3 plays, instructing participant to get off at the next exit. (The participant is able to keep the vehicle on the road.)		
END CONDITIONS	1000 feet before off ramp		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT	DESCRIPTION	IDENTIFIER	UNITS
	There are no scenario cars traveling in same direction as participant		

INTERSTATE EVENT 205: INTERSTATE CURVES			
INDICATE IF THE EVENT IS OPERATING AS EXPECTED)			
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Road departures	E205_road_depart_ct	count
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Lane position	E205_lp_avg	ft
	SD of lane position relative to mean	E205_lp_sd	ft
	SD of lane position relative to center	E205_lpn_sd	ft
	Steering wheel reversals		
	SD of speed relative to mean	E205_sp_sd	mph
	SD of speed relative to posted speed limit	E205_spn_sd	mph
	Number of center line crossings	E205_center_cross	count
	Number of right line crossings	E205_right_cross	count
	Speed	E205_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E205_spn_avg	mph
	Smoothness of lane changes (should they occur)	E205_lat_acc_avg	ft/s^2
	Lateral acceleration	E205_lat_acc	ft/s^2
	Head movement (during lane change if any)		binary 1=yes,0=no
	Turn Signal Use	E205_turn_signal	binary 1=yes, 0 = no
	SD of steering wheel position	E205_steer_sd	
	Velocity of steering wheel	E205_steer_vel	
	Jerk of steering wheel	E205_steer_jerk	

INTERSTATE EVENT 205: INTERSTATE CURVES			
	Steering error	E205_steer_error	
	Steering wheel reversals	E205_steer_rev	
	Highway turn signal use	E205_highwayturn_sig	
	Time to line crossing (TLC)	E205_tlc	
	Proportion of time TLC>2s	E205_tlc_2	proportion
	95% TLC	E205_tlc_95	
	Accelerator holds	E205_accel_holds	
	Frequency of lane changes	E205_freq_lane	count
	Velocity of accelerator position	E205_accel_vel	
	Jerk of accelerator position	E205_accel_jerk	
	SD of accelerator position	E205_accel_sd	
	Mean brake force	E205_brake_avg	
	SD of brake force	E205_brake_sd	
	Timing of participant looking at rear view mirror	E205_rear_look	
	Glance frequency at particular object	E205_freq_glance	
	Pressure output(global and local)	E205_out_pres	
	Pressure and force over time	E205_force_pres	
	Pressure point mapping	E205_map_pres	
	PERCLOS	E205_perclos	
	Eye blink frequency	E205_blink_freq	
	Eye blink duration	E205_blink_dur	
	Percent in center based on median location of gaze	E205_cent_base	
	Correlation between road curvature and eye movements	E205_eye_curve	
	Correlation between steering and road curvature	E205_steer_curve	
	Correlation between eye movements and SDLP	E205_eye_sdlp	
	Correlation between eye movements and steering	E205_eye_steer	
	Correlation between head turn and steering wheel movement	E205_headturn_wheel	
	Number of collisions	E205_num_col	
	Near misses	E205_num_miss	

INTERSTATE EVENT 205: INTERSTATE CURVES			
	Delay time	E205_delay_time	
	Rise time	E205_rise_time	
	Peak time	E205_peak_time	
	Max overshoot	E205_over_max	
	Settling time	E205_set_time	
	How well it fits the model	E205_model_fit	
	Smooth pursuit velocity	E205_smpur_vel	
	Smooth pursuit duration	E205_smpur_dur	
	Smooth pursuit frequency	E205_smpur_freq	
	Smooth pursuit maximum velocity	E205_smpur_maxvel	
	Smooth pursuit gain	E205_smpur_gain	
	SD of gaze	E205_gaze_sd	
	Gaze kurtosis	E205_gaze_kurt	
	Dwell duration	E205_dwell_time	
	Frequency of side mirror glances	E205_glance_freq_side	
	Frequency of speedometer glances	E205_glance_freq_speed	
	Glance direction	E205_glance_dir	
	Head movement	E205_head_mov	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	SD of lane position relative to mean		
	SD of speed relative to mean		
	Steering wheel reversals		
	Lateral acceleration		

- SD of lane position (relative to mean lane position)
- Speed (relative to posted or assumed speed limit)
- SD of speed (during "steady state") relative to mean speed

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when driving down a road are: SDLP, SD speed, and

speed relative to the posted or assumed speed limit. One of the most widely thought of behaviors of alcohol-impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). The same has been shown for variation in speed, which can be measured by SD Speed (Arnedt et al., 2001; Gawron & Ranney, 1988). A standard set of qualitative behaviors for police to follow mentions that alcohol-impaired drivers tend to drive slower than the speed limit by more than 10 mph (Stuster, 1997).

3.13 Interstate Event 206: Exit Ramp

The participant will take the next exit ramp off the interstate.

Interstate Event 206: Exit Ramp	
RATIONALE	The participant will get off at the exit. This will involve going from two lanes to one lane, slowing from 70 mph to about 35 mph on a gentle curve. The FARS rationale is the over-representation of impaired participant crashes on curves. The DWI detection cues to observe could be: decelerating or braking in a jerky manner, drifting out of the proper lane, and failure to signal intentions.
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 1540 Road type (lanes, surface): 2-lane interstate to single lane exit ramp Speed limit (in mph): 70 to 35 (assumed) mph Curvature: 3600 ft radius, 2816 ft radius s-curve off ramp Intersection type: exit ramp Time of Day/Date: lit night Elevation: 0 ft at beginning of ramp to 30 ft at end of ramp
PREPARATION	The participant pulls off interstate onto the off-ramp As the participant approaches the intersection, some cross traffic passes from both directions in the oncoming intersection The participant takes the exit ramp (The participant may or may not actually stop fully at the turn)
START CONDITIONS	1000 feet from start of off ramp
ACTUAL EVENT	When the participant is 500 feet from the start of the off ramp, Logstream 1 is incremented, Logstream 2 is set to 206, Logstream 4 is set to 1. The participant pulls off onto the off ramp, Logstream 5 is set to 23, Logstream 4 is set to 100 (The participant remembers the audio instructions to pull off at the given exit) When the participant is 21 seconds from the stop line at the end of the ramp, two cars are created to pass through the intersection of the off ramp with the perpendicular rural roadway. A cargo truck crosses from the left and a car from the right. Logstream 3 is set to 1. 3 seconds later, another car is created to pass through the intersection from the right. Logstream 3 is set to 2.
END CONDITIONS	Participant is at the stop line.
CLEANUP	None

Interstate Event 206: Exit Ramp			
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Driver does not take the ramp	E206_nav_error	binary 1=yes, 0 = no
	Accelerator release	E206_accel_release	binary 1=yes, 0 = no
	Brake press	E206_brake_press	binary 1=yes, 0 = no
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Speed	E206_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E206_spn_avg	mph
	Mean acceleration	E206_acc_avg	ft/s^2
	Number of center line crossings	E206_center_cross	count
	Number of right line crossings	E206_right_cross	count
	Turn signal use	E206_turn_signal	binary 1=yes, 0 = no
	Smoothness of transition onto the exit ramp (lateral)	E206_smooth_lat	
	Smoothness of transition onto the exit ramp (longitudinal)	E206_smooth_long	

Interstate Event 206: Exit Ramp			
	Head movement		binary 1=yes, 0 = no
	Lateral acceleration	E204_lat_acc	ft/s^2
	SD of steering wheel position	E206_steer_sd	
	Velocity of steering wheel	E206_steer_vel	
	Jerk of steering wheel	E206_steer_jerk	
	Steering error	E206_steer_error	
	Velocity of accelerator position	E206_accel_vel	
	Jerk of accelerator position	E206_accel_jerk	
	SD of accelerator position	E206_accel_sd	
	Mean brake force	E206_brake_avg	
	SD of brake force	E206_brake_sd	
	Glance frequency at particular object	E206_freq_glance	
	Pressure output(global and local)	E206_out_pres	
	Pressure and force over time	E206_force_pres	
	Pressure point mapping	E206_map_pres	
	PERCLOS	E206_perclos	
	Eye blink frequency	E206_blink_freq	
	Eye blink duration	E206_blink_dur	
	Percent in center based on median location of gaze	E206_cent_base	
	Correlation between head turn and steering wheel movement	E206_headturn_wheel	
	Number of collisions	E206_num_col	
	Near misses	E206_num_miss	
	Delay time	E206_delay_time	
	Rise time	E206_rise_time	
	Peak time	E206_peak_time	
	Max overshoot	E206_over_max	
	Settling time	E206_set_time	
	How well it fits the model	E206_model_fit	

Interstate Event 206: Exit Ramp			
	Smooth pursuit velocity	E206_smpur_vel	
	Smooth pursuit duration	E206_smpur_dur	
	Smooth pursuit frequency	E206_smpur_freq	
	Smooth pursuit maximum velocity	E206_smpur_maxvel	
	Smooth pursuit gain	E206_smpur_gain	
	SD of gaze	E206_gaze_sd	
	Gaze kurtosis	E206_gaze_kurt	
	Dwell duration	E206_dwell_time	
	Frequency of side mirror glances	E206_glance_freq_side	
	Frequency of speedometer glances	E206_glance_freq_speed	
	Glance direction	E206_glance_dir	
	Head movement	E206_head_mov	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Lateral acceleration		
	Mean brake force		
	Number of center line crossings		
	Number of right line crossings		

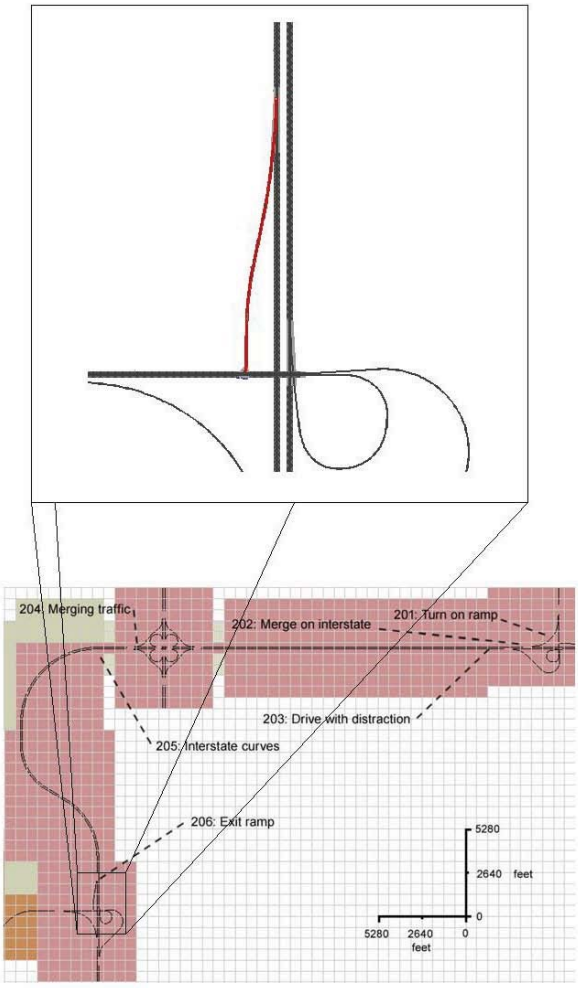


Figure 13 Interstate off-ramp includes an elevation change. The beginning of the ramp starts at zero feet and increases to thirty feet by the end of the ramp. The elevation then decreases back to zero feet after the participant turns right.

- Jerk of accelerator position
- Velocity of accelerator position
- Velocity of steering wheel
- Jerk of steering wheel

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when turning onto a ramp are: jerk and velocity of accelerator position and jerk and velocity of steering wheel position. Jerk and velocity of accelerator position look at how smoothly the participant pulled out of the parking space from a longitudinal perspective. Alcohol-impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997). The jerk and velocity of the steering wheel position look at how smoothly the participant turned onto the ramp. Research has

shown that alcohol impairs a person's ability to maintain lateral control (Calhoun et al., 2005).

3.14 Rural Event 301: Turn Off Ramp (Transitional)

The driver is at a stop sign at the end of an exit ramp. They will have been given an instruction to turn right at the intersection. The participant will make a right turn onto a rural highway and accelerate up to speed.

RURAL EVENT 301: TURN OFF RAMP (TRANSITIONAL)	
RATIONALE	The driver is required to make a right turn from the off-ramp onto a rural two-lane undivided road with a speed limit of 55 mph. There is no traffic for this transition scenario. The FARS rationale is the over-representation of impaired driving fatal crashes on dark, but lighted, undivided two-lane roads, involving a slight curve. DWI detection cues that could emerge include: turning with a wide radius, weaving across lanes, speed variation problems, and driving in the opposing lane.
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 1500 Road type (lanes, surface): 1-lane asphalt to 2-lane asphalt Speed limit (in mph): 35 mph (assumed) exit ramp to 55 mph highway Curvature: Approximate radius is 1900 ft Intersection type: Exit ramp to 2-lane rural road Time of Day/Date: Night, lighted Elevation: 30 ft to 0 ft
PREPARATION	The participant nears the stop line (The participant may or may not come to a complete stop) The participant turns right onto the 2-lane lit rural highway (The participant makes the correct turn) When the participant has driven 400 feet after making the turn, an audio instruction informing them of their next turn plays. (The participant makes the correct turn) The participant speeds up and matches the speed limit (The participant accelerates after the turn)
START CONDITIONS	The participant is 12 feet in front of the stop line
ACTUAL EVENT	The participant slows to a very low speed or come to a complete stop near the stop line. Logstream 1 is set to incremented, Logstream 2 is set to 301. (The participant may or may not come to a complete stop) The participant turns right onto the 2-lane lit rural highway. As the participant crosses the stop line logstream 4 is set to 1. As the participant finishes the turn and is on the rural highway, logstream 5 is set to 31 (The participant makes the correct turn) When the participant has driven 400 feet after making the turn, an audio instruction plays informing them of their next turn. (The participant makes the correct turn) The participant speeds up and matches the speed limit (The participant accelerates after the turn)

RURAL EVENT 301: TURN OFF RAMP (TRANSITIONAL)			
END CONDITIONS	The participant has traveled 1500 feet from the turn		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)HN THOUGHT TO CC ME ON THAT EMAIL THIS TIME	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Crossing vehicles pass through intersection	Observation variable	
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Acceleration rate at beginning of task	E301_acc_init	ft/s^2
	Complete stop	E301_complete_stop	binary 1=yes, 0 = no
	Minimum speed	E301_sp_min	mph
	Driver does not turn right at end of the ramp	E301_nav_error	binary 1=yes, 0 = no
	Acceleration rate at end of event	E301_acc_end	ft/s^2
	Done accelerating	E301_acc_done	binary 1=yes, 0 = no
	Average acceleration rate on ramp	E301_acc_avg_ramp	ft/s^2
	Average acceleration rate on rural road	E301_acc_avg_rural	ft/s^2
	Acceleration distance on rural road	E301_acc_done_d	ft
	Speed at the end of event	E301_sp_mavgnd	mph
ALCOHOL	DESCRIPTION	IDENTIFIER	UNITS

RURAL EVENT 301: TURN OFF RAMP (TRANSITIONAL)			
IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	Smooth pursuit duration		sec
	Smooth pursuit frequency		pursuits/sec
	Smooth pursuit maximum velocity		deg/sec
	Smooth pursuit gain		
	S.D. of accelerations	E301_acc_sd	ft/s^2
	Turn signal use	E301_turn_signal	binary 1=yes, 0 = no
	Head movement		binary 1=yes, 0 = no
	Deviation around the Line of Best fit for speed during acceleration (Robertson, 1996)		
	Number of center line crossings	E301_center_cross	count
	Number of right line crossings	E301_right_cross	count
	Smoothness of transition (longitudinal)	E301_smooth_long	
	Smoothness of transition (lateral)	E301_smooth_lat	
	Complete stop	E301_complete_stop	binary 1=yes, 0 = no
	Location of stop (relative to stop line)	E301_stop_pos	ft
	Heading at stop	E301_stop_hdng	deg
	Frequency of glances to traffic on left	E301_glance_freq_left	glances/sec
	Mean brake force		
	Intersection turn signal use	E301_turn_sig	
	Velocity of accelerator position	E301_accel_vel	
	Jerk of accelerator position	E301_accel_jerk	
	SD of accelerator position	E301_accel_sd	
	Mean brake force	E301_brake_avg	
	SD of brake force	E301_brake_sd	
	Speed	E301_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E301_spn_avg	mph
	Glance frequency at particular object	E301_freq_glance	
	Pressure output(global and local)	E301_out_pres	

RURAL EVENT 301: TURN OFF RAMP (TRANSITIONAL)			
	Pressure and force over time	E301_force_pres	
	Pressure point mapping	E301_map_pres	
	PERCLOS	E301_perclos	
	Eye blink frequency	E301_blink_freq	
	Eye blink duration	E301_blink_dur	
	Percent in center based on median location of gaze	E301_cent_base	
	Correlation between road curvature and eye movements	E301_eye_curve	
	Correlation between steering and road curvature	E301_steer_curve	
	Correlation between eye movements and SDLP	E301_eye_sdlp	
	Correlation between eye movements and steering	E301_eye_steer	
	Number of collisions	E301_num_col	
	Near misses	E301_num_miss	
	Delay time	E301_delay_time	
	Rise time	E301_rise_time	
	Peak time	E301_peak_time	
	Max overshoot	E301_over_max	
	Settling time	E301_set_time	
	How well it fits the model	E301_model_fit	
	Smooth pursuit velocity	E301_smpur_vel	
	Smooth pursuit duration	E301_smpur_dur	
	Smooth pursuit frequency	E301_smpur_freq	
	Smooth pursuit maximum velocity	E301_smpur_maxvel	
	Smooth pursuit gain	E301_smpur_gain	
	SD of gaze	E301_gaze_sd	
	Gaze kurtosis	E301_gaze_kurt	
	Dwell duration	E301_dwell_time	
	Frequency of side mirror glances	E301_glance_freq_side	
	Frequency of speedometer glances	E301_glance_freq_speed	
	Glance direction	E301_glance_dir	

RURAL EVENT 301: TURN OFF RAMP (TRANSITIONAL)			
	Head movement	E301_head_mov	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Mean accelerator position		
	Lateral acceleration		
	Smoothness of acceleration		
	Mean speed		
	Smooth pursuit eye movements		

- Jerk of accelerator position
- Velocity of accelerator position
- Smoothness of lane change
- Max overshoot
- Velocity of steering wheel
- Jerk of steering wheel

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when turning left are: the smoothness of pulling out, max overshoot, and jerk and velocity of accelerator position. The smoothness of lane change and max overshoot go hand in hand in the way a person pulls out of the parking space, as unimpaired drivers will get into the lane fairly quickly and impaired drivers will have to adjust their position before settling on an adequate location (Stuster, 1997). Jerk and velocity of accelerator position look at how smoothly the participant pulled out of the parking space from a longitudinal perspective. Alcohol-impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997).

3.15 Rural Event 302: Lighted Rural

The participant will follow a lighted two-lane road with a speed limit of 55 mph.

RURAL EVENT 302: LIGHTED RURAL	
RATIONALE	The driver is required to drive for a few minutes on a lighted two-lane rural road with a speed limit of 55 mph with oncoming traffic about once every 60 seconds. The FARS rationale includes the over-representation on rural two-lane undivided roads with a speed limit of 55 mph. DWI detection cues could be: weaving, drifting, lane maintenance problems, accelerating or decelerating for no good reason, varying speed, and driving in opposing lanes

RURAL EVENT 302: LIGHTED RURAL			
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 750 Road type (lanes, surface): 2-lane asphalt Speed limit (in mph): 55 mph Curvature: None Intersection type: None Time of Day/Date: Night, lighted		
PREPARATION	The participant follows this lighted two-lane road with a speed limit of 55 mph. (The participant has finished accelerating and is traveling 55 mph) The participant sees oncoming traffic on average once per 60 seconds		
START CONDITIONS	The participant has traveled 1500 feet after turning onto the rural highway		
ACTUAL EVENT	Logstream 1 is incremented, logstream 2 is set to 302, logstream 3 is set to 0, logstream 4 is set to 100. The participant follows this lighted two-lane road with a speed limit of 55 mph. (The participant is traveling 55 mph) The participant sees oncoming traffic on average once per 60 seconds		
END CONDITIONS	The participant has passed the last lamp post		
CLEANUP			
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
	Done accelerating	E301_acc_done	binary 1=yes, 0 = no
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Oncoming traffic present on average every 60 seconds	E302_oncoming_freq	avg. sec between cars
	Lighting present on road	observation	
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES	DESCRIPTION	IDENTIFIER	UNITS
	Average speed during event	E302_sp_avg	mph
	Average speed relative to speed limit	E302_spn_avg	mph
	SD speed during event relative to mean	E302_sp_sd	mph

RURAL EVENT 302: LIGHTED RURAL			
ACCORDING TO THE ASSUMPTIONS)	SD speed during event relative to speed limit	E302_spn_sd	mph
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Average lane position	E302_lp_avg	ft
	SD of lane position relative to mean	E302_lp_sd	ft
	SD of lane position relative to center of lane	E302_lpn_sd	ft
	Speed	E302_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E302_spn_avg	mph
	SD speed during event relative to mean	E302_sp_sd	mph
	SD speed during event relative to speed limit	E302_spn_sd	mph
	Number of center line crossings	E302_center_cross	count
	Number of right line crossings	E302_right_cross	count
	Frequency of glances to rear view mirror	E302_glance_freq_rear	glances/sec
	Steering wheel reversals	E302_steer_rev	
	SD of steering wheel position	E302_steer_sd	
	Velocity of steering wheel	E302_steer_vel	
	Jerk of steering wheel	E302_steer_jerk	
	Steering error	E302_steer_error	
	Time to line crossing (TLC)	E302_tlc	
	Proportion of time TLC>2s	E302_tlc_2	proportion
	95% TLC	E302_tlc_95	
	Accelerator holds	E302_accel_holds	
	Velocity of accelerator position	E302_accel_vel	
	Jerk of accelerator position	E302_accel_jerk	
	SD of accelerator position	E302_accel_sd	
	Glance frequency at particular object	E302_freq_glance	
	Pressure output(global and local)	E302_out_pres	
	Pressure and force over time	E302_force_pres	

RURAL EVENT 302: LIGHTED RURAL			
	Pressure point mapping	E302_map_pres	
	PERCLOS	E302_perclos	
	Eye blink frequency	E302_blink_freq	
	Eye blink duration	E302_blink_dur	
	Percent in center based on median location of gaze	E302_cent_base	
	Correlation between road curvature and eye movements	E302_eye_curve	
	Correlation between steering and road curvature	E302_steer_curve	
	Correlation between eye movements and SDLP	E302_eye_sdlp	
	Correlation between eye movements and steering	E302_eye_steer	
	Number of collisions	E302_num_col	
	Near misses	E302_num_miss	
	Smooth pursuit velocity	E302_smpur_vel	
	Smooth pursuit duration	E302_smpur_dur	
	Smooth pursuit frequency	E302_smpur_freq	
	Smooth pursuit maximum velocity	E302_smpur_maxvel	
	Smooth pursuit gain	E302_smpur_gain	
	SD of gaze	E302_gaze_sd	
	Gaze kurtosis	E302_gaze_kurt	
	Dwell duration	E302_dwell_time	
	Frequency of side mirror glances	E302_glance_freq_side	
	Frequency of speedometer glances	E302_glance_freq_speed	
	Glance direction	E302_glance_dir	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Lane position		
	Speed		
	SD of lane position relative to mean		
	SD of speed relative to mean		
	Steering wheel reversals		
	Number of center line crossings		

RURAL EVENT 302: LIGHTED RURAL			
	Number of right line crossings		

- SD of lane position (relative to mean lane position)
- Speed (relative to posted or assumed speed limit)
- SD of speed (during "steady state") relative to mean speed

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver are driving down a road are: SDLP, SD speed, and speed relative to the posted or assumed speed limit. One of the most widely thought of behaviors of alcohol-impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). The same has been shown for variation in speed which can be measured by SD speed (Arnedt et al., 2001; Gawron & Ranney, 1988). A standard set of qualitative behaviors for police to follow mentions that alcohol-impaired drivers tend to drive slower than the speed limit by more than 10 mph (Stuster, 1997).

3.16 Rural Event 303: Transition to Dark Rural

The road will transition to an unlighted two-lane road. The center and road edge markings are faded, and the road will have a grayish surface.

RURAL EVENT 303: TRANSITION TO DARK RURAL	
RATIONALE	The driver is required to transition to a segment of the rural road that is unlighted. The center and edge lines are faded and the road will have a grayish surface. There is no specific FARS rationale, but this transition is typical and could involve some challenging visual problems. DWI detection cues that could occur include: swerving, drifting, varying speed, and straddling the lane lines.
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet):1500 ft Road type (lanes, surface): 2-lane asphalt Speed limit (in mph): 55 mph Curvature: None Intersection type: None Time of Day/Date: Night, transition from lit to dark
PREPARATION	The participant is driving on the lighted two-lane road with a speed limit of 55 mph. (The participant is traveling 55 mph)
START CONDITIONS	Event starts at the last lamp post
ACTUAL EVENT	The participant enters the unlighted portion of the rural road. Logstream 1 is incremented, logstream 2 is set to 303, logstream 4 is set to 32. (The participant maintains speed or slows slightly.)
END CONDITIONS	Event ends 1500 feet past the last lamp post.

RURAL EVENT 303: TRANSITION TO DARK RURAL			
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	Lighted road ends—dark begins		
	Oncoming traffic every 60 seconds	E303_oncoming_freq	avg. sec between cars
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Beginning speed	E303_sp_init	mph
	Ending speed	E303_sp_mavgnd	mph
	Average speed	E303_sp_avg	mph
	Average speed relative to speed limit	E303_spn_avg	mph
	SD speed relative to mean speed	E303_sp_sd	mph
	SD speed relative to speed limit	E303_spn_sd	mph
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Average lane position	E303_lp_avg	ft
	SD of lane position relative to mean lane position	E303_lp_sd	ft
	SD of lane position relative to center of lane	E303_lpn_sd	ft
	SD speed relative to mean speed	E303_sp_sd	mph
	SD speed relative to speed limit	E303_spn_sd	mph
	Number of center line crossings	E303_center_cross	count
	Number of right line crossings	E303_right_cross	count
	Frequency of glances to rear view mirror	E303_glance_freq_rear	glances/sec

RURAL EVENT 303: TRANSITION TO DARK RURAL			
	Steering wheel reversals	E303_steer_rev	
	SD of steering wheel position	E303_steer_sd	
	Velocity of steering wheel	E303_steer_vel	
	Jerk of steering wheel	E303_steer_jerk	
	Steering error	E303_steer_error	
	Time to line crossing (TLC)	E303_tlc	
	Proportion of time TLC>2s	E303_tlc_2	proportion
	95% TLC	E303_tlc_95	
	Accelerator holds	E303_accel_holds	
	Velocity of accelerator position	E303_accel_vel	
	Jerk of accelerator position	E303_accel_jerk	
	SD of accelerator position	E303_accel_sd	
	Speed	E303_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E303_spn_avg	mph
	Glance frequency at particular object	E303_freq_glance	
	Pressure output(global and local)	E303_out_pres	
	Pressure and force over time	E303_force_pres	
	Pressure point mapping	E303_map_pres	
	PERCLOS	E303_perclos	
	Eye blink frequency	E303_blink_freq	
	Eye blink duration	E303_blink_dur	
	Percent in center based on median location of gaze	E303_cent_base	
	Correlation between road curvature and eye movements	E303_eye_curve	
	Correlation between steering and road curvature	E303_steer_curve	
	Correlation between eye movements and SDLP	E303_eye_sdlp	
	Correlation between eye movements and steering	E303_eye_steer	
	Number of collisions	E303_num_col	
	Near misses	E303_num_miss	
	Smooth pursuit velocity	E303_smpur_vel	

RURAL EVENT 303: TRANSITION TO DARK RURAL			
	Smooth pursuit duration	E303_smpur_dur	
	Smooth pursuit frequency	E303_smpur_freq	
	Smooth pursuit maximum velocity	E303_smpur_maxvel	
	Smooth pursuit gain	E303_smpur_gain	
	SD of gaze	E303_gaze_sd	
	Gaze kurtosis	E303_gaze_kurt	
	Dwell duration	E303_dwell_time	
	Frequency of side mirror glances	E303_glance_freq_side	
	Frequency of speedometer glances	E303_glance_freq_speed	
	Glance direction	E303_glance_dir	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Lane position		
	Speed		
	SD lane position relative to mean		
	SD speed relative to mean		
	Steering wheel reversals		
	Number of center line crossings		
	Number of right line crossings		

- Change in speed (from beginning of the event to the end)
- SDLP
- Maximum brake pressure

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver with a lit to unlit roadway transition are: SDLP, the change in speed from the beginning of the event to the end, and the maximum brake pressure. One of the most widely thought of behaviors of alcohol-impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). Maximum brake pressure and change in speed both look at a participant's ability to control velocity in a changing environment. It is known that alcohol-impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997).

3.17 Rural Event 304: Dark Rural

The road has transitioned to an unlighted two-lane road. The center and road edge markings are faded, and the road has a grayish surface.

RURAL EVENT 304: DARK RURAL			
RATIONALE	This segment involves a few minutes of driving on this rural, two-lane, unlighted 55 mph road with faded lane lines involving some curves. Curve radii range from 456 ft to 5500 ft. The FARS rationale includes the over-representation of impaired driving fatal crashes occurring under just these conditions. DWI cues that could emerge include: weaving across lanes, drifting, varying speed, driving in opposing lane, and running off the road.		
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 14510 Road type (lanes, surface): 2-lane asphalt with faded pavement markings Speed limit (in mph): 55 mph initially, 45 mph on curves, 55 mph at end of event Curvature: Varying straight and curved sections including approximately 45 deg left turn with radius of 1525 ft and hairpin curve, approximately 135 deg, radius of 456 ft. Intersection type: None Time of Day/Date: Night, dark Elevation: Event contains a hill approximately 55 ft high		
PREPARATION	The participant follows an unlighted two-lane road with a speed limit of 55 mph. (The participant is traveling 55 mph) The participant experiences oncoming traffic on average every 60 seconds. The participant experiences a series of curves. (The participant is traveling 45 mph) The participant experiences an oncoming car timed such that it meets the participant near the apex of one of the curves		
START CONDITIONS	The participant has passed the geometric point defining the end of the transition to the dark rural road segment (1500 ft after lighted rural roadway segment ends).		
ACTUAL EVENT	Logstream 1 is incremented, logstream 2 is set to 304. The participant follows an unlighted two-lane road with a speed limit of 55 mph. (The participant is traveling 55 mph) The participant navigates through a series of curves. (The participant is traveling 45 mph, maintains lane position, and does not crash.) Traffic frequency in oncoming lane is 1 vehicle/60 sec. The participant encounters an oncoming vehicle on a curve. When the oncoming vehicle is 800 feet from the participant, logstream 3 is set to 1 (The participant does not crash) When the oncoming vehicle is has passed the participant, logstream 3 is set to 0 (The participant does not crash)		
END CONDITIONS	500 ft before Y-intersection with transition to gravel road		
CLEANUP	None		
EVENT	DESCRIPTION	IDENTIFIER	UNITS

RURAL EVENT 304: DARK RURAL			
CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)			
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	No lights	Observation	
	Oncoming traffic (1 car/60 sec)	E304_oncoming_freq	avg. sec between cars
	Meet conflict car on apex of curve		
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Speed (average, min, and max)	E304_sp_avg E304_sp_min E304_sp_max	mph
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Lane position	E304_lp_avg	ft
	SD of lane position (relative to mean lane position)	E304_lp_sd	ft
	SD of lane position (relative to center of lane)	E304_lpn_sd	ft
	Speed	E304_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E304_spn_avg	mph
	SD of speed (relative to mean speed)	E304_sp_sd	mph
	SD of speed (relative to posted or assumed speed limit)	E304_spn_sd	mph

RURAL EVENT 304: DARK RURAL			
	Number of center line crossings	E304_center_cross	count
	Number of right line crossings	E304_right_cross	count
	Frequency of glances to rear view mirror	E304_glance_freq_rear	glances/sec
	Mean speed during hairpin turn	E302_spn_avg_hp	mph
	Steering wheel reversals	E304_steer_rev	
	SD of steering wheel position	E304_steer_sd	
	Velocity of steering wheel	E304_steer_vel	
	Jerk of steering wheel	E304_steer_jerk	
	Steering error	E304_steer_error	
	Time to line crossing (TLC)	E304_tlc	
	Proportion of time TLC>2s	E304_tlc_2	proportion
	95% TLC	E304_tlc_95	
	Accelerator holds	E304_accel_holds	
	Velocity of accelerator position	E304_accel_vel	
	Jerk of accelerator position	E304_accel_jerk	
	SD of accelerator position	E304_accel_sd	
	Glance frequency at particular object	E304_freq_glance	
	Pressure output(global and local)	E304_out_pres	
	Pressure and force over time	E304_force_pres	
	Pressure point mapping	E304_map_pres	
	PERCLOS	E304_perclos	
	Eye blink frequency	E304_blink_freq	
	Eye blink duration	E304_blink_dur	
	Percent in center based on median location of gaze	E304_cent_base	
	Correlation between road curvature and eye movements	E304_eye_curve	
	Correlation between steering and road curvature	E304_steer_curve	
	Correlation between eye movements and SDLP	E304_eye_sdlp	
	Correlation between eye movements and steering	E304_eye_steer	
	Number of collisions	E304_num_col	

RURAL EVENT 304: DARK RURAL			
	Near misses	E304_num_miss	
	Degree of conflict	E304_deg_conflict	
	Smooth pursuit velocity	E304_smpur_vel	
	Smooth pursuit duration	E304_smpur_dur	
	Smooth pursuit frequency	E304_smpur_freq	
	Smooth pursuit maximum velocity	E304_smpur_maxvel	
	Smooth pursuit gain	E304_smpur_gain	
	SD of gaze	E304_gaze_sd	
	Gaze kurtosis	E304_gaze_kurt	
	Dwell duration	E304_dwell_time	
	Frequency of side mirror glances	E304_glance_freq_side	
	Frequency of speedometer glances	E304_glance_freq_speed	
	Glance direction	E304_glance_dir	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Lane position		
	Speed		
	SD of lane position relative to mean		
	SD of speed relative to mean		
	Number of center line crossings		
	Number of right line crossings		
	Steering wheel reversals		

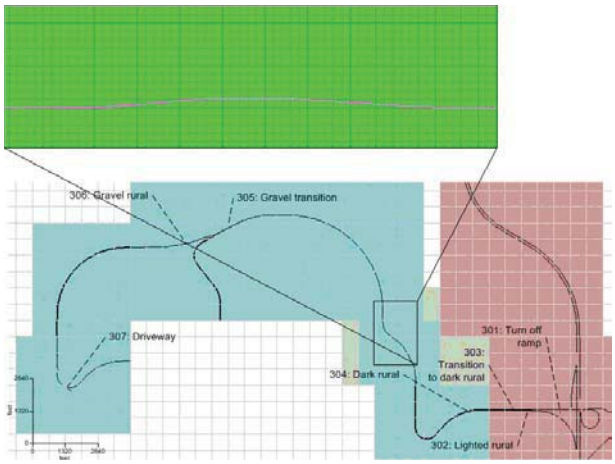


Figure 14 Elevation change for rural curves increases from zero feet to fifty, then decreases back to zero feet.

- SD of lane position (relative to mean lane position)
- Speed (relative to posted or assumed speed limit)
- SD of speed (during "steady state") relative to mean speed

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver driving down a road are: SDLP, SD speed, and speed relative to the posted or assumed speed limit. One of the most widely thought of behaviors of alcohol-impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). The same has been shown for variation in speed, which can be measured by SD speed (Arnedt et al., 2001; Gawron & Ranney, 1988). A standard set of qualitative behaviors for police to follow mentions that alcohol-impaired drivers tend to drive slower than the speed limit by more than 10 mph (Stuster, 1997).

3.18 Rural Event 305: Gravel Transition

The participant will come upon a fork in the road. The main road will curve to the left, and a gravel road will veer to the right. Participants will veer to the right, continuing straight (see Figure 15). The participant is instructed through an audio queue to continue onto the gravel road.

RURAL EVENT 305: GRAVEL TRANSITION	
RATIONALE	In this segment, the driver will come to a fork in the road, turn slightly to the right on a gravel road, and continue straight. The FARS rationale is the over-representation of high BAC crashes on gravel roads. DWI cues could be driving too fast for conditions, swerving, running off the road edge, and stopping for no apparent reason.

RURAL EVENT 305: GRAVEL TRANSITION			
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 2420 Road type (lanes, surface): Transition from faded asphalt to 2-lane gravel Speed limit (in mph): 55 mph to an assumed speed of 45 mph Curvature: None Intersection type: Y, gravel road straight ahead, asphalt road curving away Time of Day/Date: Night, dark		
PREPARATION	The participant approaches a Y intersection (gravel road going straight ahead, asphalt road curving away to the left) (The participant is driving on the road and in the correct lane) The following vehicles(approximately 500 feet behind) veer left at the intersection and not follow the onto the gravel road		
START CONDITIONS	500 ft before the Y-intersection		
ACTUAL EVENT	Logstream 1 is incremented, logstream 2 is set to 305, logstream 4 is set to 1 Once the participant has crossed into the gravel road, logstream 4 is set to 100, and logstream 5 is set to 33 The participant continues straight onto the gravel road section (The participant veers off the paved road onto the gravel road.) (The participant adjusts their speed appropriately for the gravel road surface (no posted speed limit). The following vehicles veer left at the intersection and not follow the participant onto the gravel road		
END CONDITIONS	The participant has traveled 1500 ft past the start of the gravel road.		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS

RURAL EVENT 305: GRAVEL TRANSITION			
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Participant does not take turn	E305_nav_error	binary 1=yes, 0 = no
	Initial speed (speed at beginning of event)	E305_sp_init	mph
	End speed (speed at end of event)	E305_sp_mavgnd	mph
	Accelerator release	E305_accel_release	binary 1=yes, 0 = no
	Brake press	E305_brake_press	binary 1=yes, 0 = no
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	SD of speed relative to mean	E305_sp_sd	mph
	SD of speed relative to posted or assumed speed limit	E305_spn_sd	mph
	Speed	E305_sp_avg	mph
	Speed (relative to posted or assumed speed limit)	E305_spn_avg	mph
	S.D. of steering wheel angle	E305_steer_sd	deg
	Smoothness of transition onto gravel (longitudinal)	E305_smooth_long	
	Smoothness of transition onto gravel (lateral)	E305_smooth_lat	
	Turn signal use	E305_turn_signal	binary 1=yes, 0 = no
	Steering wheel reversals	E305_steer_rev	
	SD of steering wheel position	E305_steer_sd	
	Velocity of steering wheel	E305_steer_vel	
	Jerk of steering wheel	E305_steer_jerk	
	Steering error	E305_steer_error	
	Frequency of glances to rear view mirror	E305_glance_freq_rear	glances/sec
	Accelerator holds	E305_accel_holds	
	Number of left line crossings	E305_left_cross	count
	Number of right line crossings	E305_right_cross	count

RURAL EVENT 305: GRAVEL TRANSITION			
	Velocity of accelerator position	E305_accel_vel	
	Jerk of accelerator position	E305_accel_jerk	
	SD of accelerator position	E305_accel_sd	
	Mean brake force	E305_brake_avg	
	SD of brake force	E305_brake_sd	
	Glance frequency at particular object	E305_freq_glance	
	Pressure output(global and local)	E305_out_pres	
	Pressure and force over time	E305_force_pres	
	Pressure point mapping	E305_map_pres	
	PERCLOS	E305_perclos	
	Eye blink frequency	E305_blink_freq	
	Eye blink duration	E305_blink_dur	
	Percent in center based on median location of gaze	E305_cent_base	
	Correlation between road curvature and eye movements	E305_eye_curve	
	Correlation between steering and road curvature	E305_steer_curve	
	Correlation between eye movements and SDLP	E305_eye_sdlp	
	Correlation between eye movements and steering	E305_eye_steer	
	Number of collisions	E305_num_col	
	Near misses	E305_num_miss	
	Delay time	E305_delay_time	
	Rise time	E305_rise_time	
	Peak time	E305_peak_time	
	Max overshoot	E305_over_max	
	Settling time	E305_set_time	
	How well it fits the model	E305_model_fit	
	Smooth pursuit velocity	E305_smpur_vel	
	Smooth pursuit duration	E305_smpur_dur	
	Smooth pursuit frequency	E305_smpur_freq	
	Smooth pursuit maximum velocity	E305_smpur_maxvel	

RURAL EVENT 305: GRAVEL TRANSITION			
	Smooth pursuit gain	E305_smpur_gain	
	SD of gaze	E305_gaze_sd	
	Gaze kurtosis	E305_gaze_kurt	
	Dwell duration	E305_dwell_time	
	Frequency of side mirror glances	E305_glanceglance_freq_side_side	
	Frequency of speedometer glances	E305_glance_freq_speed	
	Glance direction	E305_glance_dir	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Mean brake force		
	Mean accelerator position		

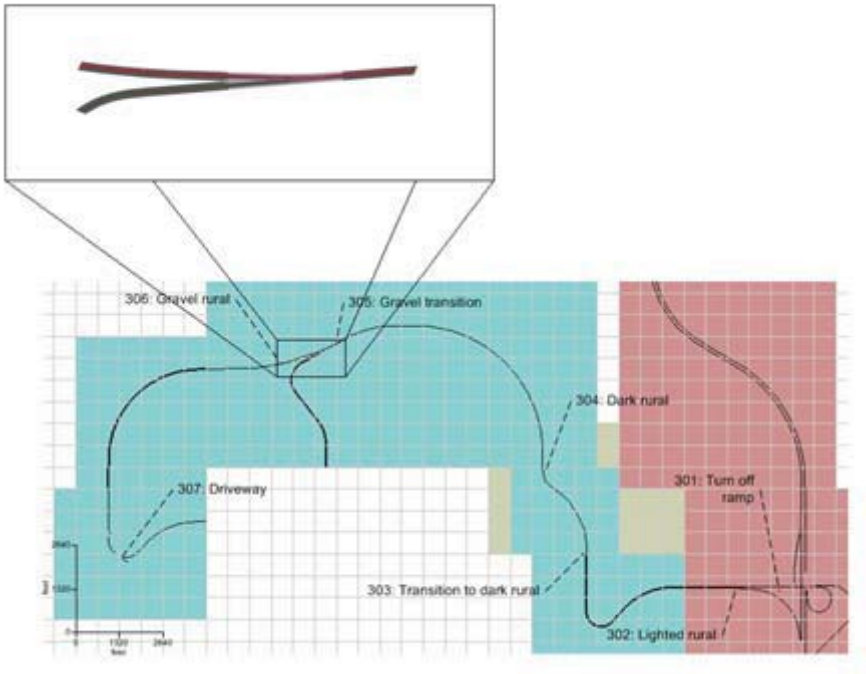


Figure 15 Rural Event 3: Entering gravel road

- Change in speed (from beginning of the event to the end)
- Maximum brake pressure
- SDLP

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver with a pavement to gravel road transition are: SDLP, the change in speed from the beginning of the event to the end, and the maximum brake pressure. One of the most widely thought of behaviors of alcohol-impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). Maximum brake pressure and change in speed both look at a participant's ability to control velocity in a changing environment. It is known that alcohol-impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997).

3.19 Rural Event 306: Gravel Rural

At distance of 1500 ft. after the transition to the gravel road, the participant will experience a series of curves and straight-aways.

RURAL EVENT 306: GRAVEL RURAL	
RATIONALE	In this segment, the driver will navigate on an unlighted gravel rural road that contains a series of curves and has no posted speed limit. The FARS rationale includes an over-representation of impaired driving fatal crashes on curves and unlighted rural gravel roads. The DWI cues that could be observed include: running off the road, almost striking objects, varying speed, and driving in the opposing lane.
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 11880 Road type (lanes, surface): 2-lane gravel with little or no shoulder Speed limit (in mph): Not posted (assumed 45 mph) Curvature: Varying straight and curved sections Intersection type: None Time of Day/Date: Night, dark
PREPARATION	At the start of the event, instruction #5 is played, informing them to pull into the first driveway on the right. The participant navigates an unlighted two-lane rural gravel road that contains a series of curves and has no posted speed limit. (The participant is assumed to travel at approximately 45 mph.)
START CONDITIONS	The participant has traveled 1670 ft past the transition to gravel at the Y-intersection.
ACTUAL EVENT	Logstream 1 is incremented; logstream 2 is set to 306. Instruction #5 is played. The participant continues along the gravel road section. The participant navigates a series of curves. (The participant adjusts their speed appropriately for the gravel road surface and curves.)
END CONDITIONS	The participant is 550 feet before driveway
CLEANUP	None

RURAL EVENT 306: GRAVEL RURAL			
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS
	No cars in either direction		
	Dark gravel road		
	No oncoming traffic	E306_oncoming_freq	avg. sec between cars
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Initial speed (speed at beginning of event)	E306_sp_init	mph
	End speed (speed at end of event)	E306_sp_mavgnd	mph
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	SD of lane position relative to mean lane position	E306_lp_sd	ft
	SD of lane position relative to center of lane	E306_lpn_sd	ft
	Lane position	E306_lp_avg	ft
	SD of speed (relative to mean speed)	E306_sp_sd	mph
	SD of speed (relative to assumed or posted speed limit)	E306_spn_sd	mph
	Speed	E306_sp_avg	mph
	Speed relative to assumed speed	E306_spn_avg	mph

RURAL EVENT 306: GRAVEL RURAL			
	Frequency of glances to rear view mirror	E306_glance_freq_rear	glances/sec
	Steering wheel reversals	E303_steer_rev	
	SD of steering wheel position	E306_steer_sd	
	Velocity of steering wheel	E306_steer_vel	
	Jerk of steering wheel	E306_steer_jerk	
	Steering error	E306_steer_error	
	Time to line crossing (TLC)	E306_tlc	
	Proportion of time TLC>2s	E306_tlc_2	proportion
	95% TLC	E306_tlc_95	
	Accelerator holds	E306_accel_holds	
	Number of left line crossings	E306_left_cross	count
	Number of right linet crossings	E306_right_cross	count
	Velocity of accelerator position	E306_accel_vel	
	Jerk of accelerator position	E306_accel_jerk	
	SD of accelerator position	E306_accel_sd	
	Glance frequency at particular object	E306_freq_glance	
	Pressure output(global and local)	E306_out_pres	
	Pressure and force over time	E306_force_pres	
	Pressure point mapping	E306_map_pres	
	PERCLOS	E306_perclos	
	Eye blink frequency	E306_blink_freq	
	Eye blink duration	E306_blink_dur	
	Percent in center based on median location of gaze	E306_cent_base	
	Correlation between road curvature and eye movements	E306_eye_curve	
	Correlation between steering and road curvature	E306_steer_curve	
	Correlation between eye movements and SDLP	E306_eye_sdlp	
	Correlation between eye movements and steering	E306_eye_steer	
	Number of collisions	E306_num_col	
	Near misses	E306_num_miss	

RURAL EVENT 306: GRAVEL RURAL			
	Smooth pursuit velocity	E306_smpur_vel	
	Smooth pursuit duration	E306_smpur_dur	
	Smooth pursuit frequency	E306_smpur_freq	
	Smooth pursuit maximum velocity	E306_smpur_maxvel	
	Smooth pursuit gain	E306_smpur_gain	
	SD of gaze	E306_gaze_sd	
	Gaze kurtosis	E306_gaze_kurt	
	Dwell duration	E306_dwell_time	
	Frequency of side mirror glances	E306_glance_freq_side	
	Frequency of speedometer glances	E306_glance_freq_speed	
	Glance direction	E306_glance_dir	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Mean lane position		
	Mean speed		
	SD of lane position relative to mean		
	SD of speed relative to mean		
	Steering wheel reversals		

- SD of speed (during "steady state") relative to mean speed
- Speed
- SDLP (relative to mean lane position)

The major variables to take into consideration when comparing an alcohol-impaired driver and an unimpaired driver when driving on a gravel road are: SDLP, SD of speed relative to the mean speed, and mean speed. One of the most widely thought of behaviors of alcohol-impaired drivers is weaving around the lane. This can be represented by the variable SDLP, which has been shown to be sensitive to alcohol (Calhoun et al., 2005; Gawron & Ranney, 1988; Reed & Green, 1999). The same has been shown for variation in speed, which can be measured by SD speed (Arnedt et al., 2001; Gawron & Ranney, 1988). A standard set of qualitative behaviors for police to follow mentions that alcohol-impaired drivers tend to drive slower than the speed limit by more than 10 mph (Stuster, 1997).

3.20 Rural Event 307: Driveway

The drive will end with the participant pulling into a gravel driveway. The participant is instructed through an audio queue to pull off on the gravel driveway. The turn is gradual.

Rural Event 307: Driveway			
RATIONALE	The drive will end with the driver pulling into a gravel driveway. The turn is gradual. This is the typical end of a trip from the bar. No FARS rationale, but could involve DWI cues such as: turning with a wide radius, almost striking an object, and stopping problems (too far, too short, etc.).		
ROAD NETWORK REQUIREMENTS	Overall length/distance needed to support event (in feet): 660 Road type (lanes, surface): 2-lane gravel to 1-lane gravel Speed limit (in mph): Assumed 45 mph to a stop Curvature: 1800ft radius intersection corridor to 510ft radius driveway Intersection type: None Time of Day/Date: Night, dark		
PREPARATION	The participant slows and turns into the drive way (The participant turns into the driveway) The participant is instructed to stop the car, ending the drive (The participant stops the car)		
START CONDITIONS	The participant is 550 ft before driveway.		
ACTUAL EVENT	The participant makes the turn onto the drive way, logstream 5 changes to 34. (The participant makes the turn) When the participant has pulled onto the driveway an audio message instructs them to stop (The participant stops)		
END CONDITIONS	The participant brakes to a complete stop.		
CLEANUP	None		
EVENT CONTINGENCY (VARIABLES THAT DEFINE DEPENDENCE OF THE CURRENT EVENT ON THE INTERPRETATION OF THE PREVIOUS EVENT)	DESCRIPTION	IDENTIFIER	UNITS
SCENARIO PERFORMANCE (MEASURES THAT INDICATE IF THE EVENT IS OPERATING AS EXPECTED)	DESCRIPTION	IDENTIFIER	UNITS

Rural Event 307: Driveway			
ASSUMED DRIVER BEHAVIOR (MEASURES THAT INDICATE WHETHER THE PARTICIPANT BEHAVES ACCORDING TO THE ASSUMPTIONS)	DESCRIPTION	IDENTIFIER	UNITS
	Initial speed	E307_sp_init	mph
	End speed	E307_sp_mavgnd	mph
	Deceleration rate	E307_acc_avg	ft/s^2
	Maximum steering angle (assuming positive indicates right turn)	E307_steer_max	deg
ALCOHOL IMPAIRMENT INDICATORS (MEASURES THAT ASSESS WHETHER THE EVENT IS SENSITIVE TO ALCOHOL IMPAIRMENT)	DESCRIPTION	IDENTIFIER	UNITS
	Turn signal use	E307_turn_signal	binary 1=yes, 0 = no
	Speed variance	E307_sp_sd	mph
	Mean brake force	E104_brake_avg	
	Smoothness of deceleration		
	Frequency of glances to rear view mirror	E307_glance_freq_rear	glances/sec
	Glance frequency at particular object	E307_freq_glance	
	Pressure output(global and local)	E307_out_pres	
	Pressure and force over time	E307_force_pres	
	Pressure point mapping	E307_map_pres	
	PERCLOS	E307_perclos	
	Eye blink frequency	E307_blink_freq	
	Eye blink duration	E307_blink_dur	
	Percent in center based on median location of gaze	E307_cent_base	
	Correlation between head turn and steering wheel movement	E307_headturn_wheel	
	Number of collisions	E307_num_col	
	Near misses	E307_num_miss	
	Delay time	E307_delay_time	

Rural Event 307: Driveway			
	Rise time	E307_rise_time	
	Peak time	E307_peak_time	
	Max overshoot	E307_over_max	
	Settling time	E307_set_time	
	How well it fits the model	E307_model_fit	
	Smooth pursuit velocity	E307_smpur_vel	
	Smooth pursuit duration	E307_smpur_dur	
	Smooth pursuit frequency	E307_smpur_freq	
	Smooth pursuit maximum velocity	E307_smpur_maxvel	
	Smooth pursuit gain	E307_smpur_gain	
	SD of gaze	E307_gaze_sd	
	Gaze kurtosis	E307_gaze_kurt	
	Dwell duration	E307_dwell_time	
	Frequency of side mirror glances	E307_glance_freq_side	
	Frequency of speedometer glances	E307_glance_freq_speed	
	Glance direction	E307_glance_dir	
ALGORITHM INPUT (MEASURES THAT IS INPUT TO THE ALGORITHM)	DESCRIPTION	IDENTIFIER	UNITS
	Mean brake force		

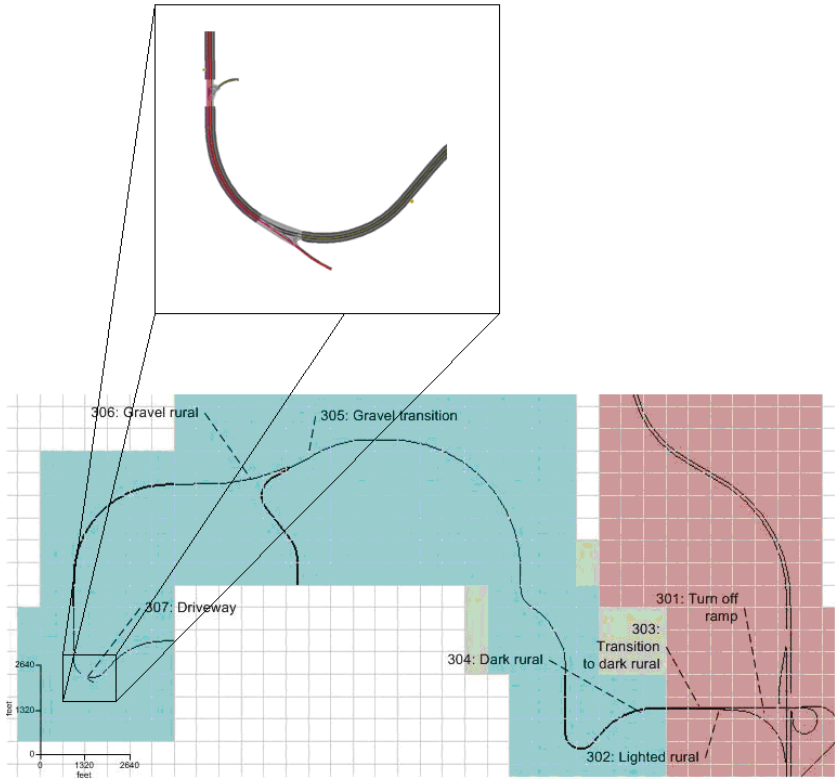


Figure 16 Driveway

- Max brake pressure
- Variation in brake pressure

Maximum brake pressure and variation in brake pressure look at a participant's ability to control velocity in a changing environment. It is known that alcohol impaired drivers have trouble slowing and speeding up in a smooth manner (Stuster, 1997).

3.21 Potential Hazards in Urban Scenario Events

The urban scenario events contain a number of potential hazards in the form of pedestrians and vehicles whose behavior might give the participants the impression that they need to react to the hazard in order to avoid collision. The location and timing of these potential hazards is catalogued so that the participants' responses may be evaluated. Each of the three scenarios contains equal numbers of each kind of hazard and to the extent possible the environment near the hazard is equivalent.

Hazard number	Name	Description
1	Walker3DRR1_01	Three dimensional pedestrian on the right in the parking lane walking in same direction as the driver.
2	Walker3DLR5_02	Two dimensional pedestrian on the left in the parking lane

		walking towards the driver.
3	Walker2DRS7_03	Two dimensional pedestrian on the right on the sidewalk walking toward the road.
4	Walker3DLR1_04	Three dimensional pedestrian on the left in the parking lane walking in the same direction as the driver.
5	Walker3DRS1_05	Three dimensional pedestrian on the right on the sidewalk walking in the same direction as the driver.
6	Walker3DLS5_06	Three dimensional pedestrian on the left on the sidewalk walking towards the driver.
7	Walker2DRS8_07	Two dimensional pedestrian on the right on the sidewalk walking towards the road and in the same direction as the driver.
8	Walker3DRS5_08	Three dimensional pedestrian on the right on the sidewalk walking towards the driver.
9	Walker3DRR1_09	Three dimensional pedestrian on the right in the parking lane walking away from the driver.
10	Walker3DLS5_10	Three dimensional pedestrian on the left on the sidewalk walking towards the driver.
11	Walker2DLS2_11	Two dimensional pedestrian on the left on the sidewalk walking towards the road in the same direction as the driver.
12	Walker3DLR5_12	Three dimensional pedestrian on the left on the parking lane walking away from the driver.
13	PullOutVespaRight	Vespa moped coming from an alley on the right pulls out into the parking lane approximately 75 ft in front of the driver and parks after traveling a short distance.
14	PullOutVespaLeft	Vespa moped coming from an ally on the left pulls out onto the parking lane approximately 18 ft in front of the driver and parks after traveling a short distance.
15	AllyTaxi	Taxi coming from an alley on the left created approximately 650 ft in front of the driver pulls through the parking lane as if it is going to turn and join the roadway but does not enter the oncoming traffic lane.
16	TaxiPullOut	Taxi parked in the opposite parking lane pulling out into the roadway and joining oncoming traffic approximately 100 ft in

		front of the driver.
17	PullOutCar1	Parked car in the oncoming lane pulling out into oncoming traffic 8 seconds in front of the driver.
18	FakeCrosser	Three dimensional pedestrian in parking lane on the left waiting for a car to pass before walking onto oncoming lane towards driver and then walking around a parked car.
19	StreetCrosser	As driver approaches intersection for E105: Left Turn, a pedestrian walks across the perpendicular street from the far corner on the right toward the driver in the crosswalk.

4 MOTION PRE-POSITIONS AND WASHOUTS

Each scenario specifies pre-position points for the motion base. Whenever one is encountered, the motion slowly ramps to the new position so that it is favorably positioned for an upcoming event. Similarly, the washout parameters are dynamically changed from one set to another when requested by the scenario. There is a washout set for turns, one for highways, and another for curves.

The three figures that follow have each pre-position and washout trigger called out on the figure. The pre-position call-out consists of three position numbers corresponding to X, Y, and turntable angle respectively. The washout call-outs will show the text 'Turn','Hwy', or 'Curve' to denote which washout file is loaded at that point.

Finally, each scenario has an initial position that controls where the simulator motion base starts at the beginning of the scenario. These positions are given in text boxes inset into each figure. The practice drive is based on scenario 1, and therefore the practice drive initial position is given in the Scenario 1 figure.

Preposition	Crossbeam X	Carriage Y	Turntable Angle
A	150 in	150 in	45 deg
B	0 in	0 in	45 deg
C	200 in	0 in	90 deg
D	200 in	0 in	90 deg
E	0 in	0 in	90 deg
F	250 in	0 in	90 deg
G	100 in	0 in	90 deg
H	100 in	0 in	90 deg

Table 7 - List of motion pre-position points with markers

Washout	Name
1	Turn.mda
2	Hwy.mda
3	Curve.mda

Table 8 - List of motion washout files with markers

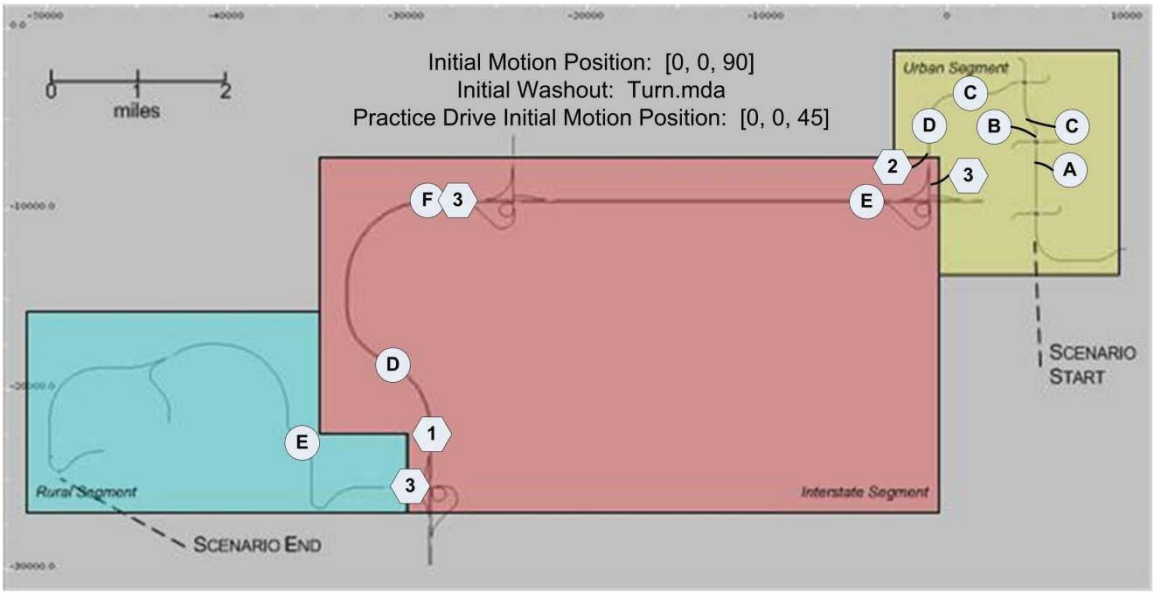


Figure 17 - Scenario 1 Pre-positions and Washouts

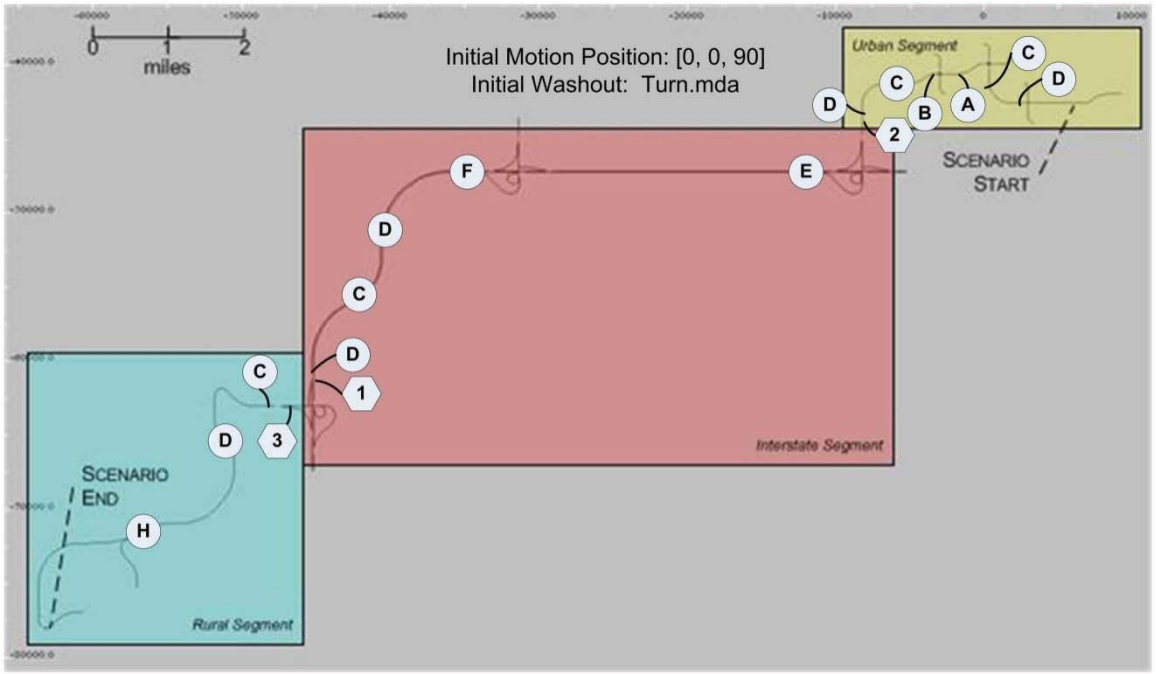


Figure 18 - Scenario 2 Pre-positions and Washouts

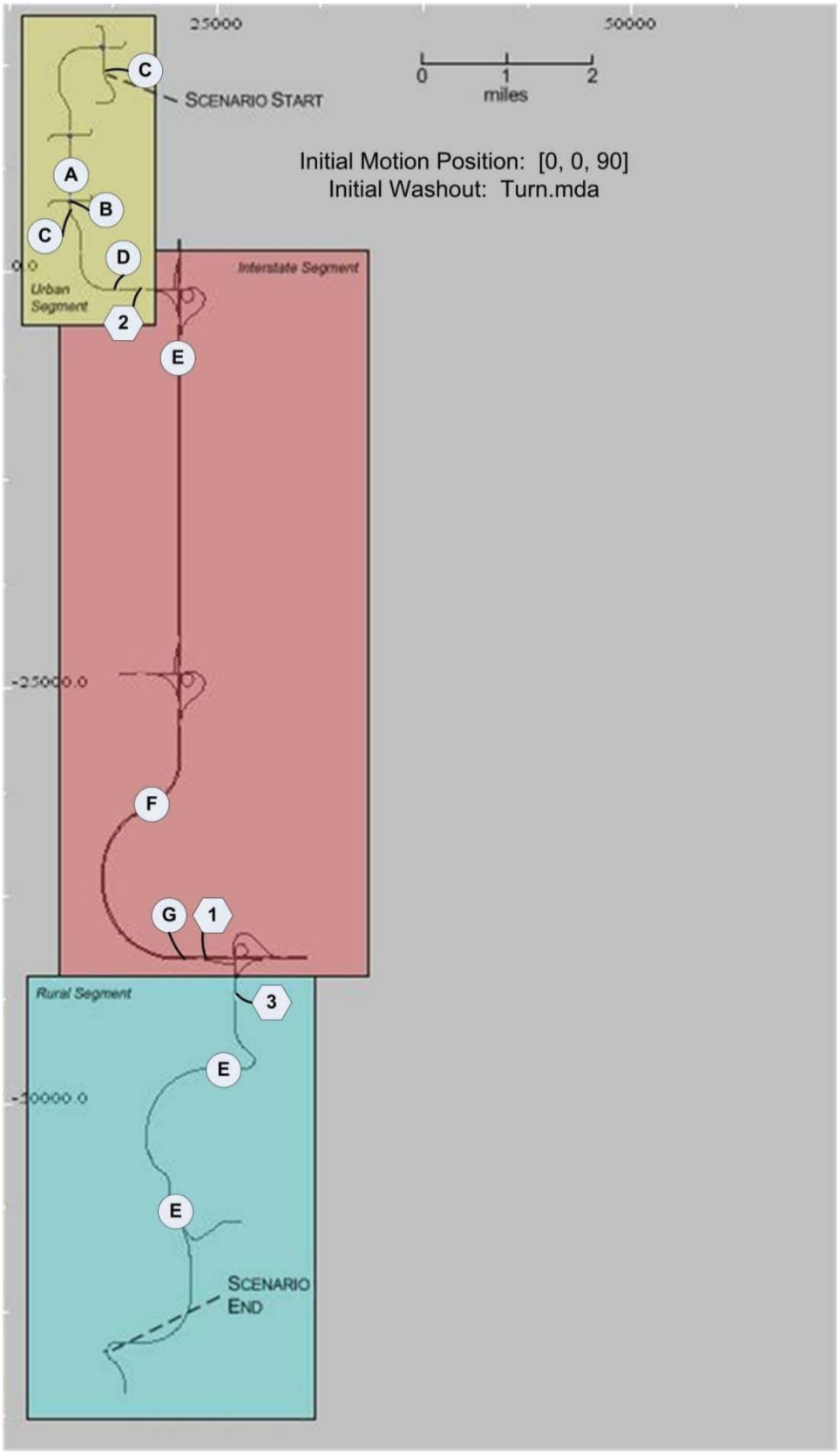


Figure 19 - Scenario 3 Pre-positions and Washouts

5 DATA REDUCTION ROUTINE

The data from the NADS is saved in DAQ files. When each of these files is written from temporary storage to long-term storage, a report is generated. This report contains the name and size of the DAQ file. Names of valid DAQ files are copied from the report and appended to an Excel spreadsheet. The first few rows of this Excel spreadsheet for Task 1 Pilot 3 are shown below. An "X" is placed in the Analyze column for the DAQ files that need to be reduced. Each time the reduction scripts are run, this Excel spreadsheet is read in and only the DAQ files specified in the Analyze column are reduced. If the eye data collected during the drives are too poor to be used for analysis, an "X" is placed in the Bad Eye column. When these DAQ files with poor eye data are reduced, a null value of 99 is given to any eye movement dependent measures. In addition, the spreadsheet contains the Run Name (which identifies the directory on the data storage server where the DAQ file is saved), the name of the DAQ file (timestamp when file was created), the date the data was collected (extracted from timestamp), the participant number, the name of the drive, the participant's age group (Y=young, M=middle, O=old), gender, and which combination of dose order and scenario order the participant was assigned to (18 possible combinations counterbalanced across age and gender).

Analyze	Ignore	Reduced	Eye (Place 'X' in column if eye data is bad)	Run Name	DAQ File	Date	Part Num	Drive	Age	Gender	Order
	X			P304YF01_1PRACT	20080919184353	09/19/2008	P304YF01	1PRACT	Y	F	01
X				P304YF01_1S1RNA	20080919185511	09/19/2008	P304YF01	1S1RNA	Y	F	01
	X			P303OM01_1PRACT	20080919193422	09/19/2008	P303OM01	1PRACT	O	M	01
X				P303OM01_1S1RNA	20080919194410	09/19/2008	P303OM01	1S1RNA	O	M	01
X				P303OM01_1S1RS5	20080919201433	09/19/2008	P303OM01	1S1RS5	O	M	01

DAQ files will be reduced as frequently as possible during main data collection (ideally, daily, but no less than three times a week).

MATLAB is used to perform the data reduction. During data reduction, each DAQ file indicated in the spreadsheet is individually opened and the required variables are read into the MATLAB workspace. Some raw values, e.g., lane deviation, need to be cleaned in order to calculate the specified dependent measures. Once the raw data is cleaned for the entire file, dependent measures are calculated for each of the scenario events.

6 DATA REDUCTION OUTPUT FILE LAYOUT

The data reduction procedure creates two output data files. The first file contains all of the dependent measures specified in Section 3, including scenario performance measures, measures of assumed driver behavior, and measures of alcohol impairment. Each row in this file contains the reduced data from one scenario event. Not all dependent measures are applicable to all events. Thus, this output file is very sparse with only a few columns containing values for a given event. Columns that are not applicable to a given event contain "NaN". A portion of this file is shown in Table 9.

The second file contains all of the dependent measures that are thought to be indicative of driver impairment due to alcohol. Each row in this file contains the reduced data from one experimental drive. Thus, each dependent measure is identified by the number of the scenario event they are associated with. For example, all dependent measures associated with the pullout event begin with "E101." Cells without data are left blank. A portion of this file is shown in Table 10.

Table 9 Data reduction output file sample – first 13 columns

Subject	RunName	Drive	Event	acc_avg	acc_end	acc_end_d	acc_end_t	acc_init	accel_release	accel_sd	accelerate	brake_press
001	20080528131249	1	E101	NaN	NaN	425.6597667	7.933333333	NaN	NaN	NaN	NaN	NaN
001	20080528131249	1	E102	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
001	20080528131249	1	E103	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0
001	20080528131249	1	E104	NaN	NaN	NaN	NaN	NaN	1	NaN	-1	0
001	20080528131249	1	E105	NaN	NaN	NaN	NaN	NaN	1	NaN	NaN	1
001	20080528131249	1	E106	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
001	20080528131249	1	E201	-1	NaN	NaN	NaN	NaN	0	NaN	NaN	0
001	20080528131249	1	E202	-1	NaN	NaN	NaN	NaN	0	-1	NaN	0
001	20080528131249	1	E203	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
001	20080528131249	1	E204	NaN	NaN	NaN	NaN	NaN	0	NaN	NaN	0
001	20080528131249	1	E205	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
001	20080528131249	1	E206	NaN	NaN	NaN	NaN	NaN	1	NaN	NaN	1
001	20080528131249	1	E301	NaN	-1	-1	NaN	-1	NaN	NaN	NaN	NaN
001	20080528131249	1	E302	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
001	20080528131249	1	E303	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
001	20080528131249	1	E304	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
001	20080528131249	1	E305	NaN	NaN	NaN	NaN	NaN	0	NaN	NaN	0
001	20080528131249	1	E306	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
001	20080528131249	1	E307	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

Table 10 Sample of second data reduction output file – first 12 columns

Subject	Drive	E101_head_turn	E101_side_mirror	E101_rear_mirror	E101_last_glance	E101_gap	E101_collision	E101_collision_obj	E101_turn_signal	E102_done_acc	E102_done_acc_t
1	1	-2	-2	-2	-2	-1	-1	-1	-1	0	-2.8
1	2	-2	-2	-2	-2	-1	-1	-1	-1	0	-2.8
1	3	-2	-2	-2	-2	-1	-1	-1	-1	0	-2.8
2	1	-2	-2	-2	-2	-1	-1	-1	-1	0	-2.8
2	2	-2	-2	-2	-2	-1	-1	-1	-1	0	-2.8
2	3	-2	-2	-2	-2	-1	-1	-1	-1	0	-2.8

7 APPENDIX

7.1 Changes to Scenarios

On March 6, 2008, it was decided that the scenario needed to be shortened from its current length of 30 minutes. After taking into account the number of simulator hours budgeted (210) and the number of participants (108), the scenarios were shortened to 24 minutes. The following modifications were made:

- Eliminate two-way stop event from the urban segment
- Increase speed limit on interstate from 65 mph to 70 mph
- Decrease the dark rural event from 3.5 minutes to 2 minutes of driving
- Decrease the gravel rural event from 3 minutes to 1.5 minutes of driving

The original and modified road networks are presented in Figure 20.

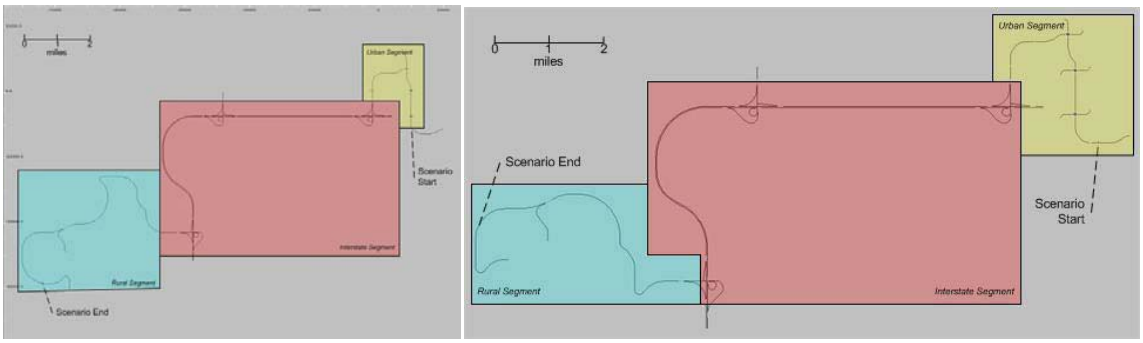


Figure 20 Old road network (left) and modified road network (right)

APPENDIX C: RECRUITMENT MATERIALS

Advertisement Wording

Main Study

Adults ages 21-34, 38-51, and 55-68 are invited to participate in a driving simulation study to determine how various levels of blood alcohol concentration impacts driving performance. Must be a moderate to heavy drinker. 4 visits total. (3 visits after 4pm, approximately 6 hours each in length). Drug and pregnancy screen completed at each visit. Must live within a 30 minute drive of UI Oakdale Campus. You will be paid for your time and effort. For more information, call 319-335-4719 or www.drivingstudies.com

Adults 55-68 are invited to participate in a driving simulation study to determine how various levels of blood alcohol concentration impacts driving performance. Must be a moderate to heavy drinker. 4 visits total. (3 visits after 4pm, approximately 6 hours each in length). Drug and pregnancy screen completed at each visit. Must live within a 30 minute drive of UI Oakdale Campus. You will be paid for your time and effort. For more information, call 319-335-4719 or www.drivingstudies.com

Adults 38-51 are invited to participate in a driving simulation study to determine how various levels of blood alcohol concentration impacts driving performance. Must be a moderate to heavy drinker. 4 visits total. (3 visits after 4pm, approximately 6 hours each in length). Drug and pregnancy screen completed at each visit. Must live within a 30 minute drive of UI Oakdale Campus. You will be paid for your time and effort. For more information, call 319-335-4719 or www.drivingstudies.com

Women 55-68 are invited to participate in a driving simulation study to determine how various levels of blood alcohol concentration impacts driving performance. Must be a moderate to heavy drinker. 4 visits total. (3 visits after 4pm, approximately 6 hours each in length). Drug and pregnancy screen completed at each visit. Must live within a 30 minute drive of UI Oakdale Campus. You will be paid for your time and effort. For more information, call 319-335-4719 or www.drivingstudies.com

Women 38-51 are invited to participate in a driving simulation study to determine how various levels of blood alcohol concentration impacts driving performance. Must be a moderate to heavy drinker. 4 visits total. (3 visits after 4pm, approximately 6 hours each in length). Drug and pregnancy screen completed at each visit. Must live within a 30 minute drive of UI Oakdale Campus. You will be paid for your time and effort. For more information, call 319-335-4719 or www.drivingstudies.com

Email Script

Email

The National Advanced Driving Simulator at The University of Iowa Oakdale Campus is inviting adults to participate in a driving simulation study to determine how varies levels of blood alcohol concentration impacts driving performance.

Who can be part of this study?

- Adults ages 21-34, 38-51 and 55-68
- Live within 30 minute drive to the University of Iowa Oakdale Campus
- You are a moderate to heavy drinker of alcoholic beverages
- Able to attend 4 study visits, (3 visits take place after 4pm approximately 6 hours each in length
- Drug and pregnancy screen completed at each visit

If you meet the above criteria and are interested in participating, please visit:

www.drivingstudies.com

Email: recruit@nads-sc.uiowa.edu

Call: 319-335-4719

If you do participate in the study, you will be paid for your time and effort.

Even if you don't qualify to participate in this study, please forward this message to anyone you know who does!

Newspaper Ad

Adults ages 21-34, 38-51, and 55-68 are invited to participate in a driving simulation study to determine how various levels of blood alcohol concentration impacts driving performance. Must be moderate to heavy drinker. Four visits total, (3 visits after 4pm, approximately 6 hours each in length). Drug and pregnancy screen completed at each visit. Must live within 30 minute drive of UI Oakdale campus. You will be paid for your time and effort.

For more information:
319 335 4719

www.drivingstudies.com

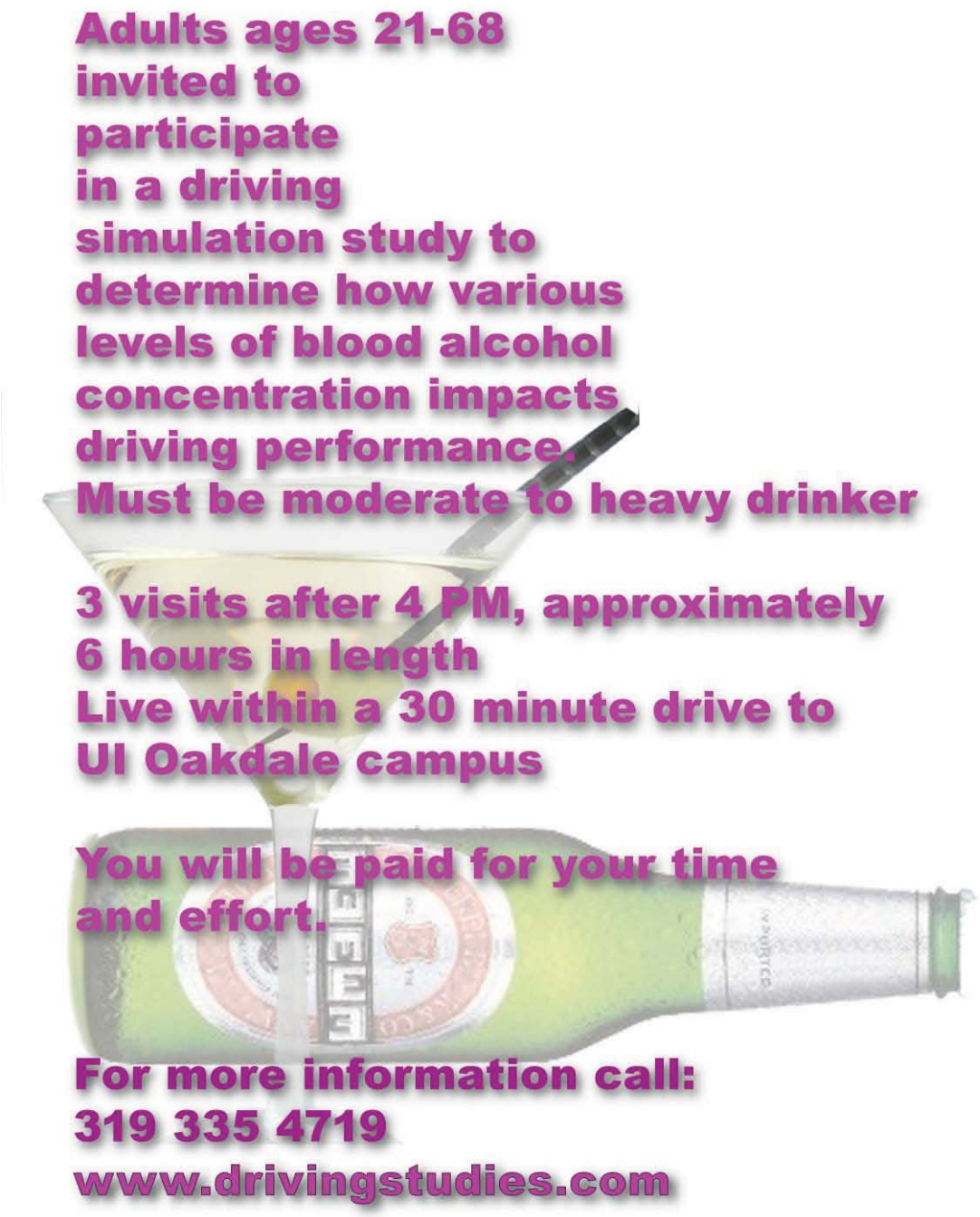
Website Script

Website script:

Main Study

Adults ages 21-34, 38-51, or 55-68 are invited to participate in a driving simulation study to determine how various levels of blood alcohol concentration impacts driving performance. Must be a moderate to heavy drinker. Four visits, (3 visits will take place after 4pm approximately 6 hours each in length). Must live within a 30 minute drive of UI Oakdale Campus. Drug and pregnancy screen completed at each visit. You will be paid for your time and effort. For more information, call 319-335-4719 or www.drivingstudies.com

Flyer


Adults ages 21-68
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levels of blood alcohol
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Must be moderate to heavy drinker
3 visits after 4 PM, approximately
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Live within a 30 minute drive to
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You will be paid for your time
and effort.
For more information call:
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www.drivingstudies.com

APPENDIX D: SCREENING PROCEDURES

Overview of Study

The purpose of this research study is to determine how varying levels of blood alcohol concentration (BAC) impacts driving performance. In order to research how BAC impacts driving performance, we will be asking you to drink alcoholic beverages on three separate visits within a controlled environment before driving in the simulator. Each visit will require you to drink enough alcohol to produce either a BAC of 0.00%, 0.05% or 0.10%.

This study involves 4 study visits, the first visit will be a screening appointment which will last approximately 1 ½ hours in length and will determine if you are eligible to be in the study. If you are eligible, the next 3 visits (dosing visits) will be conducted over a 3 week period of time, one study visit per week. These visits could last approximately 6 hours in length and will begin after 4 pm or later.

If you do enroll into the study, arrangements will be made for your transportation to and from your residence to the National Advanced Driving Simulator for the three dosing study visits as you will not be allowed to drive or be driven to your study visits.

We will ask you to not eat for 4 hours before your dosing visits, not drink alcoholic beverages within 24 hours of these study visits, not drink caffeine 30 minutes prior to your visit, and to refrain from using recreational drugs 30 days of your scheduled visits. Additionally, we will be conducting urine drug screens at each visit and for females; a urine pregnancy test will be completed for each study visit.

If you meet phone screening qualifications your study appointments will be arranged at the end of this conversation.

DETAILS OF STUDY VISITS

If you meet study criteria and are interested in participating in this study this is what will happen during the study visits.

Screening Visit (1): The first visit, staff will review the informed consent document with you and answer any questions you may have about the study, and then obtain your written consent. You will receive a copy of the informed consent document.

Then you will be asked to provide a urine sample and a urine drug screen will be performed.
FEMALES – your urine sample will additionally be screened for pregnancy.
Next you will sit quietly for 5 minutes followed by staff obtaining your blood pressure and heart rate.

If your drug screen test is positive, your blood pressure and/or heart rate doesn't meet study criteria (FEMALES- your urine screen test positive for pregnancy) your participation in the study will end. Results from these tests will remain confidential and eligibility will be documented as either YES or NO, no additional information will be recorded. If your participation is ended, you will be paid for your time and effort.

If you continue to meet study criteria, you will then complete a breath alcohol test, and fill out a questionnaire about the quantity and frequency you drink wine, beer, and liquor/spirits.

If you continue to meet study criteria, you will then complete questionnaires about your sleep patterns in the last 24 hours, your food intake within the last 4 hours, a questionnaire about your driving record, driving behavior, driving history, and drinking history, and asked to watch an overview presentation of the

simulator cab, following which staff will train you on an in-vehicle task involving changing CD tracks. Before you enter the simulator, staff will measure and record your height and weight.

Then you will complete a 5 to 8 minute practice drive in the simulator followed by a questionnaire after which you will be escorted back to the waiting room and staff will confirm your next 3 study visit dates and time.

Dosing Visits (2, 3 and 4):

You will be asked to provide a urine sample and a urine drug screen will be performed.
FEMALES – your urine sample will additionally be screened for pregnancy.
Next you will sit quietly for 5 minutes followed by staff obtaining your blood pressure and heart rate.

If your drug screen test is positive, your blood pressure and/or heart rate doesn't meet study criteria (FEMALES- your urine screen test positive for pregnancy) your participation in the study will end. Results from these tests will remain confidential and eligibility will be documented as either YES or NO, no additional information will be recorded. If your participation is ended, you will be paid for your time and effort.

If you continue to meet study criteria, you will then complete a breath alcohol test. You will then be served 3 equal sized alcoholic drinks over a period of 30 minutes. Staff will instruct and monitor you during the drinking period. Twenty minutes after you complete your last drink, staff will administer breath alcohol tests using a breath analyzer to determine your BAC until a targeted BAC is reached.

You will be asked to fill out a questionnaire about your current sleepiness level before and after your simulator drive. Before you enter the simulator, temporary stickers will be applied to your face to facilitate our ability to track your eye movements while driving.

Then we will ask you drive approximately 30 minutes and this drive will consist of 3 segments which include urban, freeway, and rural roadways. Following the drive, staff will obtain a BAC measurement using a breath analyzer and ask you to fill out a questionnaire about how you currently feel. You will be escorted out of the simulator and a standardized field sobriety test will be conducted followed by a questionnaire about your experience in the simulator. Transportation will be arranged to take you home.

At the end of the last visit (Visit 4) you will be asked a series of questions about your experience while participating in the study and staff will finalize your payment voucher.

Compensation
If you complete all study visits and procedures you will be paid $250 for your time and effort.

If you withdraw from the study or your participation ends your compensation will be pro-rated:
Visit 1 $10
Visit 2 $70
Visit 3 $80
Visit 4 $90

If you fail to meet study criteria you will be paid only $15 for the visit.

If interested, proceed to Inclusion Criteria Questions.

Inclusion Criteria ~ General Questions

Overview

Before this list of questions is administered, please communicate the following:

There are several criteria that must be met for participation in this study. I will need to ask you several questions to determine your eligibility.

If a subject fails to meet one of the following criteria, **(answers must be YES),** proceed to Closing.

1) **Do you possess a valid U.S. Drivers' License and have been a licensed driver for two years?**

2) **Are the ONLY restrictions on your driver's license limited to vision correction?**
   -vision restriction acceptable if vision is corrected to 20/20 with lenses

3) **Do you drive at least 10,000 miles per year?**

4) **You do not need to use any special equipment to help you drive such as pedal extensions, hand brake or throttle, spinner wheel knobs or other non-standard equipment? (no mechanical aid or use of prosthetic aid)**

5) **Are you between the ages: 21-34, 38-51, or 55-68**

6) **Do you live within a 30 minute drive time to The National Advanced Driving Simulator, located at Oakdale Campus?**

7) **Must be able to come to study visits after 4 pm or later? (Pilot 2,3 and Main only)**

General Inclusion Criteria is met – Administer Phone Screening Quantity-Frequency-Variability (QFV) Questionnaire

Because we are conducting a study to determine how varies levels of blood alcohol concentration impact driving performance, the following questions ask you about the quantity, frequency, and regularity of alcohol you consume. Your answers will determine if you continue to meet the study qualifications.

Administer Phone Screening Quantity-Frequency-Variability (QFV) Questionnaire

- If all Inclusion Criteria are met, proceed to General Health Exclusion
- If subject doesn't meet criteria, proceed to Closing

General Health Exclusion Criteria

7.1.1 Overview

7.1.2 Before administering this list of questions, please communicate the following:

- Because of pre-existing health conditions, some people are not eligible for participation in this study.
- I need to ask you several health-related questions before you can be scheduled for a study session.
- **Your responses are voluntary and all answers are confidential.**
- You can refuse to answer any questions and only a record of your motion sickness susceptibility will be kept as part of this study.
- No other responses will be kept.

  - If a participant fails to meet one of the following criteria, proceed to the Closing (If unsure about exclusion criteria, consult Principal Investigator)

1) If the subject is female:

- **Are you, or is there any possibility that you are pregnant?**

Exclusion criteria:

- If there is ANY possibility of pregnancy

2) Have you been diagnosed with a serious illness?

- If YES, is the condition still active?
- Are there any lingering effects?
- If YES, do you care to describe?

Exclusion criteria:

- Cancer (receiving any radiation and/or chemotherapy treatment within last 6 months)
- Crohn's disease
- Hodgkin's disease
- Currently receiving any radiation and/or chemotherapy treatment

3) Do you have Diabetes?

- Have you been diagnosed with hypoglycemia?
- If yes, do you take insulin or any other medication for blood sugar?

NOTE: Type II Diabetes accepted if controlled (medicated and under the supervision of physician)

Exclusion criteria:

- Type I Diabetes - insulin dependent
- Type II – **Uncontrolled** (see above)

4) Do you suffer from a heart condition such as disturbance of the heart rhythm or have you had a heart attack or a pacemaker implanted within the last 6 months?

- If YES, please describe?

Exclusion criteria:

- History of ventricular flutter or fibrillation
- Systole requiring cardio version (atrial fibrillation may be acceptable if heart rhythm is stable following medical treatment or pacemaker implants)

5) Have you ever suffered brain damage from a stroke, tumor, head injury, or infection?

- If YES, what are the resulting effects?
- Do you have an active tumor?
- Any visual loss, blurring or double vision?
- Any weakness, numbness, or funny feelings in the arms, legs or face?
- Any trouble swallowing or slurred speech?
- Any uncoordination or loss of control?
- Any trouble walking, thinking, remembering, talking, or understanding?

Exclusion criteria:

- A stroke within the past 6 months
- An active tumor
- Any symptoms still exist

6) Have you ever been diagnosed with seizures or epilepsy?

- If YES, how frequently and what type?

Exclusion criteria:

- A seizure within the past 12 months

7) Do you have Ménière's Disease or any inner ear, dizziness, vertigo, hearing, or balance problems?

- Wear hearing aides - full correction with hearing aides acceptable
- If YES, please describe.
- **Ménière's Disease** is a problem in the inner ear that affects hearing and balance. Symptoms can be low- pitched roaring in the ear (tinnitus), hearing loss, which may be permanent or temporary, and vertigo.
- **Vertigo** is a feeling that you or your surroundings are moving when there is no actual movement, described as a feeling of spinning or whirling and can be sensations of falling or tilting. It may be difficult to walk or stand and you may lose your balance and fall.

Exclusion criteria:

- Meniere's Disease
- Any recent history of inner ear, dizziness, vertigo, or balance problems

8) Do you currently have a sleep disorder such as sleep apnea, narcolepsy or Chronic Fatigue Syndrome?

- If YES, please describe.
- Sleep apnea: how long under treatment and was treatment successful

Exclusion criteria:

- Untreated sleep apnea
- Narcolepsy
- Chronic Fatigue Syndrome

9) Do you have migraine or tension headaches that require you to take medication daily?

- If YES, please describe.

Exclusion criteria:

- Any narcotic medications

10) Do you currently have untreated depression, anxiety disorder, ADHD or claustrophia?

- If YES, please describe.

Exclusion criteria:

- Untreated depression
- Agoraphobia, hyperventilation, or anxiety attacks
- ADHD (treated and untreated)

11) Are you currently taking any prescription or over the counter medications?

- If YES, what is the medication?
- Check PDR for possible interaction with alcohol
-
- **Are there any warning labels on your medications? Warning about using medication with alcohol or Warning about drowsiness**
- Ask potential subject to check with his/her physician that use of their medication is acceptable while drinking alcoholic beverages.
- Over the counter medications – ask potential subject to not use medication for 48 hours prior to visit if discontinued use does not compromise them medically and is acceptable to them to not use prior to visit

Exclusion criteria:

- Any sedating medications or drowsiness label on medication
- Drugs that interact with alcohol
- Subject's physician objects to use of medication while drinking alcoholic beverages
- Warning on label about use of medication with alcohol
- Unable to discontinue use of over the counter medication

12) Do you experience any kind of motion sickness?

- If YES, what were the conditions you experienced: when occurred (age), what mode of transportation, (boat, plane, train, car), and what was the intensity of your motion sickness?
- On a scale of 0 to 10**, how often** do you experience motion sickness with **0 = Never and 10 = Always**
- On a scale of 0 to 10, **how severe** are the symptoms when you experience motion sickness with **0 = Minimal and 10 = Incapacitated**

Exclusion criteria:

- One single mode of transportation where intensity is high and present
- More than 2 to 3 episodes for mode of transportation where intensity is moderate or above
- Severity and susceptibility scores rank high

If qualify:

Make appointment for all three study visits.
Provide a pick-up time.
Have subject bring their driver's license with them to their first appointment.
Remind subjects to not drink alcoholic beverages for 24 hours prior, refrain from caffeine 30 minutes before all study visits, not eat 4 hours prior to study visit time and refrain from using recreational drugs within 30 days of your scheduled visits.

APPENDIX E: AUDIT SURVEY AND CRITERIA

Study: _____
Subject: _____
Date: _____

IMPACT AUDIT Survey

1. How often do you have a drink containing alcohol?

NEVER	MONTHLY OR LESS	TWO TO FOUR TIMES A MONTH	TWO OR THREE TIMES A WEEK	FOUR OR MORE TIMES A WEEK
○	○	○	○	○

NOTE: For answering these questions, one "drink" is equal to 12 ounces of beer, or 5 ounces of wine, or 1 ounce of liquor.

2. How many drinks containing alcohol do you have on a typical day when you are drinking?

○ 1 OR 2 ○ 2 TO 4 ○ 5 OR 6 ○ 7 TO 9 ○ 10 OR MORE

3. How often do you have six or more drinks on one occasion?

○ NEVER ○ LESS THAN MONTHLY ○ MONTHLY ○ WEEKLY ○ DAILY OR ALMOST DAILY

4. How often during the last year have you found that you were not able to stop drinking once you had started?

○ NEVER ○ LESS THAN MONTHLY ○ MONTHLY ○ WEEKLY ○ DAILY OR ALMOST DAILY

5. How often during the last year have you failed to do what was normally expected from you because of drinking?

○ NEVER ○ LESS THAN MONTHLY ○ MONTHLY ○ WEEKLY ○ DAILY OR ALMOST DAILY

6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?

○ NEVER ○ LESS THAN MONTHLY ○ MONTHLY ○ WEEKLY ○ DAILY OR ALMOST DAILY

7. How often during the last year have you had a feeling of guilt or remorse after drinking?

○ NEVER ○ LESS THAN MONTHLY ○ MONTHLY ○ WEEKLY ○ DAILY OR ALMOST DAILY

8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?

○ NEVER ○ LESS THAN MONTHLY ○ MONTHLY ○ WEEKLY ○ DAILY OR ALMOST DAILY

9. Have you or someone else been injured as a result of your drinking?

○ NEVER ○ YES, BUT NOT IN THE LAST YEAR ○ YES, DURING THE LAST YEAR

10. Has a relative or friend, or a doctor or other health worker been concerned about your drinking or suggested you cut down?

○ NEVER ○ YES, BUT NOT IN THE LAST YEAR ○ YES, DURING THE LAST YEAR

Subjects will be excluded if their responses meet the following criteria.

If a subject provides an answer to **AT LEAST ONE** of the criteria for either Question 4 or 6

AND if they provide one of the listed answers to **TWO or MORE** of the criteria listed in Questions 5, 7, 8, 9, or 10 they will be excluded from the study.

4) How often during the last year have you found that you were not able to stop drinking once you had started?

if subject response is at least one of these:

- Monthly
- Weekly
- Daily or almost daily

6) How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?

- Monthly
- Weekly
- Daily or almost daily

5) How often during the last year have you failed to do what was normally expected from you because of drinking?

- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

7) How often during the last year have you had a feeling of guilt or remorse after drinking?

- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

8) How often during the last year have you been unable to remember what happened the night before because you had been drinking?

- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

9) Have you or someone else been injured as a result of your drinking?

- Yes, during the last year

10) Has a relative or friend, or a doctor or other health worker been concerned about your drinking or suggested you cut down?

- Yes, during the last year

APPENDIX F: EXPERIMENTAL PROCEDURES FOR IMPACT MAIN STUDY

The flow of the study is presented below.

Phone Screening

- Complete the telephone screening as outlined in **Screening Procedures**.
- Complete **Phone QFV**.

Screening (Visit 1)

- Upon arriving at NADS, verify that participant has a valid driver's license.
- Review elements of informed consent either verbally, encouraging participant to ask questions.
- Have participant sign and date **Informed Consent Document. (Visit 1 Only)**
- Have participant sign and date **Video Release Statement (Visit 1 Only)**
- Have the participant fill out the **Payment Voucher**. **(Visit 1 Only)**
- Escort participant to restroom so that urine sample can be collected.
- Participant asked to rest for 5 minutes. Urine drug screen and pregnancy test performed on urine sample performed during this time.
- Take participant's blood pressure and heart rate
- If drug and (females pregnancy screen), blood pressure or heart rate does not meet study requirements, participant will be taken home. If passed, participant will complete a **Breath alcohol test**.
- Have participant fill out **QFV.**
- Have participant fill out **AUDIT SURVEY**.
- If participant remains eligible, continue with IMPACT Driving Survey. If not, participant is released to go home
- Have participant fill out **IMPACT Driving Survey. (Visit 1 Only)**
- Measure and record Height and Weight of participant
- Watch training video.
- Put eye tracking stickers on before escorting to simulator.

Driving (Visit 1 Only)

- Introduce in-vehicle experimenter, who takes over at this point.
- Escort participant to the vehicle and allow him/her to be seated.
- Ask the participant if he/she has any questions.
- Calibrate Eye Tracker.
- Brief the participant on the practice drive and ask if there are any questions.
- After completing practice drive, advise participant to shift into PARK.

End of Driving (Visit 1 Only)

- After the practice drive is complete and the participant has shifted into PARK, administer the **Wellness Survey**.
- When the simulator has docked, escort the participant to the participant prep area and make sure that prep area experimenter knows he/she is there. The prep area experimenter will confirm date and time of participant's next three study visits.

Alcohol Dosing (Visit 2-4)

- Arrangements made to pick up participant at home.
- Escort participant to restroom so that urine sample can be collected.
- Participant asked to rest for 5 minutes. Urine drug screen and pregnancy test performed on urine sample performed during this time.
- Take participant's blood pressure and heart rate
- If drug and (females pregnancy screen), blood pressure or heart rate does not meet study requirements, participant will be taken home. If passed, participant will complete a **Breath alcohol test**.
- If participant remains eligible, have participant fill out Sleep/ Food Intake Survey. If not, take home.
- Administer 1st drink and allow participant 10 minutes to drink, instructing participant to pace self to drink for entire 10 minutes. Staff stays in room to monitor.
- Administer 2nd drink and allow participant 10 minutes to drink, instructing participant to pace self to drink for entire 10 minutes , instructing participant to pace self to drink for entire 10 minutes. Staff stays in room to monitor.
- Administer 3rd drink and allow participant 10 minutes to drink, instructing participant to pace self to drink for entire 10 minutes. Staff stays in room to monitor.
- Wait 16 minutes after the end of the last drink.
- Take a BAC measurement with Breathalyzer every 2-5 minutes until peak BAC of +/- 0. 005% is reached.
- When peak BAC is reached, participant is ready for simulator.

Driving (Visit 2-4)

- Introduce in-vehicle experimenter, who takes over at this point.
- Escort participant to the vehicle and allow him/her to be seated.
- Ask the participant if he/she has any questions.
- Calibrate Eye Tracker.
- Brief the participant on the study drive and ask if there are any questions.
- Administer **Stanford Sleepiness Scale**.
- DriveAfter completing study drive, advise participant to shift into PARK.

End of Driving (Visit 2-4)

- After the study drive is complete and the participant has shifted into PARK, take a BAC Measurement
- Administer the **Stanford Sleepiness Scale and Wellness Survey**.
- When the simulator has docked, escort the participant to the participant prep area and make sure that prep area experimenter knows he/she is there. The prep area experimenter takes over at this point.

Wrap-Up (Visit 2-4)

- Offer participant snack/beverage.
- Ask if participant has any questions.
- Allow participant to complete **Wellness Survey** if not finished in vehicle.
- Administer **Standardized Field Sobriety Test**.
- Administer **Realism Survey**.
- Administer **IMPACT Debrief Statement. (Visit 4 only)**
- Administer **IMPACT Debrief Interview. (Visit 4 only)**
- Participant waits comfortably at NADS facility until BAC level is less than .03.
- Arrange transportation for participant to go home

Assignment to Treatment

Table F-1 BAC sequence and event sequence across participants

		Age					
		21-34		38-51		55-68	
		Gender		Gender		Gender	
BAC Sequence	Event Sequence	Male	Female	Male	Female	Male	Female
1	1	2	2	2	2	2	2
1	2	2	2	2	2	2	2
1	3	2	2	2	2	2	2
2	1	2	2	2	2	2	2
2	2	2	2	2	2	2	2
2	3	2	2	2	2	2	2
3	1	2	2	2	2	2	2
3	2	2	2	2	2	2	2
3	3	2	2	2	2	2	2
Total		18	18	18	18	18	18

Note. BAC sequence 1 = 0.10%, 0.05%, 0.00%, 2 = 0.05%, 0.00%, 0.10%, 3 = 0.00%, 0.10%, 0.05%. Total participants must add to multiples of 54. Current number of participants = 108.

APPENDIX G: IN-CAB PROTOCOL

IMPACT MainP1 in-cab protocol (Auto Eye Tracking)

CAB ORIENTATION
[Participant has already viewed an introductory PPT about the study and the Malibu adjustments.]
[open car door] **(RAS): Please be seated and make the adjustments so you are in a comfortable driving position. If you need any help, please let me know.** *[Show mirror control panel but remind to adjust after eye tracking pix]*
[RAS enters back seat at this time] [Resting position reminder]
(RAS): We are going to set the cameras for eye tracking so please look straight ahead at this time.
[Control room should cue that ET is working.]
[after Auto ET is done, during start up of sim, play file] **Sim Start: The simulator is moving towards its start position. During this time, you may hear rumbling and feel vibrations. This is perfectly normal. There are microphones in the cab so the Simulator Operator can hear you at all times. If, for any reason, you wish to stop driving, please let us know. The Operator can bring you to a stop in just a few seconds.**
[Practice drive is only on first visit. If other than 1st visit, go directly to Main Drive.]

PRACTICE DRIVE *[First time visit only]*
(play file) **Practice Drive: Your first drive will be a practice drive. It is designed to help you get used to the simulator. During this drive you should become familiar with driving at the various posted speed limits and recognizing traffic control devices. When it is time to begin, instructions will tell you to merge into traffic. Onboard navigational instructions will provide directions to the interstate and instruct you when to adjust the CD player. A recording will tell you when it is time to stop. Do you have any questions?**
[At End, pre-recorded stop instructions will play]
[Seatbelt reminder]
[Administer first SSQ] [Exit Simulator]
.. .. Control room
.. .. RAS
.. .. Surveys
[Go to Main Drive]

MAIN DRIVE
[First visit]
(RAS): *[1st visit]* **Please look straight ahead so they can check the Eye Tracking.**
[Go to SIM START]
[Return Visit]
[open car door]
(RAS): Please be seated and make the adjustments so you are in a comfortable driving position. If you need any help, please let me know. *[Show mirror control panel but remind to adjust after eye tracking pix]*
[RAS enters back seat at this time] [Resting position reminder]
(RAS): We are going to set the cameras for eye tracking so please look straight ahead at this time.
[Control room should cue that ET is working.]
[SIM START]
[after Auto ET is done, during start up of sim, play file] **Sim Start: The simulator is moving towards its start position. During this time, you may hear rumbling and feel vibrations. This is perfectly normal. There are microphones in the cab so the Simulator Operator can hear you at all times. If, for any reason, you wish to stop driving, please let us know. The Operator can bring you to a stop in just a few seconds.**
[Sleep Scale before Main Drive]
[RAS: cue driver to upcoming drive instructions]

(play file): **MAIN: The Main drive will start shortly. Remember to listen to the on-board instructions carefully. If you have any uncertainty about navigating during the drive, please ask. Do you have any questions at this time?**
[If No...] **(RAS) Are you ready?** *[if YES, Operator cues going to RUN]* **(RAS)Standby for scenery and instructions.**
[RAS stays quiet but can give concise directions if asked, intervene for well being and study continuity or provide segue during restarts]
[RAS works with Operator to identify correct restart if needed]
END MAIN DRIVE
[Seatbelt fastened reminder. [Administer SSQ and Sleep Scale] *[Exit Simulator]*

APPENDIX H: CONTROL ROOM LOGS

Visit 2

Participant: 1 **Date:_____**

Time In: _____ **Run Name: _____**

Eye Tracker Notes:

EVENT	EVENT	COMMENTS
Pull Out	☐ Okay ☐ Problem	
Urban Drive	☐ Okay ☐ Problem	
Green Light	☐ Okay ☐ Problem	
Yellow Light Dilemma	☐ Okay ☐ Problem	
Left Turn	☐ Okay ☐ Problem	
Urban Curves	☐ Okay ☐ Problem	
Turn On Ramp	☐ Okay ☐ Problem	
Merge On	☐ Okay ☐ Problem	
Distracted Interstate Drive	☐ Okay ☐ Problem	

Merging Traffic	☐ Okay ☐ Problem	
Interstate Curves	☐ Okay ☐ Problem	
Exit Ramp	☐ Okay ☐ Problem	
Turn Off Ramp	☐ Okay ☐ Problem	
Lighted Rural	☐ Okay ☐ Problem	
Transition To Dark Rural	☐ Okay ☐ Problem	
Dark Rural	☐ Okay ☐ Problem	
Gravel Transition	☐ Okay ☐ Problem	
Gravel Rural	☐ Okay ☐ Problem	
Driveway	☐ Okay ☐ Problem	

Time Out: _____

Visit 3

Participant: 1 **Date: _____**

Time In: _____ **Run Name: _____**

Eye Tracker Notes:

EVENT	EVENT	COMMENTS
Pull Out	☐ Okay ☐ Problem	
Urban Drive	☐ Okay ☐ Problem	
Green Light	☐ Okay ☐ Problem	
Yellow Light Dilemma	☐ Okay ☐ Problem	
Left Turn	☐ Okay ☐ Problem	
Urban Curves	☐ Okay ☐ Problem	
Turn On Ramp	☐ Okay ☐ Problem	
Merge On	☐ Okay ☐ Problem	
Distracted Interstate Drive	☐ Okay ☐ Problem	

Merging Traffic	☐ Okay ☐ Problem	
Interstate Curves	☐ Okay ☐ Problem	
Exit Ramp	☐ Okay ☐ Problem	
Turn Off Ramp	☐ Okay ☐ Problem	
Lighted Rural	☐ Okay ☐ Problem	
Transition To Dark Rural	☐ Okay ☐ Problem	
Dark Rural	☐ Okay ☐ Problem	
Gravel Transition	☐ Okay ☐ Problem	
Gravel Rural	☐ Okay ☐ Problem	
Driveway	☐ Okay ☐ Problem	

Time Out: _____

Visit 4

Participant: 1 **Date: _____**

Time In: _____ **Run Name: _____**

Eye Tracker Notes:

EVENT	EVENT	COMMENTS
Pull Out	☐ Okay ☐ Problem	
Urban Drive	☐ Okay ☐ Problem	
Green Light	☐ Okay ☐ Problem	
Yellow Light Dilemma	☐ Okay ☐ Problem	
Left Turn	☐ Okay ☐ Problem	
Urban Curves	☐ Okay ☐ Problem	
Turn On Ramp	☐ Okay ☐ Problem	
Merge On	☐ Okay ☐ Problem	
Distracted Interstate Drive	☐ Okay ☐ Problem	

Merging Traffic	☐ Okay ☐ Problem	
Interstate Curves	☐ Okay ☐ Problem	
Exit Ramp	☐ Okay ☐ Problem	
Turn Off Ramp	☐ Okay ☐ Problem	
Lighted Rural	☐ Okay ☐ Problem	
Transition To Dark Rural	☐ Okay ☐ Problem	
Dark Rural	☐ Okay ☐ Problem	
Gravel Transition	☐ Okay ☐ Problem	
Gravel Rural	☐ Okay ☐ Problem	
Driveway	☐ Okay ☐ Problem	

Time Out: _____

APPENDIX I: INFORMED CONSENT DOCUMENT (MAIN IFC)

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APPROVED BY: IRB-01
IRB ID #: 200705757
APPROVAL DATE: 04/01/09
EXPIRATION DATE: 06/12/09

INFORMED CONSENT DOCUMENT

Project Title: **Advanced Vehicle-Based Countermeasures for Alcohol-Related Crashes**

Research Team: **John Lee, PHD, Timothy Brown, PHD, Jane Moeckli, PHD, Dawn Marshall, MS, Scott Egerton, BS, Michelle Reyes, BSE, Cheryl Roe, BS, Sue Ellen Salisbury, BS, Debbie Hofmann, RN, Catherine Mize, BS, Julie Ulland, BS, Lisa Maske, RN, Rachel Chamley, Benjamin Dow, BS, Daniel Dow, Will Hurd, Mindy Dow, BA, Tara Smyser, MS, Claude Laroche, BS, Jaclyn Iacovelli**

This consent form describes the research study to help you decide if you want to participate. This form provides important information about what you will be asked to do during the study, about the risks and benefits of the study, and about your rights as a research subject.

- If you have any questions about or do not understand something in this form, you should ask the research team for more information.
- You should discuss your participation with anyone you choose such as family or friends.
- Do not agree to participate in this study unless the research team has answered your questions and you decide that you want to be part of this study.

WHAT IS THE PURPOSE OF THIS STUDY?

This is a research study. We are inviting you to participate in this research study because you are between the ages of 21-34, 38-51, and 55-68, with a valid driver's license for at least two years, drive a minimum of 10,000 miles per year, in good health, are a moderate or heavy drinker, and live within a 40-mile radius of the National Advanced Driving Simulator.

The purpose of this research study is to determine how varying levels of blood alcohol concentration (BAC) impacts driving performance. In order to research how BAC impacts driving performance, you will be asked to drink alcoholic beverages on three separate visits within a controlled environment before driving in the simulator. Each visit will require you to drink enough alcohol to produce either a BAC of 0.00%, 0.05% or 0.10%.

HOW MANY PEOPLE WILL PARTICIPATE?

Approximately **170** people will take part in this study conducted by investigators at the University of Iowa.

HOW LONG WILL I BE IN THIS STUDY?

If you agree to take part in this study, your involvement will require four study visits, one screening visit, approximately 1 ½ hours in length and three dosing visits that will each be separated by one week. All three dosing visits must be the same time of day and will begin after -4pm and could last approximately 6 hours.

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APPROVAL DATE: 04/01/09
EXPIRATION DATE: 06/12/09

WHAT WILL HAPPEN DURING THIS STUDY?

Visit 1 (Screening Visit)

Upon arrival at NADS, study staff will verbally review this document with you, answer any questions you may have about the study, provide you time to read this document and then obtain your written consent. You will receive a copy of this signed Informed Consent Document.

Then you will be asked to provide a urine sample and a urine drug screen test will be performed. Female subjects' urine specimen will additionally be tested and screened to determine if they are pregnant. Then you will be asked to sit quietly and rest 5 minutes followed by staff obtaining your blood pressure and heart rate. Your participation in the study will end if your drug screen test is positive, your blood pressure and/or heart rate does not meet the study requirements, and if female, you test positive for pregnancy. Results from the drug screen, blood pressure, heart rate, and for females, pregnancy test will remain confidential and your eligibility status will be documented as either a yes or no. No other information will be recorded. If you meet study criteria, you will then be asked to complete a breath alcohol test followed by the completion of a questionnaire that ask you questions about the quantity and frequency you drink wine, beer, and alcoholic beverages and another questionnaire about your drinking habits. If you meet study criteria, you will ask to complete a questionnaire about your driving record, driving behavior, driving history and drinking history. If you fail to meet study criteria, you will be paid for your time and effort.. You will then be asked to watch an overview presentation of the simulator cab and staff will train you on an in-vehicle task involving changing CD tracks. Before you enter the simulator, staff will measure and record your height and weight.

Then you will then be escorted into the simulator, provided with an overview of the simulator cab and asked to drive a 5-8 minute practice drive in order for you to be comfortable with driving the simulator. After the practice drive, you will be asked to fill out a questionnaire about how you currently feel and then escorted back to the waiting room. Staff will confirm your next three study visits with you and you will be free to go.

Visits 2, 3 and 4 (Dosing Visits)

Arrangements will be made to transport you to the National Advanced Driving Simulator (NADS) via taxi or shuttle for your appointed time. You will be instructed to not eat within four hours of your appointed time and refrain from drinking any caffeine 30 minutes prior to your appointed time.

First staff will provide a brief overview of your study procedures for this visit. Then you will be asked to provide a urine sample and a urine drug screen test will be performed. Female subjects' urine specimen will additionally be tested and screened to determine if they are pregnant. Then you will be asked to sit quietly and rest 5 minutes followed by staff obtaining your blood pressure and heart rate. Your participation in the study will end if your drug screen test is positive, your blood pressure and/or heart rate does not meet the study requirements, and if female, you test positive for pregnancy. Results from the drug screen, blood pressure, heart rate, and for females, pregnancy test will remain confidential and your eligibility status will be documented as either a yes or no. No other information will be

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IRB ID #: 200705757
APPROVAL DATE: 04/01/09
EXPIRATION DATE: 06/12/09

recorded.

If you meet study criteria, you will then be asked to complete a breath alcohol test. If your participation is ended, you will be paid for your time and effort and transportation will be arranged to take you home. If you remain eligible, you will complete several a questionnaire about your sleep patterns and another about your food intake within the last 24 hours.

Your age, gender, height, weight, and drinking practices will be used to calculate the amount of alcohol you will be asked to drink prior to the main study drive. You will be served three equal sized alcoholic drinks over a drinking period of 30 minutes at 10-minute intervals and you will be instructed to pace each drink evenly over the entire 10 minutes. Staff will be monitoring you continually throughout the drinking period.

Sixteen minutes after completion of your third drink staff will administer breath alcohol tests using a breath analyzer at five-minute intervals to determine your Blood Alcohol Concentration (BAC) until a targeted BAC is reached. Prior to entering the simulator for the main drive, temporary stickers will be applied to your face to facilitate our ability to track your eye movements while you drive.

You will be escorted into the simulator, eye tracking procedures will be conducted and you will be asked to drive a 30 minute drive. Your drive will consist of 3 segments, each 10 minutes in length which includes urban, freeway, and rural roadways. You will be asked to complete a questionnaire about your current sleepiness level before and after the study drive.

Following the drive, a BAC measurement will be obtained using the breath analyzer, a standardized field sobriety test will be conducted and ask to complete a questionnaire about your experience in the simulator. You will be asked to wait until your BAC drops below 0.03%, at which time transportation will be arranged to take you home.

At the end of your fourth visit, you will be asked a series of questions about your experience while participating in the study and staff will finalize your payment voucher and transportation will be arranged to take you home.

Some of the questionnaires will ask about illegal behaviors such as driving while intoxicated. You may skip any questions that you do not wish to answer on the questionnaires. However, if you choose not to answer questions about the quantity and frequency of your current drinking habits, and/or not meet study criteria for this questionnaire, your participation may be ended in the study.

<u>All driving trials will be recorded on video.</u>

The simulator contains sensors that measure vehicle operation, vehicle motion, and your driving actions. The system also contains video cameras that capture images of you while driving (e.g., driver's hand position on the steering wheel, forward road scene). These sensors and video cameras are located in such a manner that they will not affect you or obstruct your view while driving. The information collected using these sensors and video cameras are recorded for analysis by research staff and may be used as described in the Confidentiality section below.

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IRB ID #: 200705757
APPROVAL DATE: 04/01/09
EXPIRATION DATE: 06/12/09

We will keep your name and information about you including birth date, contact phone numbers and the annual mileage you drive each year on file. In the future, we may contact you to see if you would be willing to complete questionnaires, interviews, or drives relating the data from this study to future studies. Agreeing to participate in this study does not obligate you to participate in future studies. You will be asked to give a separate consent for any future studies.

WHAT ARE THE RISKS OF THIS STUDY?

You may experience one or more of the risks indicated below from being in this study. In addition to these, there may be other unknown risks, or risks that we did not anticipate, associated with being in this study.

The amount of alcohol which you will drink during the study will be enough to produce a 0.11% BAC, and a single occasion of drinking to that level is not expected to produce serious or long term adverse effects. It is possible, however, that you may experience temporary nausea, dizziness, headache, and/or hangover. If you start to feel any of those symptoms, please notify study staff immediately. You and study staff can discuss whether it is desirable for you to continue participating in the study. If you decide to stop participation, you will not lose any benefits to which you were previously entitled. Chronic or heavy alcohol use can have adverse health consequences and may lead to dependency.

Female participants should clearly understand that alcohol, even in small to moderate amount, may damage a fetus. All women who participate in the study will be required to provide urine for a pregnancy test. If you are pregnant, or if it is possible that you may be pregnant, do not enroll in this study. Pregnancy tests are not 100% accurate. It is possible, although not likely, that a pregnancy test taken at NADS may result in a false positive or a false negative.

The risk involving driving the simulator is possible discomfort associated with simulator disorientation. Previous studies with simulator driving intensities and simulator setups produced few disorientation effects. When effects were reported, they were usually mild to moderate and consisted of slight uneasiness, warmth, or eyestrain for a small number of participants. These effects typically last for only a short time, usually 10-15 minutes, after leaving the simulator. You may quit driving at any time if you experience any discomfort.

If you ask to quit driving as a result of discomfort, you will be allowed to quit at once. If you ask to quit driving due to discomfort, you will be escorted to a room, asked to sit and rest, and offered a beverage and snack. A trained staff member will determine if and when you will be allowed to leave. If you show few or no signs of discomfort, you will be transported home.

If you experience anything other than slight effects, a follow-up call will be made to you 24 hours later to ensure you're not feeling ill effects.

An experimenter will be in the back seat of the simulator cab to ensure your safety while you drive.

Risks associated with latex stickers can be dryness, itching, burning, scaling, and lesions of the skin.

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APPROVED BY: IRB-01
IRB ID #: 200705757
APPROVAL DATE: 04/01/09
EXPIRATION DATE: 06/12/09

Risks associated with temporary tattoos can be mild skin irritation during removal.

The questionnaires collect information about certain types of illegal activity such as alcohol and recreational/illegal drug usage. Data collected from questionnaires will remain confidential and can only be identified by a study assigned number

WHAT ARE THE BENEFITS OF THIS STUDY?

You will not benefit from being in this study.

However, we hope that, in the future, other people might benefit from this study because a better understanding of how alcohol impairs specific driving performance may allow the development of new technologies that could minimize alcohol related crashes in the future.

WILL IT COST ME ANYTHING TO BE IN THIS STUDY?

You will not have any **costs** for being in this research study.

WILL I BE PAID FOR PARTICIPATING?

You will be paid for being in this research study. You will need to provide your social security number (SSN) in order for us to pay you. You may choose to participate without being paid if you do not wish to provide your social security number (SSN) for this purpose. You may also need to provide your address if a check will be mailed to you. If your social security number is obtained for payment purposes only, it will not be retained for research purposes.

If you agree to participate in this study, you will be paid $250 if you complete all study visits and procedures.
If you withdraw or your participation ends, your compensation will be pro-rated as follows:

Visit 1 (Screening)	$10
Visit 2	$70
Visit 3	$80
Visit 4	$90
Total (complete all visits)	$250

In the event that you fail to meet the study criteria (drug screen, pregnancy screen, blood pressure and/or heart rate screen) you will be paid only $5 for the visit.

WHO IS FUNDING THIS STUDY?

The National Highway Traffic and Safety Administration (NHTSA) is the study sponsor and is funding this research study. This means that the University of Iowa is receiving payments from them to support

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APPROVED BY: IRB-01
IRB ID #: 200705757
APPROVAL DATE: 04/01/09
EXPIRATION DATE: 06/12/09

the activities that are required to conduct the study. No one on the research team will receive a direct payment or increase in salary from NHTSA for conducting this study.

WHAT IF I AM INJURED AS A RESULT OF THIS STUDY?

- If you are injured or become ill from taking part in this study, medical treatment is available at the University of Iowa Hospitals and Clinics.
- No compensation for treatment of research-related illness or injury is available from the University of Iowa unless it is proven to be the direct result of negligence by a University employee.
- If you experience a research-related illness or injury, you and/or your medical or hospital insurance carrier will be responsible for the cost of treatment.

WHAT ABOUT CONFIDENTIALITY?

We will keep your participation in this research study confidential to the extent described in this document and permitted by law. However, it is possible that other people such as those indicated below may become aware of your participation in this study and may inspect and copy records pertaining to this research. Some of these records could contain information that personally identifies you.

- federal government regulatory agencies,
- auditing departments of the University of Iowa, and
- the University of Iowa Institutional Review Board (a **co**mmittee that reviews and approves research studies)

You will be assigned a study number which will be used instead of your name to identify all data collected for the study. The list linking your study number and your name will be stored in a secure location and will be accessible only to the researchers at the University of Iowa. All records and data containing confidential information will be maintained in locked offices or on a secure password protected computer systems that are accessible to the researchers, the study sponsor, and its agents. It is possible that persons viewing the video data may be able to identify you. If we write a report or article about this study, we typically describe the study results in a summarized manner so that you cannot be identified by name.

The **engineering data** collected and recorded in this study (including any performance scores based on these data) will be analyzed along with data gathered from other participants. These data may be publicly released in final reports or other publications or media for scientific (e.g., professional society meetings), regulatory (e.g., to assist in regulating devices), educational (e.g., educational campaigns for members of the general public), outreach (e.g., nationally televised programs highlighting traffic safety issues), legislative (e.g., data provided to the U.S. Congress to assist with law-making activities), or research purposes (e.g., comparison analyses with data from other studies). Engineering data may also be released individually or in summary with that of other participants, but will not be presented publicly in a way that permits personal identification, except when presented in conjunction with video data.

The **video data** (video image data recorded during your drive) recorded in this study includes your video-recorded likeness and all in-vehicle audio including your voice (and may include, in some views, superimposed performance information). Video and in-vehicle sounds will be used to examine your

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IRB ID #: 200705757
APPROVAL DATE: 04/01/09
EXPIRATION DATE: 06/12/09

driving performance and other task performance while driving. Video image data (in continuous video or still formats) and associated audio data may be publicly released, either separately or in association with the appropriate engineering data for scientific, regulatory, educational, outreach, legislative, or research purposed (as noted above).

The **simulator data** is captured and stored on hard drives located within a limited access area of the NADS facility. Access to simulator data is controlled through permissions established on a per-study basis.

If we write a report or article about this study or share the study data set with others, we will do so in such a way that you cannot be directly identified.

WILL MY HEALTH INFORMATION BE USED DURING THIS STUDY?

The Federal Health Insurance Portability and Accountability Act (HIPAA) requires your health care provider to obtain your permission for the research team to access or create "protected health information" about you for purposes of this research study. Protected health information is information that personally identifies you and relates to your past, present, or future physical or mental health condition or care. We will access or create health information about you, as described in this document, for purposes of this research study. Once your health care provider has disclosed your protected health information to us, it may no longer be protected by the Federal HIPAA privacy regulations, but we will continue to protect your confidentiality as described under "Confidentiality."

We may share your health information related to this study with other parties including federal government regulatory agencies, the University of Iowa Institutional Review Boards and support staff, and the National Highway Traffic and Safety Administration.

You cannot participate in this study unless you permit us to use your protected health information. If you choose *not* to allow us to use your protected health information, we will discuss any non-research alternatives available to you. Your decision will not affect your right to medical care that is not research-related. Your signature on this Consent Document authorizes your health care provider to give us permission to use or create health information about you.

Although you may not be allowed to see study information until after this study is over, you may be given access to your health care records by contacting your health care provider. Your permission for us to access or create protected health information about you for purposes of this study has no expiration date. You may withdraw your permission for us to use your health information for this research study by sending a written notice to Dr. John D. Lee, College of Engineering, 2130 Seamans Center, University of Iowa However, we may still use your health information that was collected before withdrawing your permission. Also, if we have sent your health information to a third party, such as the study sponsor, or we have removed your identifying information, it may not be possible to prevent its future use. You will receive a copy of this signed document.

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APPROVED BY: IRB-01
IRB ID #: 200705757
APPROVAL DATE: 04/01/09
EXPIRATION DATE: 06/12/09

IS BEING IN THIS STUDY VOLUNTARY?

Taking part in this research study is completely voluntary. You may choose not to take part at all. If you decide to be in this study, you may stop participating at any time. If you decide not to be in this study, or if you stop participating at any time, you won't be penalized or lose any benefits for which you otherwise qualify.

What if I Decide to Drop Out of the Study?

If you decide to leave the study early, we ask you to contact Sue Ellen Salisbury at (319) 335-4666 as soon as you decide not to participate.

Can Someone Else End my Participation in this Study?

Under certain circumstances, the researchers or NHTSA might decide to end your participation in this research study earlier than planned. This might happen because you fail the drug screen testing, your blood pressure and/or heart rate does not meet the study requirements, and for females, you are or become pregnant while participating. Additionally, your participation may end if you fail to operate the research vehicle in accordance with the instructions provided or if there are technical difficulties with the driving simulator.

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IRB ID #: 200705757
APPROVAL DATE: 04/01/09
EXPIRATION DATE: 06/12/09

WHAT IF I HAVE QUESTIONS?

We encourage you to ask questions. If you have any questions about the research study itself, please contact: Dr. John Lee, (319) 384-0810. If you experience a research-related injury, please contact: Dr. John Lee, (319) 384-0810.

If you have questions, concerns, or complaints about your rights as a research subject or about research related injury, please con tact the Human Subjects Office, 340 College of Medicine Administration Building, The University of Iowa, Iowa City, Iowa, 52242, (319) 335-6564, or e-mail irb@uiowa.edu. General information about being a research subject can be found by clicking "Info for Public" on the Human Subjects Office web site, http://research.uiowa.edu/hso. To offer input about your experiences as a research subject or to speak to someone other than the research staff, call the Human Subjects Office at the number above.

This Informed Consent Document is not a contract. It is a written explanation of what will happen during the study if you decide to participate. You are not waiving any legal rights by signing this Informed Consent Document. Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Subject's Name (printed): _____

Do not sign this form if today's date is on or after EXPIRATION DATE: 06/12/09.

_____ _____
(Signature of Subject) (Date)

Statement of Person Who Obtained Consent

I have discussed the above points with the subject or, where appropriate, with the subject's legally authorized representative. It is my opinion that the subject understands the risks, benefits, and procedures involved with participation in this research study.

_____ _____
(Signature of Person who Obtained Consent) (Date)

APPENDIX J: QUANTITY, FREQUENCY, VARIABILITY (QFV) SCALE

QFV Screening

6/10/2009

Check columns

Wine	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum
5 – 6 glasses						0	0
3 - 4 glasses						0	0
1 – 2 glasses						0	0

3b

Beer	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum
5 – 6 cans						0	0
3 – 4 cans						0	0
1 – 2 cans						0	0

4b

Liquor (Spirits)	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum
5 – 6 drinks						0	0
3 – 4 drinks						0	0
1 – 2 drinks						0	0

5b

	7	8	9	6	
Frequency Table	Wine	Beer	Liquor (Spirits)	Any kind of alcoholic drink	Check sum
3 or more times a day					0
2 times a day					0
Nearly every day					0
3-4 times per week					0
Once or twice per week					0
2-3 times a month					0
About once a month					0
Less than once a month but at least once a year					0
Never					0

Check Sums OK	Error With Frequency Table!
	Non-Drinker

The National Advanced Driving Simulator
at The University of Iowa

6/10/2009

Q-F-V Scoring

CHART I
Q-V CLASS

Q-V CLASS	MODAL QUANTITY	MAXIMUM QUANTITY
1	5-6	5-6
2	3-4	5-6 less than half the time
3	3-4	5-6 once in awhile
4	no mode	5-6 less than half the time
5	3-4	3-4
6	1-2	5-6 less than half the time
7	no mode	5-6 once in awhile
8	1-2	5-6 once in awhile
9	1-2	3-4 less than half the time
10	1-2	3-4 once in awhile
11	1-2	1-2

CHART II
Q-F-V CLASS

Enroll ONLY individuals whose are classified as a moderate of heavy drinker as defined below.

Q-F-V CLASS	FREQUENCY (maximum frequency of any beverage)	Q-V Class
Heavy Drinkers	Three or more times a day	1-11
	Twice a day	1-9
	Every day or nearly every day	1-8
	3-4 times a week	1-5
	1-2 times a week	1-4
	2-3 times a month	1
Moderate Drinkers	Twice a day	10-11
	Every day or nearly every day	9-10
	3-4 times a week	6-9
	1-2 times a week	5-9
	2-3 times a month	2-8
	About once a month	1-6

QFV Screening

6/10/2009

						Check columns		
Wine	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum	3b
5 – 6 glasses					X	0	0	
3 - 4 glasses					X	0	0	
1 – 2 glasses					X	0	0	

Beer	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum	4b
5 – 6 cans			X			0	1	
3 – 4 cans	X					1	1	
1 – 2 cans				X		0	1	

Liquor (Spirits)	Nearly every time	More than half the time	Less than half the time	Once in a while	Never	modal check	check sum	5b
5 – 6 drinks					X	0	0	
3 – 4 drinks					X	0	0	
1 – 2 drinks	X					1	1	

	7	8	9	6	
Frequency Table	Wine	Beer	Liquor (Spirits)	Any kind of alcoholic drink	Check sum
3 or more times a day					0
2 times a day					0
Nearly every day					0
3-4 times per week					0
Once or twice per week					0
2-3 times a month		X		X	2
About once a month					0
Less than once a month but at least once a year			X		1
Never	X				1

Check Sums OK	Frequency Table OK
	Moderate Drinke

The National Advanced Driving Simulator
at The University of Iowa

6/10/2009

APPENDIX K: DRIVING SURVEY T2

Study: Impact2008
Participant: _____
Date: _____

IMPACT Driving Survey

As part of this study, it is useful to collect information describing each participant. The following questions ask about you and your health, your driving patterns, and your alcohol consumption. Please read each question carefully. If something is unclear, ask the researcher for help. Your participation is voluntary and you have the right to omit questions if you choose. Please remember that all of your answers will be kept confidential.

Background Information

1) What is your birth date? _____ / _____ / _____
Month Day Year

2) What age are you today? _____

3) What is your gender?
- ❒ Male
- ❒ Female

4) What is your marital status? (Check only one)
- ❒ Single, never married
- ❒ Married
- ❒ Domestic Partnership
- ❒ Separated or Divorced
- ❒ Widowed

5) What was your total household income last year? (Check only one)
- ❒ $0- $24,999
- ❒ $25,000- $29,999
- ❒ $30,000 - $34,999
- ❒ $35,000 - $39,999
- ❒ $40,000 - $49,999
- ❒ $50,000 - $59,999
- ❒ $60,000 - $69,999
- ❒ $70,000 - $79,999
- ❒ $80,000 - $89,999
- ❒ $90,000 - $99,999
- ❒ $100,000 or more

6) What is your present employment status? (Check only one)
- ❒ Unemployed
- ❒ Retired
- ❒ Work part-time
- ❒ Work full-time
- ❒ None of the above

7) What type of work do you do (e.g., teacher, homemaker)? _____

8) How many children do you have? _____

1

9) How many children under the age of 18 live at home? _____

10) How many children under the age of 14 live at home? _____

11) Of which ethnic origin(s) do you consider yourself? (Check all that apply)

- ❒ American Indian/Alaska Native
- ❒ Asian
- ❒ Black/African American
- ❒ Hispanic/Latino
- ❒ Native Hawaiian/Other Pacific Islander
- ❒ White/Caucasian
- ❒ Other

12) What is the highest level of education that you have completed? (Check only one)

- ❒ Primary School
- ❒ High School Diploma or equivalent
- ❒ Technical School or equivalent
- ❒ Some College or University
- ❒ Associate's Degree
- ❒ Bachelor's Degree
- ❒ Some Graduate or Professional School
- ❒ Graduate or Professional Degree

Driving Experience

13) How old were you when you started to drive? _____ years of age

14) For which of the following do you currently hold a valid driver's license within the United States? (Check all that apply)

	Vehicle Type	Year When FIRST Licensed (May be Approximate)
❒	Passenger Vehicle License	____ ____ ____ ____
❒	Commercial Truck License	____ ____ ____ ____
❒	Motorcycle License	____ ____ ____ ____
❒	Other: _____	____ ____ ____ ____
❒	Other: _____	____ ____ ____ ____

15) How often do you drive? (Check the most appropriate category)

- ❒ Less than once weekly
- ❒ At least once weekly
- ❒ At least once daily

16) Approximately how many miles do you drive per year in each vehicle type, excluding miles driven for work-related activities? (Check only one for each vehicle)

Car	Motorcycle	Truck	Other: _____
Do not drive	Do not drive	Do not drive	Do not drive
Under 2,000	Under 2,000	Under 2,000	Under 2,000
2,000 - 7,999	2,000 - 7,999	2,000 - 7,999	2,000 - 7,999
8,000 - 12,999	8,000 - 12,999	8,000 - 12,999	8,000 - 12,999
13,000 - 19,999	13,000 - 19,999	13,000 - 19,999	13,000 - 19,999
20,000 or more	20,000 or more	20,000 or more	20,000 or more

17) Is any driving you do work-related? (Check only one)

❒ No (Go to question # 18)
❒ Yes (please complete question 17a below)

17a) How many work-related miles do you drive per year? (Check only one)
❒ Under 2,000
❒ 2,000 - 7,999
❒ 8,000 - 12,999
❒ 13,000 - 19,999
❒ 20,000 or more

18) How frequently do you drive in the following environments? (Check only one for each environment)

	Never	Yearly	Monthly	Weekly	Daily
Residential	❒	❒	❒	❒	❒
Business District	❒	❒	❒	❒	❒
Rural Highway (e.g., Route 6)	❒	❒	❒	❒	❒
Interstate (e.g., Interstate 80)	❒	❒	❒	❒	❒
Gravel Roads	❒	❒	❒	❒	❒

19) What speed do you typically drive in a **residential area** when the speed limit is **25**?
_____mph

20) What speed do you typically drive in a **business district** when the speed limit is **35**?
_____mph

21) What speed do you typically drive on a **rural highway** when the speed limit is **55**?
_____mph

22) What speed do you typically drive on the **Interstate** when the speed limit is **65?** _____mph

23) What speed do you typically drive on a **gravel road**? _____mph

24) Have you ever had to participate in any driver improvement courses due to moving violations?

❒ No
❒ Yes (Please describe) _____

25) When driving, how frequently do you perform each of the following tasks/maneuvers?

(Check the most appropriate answer for each task/maneuver)

	Never	Rarely	Occasionally	Frequently	Always	Not Applicable
Change lanes on Interstate or freeway	❒	❒	❒	❒	❒	❒
Keep up with traffic in town	❒	❒	❒	❒	❒	❒
Keep up with traffic on two-lane highway	❒	❒	❒	❒	❒	❒
Keep up with traffic on Interstate or freeway	❒	❒	❒	❒	❒	❒
Pass other cars on Interstate or freeway	❒	❒	❒	❒	❒	❒
Exceed speed limit	❒	❒	❒	❒	❒	❒
Wear a safety belt	❒	❒	❒	❒	❒	❒
Make left turns at uncontrolled intersections	❒	❒	❒	❒	❒	❒

26) How comfortable do you feel when you drive in the following conditions or perform the following maneuvers? (Check the most appropriate answer for each condition)

	Very Uncomfortable	Slightly Uncomfortable	Slightly Comfortable	Very Comfortable	Not Applicable
Highway/freeway	❒	❒	❒	❒	❒
After drinking alcohol	❒	❒	❒	❒	❒
With children	❒	❒	❒	❒	❒
High-density traffic	❒	❒	❒	❒	❒
Passing other cars	❒	❒	❒	❒	❒
Changing lanes	❒	❒	❒	❒	❒
Making left turns at uncontrolled intersections	❒	❒	❒	❒	❒

Violations

27) Within the past five years, how many tickets have you received for the following?
(Please check a response for each ticket)

	0	1	2	3+
Speeding	❒	❒	❒	❒
Going too slowly	❒	❒	❒	❒
Failure to yield right of way	❒	❒	❒	❒
Disobeying traffic lights	❒	❒	❒	❒
Disobeying traffic signs	❒	❒	❒	❒
Improper passing	❒	❒	❒	❒
Improper turning	❒	❒	❒	❒
Reckless driving	❒	❒	❒	❒
Following another car too closely	❒	❒	❒	❒
Operating While Intoxicated (OWI) or Driving Under the influence (DUI)	❒	❒	❒	❒
Other (please specify **type** and **frequency** of violation) _____				

Accidents

28) In the past five years, how many times have you been the driver of a car involved in an accident?

❒ 0 (Go to question # 29 on page 7)
❒ 1
❒ 2
❒ 3
❒ 4 or more

Please provide the following information for each accident on the next page.

Accident 1

Was another vehicle involved?	❒ No	❒ Yes
Was a pedestrian involved?	❒ No	❒ Yes
Were you largely responsible for this accident?	❒ No	❒ Yes
Did you go to driver's rehabilitation?	❒ No	❒ Yes
Weather Condition: _____	Month/Year: _____	
Description: _____		

Accident 2

Was another vehicle involved?	❒ No	❒ Yes
Was a pedestrian involved?	❒ No	❒ Yes
Were you largely responsible for this accident?	❒ No	❒ Yes
Did you go to driver's rehabilitation?	❒ No	❒ Yes
Weather Condition: _____	Month/Year: _____	
Description: _____		

Accident 3

Was another vehicle involved?	❒ No	❒ Yes
Was a pedestrian involved?	❒ No	❒ Yes
Were you largely responsible for this accident?	❒ No	❒ Yes
Did you go to driver's rehabilitation?	❒ No	❒ Yes
Weather Condition: _____	Month/Year: _____	
Description: _____		

Health Status

29) How often do you experience motion sickness? (Circle only one)

0 1 2 3 4 5 6 7 8 9 10
Never Always

30) How severe are your symptoms when you experience motion sickness (Circle only one)

0 1 2 3 4 5 6 7 8 9 10
None Severe

31) Have you taken any medication in the past 48 hours? (Check only one)

❒ No
❒ Yes (Please list all) _____

_____

32) What is your normal bedtime (hour of the day)? _____

Alcohol Consumption History

33) When you drink alcoholic beverages, where do you **usually** drink?

❒ At home
❒ At a friend's home
❒ Public place (restaurant, bar, sports arena, etc.)

34) In a typical month, how many hours do you wait to drive after consuming what number of drinks?

❒ Not Applicable, proceed to next question
❒ Applicable, complete table below

(Mark all that apply. For example, if every week you have one glass of wine with dinner at your favorite restaurant and drive home less than one hour before you finish the glass and on three Sundays each month you have four beers while watching the game and wait 1 hour after finishing your last drink to drive, you would mark the following:

EXAMPLE TABLE

	<1 hour	*1 hour*	*2 hours*
1 drink	*4*		
2 drinks			
3 drinks			
4 drinks		*3*	

	< 1 hour	**1 hour**	**2 hours**	**3 hours**	**4 hours**	**5 hours**	**6 or more**
1 drink							
2 drinks							
3 drinks							

4 drinks							
5 drinks							
6 or more							

35) Compare your driving to other people's driving:

a) After **one** alcoholic beverage, I rate my driving as compared with others who have consumed as much alcohol as I have as: (*make a slash mark anywhere along the line*)

Far worse about the same considerably better

b) After **two** alcoholic beverages, I rate my driving as compared with others who have consumed as much alcohol as I have as: (*make a slash mark anywhere along the line*)

Far worse about the same considerably better

c) After **five** alcoholic beverages, I rate my driving as compared with others who have consumed as much alcohol as I have as: (*make a slash mark anywhere along the line*)

Far worse about the same considerably better

36) How many times per month do you operate a motor vehicle after consuming too much alcohol?

❒ Never
❒ 1-2
❒ 3-5
❒ 6-10
❒ 11-15
❒ 16 or more

37) How many times per month do you drive after someone has encouraged you not to because of your level of intoxication?

❒ Never
❒ 1-2
❒ 3-5
❒ 6-10
❒ 11-15
❒ 16 or more

38) Do you have a maximum number of alcoholic beverages you can consume after which you do not operate a motor vehicle?

❒ No
❒ Yes, how many_____

39) Have you ever been pulled over by the police and been given a breathalyzer or standard field sobriety test?

❒ No
❒ Yes, how many times? _____

40) Have you

a) **ever** been charged for operating while intoxicated (OWI) or for driving under the influence of alcohol (DUI)?

❒ No
❒ Yes, how many times? _____

b) been charged for operating while intoxicated (OWI) or for driving under the influence of alcohol (DUI) in the **past 3 years**?

❒ No
❒ Yes, how many times? _____

41) Have you ever caused an accident while under the influence of alcohol?

❒ No
❒ Yes

42) Have you ever been in an accident where someone else was under the influence of alcohol?

❒ No
❒ Yes

43) Have your driving privileges ever been suspended or revoked for operating while intoxicated (OWI) or for driving under the influence of alcohol (DUI)?

❒ No
❒ Yes

Continue to the next page

Other Studies

44) Have you participated in other driving studies?

❒ No (End of questionnaire)
❒ Yes (please provide details for each study you have participated in below)

Study 1
What vehicle was used for this study? (Check only one)

❒ Actual car - only
❒ Another simulator - only
❒ National Advanced Driving Simulator (Motion Simulator)
❒ National Advanced Driving Simulator (Static Simulator)
❒ Both - actual car and another simulator
❒ Both - actual car and the National Advanced Driving Simulator (Motion Simulator)

Brief Description:
_____

_____

Study 2
What vehicle was used for this study? (Check only one)

❒ Actual car - only
❒ Another simulator - only
❒ National Advanced Driving Simulator (Motion Simulator)
❒ National Advanced Driving Simulator (Static Simulator)
❒ Both - actual car and another simulator
❒ Both - actual car and the National Advanced Driving Simulator (Motion Simulator)

Brief Description:
_____

_____

Study 3
What vehicle was used for this study? (Check only one)

❒ Actual car - only
❒ Another simulator - only
❒ National Advanced Driving Simulator (Motion Simulator)
❒ National Advanced Driving Simulator (Static Simulator)
❒ Both - actual car and another simulator
❒ Both - actual car and the National Advanced Driving Simulator (Motion Simulator)

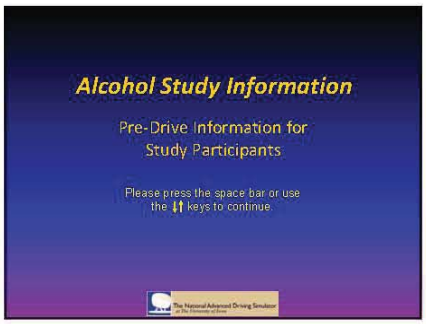
Brief Description:
_____

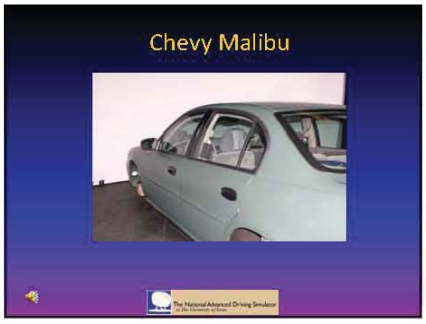
_____

The End

APPENDIX L: ORIENTATION PRESENTATION

11/24/2008





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Fasten Seatbelt

Resting Position

Intercom System

The cab has an intercom system which allows the researchers to hear you. It is already adjusted for the drive today. If for any reason you want to stop driving, please tell us. The operator will hear you and can end the drive in just a few seconds. The driving instructions will be given through the intercom system as well.

Eye Tracking Cameras

Mirrors

You will need to use the side and rear view mirrors for the drives today. The mirrors can be adjusted by using the control panel on the door. Set the side mirrors in much the same way as you would set the mirrors on your car. Wait to adjust the mirrors until after the eye tracking cameras have been calibrated. The control panel should be pressed firmly. If you need assistance, please ask the researcher in the simulator for some help.

Practice Drive

Your first drive today will be a practice drive. It is designed to help you get used to the simulator. Please become familiar with driving at the posted speed limits and recognizing traffic control devices. An onboard instruction will ask you to change the CD player for practice.

The practice drive starts with your vehicle parked along a city street. When it is time to begin, shift into Drive, then enter into traffic when it is safe to do so. Stay on the original road. You will drive to an interstate where you should merge and accelerate to the speed limit. Onboard navigational instructions will guide you to the interstate. A recording will tell you when it is time to stop.

Study Drive

The study drive is designed to mimic a trip from a city bar to a rural residence via the interstate. You will be driving on city streets, an interstate, and country roads. Speed limits are posted. Navigational instructions will be played as you travel to your destination. The drive is approximately 25 minutes long.

The drive starts from the parking lane in the city's business district. When it is time to begin, shift into Drive, and merge into traffic when it is safe to do so. Continue driving until you enter the driveway, at which time you should park near the garage.

Your Destination

CD Player

At several points in your drive you will be told to adjust the CD player. The CD player has three separate controls that you will operate for this task: the ON button, the selection lever, and the OFF button. Press the ON button for power, move the selection lever up or down once for each track, then press the OFF button. Do not press the MODE button. Please familiarize yourself with these controls at this time, and during your practice drive. When you have learned the controls, please press the space bar to advance this slide.

Conclusion

This concludes the briefing presentation. We are glad to answer any questions you may have at this time.

APPENDIX M: WELLNESS SURVEY

Study: **Impact**

Participant: _____

Visit: _____

Date:_____

WELLNESS SURVEY

Directions: Circle one option for each symptom to indicate whether that symptom applies to you right now.

1. General Discomfort ..... None ..... Slight ..... Moderate ..... Severe
2. Fatigue ..... None ..... Slight ..... Moderate ..... Severe
3. Headache ..... None ..... Slight ..... Moderate ..... Severe
4. Eye Strain ..... None ..... Slight ..... Moderate ..... Severe
5. Difficulty Focusing ..... None ..... Slight ..... Moderate ..... Severe
6. Salivation Increased ..... None ..... Slight ..... Moderate ..... Severe
7. Sweating ..... None ..... Slight ..... Moderate ..... Severe
8. Nausea ..... None ..... Slight ..... Moderate ..... Severe
9. Difficulty Concentrating ..... None ..... Slight ..... Moderate ..... Severe
10. *"Fullness of the Head" ..... None ..... Slight ..... Moderate ..... Severe
11. Blurred Vision ..... None ..... Slight ..... Moderate ..... Severe
12. Dizziness with Eyes Open ..... None ..... Slight ..... Moderate ..... Severe
13. Dizziness with Eyes Closed ..... None ..... Slight ..... Moderate ..... Severe
14. **Vertigo ..... None ..... Slight ..... Moderate ..... Severe
15. ***Stomach Awareness ..... None ..... Slight ..... Moderate ..... Severe
16. Burping ..... None ..... Slight ..... Moderate ..... Severe
17. Vomiting..... None ..... Slight ..... Moderate……..Severe
18. Other _____ ..... None ..... Slight ..... Moderate……..Severe

* Fullness of the head is an awareness of pressure in the head.

**Vertigo is experienced as loss of orientation with respect to vertical upright.

***Stomach awareness is a feeling of discomfort which is just short of nausea.

APPENDIX N: REALISM SURVEY

Study: Impact
Participant: ____
Visit: 1 or 2 or 3
Date: _____

REALISM SURVEY

For each of the following items, circle the number that best indicates how closely the simulator resembles an actual car in terms of appearance, sound, and response. If an item is not applicable, circle NA.

	General Driving	Not at all realistic						Completely Realistic	
1	Response of the seat adjustment levers	0	1	2	3	4	5	6	NA
2	Response of the mirror adjustment levers	0	1	2	3	4	5	6	NA
3	Response of the door locks and handles	0	1	2	3	4	5	6	NA
4	Response of the fans	0	1	2	3	4	5	6	NA
5	Response of the gear shift	0	1	2	3	4	5	6	NA
6	Response of the brake pedal	0	1	2	3	4	5	6	NA
7	Response of accelerator pedal	0	1	2	3	4	5	6	NA
8	Response of the speedometer	0	1	2	3	4	5	6	NA
9	Response of the steering wheel while driving straight	0	1	2	3	4	5	6	NA
10	Response of the steering wheel while driving on curves	0	1	2	3	4	5	6	NA
11	Feel when accelerating	0	1	2	3	4	5	6	NA
12	Feel when braking	0	1	2	3	4	5	6	NA
13	Ability to read road and warning signs	0	1	2	3	4	5	6	NA
14	Appearance of car interior	0	1	2	3	4	5	6	NA
15	Appearance of signs	0	1	2	3	4	5	6	NA
16	Appearance of roads and road markings	0	1	2	3	4	5	6	NA
17	Appearance of urban scenery	0	1	2	3	4	5	6	NA
18	Appearance of rural scenery	0	1	2	3	4	5	6	NA
19	Appearance of freeway scenery	0	1	2	3	4	5	6	NA
20	Appearance of intersections	0	1	2	3	4	5	6	NA
21	Appearance of headlights	0	1	2	3	4	5	6	NA
22	Appearance of gravel road	0	1	2	3	4	5	6	NA
23	Appearance of other vehicles	0	1	2	3	4	5	6	NA
24	Appearance of rear-view mirror image	0	1	2	3	4	5	6	NA
25	Sound of the car	0	1	2	3	4	5	6	NA
26	Sound of other vehicles	0	1	2	3	4	5	6	NA
27	Overall feel of the car when driving	0	1	2	3	4	5	6	NA
28	Overall similarity to real driving	0	1	2	3	4	5	6	NA
29	Overall Appearance of driving scenes	0	1	2	3	4	5	6	NA

1

Study: Impact
Participant: ____
Visit: 1 or 2 or 3

	Situational Driving	Not at all realistic						Completely Realistic	
30	Feel of driving straight while going 25 mph	0	1	2	3	4	5	6	NA
31	Feel of driving straight while going 35 mph	0	1	2	3	4	5	6	NA
32	Feel of driving straight while going 55 mph	0	1	2	3	4	5	6	NA
33	Feel of driving straight while going 65 mph	0	1	2	3	4	5	6	NA
34	Feel of driving on a curved road while going 25 mph	0	1	2	3	4	5	6	NA
35	Feel of driving on a curved road while going 55 mph	0	1	2	3	4	5	6	NA
36	Feel of driving on a curved road while going 65 mph	0	1	2	3	4	5	6	NA
37	Feel of accelerating from a stopped position	0	1	2	3	4	5	6	NA
38	Feel of braking to a stop	0	1	2	3	4	5	6	NA
39	Performing a 90 degree turn to the left while going 25 mph	0	1	2	3	4	5	6	NA
40	Performing a 90 degree turn to the right from a stopped position	0	1	2	3	4	5	6	NA
41	Feel of driving on the freeway	0	1	2	3	4	5	6	NA
42	Feel of changing lanes on the freeway	0	1	2	3	4	5	6	NA
43	Feel of driving on a freeway on/exit ramp	0	1	2	3	4	5	6	NA
44	Feel of driving on gravel road	0	1	2	3	4	5	6	NA
45	Ability to stop the vehicle	0	1	2	3	4	5	6	NA
46	Ability to respond to other vehicles	0	1	2	3	4	5	6	NA
47	Ability to keep straight in your lane	0	1	2	3	4	5	6	NA
48	Ability to respond at intersections	0	1	2	3	4	5	6	NA

APPENDIX O: SLEEP AND FOOD INTAKE SURVEY

Study: IMPACT
Participant: _____
Visit: _____
Date_____

Sleep and Food Intake Survey

As part of this study, it is useful to collect information about your sleep and food intake. Please read each question carefully. If something is unclear, ask the researcher for assistance. Your participation is voluntary and you have the right to omit questions if you choose.

1) On a typical _____, when do you normally go to bed?
(Staff only: The blank will be filled in by staff for each subject for the preceding night (i.e. if subject comes in on a Monday, the blank will be filled in with Sunday)).

2) On a typical _____, when do you normally wake up?
(Staff only: The blank will be filled in by staff for each subject relative to the night in which data collection occurs (i.e. if subject comes in on a Monday, the blank will be filled in with Monday)).

3) What time did you go to sleep last night? _____ AM/PM

4) What time did you wake today? _____ AM/PM

5) In total, how many hours did you sleep last night? _____

6) Do you feel that you got enough sleep? ❒No ❒Yes

7) Did you take a nap today?
   ❒ No
   ❒ Yes, times? _____

8) When did you eat your last meal? _____AM/PM
   a) What did you eat at that meal?
   _____
   _____

9) Have you had anything to eat since your last meal?
   ❒ No
   ❒ Yes, when? _____AM/PM
      a) What did you eat? _____

10) Have you had any nicotine in the last 24 hours?

- ❒ No
- ❒ Yes, when? _____ AM/PM
  - a) How many cigarettes did you smoke? _____
  - b) How much chewing tobacco did you use? _____
  - c) Other forms of nicotine? (type and frequency) _____

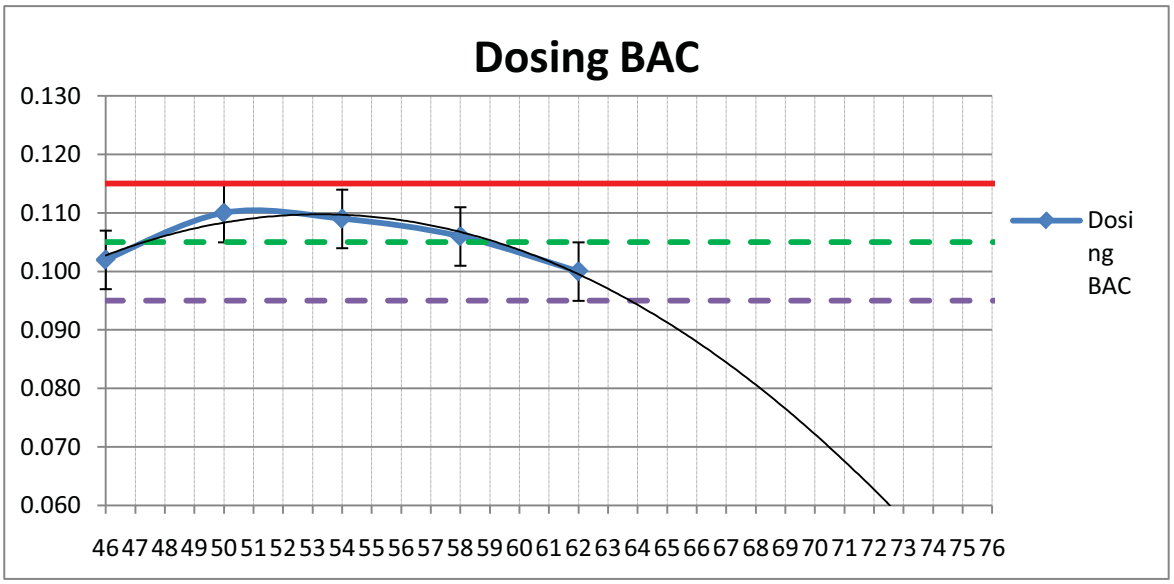
11) Have you had any caffeine in the last 24 hours?

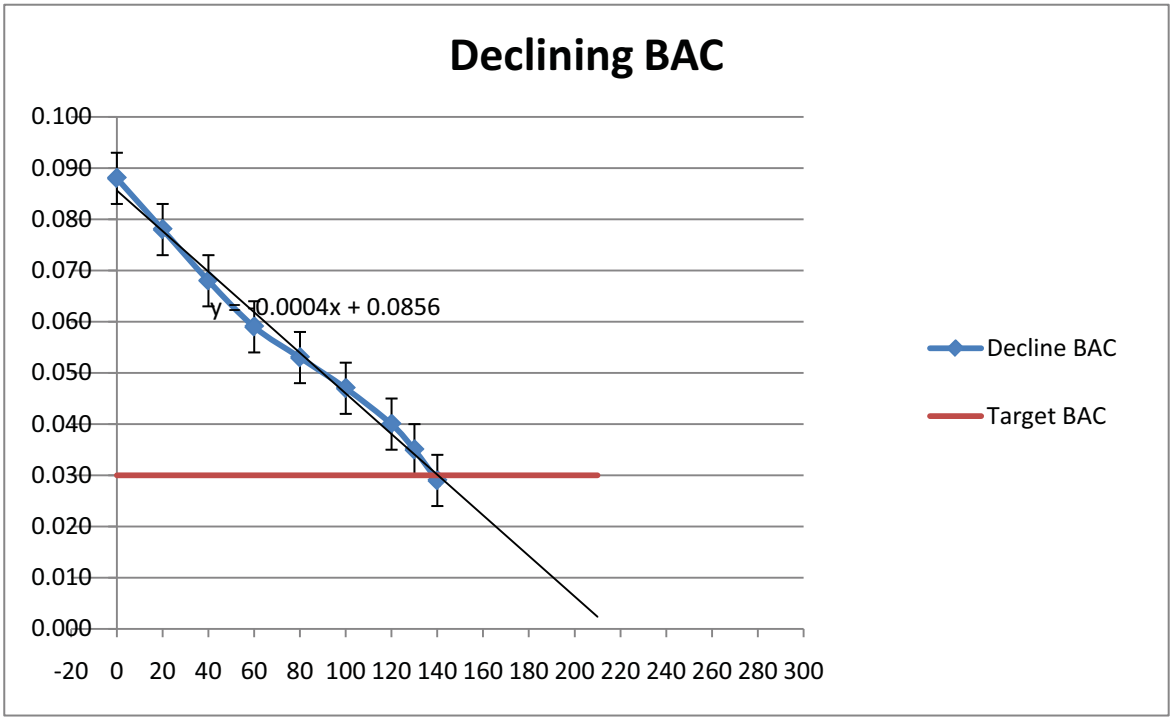
- ❒ No
- ❒ Yes, when? _____ AM/PM
  - a) How many cups of coffee did you drink? _____
  - b) How many cans of caffeinated soda did you drink? _____
  - c) Other forms of caffeine? (type and frequency) _____

12) Have you had any alcohol in the last 24 hours?

- ❒ No
- ❒ Yes, when? _____ AM/PM
  - a) How many cans of beer did you drink?_____
  - b) How many glasses of wine did you drink? _____
  - c) How many mixed drinks did you consume? _____
  - d) How many shots of alcohol did you consume? _____

APPENDIX P: SAMPLE BAC PLOTS





APPENDIX Q: STANDARD FIELD SOBRIETY TEST

STANDARD FIELD SOBIETRY TEST

Gaze Nystagmus Test

I am going to check your eyes. *(Remove glasses)*

Please keep your head still and follow this pen(cil) with your eyes.

Keep your eyes on the pen(cil) at all times.

- ☐ Nystagmus in right eye is moderate or distinct when eye is moved as far as possible to the right.
- ☐ Right eye cannot follow moving object smoothly.
- ☐ Onset of gaze nystagmus in right eye occurs before 45 degrees (some white is visible).
- ☐ Nystagmus in left eye is moderate or distinct when eye is moved as far as possible to left.
- ☐ Left eye cannot follow moving object smoothly.
- ☐ Onset of gaze nystagmus in left eye occurs before 45 degrees (some white is visible).

Walk and Turn Test

Please put your left foot on the line and then your right foot in fron of it like this *(demonstrate)*

When I tell you to begin, take 9 heel-to-toe steps down the line, turn around, and take 9 heel-to-toe steps back.

Make your turn by keeping one foot on the line and then using your other foot to turn like this. *(demonstrate)*

Keep your hands at your sides, watch your feet at all times, and count your steps out loud. Count your first step from the heel-to-toe position as "one". Do you understand? Please begin.

- ☐ Cannot keep balance while listening to instructions.
- ☐ Starts before instructions are finished.
- ☐ Stops while walking to steady self.
- ☐ Does not touch heel to toe.
- ☐ Loses balance while turning.
- ☐ Incorrect number of steps.
- ☐ Cannot do test (steps off line 3 or more times)

One-Leg-Stand Test

Please stand with your heels together and your arms down at your sides, like this. *(demonstrate)*

When I tell you to, I want you to raise one foot out in front of you about 6 inches off the ground and hold it flat like this. *(demonstrate)*

At the same time count rapidly from one thousand one to one thousand thirty, while watching your foot.

Do you understand?

Please begin by raising either your right or left foot.

- ☐ Sways while balancing
- ☐ Uses arms to balance.
- ☐ Hopping.
- ☐ Puts foot down.
- ☐ Cannot do test (puts foot down 3 or more)

APPENDIX R: SLEEPINESS SCALE

Study: **Impact**
Participant: _____
Pre-drive: 1 or 2
Post-drive: 1 or 2
Date: __ __

SLEEPINESS SCALE

Degree of Sleepiness	Scale Rating
Feeling active, vital, alert, or wide awake	1
Functioning at high levels, but not at peak; able to concentrate	2
Awake, but relaxed; responsive but not fully alert	3
Somewhat foggy, let down	4
Foggy; losing interest in remaining awake; slowed down	5
Sleepy, woozy, fighting sleep; prefer to lie down	6
No longer fighting sleep, sleep onset soon; having dream-like thoughts	7
Asleep	X

APPENDIX S: DEBRIEFING STATEMENT

IMPACT Debriefing Statement

When is it safe to drive again?

At the time you will be transported home from completing this study visit, your Blood Alcohol Concentration (BAC) level will be at or less than 0.03%. Although you could legally drive at this level, we ask you to wait 2 hours after you are returned home to drive to ensure your BAC level is 0.00%.

APPENDIX T: DEBRIEFING QUESTIONS

IMPACT Debrief Interview

[Document for research staff only. Interview will include, but is not limited to, the following questions; follow-up questions may be asked. Staff: Mark all boxes that apply for high-level analysis.]

In this interview, I'll ask you questions regarding impairment, driving, and potential future technologies that could be designed to assist intoxicated drivers. Your participation is voluntary and you have the right to skip questions if you choose. All of your answers will be kept confidential. Throughout the interview when I say "drinking" I'm referring to the consumption of alcohol.

1. Have you ever driven after you consumed alcohol but believed you were still able to drive safely?
   [ ] Yes [ ] No [ ] Other

   a. What factors played a role in your decision to drive or not to drive?
   IF PARTICIPANT REPORTS NEVER DRIVING AFTER DRINKING, GO TO QUESTION 5.

2. Have you ever driven when you knew you were too intoxicated to drive safely?
   [ ] Yes [ ] No [ ] Other

   a. What factors played a role in your decision to drive or not to drive after drinking?
   b. If there was a point where you were too intoxicated to drive safely, how did you know it was not safe to drive?

3. After the occasions when you drank, what differences did you notice in your driving (for example, how you control your driving speed, lane position, etc.)?

[ ] No difference	[ ] Lateral control, general	[ ] Curves/turns
[ ] Longitudinal control, general	[ ] Speed, increase	[ ] Speed, decrease
[ ] Reaction time to environment	[ ] Reaction time to critical event	[ ] Other

   a. Can you describe any differences you noticed in the types of things you paid attention to, or in your ability to focus while driving?
   [ ] No difference
   [ ] Reduced ability to focus or pay attention [ ] Increased ability to focus or pay attention
   [ ] Other

   b. In what ways did your driving or attention change based on external factors, like passengers in the vehicle or the weather?
   [ ] No difference
   [ ] Degraded driving performance [ ] Improved driving performance
   [ ] Reduced ability to focus or pay attention [ ] Increased ability to focus or pay attention
   [ ] Other

c. As your level of intoxication increases how does it affect your driving skills or ability to focus or pay attention to the roadway?
   [ ] No difference
   [ ] Degraded performance with increased intoxication
   [ ] Improved performance with increased intoxication
   [ ] Reduced focus or attention with increased intoxication
   [ ] Increased focus or attention with increased intoxication
   [ ] Other

4. How do you adjust your driving after you have been drinking?
   [ ] No change [ ] Adjust driving after drinking [ ] Other

   a. Do your adjustments change depending on how impaired you are? Please describe.
      [ ] Yes [ ] No [ ] Other

5. Impairment from alcohol consumption has been shown to decrease drivers' mental and physical abilities. I'd like to hear your thoughts on the role technology can play in assisting impaired drivers or making the roadway safer for surrounding traffic.

   Imagine a system in a vehicle that could detect when a driver is impaired based on the performance or behavior of the driver and vehicle.
   a. What are your thoughts about a system that detects when a driver is below or above the legal impairment level with 100% accuracy every time a vehicle is driven?
      [ ] Positive [ ] Negative [ ] Mixed [ ] Other

   b. What are your thoughts about a system that accurately identifies all impaired drivers but also wrongly identifies some sober drivers as impaired?
      [ ] Positive [ ] Negative [ ] Mixed [ ] Other

   c. What are your thoughts about a system that represents the opposite extreme – it accurately identifies all sober drivers, but also wrongly identifies some impaired drivers as sober?
      [ ] Positive [ ] Negative [ ] Mixed [ ] Other

   d. Of the previous two examples, which is more acceptable to you?
      [ ] B is more acceptable to me [ ] C is more acceptable to me [ ] Other

   e. Which do you think would be more acceptable to the general public? Why?
      [ ] Same as question d [ ] Different from question d [ ] Other

6. If your vehicle could detect your level of alcohol impairment how would you like it to respond?

Now I'd like to get your feedback on some hypothetical actions that a system designed to detect impairment could take. Let's assume that the impairment detection system is sufficiently accurate and reliable.

7. What do you think about a system that could notify you when you are impaired with an indicator, such as a warning icon on the dash or voice alert?
   [ ] Positive [ ] Negative [ ] Mixed [ ] Other

   a. If you received this kind of alert, how would you respond?
   b. How would it affect your ability to pay attention to driving?
      [ ] No change [ ] Distraction [ ] Other

8. What do you think about a system that could give you an assessment of your driving after you return home when it detects impairment, like a report card?
   [ ] Positive [ ] Negative [ ] Mixed [ ] Other

   a. Would it affect your decision to drive or how you drive the next time you drank, and if so, how?
      [ ] Yes [ ] No [ ] Other

   b. What do you think about a system that could give you an assessment of your driving after you return home whether it indicates impairment or not?
      [ ] Positive [ ] Negative [ ] Mixed [ ] Other

9. What do you think about a system that could notify a friend or relative to request help when you are impaired?
   [ ] Positive [ ] Negative [ ] Mixed [ ] Other

   a. What about a system that could notify the police to request assistance?
      [ ] Positive [ ] Negative [ ] Mixed [ ] Other

   a. How would you respond to this system if it were in vehicles?

10. What do you think about a system that could automatically take full or partial control over certain functions, like steering or driving speed, when it detected impairment?
    [ ] Positive [ ] Negative [ ] Mixed [ ] Other

    a. If you had this type of system, how would you respond?

11. What do you think about a system that could collect data in something like an airplane's black box, which could be accessed by insurance companies and/or law enforcement after a crash or serious violation to determine if impairment was a factor?
    [ ] Positive [ ] Negative [ ] Mixed [ ] Other

    a. How would you respond to this system if it were in vehicles?

12. Generally, what do you see as obstacles to implementing these types of driver assistance systems?

13. Which of the systems, if any, would make you a safer driver?
    [ ] None [ ] Warning alert [ ] Trip report [ ] Notifying friend/relative/police
    [ ] Automation [ ] Black box [ ] Other

14. Which do you think would reduce crashes?
    [ ] None [ ] Warning alert [ ] Trip report [ ] Notifying friend/relative/police
    [ ] Automation [ ] Black box [ ] Other

APPENDIX U: RESULTS

Table U-1

Lane Deviation by Age Group Across Events

	Age Group											
	21-34			38-51			55-68			Total		
Event	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Urban Drive (102)	.81	107	.18	.83	108	.20	.81	108	.18	.82	323	.19
Green Light (103)	.63	107	.23	.61	108	.21	.64	108	.21	.63	323	.21
Yellow Dilemma (104)	.61	107	.25	.64	106	.30	.66	107	.28	.64	320	.28
Urban Curves (106)	.92	108	.16	.97	108	.20	.99	108	.20	.96	324	.19
Interstate Curves (205)	1.60	108	.59	1.52	107	.37	1.64	105	.56	1.59	320	.52
Lighted Rural (302)	.44	108	.26	.45	108	.24	.45	108	.23	.45	324	.24
Transition to Dark Rural (303)	.73	108	.29	.82	108	.27	.76	108	.27	.77	324	.28
Dark Rural (304)	1.03	107	.22	1.15	108	.24	1.12	107	.26	1.10	322	.25
Dark Rural Hairpin Curve (304)	.92	107	.31	.95	108	.33	.89	107	.30	.92	322	.31
Gravel Rural (306)	.82	107	.26	.82	108	.23	.78	107	.24	.81	322	.24
Composite	48.72	105	9.87	50.83	105	10.43	50.46	103	9.64	50.00	313	10.00

Table U-2

Lane Deviation by Gender Across Events

	Gender								
	Female			Male			Total		
Event	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Urban Drive (102)	.83	161	.19	.81	162	.19	.82	323	.19
Green Light (103)	.61	161	.20	.64	162	.22	.63	323	.21
Yellow Dilemma (104)	.65	160	.28	.63	160	.27	.64	320	.28
Urban Curves (106)	.98	162	.21	.93	162	.17	.96	324	.19
Interstate Curves (205)	1.50	160	.50	1.68	160	.52	1.59	320	.52
Lighted Rural (302)	.45	162	.24	.45	162	.25	.45	324	.24
Transition to Dark Rural (303)	.77	162	.26	.78	162	.30	.77	324	.28
Dark Rural (304)	1.04	161	.20	1.16	161	.27	1.10	322	.25
Dark Rural Hairpin Curve (304)	.89	161	.27	.95	161	.35	.92	322	.31
Gravel Rural (306)	.81	161	.23	.81	161	.26	.81	322	.24
Composite	49.27	156	9.64	50.73	157	10.32	50.00	313	10.00

Table U-3

Average Speed by Age Group Across Events

	Age Group											
	21-34			38-51			55-68			Total		
Event	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Urban Drive (102)	28.28	107	3.62	28.10	108	3.38	26.66	108	3.48	27.68	323	3.56
Green Light (103)	29.12	107	4.34	28.20	108	3.17	26.77	108	4.43	28.02	323	4.12
Yellow Dilemma (104)	17.15	108	12.09	18.68	108	11.11	18.55	108	11.25	18.13	324	11.48
Left Turn (105)	19.04	108	4.77	18.63	108	4.77	18.16	108	4.23	18.61	324	4.60
Urban Curves (106)	34.66	108	3.58	34.53	108	2.61	33.38	108	3.69	34.19	324	3.37
Interstate Curves (205)	68.08	108	4.26	66.75	107	4.50	63.99	105	4.25	66.29	320	4.64
Exit Ramp (206)	36.94	108	5.34	34.03	108	4.07	30.42	108	3.52	33.80	324	5.11
Lighted Rural (302)	55.78	108	3.33	55.08	108	3.31	54.57	108	2.78	55.14	324	3.18
Transition to Dark Rural (303)	55.71	108	4.10	54.64	108	3.70	53.97	108	3.48	54.77	324	3.82
Dark Rural (304)	53.45	107	3.36	53.00	108	3.11	50.99	108	3.29	52.48	323	3.41
Dark Rural Hairpin Curve (304)	46.45	107	5.00	46.29	108	3.58	43.42	108	3.94	45.38	323	4.42
Gravel Transition (305)	47.57	107	6.08	45.09	108	5.58	40.69	108	7.12	44.44	323	6.89
Gravel Rural (306)	45.63	107	7.81	43.38	108	6.57	41.22	107	7.49	43.41	322	7.50
Composite	46.29	108	10.25	49.03	108	8.37	54.68	108	9.47	50.00	324	10.00

Table U-4

Average Speed by Gender Across Events

	Gender								
	Female			Male			Total		
Event	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Urban Drive (102)	28.15	161	3.64	27.22	162	3.42	27.68	323	3.56
Green Light (103)	28.57	161	4.27	27.48	162	3.92	28.02	323	4.12
Yellow Dilemma (104)	20.25	162	11.65	16.00	162	10.94	18.13	324	11.48
Left Turn (105)	18.86	162	4.58	18.35	162	4.62	18.61	324	4.60
Urban Curves (106)	34.80	162	3.49	33.58	162	3.14	34.19	324	3.37
Interstate Curves (205)	65.40	160	4.50	67.18	160	4.63	66.29	320	4.64
Exit Ramp (206)	32.99	162	4.65	34.60	162	5.43	33.80	324	5.11
Lighted Rural (302)	54.62	162	3.29	55.67	162	2.98	55.14	324	3.18
Transition to Dark Rural (303)	54.09	162	4.10	55.46	162	3.40	54.77	324	3.82
Dark Rural (304)	51.60	161	3.52	53.35	162	3.08	52.48	323	3.41
Dark Rural Hairpin Curve (304)	44.22	161	4.37	46.53	162	4.18	45.38	323	4.42
Gravel Transition (305)	42.99	161	6.41	45.88	162	7.07	44.44	323	6.89
Gravel Rural (306)	42.06	161	7.30	44.76	161	7.49	43.41	322	7.50
Composite	51.02	162	9.83	48.98	162	10.09	50.00	324	10.00

Table U-5

Speed Deviation by Age Group Across Events

	Age Group											
	21-34			38-51			55-68			Total		
Event	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Urban Drive (102)	3.09	107	2.20	3.42	108	2.09	3.29	108	1.81	3.27	323	2.04
Green Light (103)	1.28	107	.78	1.44	108	.75	1.36	108	.72	1.36	323	.75
Yellow Dilemma (104)	4.97	108	4.25	4.35	108	4.20	3.45	108	3.74	4.25	324	4.11
Urban Curves (106)	2.77	108	.77	2.78	108	.71	2.96	108	.98	2.84	324	.83
Interstate Curves (205)	1.99	108	1.19	2.08	107	.88	2.26	105	.95	2.11	320	1.02
Lighted Rural (302)	.53	108	.43	.60	108	.45	.52	108	.40	.55	324	.43
Transition to Dark Rural (303)	.75	108	.53	.94	108	.69	1.05	108	.77	.91	324	.68
Dark Rural (304)	4.58	107	1.15	4.69	108	1.19	5.00	108	.89	4.76	323	1.10
Dark Rural Hairpin Curve (304)	2.82	107	1.17	2.42	108	1.02	2.66	108	1.33	2.63	323	1.19
Gravel Transition (305)	3.26	107	1.88	3.30	108	1.43	4.16	108	2.07	3.57	323	1.85
Gravel Rural (306)	2.57	107	1.07	2.81	108	1.06	2.84	107	1.11	2.74	322	1.08
Composite	51.78	108	9.97	50.13	108	9.72	48.09	108	10.06	50.00	324	10.00

Table U-6

Speed Deviation by Gender Across Events

	Gender								
	Female			Male			Total		
Event	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Urban Drive (102)	3.43	161	2.17	3.10	162	1.89	3.27	323	2.04
Green Light (103)	1.41	161	.84	1.32	162	.65	1.36	323	.75
Yellow Dilemma (104)	3.66	162	4.04	4.85	162	4.09	4.25	324	4.11
Urban Curves (106)	2.90	162	.84	2.78	162	.81	2.84	324	.83
Interstate Curves (205)	2.18	160	1.06	2.04	160	.98	2.11	320	1.02
Lighted Rural (302)	.58	162	.43	.52	162	.42	.55	324	.43
Transition to Dark Rural (303)	1.04	162	.77	.79	162	.55	.91	324	.68
Dark Rural (304)	5.15	161	1.10	4.36	162	.93	4.76	323	1.10
Dark Rural Hairpin Curve (304)	2.73	161	1.09	2.53	162	1.27	2.63	323	1.19
Gravel Transition (305)	3.75	161	1.74	3.40	162	1.95	3.57	323	1.85
Gravel Rural (306)	2.84	161	1.05	2.64	161	1.11	2.74	322	1.08
Composite	47.77	162	9.26	52.23	162	10.25	50.00	324	10.00

Table U-7

Lane Deviation Composite Score by BAC, Age Group, and Gender

BAC	Age Group	Gender	*M*	*SD*	*N*
.00%	21-34	Male	46.99	8.39	15
		Female	44.76	8.76	18
		Total	45.77	8.54	33
	38-51	Male	44.26	8.55	18
		Female	49.68	8.35	15
		Total	46.72	8.76	33
	55-68	Male	47.07	8.45	15
		Female	48.67	6.81	16
		Total	47.89	7.56	31
	Total	Male	45.99	8.40	48
		Female	47.54	8.17	49
		Total	46.77	8.28	97
.05%	21-34	Male	46.74	6.63	15
		Female	50.28	10.31	18
		Total	48.67	8.88	33
	38-51	Male	48.98	11.63	18
		Female	54.03	10.27	15
		Total	51.27	11.16	33
	55-68	Male	49.84	8.63	15
		Female	48.96	10.88	16
		Total	49.38	9.71	31
	Total	Male	48.55	9.27	48
		Female	51.00	10.48	49
		Total	49.79	9.93	97

Table U-7

Lane Deviation Composite Score by BAC, Age Group, and Gender

BAC	Age Group	Gender	*M*	*SD*	*N*
.10%	21-34	Male	54.32	11.78	15
		Female	50.54	10.07	18
		Total	52.26	10.88	33
	38-51	Male	51.29	6.63	18
		Female	59.40	12.21	15
		Total	54.98	10.26	33
	55-68	Male	56.37	11.02	15
		Female	55.27	9.86	16
		Total	55.80	10.28	31
	Total	Male	53.82	9.90	48
		Female	54.80	11.10	49
		Total	54.31	10.48	97

Table U-8

Average Speed Composite Score by BAC, Age Group, and Gender

BAC	Age Group	Gender	*M*	*SD*	*N*
.00%	21-34	Male	48.03	7.56	18
		Female	45.37	11.11	18
		Total	46.70	9.46	36
	38-51	Male	51.09	9.77	18
		Female	50.43	7.29	18
		Total	50.76	8.50	36
	55-68	Male	56.24	10.13	18
		Female	55.98	7.48	18
		Total	56.11	8.78	36
	Total	Male	51.79	9.67	54
		Female	50.59	9.68	54
		Total	51.19	9.65	108
.05%	21-34	Male	48.25	9.91	18
		Female	44.96	10.67	18
		Total	46.60	10.29	36
	38-51	Male	49.87	8.07	18
		Female	47.55	7.30	18
		Total	48.71	7.67	36
	55-68	Male	55.72	8.52	18
		Female	53.55	8.77	18
		Total	54.63	8.59	36
	Total	Male	51.28	9.28	54
		Female	48.69	9.56	54
		Total	49.98	9.47	108

Table U-8

Average Speed Composite Score by BAC, Age Group, and Gender

BAC	Age Group	Gender	*M*	*SD*	*N*
.10%	21-34	Male	47.06	10.51	18
		Female	44.06	11.92	18
		Total	45.56	11.18	36
	38-51	Male	48.64	9.08	18
		Female	46.59	8.68	18
		Total	47.62	8.82	36
	55-68	Male	54.32	11.22	18
		Female	52.30	10.85	18
		Total	53.31	10.93	36
	Total	Male	50.01	10.59	54
		Female	47.65	10.94	54
		Total	48.83	10.78	108

Table U-9

Speed Deviation Composite Score by BAC, Age Group, and Gender

BAC	Age Group	Gender	*M*	*SD*	*N*
.00%	21-34	Male	48.59	9.33	18
		Female	54.89	5.19	18
		Total	51.74	8.09	36
	38-51	Male	49.07	7.74	18
		Female	53.54	7.92	18
		Total	51.31	8.04	36
	55-68	Male	47.51	8.33	18
		Female	49.58	11.09	18
		Total	48.54	9.72	36
	Total	Male	48.39	8.35	54
		Female	52.67	8.57	54
		Total	50.53	8.69	108
.05%	21-34	Male	50.18	6.52	18
		Female	53.16	12.01	18
		Total	51.67	9.64	36
	38-51	Male	49.34	8.84	18
		Female	53.87	10.61	18
		Total	51.61	9.90	36
	55-68	Male	47.60	9.50	18
		Female	50.47	11.28	18
		Total	49.03	10.38	36
	Total	Male	49.04	8.30	54
		Female	52.50	11.20	54
		Total	50.77	9.96	108

Table U-9

Speed Deviation Composite Score by BAC, Age Group, and Gender

BAC	Age Group	Gender	*M*	*SD*	*N*
.10%	21-34	Male	48.26	13.51	18
		Female	55.60	9.41	18
		Total	51.93	12.06	36
	38-51	Male	45.68	8.51	18
		Female	49.27	12.56	18
		Total	47.48	10.73	36
	55-68	Male	43.73	9.78	18
		Female	49.68	9.95	18
		Total	46.71	10.18	36
	Total	Male	45.89	10.77	54
		Female	51.52	10.92	54
		Total	48.70	11.16	108

Table U-10

Lane Deviation by BAC Status Across Events

	BAC Status								
	BAC < .08%			BAC ≥ .08%			Total		
Event	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Urban Drive (102)	**.80**	**223**	**.19**	**.85**	**89**	**.17**	**.82**	**312**	**.19**
Green Light (103)	**.61**	**223**	**.21**	**.66**	**89**	**.23**	**.62**	**312**	**.21**
Yellow Dilemma (104)	**.61**	**223**	**.26**	**.69**	**86**	**.31**	**.63**	**309**	**.28**
Urban Curves (106)	**.92**	**224**	**.17**	**1.05**	**89**	**.21**	**.96**	**313**	**.19**
Interstate Curves (205)	**1.51**	**223**	**.32**	**1.76**	**86**	**.75**	**1.58**	**309**	**.49**
Lighted Rural (302)	.44	224	.24	.45	89	.25	.44	313	.24
Transition to Dark Rural (303)	.77	224	.28	.77	89	.26	.77	313	.27
Dark Rural (304)	**1.05**	**223**	**.22**	**1.20**	**89**	**.28**	**1.10**	**312**	**.24**
Dark Rural Hairpin Curve (304)	.91	223	.30	.94	89	.33	.92	312	.31
Gravel Rural (306)	**.78**	**223**	**.22**	**.88**	**89**	**.28**	**.81**	**312**	**.24**
Composite	**48.14**	**220**	**9.12**	**54.32**	**83**	**10.60**	**49.83**	**303**	**9.92**

Note. BAC differences shown in bold are statistically significant at $p < .05$.

Table U-11

Average Speed by BAC Status Across Events

	BAC Status								
	BAC < .08%			BAC ≥ .08%			Total		
Event	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Urban Drive (102)	**27.34**	**223**	**3.33**	**28.46**	**89**	**3.92**	**27.66**	**312**	**3.54**
Green Light (103)	**27.65**	**223**	**3.69**	**28.85**	**89**	**4.94**	**27.99**	**312**	**4.11**
Yellow Dilemma (104)	**17.20**	**224**	**11.63**	**20.09**	**89**	**11.17**	**18.02**	**313**	**11.56**
Left Turn (105)	18.48	224	4.57	19.07	89	4.73	18.65	313	4.61
Urban Curves (106)	34.09	224	3.25	34.43	89	3.74	34.19	313	3.39
Interstate Curves (205)	66.09	223	4.87	66.66	86	4.18	66.25	309	4.69
Exit Ramp (206)	33.52	224	5.10	34.40	89	5.18	33.77	313	5.13
Lighted Rural (302)	55.18	224	3.26	54.83	89	3.03	55.08	313	3.19
Transition to Dark Rural (303)	54.94	224	3.76	54.07	89	3.91	54.70	313	3.82
Dark Rural (304)	52.32	223	3.29	52.50	89	3.54	52.37	312	3.36
Dark Rural Hairpin Curve (304)	45.36	223	4.31	45.38	89	4.75	45.37	312	4.43
Gravel Transition (305)	44.28	223	6.61	45.10	89	6.89	44.52	312	6.69
Gravel Rural (306)	43.19	223	7.16	43.90	89	8.13	43.39	312	7.44
Composite	50.53	224	9.61	49.04	89	10.81	50.11	313	9.97

Note. BAC differences shown in bold are statistically significant at $p < .05$.

Table U-12

Speed Deviation by BAC Status Across Events

	BAC Status								
	BAC < .08%			BAC ≥ .08%			Total		
Event	*M*	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Urban Drive (102)	3.16	223	1.93	3.53	89	2.28	3.27	312	2.04
Green Light (103)	1.37	223	.78	1.38	89	.70	1.38	312	.76
Yellow Dilemma (104)	4.29	224	3.97	4.22	89	4.41	4.27	313	4.09
Urban Curves (106)	2.82	224	.84	2.84	89	.79	2.82	313	.82
Interstate Curves (205)	2.09	223	.98	2.14	86	1.13	2.11	309	1.03
Lighted Rural (302)	.52	224	.36	.60	89	.52	.55	313	.42
Transition to Dark Rural (303)	.86	224	.64	1.03	89	.77	.91	313	.68
Dark Rural (304)	4.78	223	1.02	4.68	89	1.14	4.75	312	1.06
DarkRural (304) (HP)	2.66	223	1.19	2.52	89	1.17	2.62	312	1.19
Gravel Transition (305)	3.44	223	1.79	3.67	89	1.77	3.51	312	1.78
Gravel Rural (306)	2.71	223	1.08	2.79	89	1.11	2.73	312	1.08
Composite	50.55	224	9.51	49.13	89	11.10	50.15	313	9.99

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