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Task Report: On-Road Study of Willingness to Engage in Distracting Tasks

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16. Abstract <p>This experiment addressed drivers' willingness to engage in various sorts of potentially distracting tasks. Eighty-eight participants were equally distributed among four age groups: teen (16-17), young (18-24), middle (25-59), and older (60+). There were two parts to the data collection: an on-road portion and a take-home booklet portion. In the on-road portion, participants drove their own vehicles over a specified route. At selected points, the experimenter described a specific in-vehicle task. Participants rated how willing they would be to engage in that task at that time and place. Participants also rated how risky it would be to engage in that task at that time and place. Participants did not actually engage in the task. Eighty-one on-road situations were included, where a situation was the combination of a specific in-vehicle task and a specific driving location and maneuver. The in-vehicle tasks included various activities involving cell phones, PDAs, and navigation systems. The take-home booklet sought information about the participant's familiarity with various in-vehicle technologies, additional situations for willingness and risk ratings, stated reasons underlying ratings, and self-ratings of certain aspects of driving behavior and decision-making style. Ratings of willingness and of risk were highly correlated and yielded essentially the same findings. Analyses examined in detail the relationship of willingness to engage in a task as a function of specific tasks, driver age and sex, driving maneuvers and roadway types, environmental factors, familiarity with the technology, and individual driver attributes related to driving style, decision style, and multi-tasking. Differences in willingness, risk perception, and stated reasons for ratings were seen among age groups. Willingness to engage in potentially distracting activities was also related to more general driver attributes of driving intensity and multitasking.</p> <p>The National Institute of Child Health and Human Development, Prevention Research Branch, Division of Epidemiology, Statistics, and Prevention Research, contributed funding specifically for the inclusion of teen-age study participants (under Contract GS-23F-8144H: Pilot Assessment of Young Driver Distraction).</p>			
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Abstract

This report describes the findings of an on-the-road experiment addressing drivers' willingness to engage in various sorts of potentially distracting tasks. Eighty-eight participants took part in the study, equally distributed among four age groups: teen (16-17), young (18-24), middle (25-59), and older (60+). There were two parts to the data collection: an on-road portion and a take-home booklet portion. In the on-road portion, participants drove their own vehicles over a specified route. At selected points, the experimenter described a specific in-vehicle task. Participants rated how willing they would be to engage in that task at that time and place. Participants also rated how risky it would be to engage in that task at that time and place. Participants did not actually engage in the task. Eighty-one different situations were included in the on-road portion of the experiment, where a situation was the combination of a specific in-vehicle task and a specific driving location and maneuver. Eleven different driving locations/maneuvers on various roadway types were included. Fourteen different in-vehicle tasks were included, among them various activities involving cell phones, PDAs, and navigation systems. After completing the on-road portion, participants were given a booklet to take home and complete. The booklet questions sought information about the participant's familiarity with various in-vehicle technologies, additional situations for willingness and risk ratings, stated reasons underlying ratings, and self-ratings of certain aspects of driving behavior and decision-making style.

Ratings of willingness and of risk were highly correlated and yielded essentially the same findings. Analyses examined in detail the relationship of willingness to engage in a task as a function of specific tasks, driver age and sex, driving maneuvers and roadway types, environmental factors, familiarity with the technology, and individual driver attributes related to driving style, decision style, and multi-tasking. In general, there was little reluctance to engage in most cell phone activities in any situation. People were more willing to use cell phones while driving than to use navigation systems, and more willing to use navigation systems than PDAs. Typical cell phone tasks (dialing, conversation) were seen as roughly equivalent in risk to such other activities as drinking something hot or tuning a radio, and less risky than eating something messy (such as a taco). Willingness was generally not strongly related to roadway type, although it was sensitive to specific driving maneuvers (e.g., exiting a freeway, making a left turn at an arterial intersection). Differences in willingness, risk perception, and stated reasons for ratings were seen among age groups. Willingness to engage in potentially distracting activities was also related to more general driver attributes of driving intensity and multitasking.

1.0 Background and Objective

The potential hazard of distraction when using in-vehicle technologies has become a major concern in the highway safety field (Llaneras, 2000). In this report, the term “in-vehicle technology” refers to a device that may be used in a vehicle, whether it is a portable device carried into the vehicle or an installed device embedded in the vehicle. Cellular phones are the most familiar example of an in-vehicle device and are the subject of serious debate about appropriate use and needs for regulation. Other in-vehicle devices, such as navigation systems, are becoming more common in new vehicles and more extensive information and communication systems are under development. To minimize the risks of distraction from in-vehicle technologies, two factors must be addressed: 1) the attentional demands the technology design imposes on the driver and 2) the driver’s decision to use the technology while driving. The first of these issues has received considerable research attention while the second has received almost none.

Numerous studies have now demonstrated that in-vehicle technology use can have deleterious consequences on aspects of the driving task: lane positioning, speed control, car following, situation awareness, hazard recognition. These studies typically have research participants drive a vehicle (or driving simulator) under conditions determined by the experimenter and engage in tasks specified by the experimenter, at times and places controlled by the experimenter. Thus this research addresses the very important question of what can happen when a driver attempts to engage in some task under certain driving conditions. What it does not tell us is what drivers actually choose to do while driving. An in-vehicle technology presents a safety problem to the extent that drivers choose to use it at inappropriate times. The actual risk associated with some device will be a joint function of how that device interferes with driving and the circumstances under which drivers are willing to use that device. While there has been some qualitative consideration of driver motivation and decision making through focus group studies (e.g., Lerner and Balliro, 2003a), there does not appear to be any quantitative, roadway-based research to understand driver willingness to engage in various tasks. The focus of the research presented here concerns the factors influencing a driver’s willingness to engage in certain non-driving tasks. Information about driver decision making may contribute to a broad array of distraction-related countermeasures, such as public education, driver training, user interface design, needs for warnings, criteria for lock-outs of certain functions while driving, function allocation for driver assist systems, criteria for safety assessments, and design of adaptive driver interface systems.

Individual driver attributes are likely to be important considerations for understanding driver decisions about engaging in in-vehicle tasks. In particular, driver age is known to be associated with crashes, performance capabilities, in-vehicle device use, attention-sharing capabilities, and risk perception. Inexperienced teenage drivers and older drivers are groups that merit specific attention. Teen drivers are more likely to engage in high-risk behaviors, have motivations distinct from other drivers, and be less capable in various aspects of the driving task (Lerner, Tornow, Freedman Llaneras, Rabinovich, and Steinberg, 1999). Older drivers experience a range of perceptual and information-processing decrements and tend to be more risk-averse (Dewar, 2001). Therefore it is important that any effort to investigate driver willingness to

engage in technology use give specific consideration to these at-risk driver groups, as well as to the driving population at large.

This report describes the method and findings of an on-the-road experiment addressing drivers' willingness to engage in various sorts of potentially distracting tasks. This experiment is one portion of a larger effort to understand how drivers make decisions about engaging in tasks, particularly technology-related tasks, that may entail risks of distraction. This work is jointly funded by the National Highway Traffic Safety Administration and by the National Institute of Child Health and Human Development. In an initial phase of the work, focus groups on the topic were conducted with drivers who were also technology users. Separate groups were conducted for each of four age groups: teenagers (16-18), young (18-24), middle (30-55), and older (60+). The findings of these focus groups (reported in Lerner and Balliro, 2003a, Lerner and Balliro, 2003b) helped provide a basis for the scenarios and methods used in the on-the-road experiment.

The on-road experiment examines both driving situation variables and distracting task variables as they relate to driver decisions about engaging in tasks. Driver factors are also of interest, particularly age and familiarity with the technology. Driver age is known to influence risk taking in general, with young drivers being more risk-willing and older drivers being more risk-averse. There are also findings of different types and degrees of in-vehicle technology use associated with driver age. Therefore this study includes comparison of driver age groups.

2.0 Method

2.1 Overview

The primary purpose of the experiment was to collect ratings of how willing drivers would be to engage in various in-vehicle tasks under various driving conditions. There were two phases to the data collection: on-road drive and take home questionnaire. In the on-road portion, participants drove a specified route in their own vehicles. At selected points, the experimenter described an in-vehicle task, and the participant rated how willing they would be to engage in the task at that time and place and how risky it would be to do so. The participants never actually engaged in the in-vehicle task, but simply indicated their willingness to do so. Each participant rated 81 unique combinations of in-vehicle task and driving situation.

After completing the on-road phase, the participant was given a take-home questionnaire booklet to complete and return by mail. The questionnaire had several purposes:

- To provide an explanation of why certain situations were given their particular ratings
- To rate new situations which included factors not present during the on-road phase (such as inclement weather, presence of certain passenger types, traffic congestion)
- To benchmark the booklet ratings by including some rating situations identical to those encountered on the road
- To get detailed information on the participant's familiarity with various in-vehicle technologies and tasks
- To obtain self-ratings of certain aspects of driving behavior/attitudes and decision-making style.

2.2 Participants

Eighty-eight licensed drivers (43 males, 45 females) in the Washington, DC area were recruited to participate in the study. All participants had normal or corrected-to-normal vision, access to a personal vehicle, and current vehicle insurance. Participants were evenly divided between four age groups: Teen (16-17), Young (18-24), Middle (25-59), and Older (60+). Potential participants were recruited and screened for self-reported familiarity with in-vehicle devices. The actual degree of familiarity was later established from the response to questions in the take-home questionnaire. All drivers reported using a cell phone in their vehicles. Lower rates of familiarity were reported for PDA or navigation system use.

Table 1 provides a more detailed breakdown of participant characteristics and in-vehicle technologies used. For the 22 participants in each age group, the table shows the percent of males and females and the percent who reported themselves to be at least "somewhat familiar" with a given technology (based on rated familiarity answers in the take home booklet).

Age Group	N	Male	Female	Familiar Cell Phone	Familiar PDA	Familiar Navigation
Teen (16-17)	22	50%	50%	100%	41%	23%
Young (18-24)	22	50%	50%	100%	86%	55%
Middle (25-59)	22	36%	64%	100%	77%	68%
Older (60 +)	22	59%	41%	100%	64%	68%

Table 1. Summary of Research Participant Characteristics

2.3 On-Road Ratings

The purpose of the on-road study was to determine drivers' willingness to engage in various in-vehicle tasks and to determine how risky they believe those tasks to be. For safety reasons, drivers did not actually perform the tasks. Rather, they gave verbal ratings of willingness and risk. Both willingness and risk were rated on a scale of 1 to 10. For willingness, a rating of 1 corresponded to 'I would absolutely not do this task now' and a rating of 10 corresponded to 'I would be very willing to do this task now with no concerns at all.' For the ratings of the risk involved in performing a task, a rating of 1 corresponded to 'No additional risk beyond my normal driving' and a rating of 10 corresponded to 'Very likely I would be involved in an accident.'

During the course of the on-road study, the experimenter verbally presented participants with 14 in-vehicle tasks that involved performing different functions with a cell phone, a navigation system, and a PDA, in addition to non-technological tasks such as eating, drinking, and conversing with a passenger. The complete list of in-vehicle tasks is presented in Table 2. Participants were asked to rate each of the 14 tasks multiple times at different locations.

There were 11 locations which differed from one another in terms of road type and maneuver. Table 3 describes each of these. In total, participants were asked to make 81 ratings of willingness and risk. Each rating situation was a unique combination of in-vehicle task and road location (roadway/maneuver). Table 4 presents a matrix showing the combinations of tasks and locations used during the on-road study. As evident from the matrix, the 81 situations evaluated represent a selection from the full set of 154 possible combinations (14 tasks X 11 locations). Based on piloting, it was determined that the maximum number of data trials that were practical with a single session was about 80. The subset selected for inclusion in the study was chosen to provide a broad sampling of sites and tasks and allow for some driving situations to be paired with the full range of in-vehicle tasks. The non-systematic structure of the subset of possible situations does not allow for an analyses of variance of the full data that can isolate the main effects of in-vehicle task and driving location, and their interaction. However, note in Table 4 that, for three roadway locations (freeway mainline, arterial mainline, two-lane road), all 14 in-vehicle tasks were presented. Therefore the design allowed a task-by-location ANOVA for this subset.

Device/Object	Task	Narrative Description
Cell phone	Answer a call	Your phone rings. You are not expecting a call. Your caller ID shows an unfamiliar number: willingness to answer the incoming call.
Cell phone	Key in a call	You are running late to meet a friend. You know your friend's phone number by memory: willingness to key in a call.
Cell phone	Hold personal conversation	You are engaged in a personal cell phone conversation with a close friend: willingness to continue conversing on the phone.
Cell phone	Key in text message	You want to remind your friend/family member of your dinner plans for this evening: willingness to key in and send a short text message.
PDA	Look up stored phone number	You are on your way to see your physician but cannot remember his/her exact street address. You want to call to find out but do not remember the phone number: willingness to look up a stored number in PDA.
PDA	Pick up and read email	You are expecting an email message from a co-worker: willingness to check PDA for new messages and read email if it has arrived.
PDA	Key in and send email	You want your spouse or roommate to pick something up for dinner on their way home from work: willingness to send a short email asking him/her to pick something up.
Navigation system	Key in new destination	You have left your house in a rush and are heading toward an unfamiliar area: willingness to key a destination into your navigation system.
Navigation system	Call up stored destination	You are in an unfamiliar area and would like to head home but are unsure of the best route to take: willingness to access a stored destination in your navigation system.
Navigation system	Search for nearby Starbucks	You would like to find a nearby Starbucks: willingness to search for the nearest Starbucks using your navigation system's search feature.
CD player	Select and insert CD	You would like to hear a CD that is in your CD book, located in the glove box: willingness to search for and insert a CD.
Passenger	Hold personal conversation	You are driving with a passenger in your vehicle: willingness to converse with the passenger.
Beverage	Drink hot beverage	You have a hot drink with a lid on it: willingness to drink it.
Food	Unwrap and eat taco	You bought a taco and are hungry. The taco is in a wrapper: willingness to eat the taco.

Table 2. In-Vehicle Tasks Rated On-the-Road

Roadway Type	Maneuver	Description
Freeway	Proceeding on mainline	Driving along mainline lanes of a 4-lane (plus local lanes separated by barrier) suburban interstate highway, 55 mph speed limit
Freeway	Entrance/merge	Arterial road approach to freeway entrance ramp and merge lane
Freeway	Exit	Move to freeway exit lane and take off ramp
Arterial	Proceeding on mainline	Driving along in through lanes of 3-lane arterial in commercial area
Arterial	Unprotected left	Left turn from a left turn bay at an unprotected signalized intersection on the arterial,
Arterial	Protected U-turn	U-turn on the arterial at an intersection with a left turn bay and protected signal phase (vehicle may have made maneuver during either protected or unprotected phase)
Arterial	Stopped at signal	Stopped for a red traffic signal on the arterial road
Parking lot	Exit to arterial	Approaching lot driveway to exit and turn right onto arterial road
Parking lot	Search for parking space	Drive up and down aisles of supermarket lot
Two-lane highway	Proceeding	Drive along two-lane highway with many curves and no shoulder, 35 mph speed limit
Residential	Proceeding	Drive on residential streets in a single family home community, little traffic

Table 3. Roadway Locations at Which Ratings Were Obtained

IN-VEHICLE TASKS

DRIVING LOCATION	CELL PHONE TASKS				PDA TASKS			NAVIGATION SYSTEM TASKS			NON-TECHNOLOGY TASKS			
	Answer a call	Key in a call	Personal Conversation	Enter Text Message	Look up stored phone number	Pick up & read message	Key & send email	Key in a new destination	Call up a stored destination	Search for Starbucks	Search for and insert CD	Converse with passenger	Hot drink	Eat a Taco
Freeway Mainline	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Freeway Entrance/Merge	X	X	X	X		X		X						
Freeway Exit	X	X				X		X						
Arterial Mainline	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Arterial U-turn/Protected	X							X						
Arterial Left turn/Unprotected	X					X								
Arterial Stopped at Signal	X	X				X		X						
Parking Lot - Inside	X	X	X			X		X	X		X	X	X	X
Parking Lot - Exit to Arterial	X	X				X					X			X
Minor 2 Lane/Winding	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Minor Local/Residential	X	X	X	X		X		X						

Table 4. Combinations of In-Vehicle Tasks and Roadway Locations Included in the Experiment

2.4 On-Road Driving Route

The 45-mile test route was located in Montgomery County, Maryland, and took between 60 and 90 minutes to complete. The route encompassed different road types: freeway, arterial, two-lane winding highway, residential street, and parking lot. Participants drove their own vehicles and were instructed to drive as they normally would, and were guided through the route by the experimenter. Appendix A is the experimenter's guide that describes the route and the locations where ratings were to be collected.

In driving the route, the various locations for ratings were blocked into three distinct route segments: arterial (including parking lot); freeway (including arterial approach to freeway entrance); and minor road (two-lane highway and residential street). To control for effects of familiarity and experience, participants drove the test route in one of four randomly-assigned sequences: Arterial – Minor – Freeway (AMF), Freeway – Minor – Arterial (FMA), Freeway – Arterial – Minor (FAM), and Minor – Arterial – Freeway (MAF). The route within each segment of the trip remained constant.

2.5 Procedure

Sessions were conducted on weekdays, in mid-morning and afternoon, and timed to avoid periods of peak congestion. Traffic on the arterial road at these times was typically significant but not impeded; traffic on the freeway was moderate and free-flow. Most sessions took place in clear dry weather. Occasional participants encountered light rain during portions of their drive. Sessions were canceled if there was steady rain. Participants were instructed to bring their driver's license, proof of auto insurance, and in the case of teen participants, the completed parental consent form. All participants were also directed to have at least a half tank of fuel in their vehicles.

The participant met the experimenter at an office site in Rockville, Maryland. Upon the participant's arrival, the experimenter gave the participant a brief summary of the purpose of the study. The participant then read and signed the informed consent form. Next, the experimenter played an 11-minute training video which was used to clarify each in-vehicle task for the participant. The training examples included both carry-on (e.g. cell phone) and installed (e.g., navigation system) example devices. The video showed a model performing the tasks as a narrator described the actions being performed by the model. Participants were instructed to imagine performing tasks as they normally would, but to refer back to the video for tasks with which they were not familiar. So, for example, if a participant was unfamiliar with the task of entering a destination into a navigation system, the video showed the steps involved. If the participant was already familiar with this task, the video clarified certain aspects (e.g., the destination was not stored), but the participant was free to imagine use of his or her own personal system, which might differ in some ways from the product used in the video demonstration.

After the video was completed and the participant had the opportunity to ask questions, the experimenter outlined the details of the on-road procedure and thoroughly explained the rating scales. The participant and experimenter then initiated the drive session, which began with

practice in using the rating scales. The experimenter sat in the rear seat on the passenger side, from where he or she read instructions and recorded the participant's ratings. On the way to the first test site, the experimenter guided the participant through five practice trials. Practice trials followed the same procedure as the study trials that followed. The experimenter provided feedback and questioned the participant to confirm his or her understanding of the procedure and his or her confidence in using the rating scales. Practice was extended until both the experimenter and participant felt confident in the ratings.

Upon arrival at the test site, the experimenter began presenting the study trials. The experimenter had a list of tasks which included the location where each task should be presented. A description of the task was read to the participant as the vehicle was approaching the point where the rating was to be made. The experimenter then said "Now" when the vehicle actually reached the point where the rating was to be made. For some locations, the precise timing was not very critical (e.g., for driving along the mainline section of freeway). For other situations, such as approaching a freeway exit ramp or turning out of a parking lot onto a busy arterial, the timing was more critical and the point of saying "now" was more precisely defined. Participants were instructed to give their first impression and to answer quickly once the experimenter requested a rating. As an example, for the task of answering a cell phone call at the location of a freeway exit maneuver, as the exit area was being approached the experimenter would read "Your phone rings. You are not expecting a call. Your caller ID shows an unfamiliar number. Willingness to answer incoming call:" As the vehicle moved to the exit lane, the experimenter would say "now." The participant would then immediately provide a rating (1-to-10) of his or her willingness to answer a call at that point. Then he or she would provide a second rating to indicate the risk involved in answering a call at that point. This procedure was used for all 81 combinations of in-vehicle tasks and locations. The experimenter recorded ratings on a data collection form. Three different versions of the data collection forms were prepared, differing in the order in which tasks were listed. The version of the data collection form to be used for each participant was determined randomly before the session.

After completing the test route and returning to the office site, the experimenter provided the participant with the take-home booklet. The participant was encouraged to complete the booklet as soon as possible so that he or she could accurately recall the driving situations and answer questions related to his or her ratings. The participant was given partial payment for his or her participation, the balance to be sent to him or her after he or she mailed back the completed questionnaire using a pre-addressed envelope.

The detailed experimenter protocol for the session is attached as Appendix B.

2.6 Take-home Booklet

The take-home booklet was comprised of a cover page and five sections of questions. A copy of the booklet is in Appendix C. The five sections were in the same sequence for all participants; however, several different random orders of questions within Parts 1 and 2 were used. The cover section included spaces where the participant indicated his or her age, gender, and years licensed to drive. No other personal identifying information was included on the form. Part 1 of the

booklet included spaces where participants explained why they rated certain situations as they did. Eight situations from the on-road drive were presented; these were:

- Keying in a cell phone call while driving on an interstate highway
- Continuing a personal cell phone conversation while merging onto a freeway
- Keying in a text message on a cell phone while driving on an arterial road
- Keying in a text message on a cell phone while driving on a winding two-lane road
- Checking for and reading email from a PDA while at a red light on an arterial road
- Recalling directions for a stored destination in a navigation system while driving on an interstate highway
- Keying in a new destination in a navigation system while driving on a residential road
- Eating a taco while driving on an interstate highway

The ratings of willingness and risk that the participant had given on-road were indicated for each situation. The experimenter recorded this information in the booklet before giving the booklet to the participant. The participant’s task was to “explain exactly why you rated the situation as you did.”

Part 2 of the questionnaire included questions asking participants to rate situations for willingness to engage and risk. The questions used the same rating scales employed in the on-road phase. The instructions for Part 2 noted the similarity of the scenes to what the participant had encountered during the on-road drive, except that some situational aspect might be included. Twenty situations were presented, in a standard form, as shown in the example below:

Trip Conditions	The Task You Want To Do
Location: I-270 freeway; there is road construction going on and one lane is closed Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Key a new destination into your navigation system. You are in a rush and heading toward an unfamiliar destination.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

Five of these twenty situations were identical to situations encountered during the on-road drive. These allowed a direct comparison of on-road and booklet ratings, to determine what, if any, differences existed between the two procedures. The other 15 situations modified situations that had been encountered on the road. These modifications included things such as weather, passengers, traffic, and driver states. Table 5 describes the twenty situations included in Part 2. The first five situations in the list are the replications of on-road situations and the subsequent fifteen situations are those with some added feature.

Part 3 of the booklet included questions that asked participants to rank how risky each of 32 in-vehicle tasks are and how risky each of ten driving conditions are. Unlike previous sections, these were *general* ratings in that in-vehicle tasks were rated for driving in general (not a specific location) and locations were rated without respect to any in-vehicle task. For the three tasks rated as most risky, and the two sites rated as most risky, the participants were asked to explain why these were seen as most risky.

Part 4 included questions that asked participants to rate their familiarity with technologies and tasks associated with the use of the particular devices, using a five point scale (1= very unfamiliar, 5= very familiar). There were questions related to cell phones, PDAs, and navigation systems. Participants were asked whether they had such devices. The first rating question was then, "How familiar are you with your [device] functions and capabilities?" The second question was, "How familiar are you with using the [device] while you drive?" Subsequent questions then asked about familiarity with doing specific tasks (e.g., opening and reading an email on the PDA).

Part 5 of the booklet included questions that asked the participant to make various self-ratings; this part was divided into subparts. The ratings were on a five-point scale, where 1= strongly disagree and 5= strongly agree. In Part 5A, the participants rated their agreement with descriptions of driving attitudes or behaviors. Some of these dealt with the intensity or aggressiveness of their driving (e.g., I like to drive at relatively high speed) and others dealt with multitasking while driving (e.g., compared to the average driver, I am very good at handling multiple activities while I drive). Part 5B dealt with decision making style, and was not tied specifically to driving. The questions were related to how impulsive or deliberative the participant generally tends to be (e.g., when I am presented with a problem, I stop and think things through before I act).

Participants returned the completed booklet using a pre-addressed stamped envelope. Most booklets were returned within about a week of the on-road session.

In-Vehicle Task	Roadway Location	Additional Feature
Answer cell phone call	Arterial road	
Key in cell phone number	Parking lot	
Check email on PDA	Freeway	
Enter navigation destination	Freeway entrance	
Find and retrieve CD	Two-lane winding road	
Answer cell phone call	Arterial road	Hard rain
Answer cell phone call	Arterial road	3 year old child in vehicle
Answer cell phone call	Arterial road	Two friends (age peers) in vehicle
Key in cell phone number	Arterial road	Hard rain
Key in cell phone number	Arterial road	Heavy traffic congestion
Key in cell phone number	Arterial road	Darkness
Key in cell phone text message	Arterial road	Two friends (age peers) in vehicle
Key in cell phone text message	Arterial road	Hard rain
Unwrap and eat taco	Arterial road	3 year old child in vehicle
Enter navigation destination	Freeway	Construction zone
Answer cell phone call	Freeway	Fatigue
Nav system search for Starbucks	Freeway	Fatigue
Key in cell phone number	Freeway	Long boring drive
Check email on PDA	Freeway	Heavy traffic congestion
Check email on PDA	Freeway entrance	Expecting urgent business message

Table 5. Situations Included in Part 2 of the Booklet.

3.0 Findings

3.1 On-road Ratings of Willingness and Risk

The group mean ratings of willingness to engage in a task for each of the 81 driving situations (in-vehicle task at a given location) are presented in Table 6. The columns of the matrix show the in-vehicle task and the rows show the driving location; the entries in each cell show the mean willingness ratings for the entire group of 88 participants. Table 7 provides analogous data for the risk ratings. As evident from these tables, the ratings varied widely across the situations. On the 1-to-10 rating scale, group mean willingness scores ranged from 2.76 (for picking up a PDA message at a freeway exit area) to 9.24 (for conversing with a passenger on an arterial road). Group mean risk ratings ranged from 2.03 (for conversing with a passenger on a two-lane road) to 7.73 (for picking up a PDA message at a freeway exit area). For both willingness and risk ratings, the ratings were significantly related to the driving situation. The willingness ratings and risk ratings were each subjected to a three-factor (situation X age group X gender) analysis of variance. The analyses are summarized in Table 8. The findings were similar for both types of ratings. The main effects of situation, age, and gender were statistically significant. The age-by-gender interaction was statistically significant. However, none of the interactions with driving situation were significant. This means that the relative relationships among the various driving situations were similar for all four age groups. The main effects of age and gender, and their interaction, can be seen in Figures 1 (for willingness) and 2 (for risk). “Willingness” decreases with age and “risk” increases with age. Males rate higher willingness and lower risk than females. Gender effects are pronounced for willingness for the older group; gender effects are pronounced for risk for both the middle age and older groups. However, there is little effect of gender for the teenage and young driver groups.

Appendix D presents the mean ratings and standard deviations for all 81 situations in list form. For each situation, the appendix shows the group mean willingness rating, the standard deviation of the willingness ratings, the group mean risk rating, and the standard deviation of the risk ratings. The standard deviations, across the group of 88 participants, were generally in the range of 2-to-3 rating scale units, with the willingness ratings showing slightly larger standard deviations than the risk ratings. For willingness, the standard deviations ranged from 1.62 to 3.37, with a median of 2.78. For risk, the standard deviations ranged from 1.71 to 3.15, with a median of 2.51. For both willingness and risk ratings, the standard deviations were smallest for the four situations involving conversation with a passenger. For both willingness and risk ratings, the standard deviations were highest (i.e., agreement among participants was least) for the two situations that involved answering a cell phone call while dealing with a turning maneuver (unprotected left turn or protected U-turn).

IN-VEHICLE TASKS

DRIVING LOCATION	CELL PHONE TASKS				PDA TASKS			NAVIGATION SYSTEM TASKS			NON-TECHNOLOGY TASKS			
	Answer a call	Key in a call	Personal Conversation	Enter Text Message	Look up stored phone number	Pick up & read message	Key & send email	Key in a new destination	Call up a stored destination	Search for Starbucks	Search for and insert CD	Converse with passenger	Hot drink	Eat a Taco
Freeway Mainline	6.79	6.78	7.94	3.44	4.55	3.45	3.01	4.70	5.50	4.98	5.98	9.19	6.91	5.83
Freeway Entrance/Merge	6.42	5.33	7.55	3.32		3.25		3.94						
Freeway Exit	6.07	5.22				2.76		3.26						
Arterial Mainline	7.13	6.80	8.05	3.75	4.49	3.75	3.26	4.52	5.65	4.47	5.86	9.24	6.97	6.00
Arterial U-turn/Protected	4.51					3.01								
Arterial Left turn/Unprotected	5.47							4.11						
Arterial Stopped at Signal	8.06	8.11				6.20		6.92						
Parking Lot - Inside	6.50	6.13				4.05					5.36			5.27
Parking Lot - Exit to Arterial	7.03	6.27	7.33			4.00		5.22	5.58		6.43	8.99	6.07	5.35
Minor 2 Lane/Winding	7.26	7.01	7.98	3.92	4.74	3.69	3.32	4.85	5.68	4.74	6.09	9.23	7.47	6.00
Minor Local/Residential	7.82	7.41	8.57	4.83		4.74		5.60						

Table 6. Mean willingness ratings for on-road situations

IN-VEHICLE TASKS

DRIVING LOCATION	CELL PHONE TASKS				PDA TASKS			NAVIGATION SYSTEM TASKS			NON-TECHNOLOGY TASKS			
	Answer a call	Key in a call	Personal Conversation	Enter Text Message	Look up stored phone number	Pick up & read message	Key & send email	Key in a new destination	Call up a stored destination	Search for Starbucks	Search for and insert CD	Converse with passenger	Hot drink	Eat a Taco
Freeway Mainline	4.22	4.59	3.67	7.07	6.44	7.16	7.59	6.48	7.07	6.09	5.45	2.33	4.08	5.17
Freeway Entrance/Merge	4.45	5.59	3.98	7.44		7.38		6.74						
Freeway Exit	5.00	5.92				7.73		7.67						
Arterial Mainline	3.92	4.74	3.43	7.09	6.10	6.89	7.27	6.36	5.28	6.28	5.27	2.13	4.17	4.94
Arterial U-turn/Protected	6.42					7.38								
Arterial Left turn/Unprotected	5.67							6.37						
Arterial Stopped at Signal	2.39	2.66				4.28		3.78						
Parking Lot - Inside	4.09	4.49				6.09					4.91			4.99
Parking Lot - Exit to Arterial	4.09	4.50	3.78			6.11		5.45	4.98		4.34	2.27	4.60	5.10
Minor 2 Lane/Winding	3.55	4.15	3.32	6.68	6.26	6.84	7.25	6.16	5.13	6.03	5.23	2.03	3.68	5.10
Minor Local/Residential	2.95	3.41	2.63	5.48		5.69		5.47						

Table 7. Mean risk ratings for on-road situations

WILLINGNESS

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Situation	80	19433.39	242.92	35.09	<.0001
Age Group	3	3046.12	1015.37	146.69	<.0001
Gender	1	486.75	486.75	70.32	<.0001
Situation x Age Group	240	1711.22	7.13	1.03	0.3636
Situation x Gender	80	422.17	5327717.00	0.76	0.9430
Age Group x Gender	3	670.31	233.44	32.28	<.0001
Situation x Age Group x Gender	240	1443.31	6.01	0.87	0.9266

RISK

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Situation	80	15440.93	193.01	32.05	<.0001
Age Group	3	2336.66	778.89	129.34	<.0001
Gender	1	301.74	301.74	50.10	<.0001
Situation x Age Group	240	1447.17	6.03	1.00	0.4831
Situation x Gender	80	388.72	4.86	0.81	0.8945
Age Group x Gender	3	632.41	210.80	35.00	<.0001
Situation x Age Group x Gender	240	1260.52	5.25	0.87	0.9210

Table 8. Analyses of variance for on-road ratings of willingness and risk

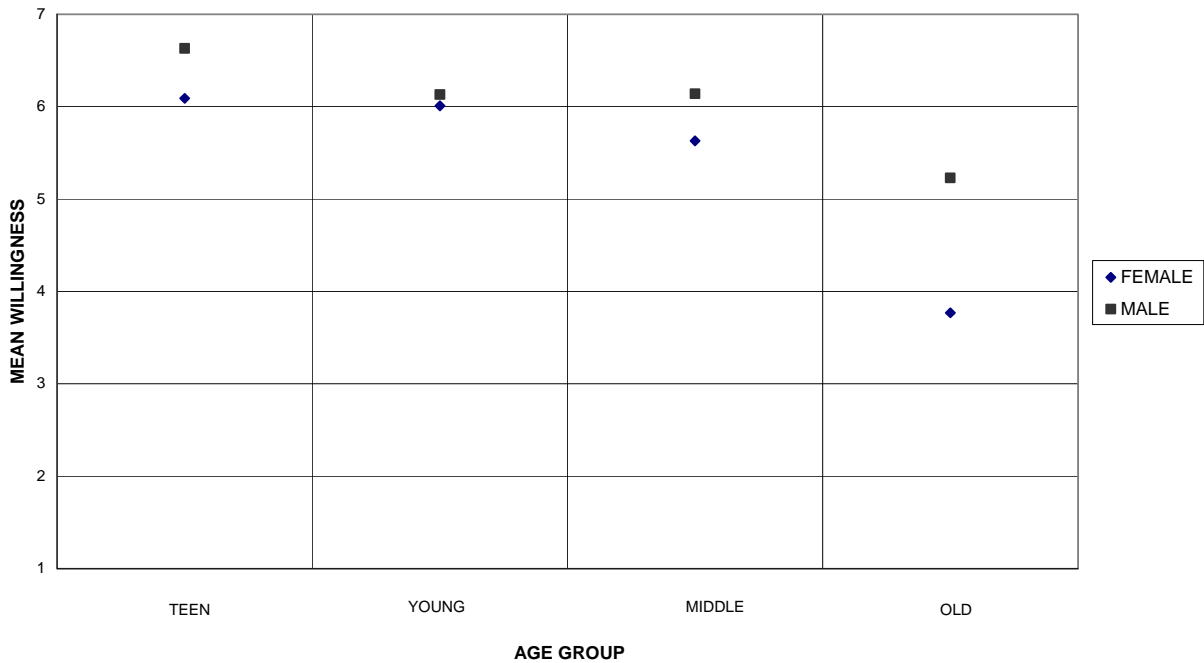


Figure 1. Group mean willingness ratings for age and gender groups

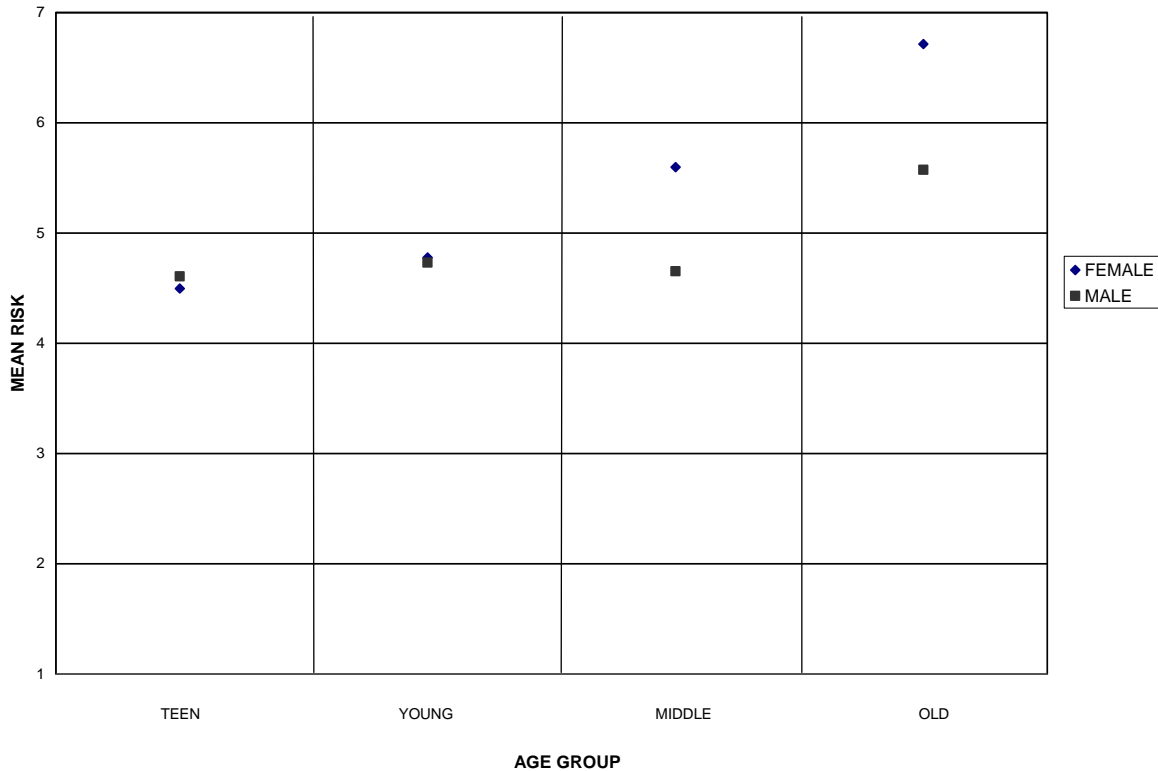


Figure 2. Group mean risk ratings for age and gender groups

The ratings for willingness to engage in a task and the risk of engaging in a task were very strongly related. The correlation of the group mean ratings for the 81 situations was -0.98, meaning that high scores on one scale were related to low scores on the other. This is illustrated in the scatterplot of Figure 3. As seen in the scatterplot, none of the 81 points deviated substantially from the regression line. In other words, there was no case where the willingness to engage in a task was substantially greater or less than would be predicted based on how risky it was perceived to be. This strong linear relationship was true for each of the four age groups considered individually as well; the correlation coefficient exceeded 0.96 for every group. Although a positive correlation would certainly be predicted for these two sets of ratings, there is no *a priori* reason to assume such a strong linear relationship across the range of ratings. For example, there might have been an S-shaped function, where willingness was uniformly low when risk values exceeded some point and uniformly high when risk values fell below some point. The strong linear relationship across the range of ratings indicates that both willingness ratings and risk ratings provided similar information. Based on this very strong correlation, the subsequent discussion of findings will focus on the ratings of willingness to engage in a task, recognizing that the risk ratings yield similar results. One exception is in the comparison of on-road versus booklet ratings, where there were some differences in the findings for willingness and risk; therefore both sets of data are provided in that section of the Findings.

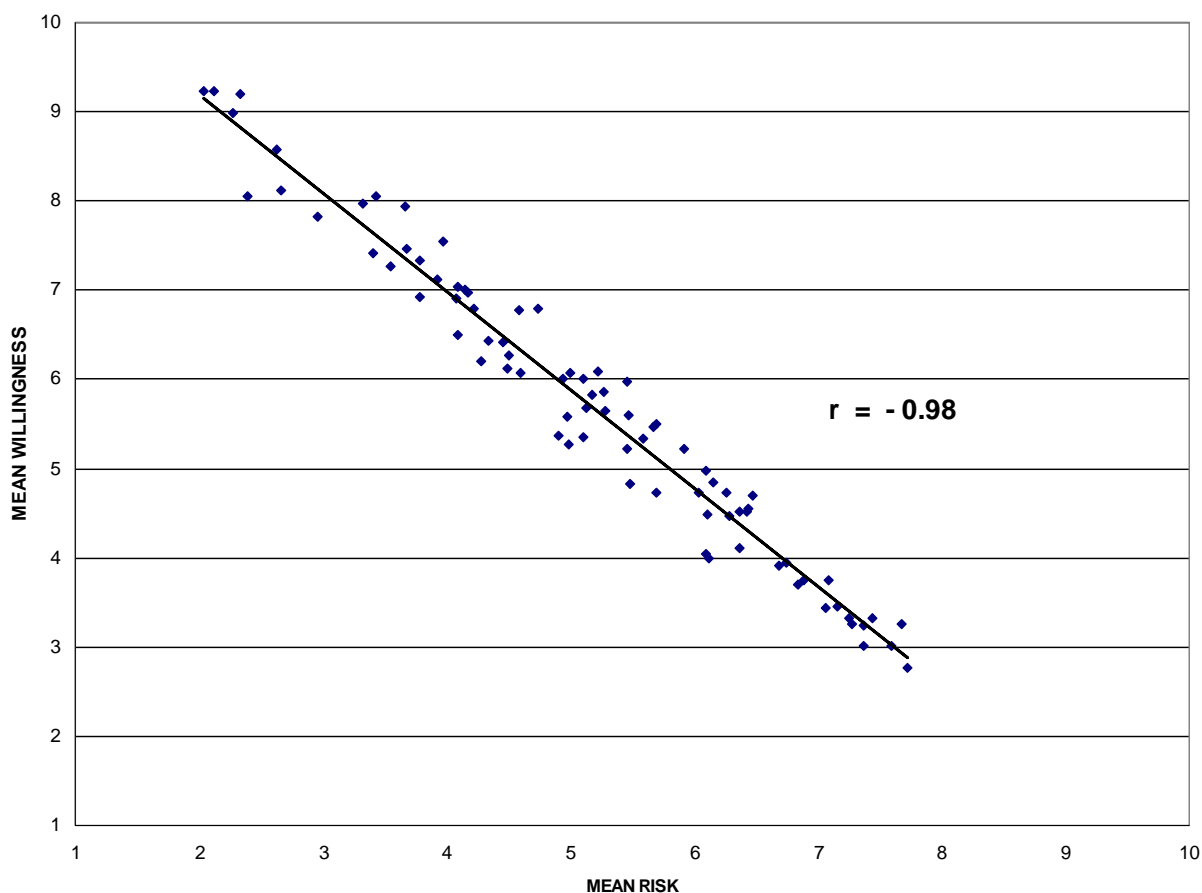


Figure 3. Scatterplot of mean willingness and risk ratings for 81 on-road situations

Because the experimental design only included 81 of the possible 154 combinations of 14 tasks and 11 roadway locations, the comparisons among different tasks and among different locations must be based on selected subsets of the data. One such subset involves “mainline” driving on three different types of road: freeway, arterial, and two-lane highway. All 14 in-vehicle tasks occurred for each of these three driving conditions. This permitted a formal ANOVA to be conducted with in-vehicle task and driving location as independent factors. Figure 4 plots the mean willingness rating for each task as a function of roadway type. The figure shows that although there were substantial differences in how each task was rated, the type of road the driver was on had relatively little effect. Three-way (location-by-task-by-age group) ANOVAs were conducted on these data and the results are shown in Table 9. The main effect of task was statistically significant for both willingness and risk ratings. The main effect of location was statistically significant only for risk, although it approached significance for willingness ($p = 0.10$). Driver age had a significant main effect, and in contrast to the analyses for the full set of

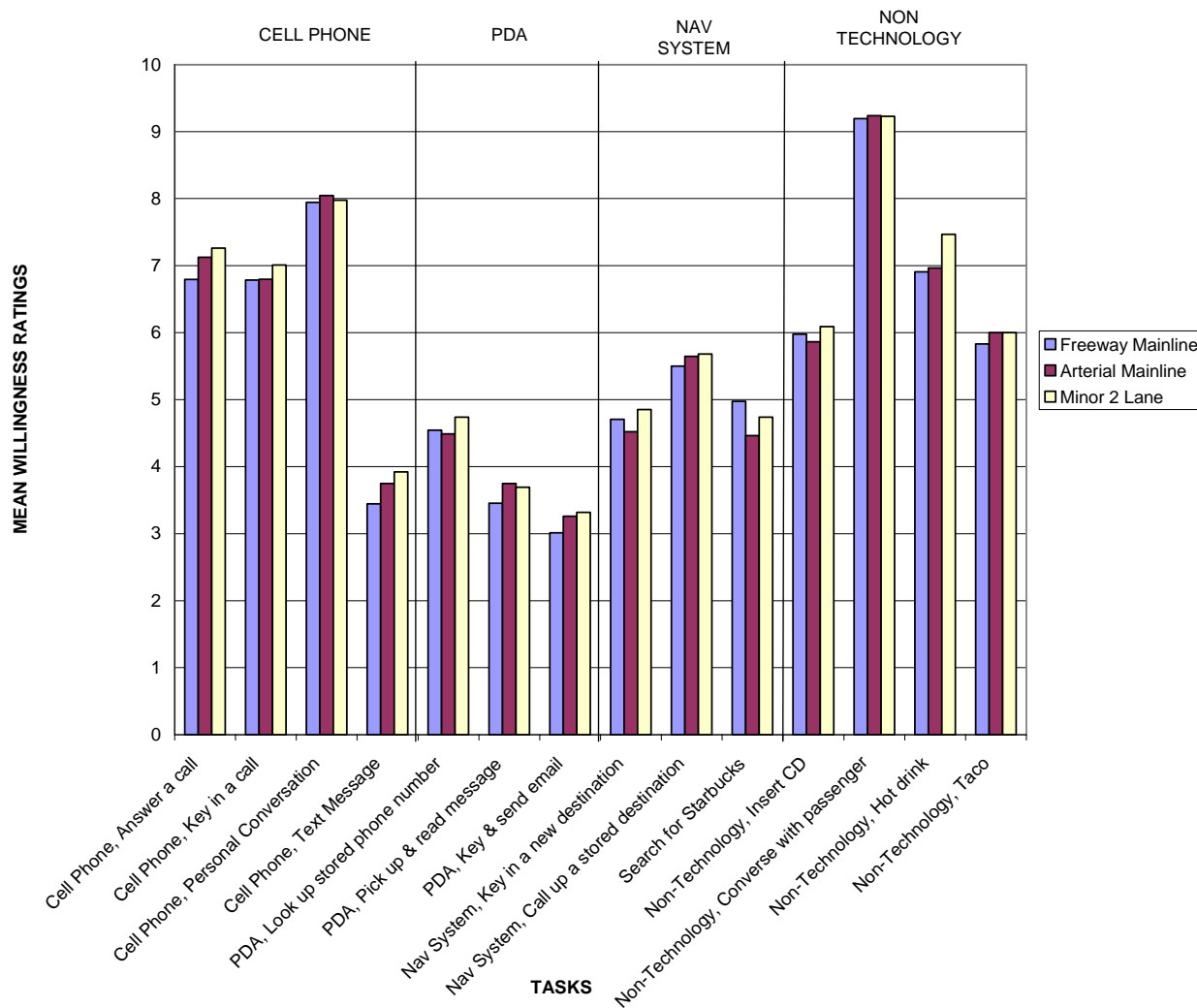


Figure 4. Mean willingness ratings for 14 in-vehicle tasks during mainline driving on freeway, arterial, and two-lane roads

81 situations (Table 8), age interacted significantly with both driving location and in-vehicle task.

Figure 5 shows the location-by-age interaction for the willingness ratings. Mean ratings for each age group, and for all groups combined, are shown as separate functions. The main effect of age is evident in the separation of the lines for the various age groups. The small (and for willingness, non-significant) effect of location is seen in the relatively flat line for the combined group of all participants. The interaction effect is evident in comparing the functions for each age group. For young, middle, and older driver groups, there was very little difference among the three driving locations. In contrast, the teen drivers showed less willingness, and greater perceived risk, on the freeway as compared to the arterial and two-lane roads. This was also the nature of the location-by-age interaction for the risk ratings.

Figure 6 shows the in-vehicle task-by-age interaction for the willingness ratings. Mean ratings for each age group, and for all groups combined, are shown as separate functions. As with Figure 5, the main effect of age is evident in the separation of the lines for each age group, with the older group consistently giving the lowest willingness ratings. The main effect of task is seen in the general shifting of means from task to task. The differences among age groups changes somewhat from task to task, as indicated by the significant task-by-age interaction. While the older group's ratings are consistently below the others, the differences between middle, young, and teen groups are sometimes pronounced and sometimes negligible. Although the teen drivers tended to be most willing to engage in tasks, the figure indicates that this overall effect is due to differences on some tasks, but not others. In particular, teens seem more willing to engage in the PDA tasks and cell phone text messaging.

The statistically significant interaction of age with in-vehicle task and with driving location in this analysis contrasts with the non-significant interaction of age with situation in the analysis that included all 81 situations (Table 8). This could be due to separating the effects of task and location in the analysis or might suggest that the interactions present for mainline driving were not present for other tasks. In any case, the interaction effect for driving location was quite small and primarily due to the teen/freeway condition. The interaction of age with in-vehicle task is more complex and may be somewhat confounded with familiarity with the task (see Section 3.2).

In summary, considering just “mainline” driving locations, the ratings were not very sensitive to the type of road the driver was on, with the exception of freeway driving for the teen driving group. While the willingness (and risk) ratings varied considerably from task to task, the type of road did not seem to matter much.

WILLINGNESS

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Task	13	10734.13	825.70	130.44	<.0001
Location	2	28.32	14.16	2.24	0.1069
Age Group	3	1739.10	579.70	91.58	<.0001
Task x Location	26	46.04	1.77	0.28	0.9999
Task x Age Group	39	544.13	13.95	2.20	<.0001
Location x Age Group	6	105.91	17.65	2.79	0.0104
Task x Location x Age Group	78	150.70	1.93	0.31	1.0000

RISK

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Task	13	7037.31	610.56	107.24	<.0001
Location	2	67.77	33.89	5.95	0.0026
Age Group	3	1068.88	356.29	62.58	<.0001
Task x Location	26	44.09	1.70	0.30	0.9998
Task x Age Group	39	441.36	11.32	1.99	0.0003
Location x Age Group	6	117.08	19.51	3.43	0.0022
Task x Location x Age Group	78	114.51	1.47	0.26	1.0000

Table 9. Analyses of variance for on-road ratings of willingness and risk for mainline driving locations.

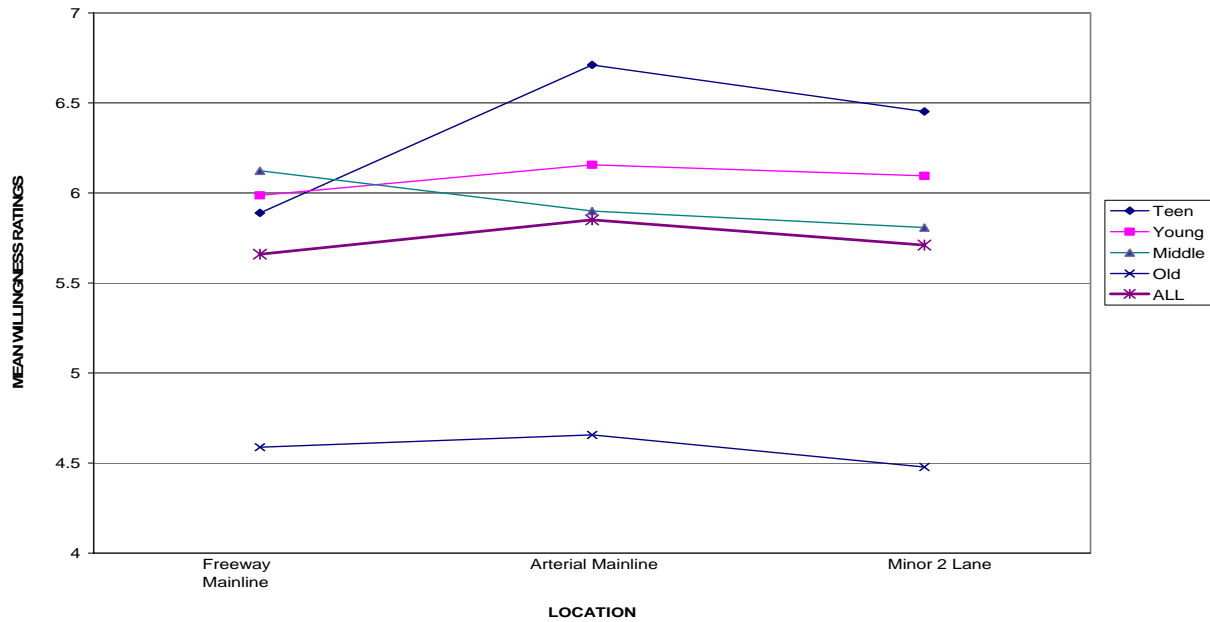


Figure 5. Mean willingness ratings (averaged across 14 in-vehicle tasks) for mainline driving locations, by age group.

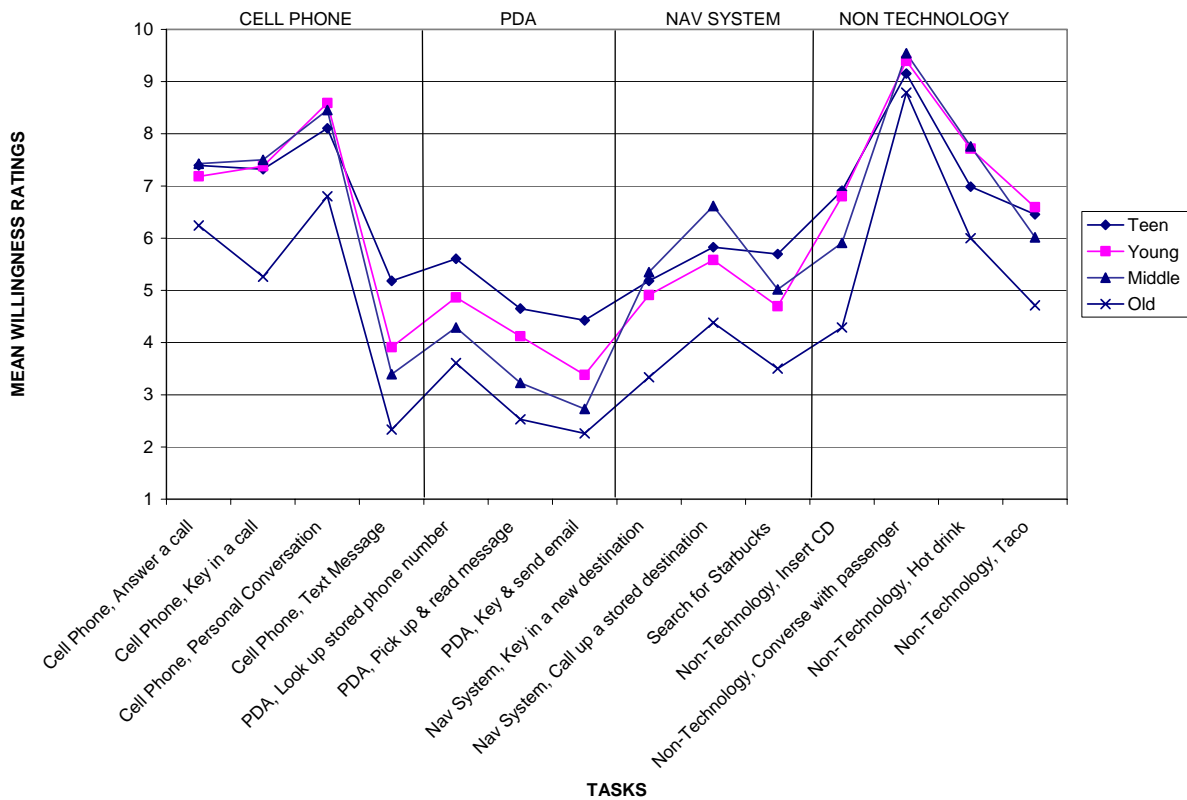


Figure 6. Mean willingness ratings (averaged across three mainline driving locations) for 14 tasks, by age group.

On the other hand, when some maneuver other than mainline driving was involved, the ratings could vary substantially. This can be best illustrated by considering the maneuvers for the four in-vehicle tasks for which all or most driving situations were presented. These data are shown in Table 10. Separate sections of the table provide data for each of the four in-vehicle tasks: answering a cell phone, placing a cell phone call, picking up/reading a PDA message, and entering a destination into a navigation system. The columns of the table show the various roadway types. The rows indicate various maneuvers. Comparing the numbers within a column gives an indication of how willingness varies based on the particular maneuver. For example, on the arterial road, the willingness to answer a cell phone call ranges from a low of 4.51 while making a U-turn to a high of 8.06 while stopped at a traffic signal. Given that the standard deviations of the willingness ratings were typically around 2.8 rating scale units (Appendix D), the standard error of the mean for the group of 88 participants is approximately 0.3 rating scale units. Therefore, differences in this table of roughly 0.6 rating scale units (two standard errors) may be taken as statistically meaningful. Comparing the top row (“mainline”) for the first three columns, there is little difference among freeway, arterial, and two-lane roads, as already discussed. However, there was greater willingness to engage in these tasks on the residential streets. On the freeway, the general ordering of the means was the same for all four in-vehicle tasks shown in the table: relative to mainline driving, there was less willingness to engage in the task when entering the freeway area from the arterial road. There was even less willingness when approaching an exit point while on the freeway. The magnitude of these differences was less for answering a cell phone call and picking up a PDA message than it was for placing a cell phone call or entering a destination in a navigation system. On the arterial road, there was greater willingness to engage in all four tasks when stopped at a traffic signal. There was less willingness when approaching the turning maneuver (left turn or U-turn). Table 10 also includes two parking lot locations. One location is driving through the aisles of the lot, as when looking for a parking space. The other location is approaching the driveway of the lot, about to exit onto the arterial road. For the task of answering a cell phone, participants were about as willing to answer a call under either of these parking lot conditions as they were while driving on a freeway, arterial, or two-lane road. This was also the case for picking up a PDA message or entering a destination in a navigation system. However, there was less willingness to do these things in the parking lot as opposed to a residential street. In contrast to these other tasks, participants were somewhat less willing to place a call while in a lot than in the mainline driving situations.

RATINGS OF WILLINGNESS TO ANSWER A CELL PHONE CALL

MANEUVER	ROAD TYPE				
	Freeway	Arterial	Two-lane	Residential	Parking Lot
Mainline	6.79	7.13	7.26	7.82	
Enter	6.42				
Exit	6.07				
U-turn		4.51			
Left turn		5.47			
Stopped		8.06			
In Aisle					6.50
Exiting to Arterial					7.03

RATINGS OF WILLINGNESS TO PLACE A CELL PHONE CALL

MANEUVER	ROAD TYPE				
	Freeway	Arterial	Two-lane	Residential	Parking Lot
Mainline	6.78	6.80	7.01	7.41	
Enter	5.33				
Exit	5.22				
U-turn					
Left turn					
Stopped		8.11			
In Aisle					6.13
Exiting to Arterial					6.27

RATINGS OF WILLINGNESS TO PICK UP & READ A PDA MESSAGE

Maneuver	Road Type				
	Freeway	Arterial	Two-lane	Residential	Parking Lot
Mainline	3.45	3.75	3.69	4.74	
Enter	3.25				
Exit	2.76				
U-turn		3.01			
Left turn					
Stopped		6.20			
In Aisle					4.05
Exiting to Arterial					4.00

RATINGS OF WILLINGNESS TO ENTER DESTINATION IN A NAVIGATION SYSTEM

Maneuver	Road Type				
	Freeway	Arterial	Two-lane	Residential	Parking Lot
Mainline	4.70	4.52	4.85	5.60	
Enter	3.94				
Exit	3.26				
U-turn					
Left turn		4.11			
Stopped		6.92			
In Aisle					
Exiting to Arterial					5.22

Table 10. Mean willingness ratings for four in-vehicle tasks during various driving situations

Summarizing, driver willingness to engage in a task was greater on residential streets than on freeways, arterials, or two-lane roads, which did not differ much from one another. There was greater willingness to initiate a task when stopped for a signal, and less willingness when encountering a maneuver. However, in absolute terms, even during a maneuver, there was still substantial willingness to engage in the two cell phone activities. This was also the case for driving in a commercial parking lot.

Comparing the 14 in-vehicle activities included in the experiment, there were substantial differences in the rated willingness to engage in these tasks. This can be seen graphically in Figure 4, for those tasks occurring during mainline driving on the various roadway types. Of all tasks, conversing with a passenger was the activity that drivers were most willing to do, with group mean ratings over 9 on the 10-point scale. Drivers were also quite willing to answer or place a cell phone call or engage in cell phone conversation, although there was clearly somewhat less willingness (and more perceived risk) than for passenger conversation. These phone activities were rated approximately equivalent to drinking something hot while driving. Participants were substantially less willing to engage in the other technology-related tasks. Text messaging on the cell phone and the various PDA tasks were rated low on willingness. Navigation system-related tasks were somewhat intermediate. It should be noted that about half the participants in the study were not personally familiar with the use of a navigation system (the effects of familiarity with the technologies are discussed below).

3.2 Effects of Familiarity with the Technology on On-Road Ratings

Participants differed in how familiar they were with the various technologies and in-vehicle tasks employed in this experiment. Although there was an initial training period, prior to data collection, to provide some familiarization with each activity, participants varied substantially in their real-world use of these products.

Table 11 shows the familiarity of participants with the in-vehicle technologies as a function of age group. Familiarity was determined from the ratings on the take-home questionnaire. For purposes of Table 10, familiarity ratings of 1 or 2 (on the 5-point scale) were treated as “unfamiliar,” a rating of 3 was “somewhat familiar,” and ratings of 4 or 5 were treated as “familiar.” As the table shows, nearly every participant in the experiment (95%) considered themselves “familiar” with the use of a cell phone. In contrast, only 44% were familiar with a PDA and only 31% were familiar with a navigation system. About half of the participants were unfamiliar with a navigation system, and about a third unfamiliar with a PDA. Familiarity was related to age group. In this sample, teens were least familiar with navigation systems and PDAs. Older participants were less familiar with PDAs than young or middle age groups. Young drivers had somewhat less familiarity with navigation systems than the middle and older groups.

CELL PHONE	% Unfamiliar	% Somewhat Familiar	% Familiar	Total %
ALL	0	5	95	100
Teen	0	0	100	100
Young	0	0	100	100
Middle	0	5	95	100
Old	0	14	86	100

PDA	% Unfamiliar	% Somewhat Familiar	% Familiar	Total %
ALL	33	23	44	100
Teen	59	27	14	100
Young	14	27	59	100
Middle	23	14	64	100
Old	36	23	41	100

NAV SYSTEM	% Unfamiliar	% Somewhat Familiar	% Familiar	Total %
ALL	46	23	31	100
Teen	77	5	18	100
Young	45	36	18	100
Middle	32	27	41	100
Old	32	23	45	100

Table 11. Participant familiarity with in-vehicle technologies, for all and for each age group

Table 12 is similar to Table 11, but the ratings are specifically for familiarity of use while driving. Most (89%) participants considered themselves familiar with using a cell phone while driving, although the percentage was somewhat lower for the teens (77%). Very few participants (14%) were familiar with using a PDA while driving; most (72%) were unfamiliar. This was true for all age groups. Most (69%) were also unfamiliar with the use of a navigation system while driving, although familiarity was somewhat higher (50% familiar or somewhat familiar) for the middle age group.

CELL PHONE	% Unfamiliar	% Somewhat Familiar	% Familiar	Total %
ALL	3	9	89	100
Teen	0	23	77	100
Young	0	0	100	100
Middle	0	5	95	100
Old	14	5	82	100

PDA	% Unfamiliar	% Somewhat Familiar	% Familiar	Total %
ALL	72	14	14	100
Teen	91	5	5	100
Young	68	9	23	100
Middle	55	27	18	100
Old	73	18	9	100

NAV SYSTEM	% Unfamiliar	% Somewhat Familiar	% Familiar	Total %
ALL	69	15	16	100
Teen	86	9	5	100
Young	73	18	9	100
Middle	50	18	32	100
Old	68	14	19	100

Table 12. Participant familiarity with use of in-vehicle technologies while driving, for all and for each age group

The effects of technology familiarity on willingness to engage in the use of the technology while driving was assessed using analyses of variance. Since nearly all participants were familiar with use of the cell phone, the analyses were only conducted for the PDA and navigation system technologies. A two-factor (situation and familiarity) analysis was conducted for each technology. Only those situations involving the particular technology were included in the analysis (i.e., the analysis of familiarity with PDA use only included those on-road ratings that involved some PDA-related task). For the PDA tasks, the ANOVA revealed a significant main effect of situation ($F = 11.38$, $df = 14$; $p < .0001$), but no significant effect of familiarity ($F = 1.64$, $df = 2$; n.s.) and no situation-by-familiarity interaction ($F = 0.50$, $df = 28$; n.s.). For the navigation system tasks, there was a significant effect of both familiarity ($F = 8.23$, $df = 14$; $p < .0001$) and situation ($F = 8.02$, $df = 2$; $p < .0005$), but no interaction ($F = 0.41$, $df = 28$; n.s.). The familiarity effect was such that those participants familiar with navigation system use were less willing to engage in navigation system tasks (mean rating of 4.6 across all 15 situations involving the navigation system) than those somewhat familiar or unfamiliar (mean of 5.3 for each). However, there is some concern interpreting these findings, given that familiarity was

somewhat confounded with age group. Therefore additional analyses were run, including age group as a factor. Given the small number of observations for some cells, the age groups were combined into a younger group (teen and young) and an older group (middle and old). For the three-factor analysis of PDA familiarity, there was again no main effect of familiarity nor a familiarity-by-situation interaction, although the main effects of situation and age were significant. For the three-factor analysis of navigation system familiarity, the main effects of familiarity, situation, and age were all significant. The interaction of familiarity with situation was not statistically significant. The finding of an effect of familiarity for navigation system ratings therefore does not appear to be attributable to a confound with age, at least as the age groups were defined for this analysis. The finding is that familiarity with use of the navigation system leads to more conservative ratings of willingness to engage in the navigation system tasks.

3.3 Effects of Additional Factors on Ratings

There are a variety of potentially important factors that could not be easily manipulated in the on-road portion of the study. While these factors may be of real interest, for reasons of safety or control they could not be included during the on-road session. Therefore, the take-home booklet was used to evaluate the effects of such factors on driver willingness to engage in various tasks. The method for doing this was to describe a situation (trip conditions and in-vehicle task) and have the participants give willingness and risk ratings precisely as they did during the on-road portion of the experiment. The situations replicated situations encountered during the on-road session, but some additional feature was added to the situation in most cases. The features considered were: raining hard; the presence of two age-peer passengers; the presence of a three-year-old child passenger; night driving; traffic congestion; construction zone lane closure; boredom (during long, familiar trip); fatigue; and urgency. Table 5, presented earlier, summarizes the situations included in this portion of the booklet.

The logic of this procedure was to compare the ratings for situations that had an added feature with ratings given to the identical situation without that feature. However, a complication for interpreting the findings is that the “control” situation (without the feature) was rated in the on-road portion of the study, whereas the situation with the added feature was rated through the take-home booklet. Even though the situations and rating methods were made as parallel as possible, differences between situations could be related to the method as well as the situation features. For this reason, five of the twenty booklet situations did not include an additional feature but rather exactly replicated an on-road situation. These five situations could then be used to “benchmark” the booklet data and determine if any correction factors were desirable. Therefore the relationship of on-road ratings to booklet ratings for same situations is presented first, followed by findings regarding additional situation features.

Relationship of on-road ratings to booklet ratings for same situations

Table 13 presents the group mean ratings of willingness and risk for both modes of rating (on-road and booklet) for each of the five in-common situations. Figure 7 plots the group mean on-road willingness rating and group mean booklet situation rating for each of the five in-common

situations. As the figure indicates, the two sets of willingness ratings are similar, but not identical. Three-factor analyses of variance were conducted to evaluate the effect of the mode of rating. The three factors were the rating mode (on-road or booklet), the situation (five situations), and age group. Table 14 summarizes the ANOVA for willingness ratings and risk ratings. For willingness ratings, the main effects of situation and age group were statistically significant. The main effect of mode was not significant at the $p \leq 0.05$ level ($p=0.058$). The only significant interaction term was the mode-by-situation interaction. A parallel analysis of the risk ratings found only the main effects of situation and age group to be significant. The mode-by-situation interaction was not significant at the $p=0.05$ level ($p=.06$). For risk ratings, the absence of a significant main effect of mode, the relatively weak interaction with situation, and the generally small (0.1 to 0.8 rating scale units) differences for a given situation, suggest that the mode of rating is not of substantial concern. On-road and booklet ratings of risk therefore can be compared with one-another with reasonable accuracy. However, for the ratings of willingness to engage in the tasks, the presence of the significant interaction term, and the larger magnitude of differences for some cases, complicate interpretation of the findings. If there was a significant main effect of mode of rating, but no significant interaction, then a simple across-the-board correction factor could be applied. However, as Figure 7 shows, booklet ratings were about one rating scale unit higher for two of the situations, almost identical to on-road ratings for two other situations, and about half a unit lower for the final situation. The higher booklet ratings occurred for the arterial road and parking lot situations. No parking lot situation was included in the “added factors” situations, but a variety of arterial road situations were. To the extent the difference seen in Figure 7 is real, the tendency for higher willingness ratings in the booklet mode means that since the control (no added factor) condition was rated on-the-road, the bias toward higher booklet ratings may obscure real reductions in willingness as a result of the added factor.

	ON ROAD		BOOKLET	
	Willingness	Risk	Willingness	Risk
Freeway Mainline, PDA Pick Up & Read Msg	3.45	7.16	3.54	7.29
Arterial Mainline, Cell Phone Answer a Call	7.13	3.92	8.16	3.20
Parking Lot-Exit to Arterial, Cell Phone Key in a Call	6.27	4.50	7.36	3.70
Minor 2 Lane, Non-Technology Search for & Insert CD	6.09	5.23	5.61	5.56
Freeway Entrance/Merge, Nav System Key in New Destination	3.94	6.74	3.89	7.03

Table 13. Mean on-road and take-home booklet ratings of willingness and risk for five in-common situations

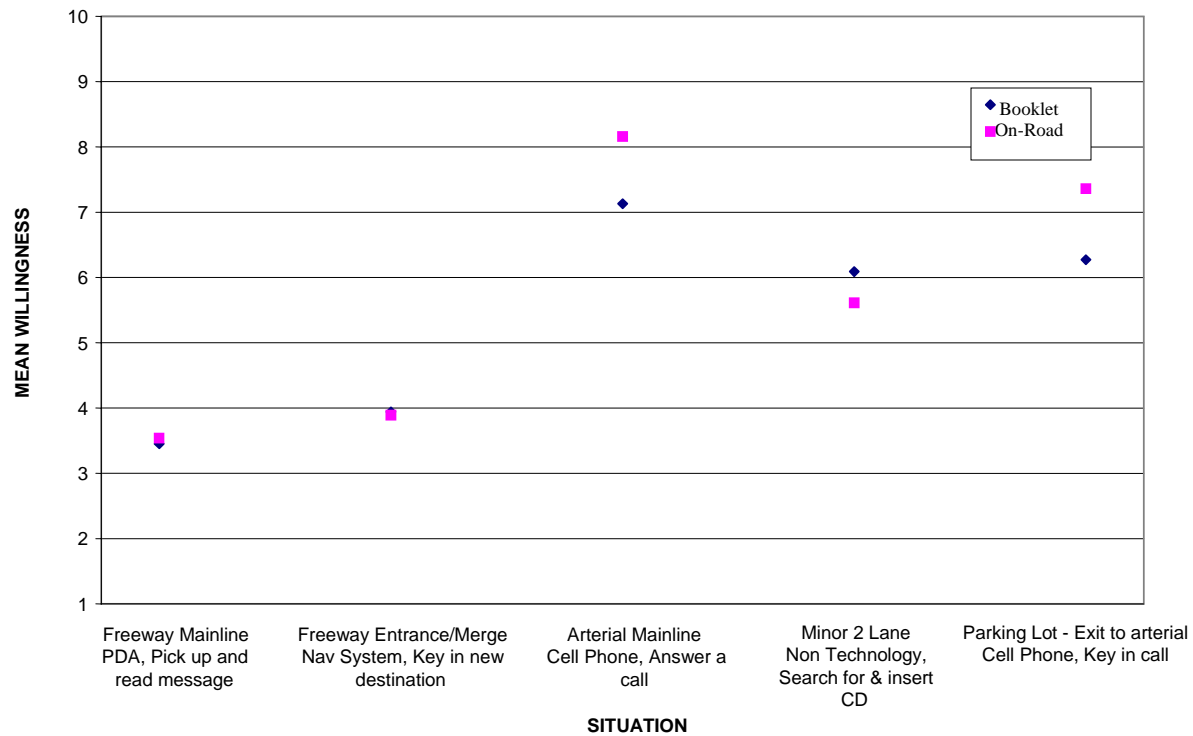


Figure 7. Mean on-road and take-home booklet willingness ratings for five in-common situations

WILLINGNESS

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Mode	1	25.44	25.44	3.60	0.0583
Situation	4	2277.53	569.38	80.48	<.0001
Age Group	3	371.60	123.87	17.51	<.0001
Mode x Situation	4	84.46	21.14	2.98	0.0184
Mode x Age Group	3	22.58	7.53	1.06	0.3635
Situation x Age Group	12	93.18	7.77	1.10	0.3585
Mode x Situation x Age Group	12	29.29	2.44	0.35	0.9805

RISK

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Mode	1	5.35	5.35	0.89	0.3467
Situation	4	1860.13	465.03	77.06	<.0001
Age Group	3	304.32	101.44	16.81	<.0001
Mode x Situation	4	54.38	13.60	2.25	0.0617
Mode x Age Group	3	3.59	1.20	0.20	0.8977
Situation x Age Group	12	96.53	8.14	1.33	0.1940
Mode x Situation x Age Group	12	24.37	2.03	0.34	0.9825

Table 14. Analyses of variance for mode of rating (on-road or booklet), for ratings of willingness and risk

Effects of the various factors added in the booklet situations

The left columns of Table 15 presents the willingness and risk ratings for the 15 situations that had some added feature not present in the on-road ratings. The center columns of the table present the relevant comparison data (same situation without the added feature). For all cases, there is a comparable on-road comparison. For two cases, the comparison situation also was included among the booklet situations, so for these two instances a direct comparison between booklet ratings is possible. The rightmost columns show the booklet ratings for those two cases. With one clear exception (the effect of rain on answering a cell phone call on the freeway), the order of magnitude of the effect of the feature was similar for the willingness ratings and the risk ratings. This somewhat obviates the concerns regarding the benchmark comparisons for the willingness ratings, as discussed above.

Added Factor	Situation	Booklet		Comparison			
		Willingness	Risk	On Road		Booklet	
				Willingness	Risk	Willingness	Risk
Rain	Arterial Mainline/Cell Phone Key in a Call	5.49	6.07	6.80	4.74		
	Arterial Mainline/Cell Phone Enter Text	3.32	7.77	3.75	7.09		
	Freeway Mainline/Cell Phone Answer a Call	6.73	5.26	6.79	4.22		
Peers	Arterial Mainline/Cell Phone Answer a Call	7.85	3.51	7.13	3.92	8.16	3.20
	Arterial Mainline/Cell Phone Enter Text	4.09	6.75	3.75	7.09		
Child	Arterial Mainline/Cell Phone Answer a Call	7.26	4.10	7.13	3.92		
	Arterial Mainline/Non-Technology Eat a Taco	5.13	5.69	6.00	4.94		
Night	Arterial Mainline/Cell Phone Key in a Call	6.90	4.66	6.80	4.74		
Congestion	Freeway Mainline/PDA Pick Up & Read Msg	3.25	7.60	3.45	7.16	3.54	7.29
	Arterial Mainline/Cell Phone Key in a Call	6.22	5.50	6.80	4.74		
Construction	Freeway Mainline/Nav System Key In New Destination	3.92	7.24	4.70	6.48		
Boredom	Freeway Mainline/Cell Phone Key in a Call	7.84	3.69	6.78	4.59		
Fatigue	Freeway Mainline/Cell Phone Answer a Call	7.45	4.41	6.79	4.22		
	Freeway Mainline/Nav System Search for Starbucks	4.45	6.70	4.98	6.09		
Urgency	Freeway Entrance/Merge/PDA Pick Up & Read Msg	3.41	7.48	3.25	7.38		

Table 15. Mean willingness and risk booklet ratings for situations with added factors

The following was observed regarding added scenario features:

- **Rain**—Risk ratings were notably higher under hard rain for each of the three situations that included rain. However, while rain resulted in a substantial drop in willingness to key in a phone call on an arterial road, it had a more moderate effect on willingness to enter a text message on an arterial road. This smaller effect may in part reflect a floor effect, since willingness was already rated quite low for this task. Rain had virtually no effect on willingness to answer a phone on a freeway.
- **Peers**—Peers in the presence of age peers, risk ratings were slightly lower for the two phone-related tasks and willingness was slightly higher. The reason for this is not known, but clearly participants were not viewing passenger presence as a factor that amplified risk. As the absence of a significant situation-by-age interaction implies, this

finding was not attributable to any particular age group; the effect was similar for all ages.

- Child—The presence of a toddler passenger had virtually no effect on ratings related to answering a phone call on an arterial road. However, a toddler did result in some increased perceived risk and reluctance to engage in eating a messy food (taco).
- Night—Night conditions had no effect on the ratings for the single situation included (keying in a phone message on an arterial).
- Congestion—Congestion had little effect on the willingness to engage in reading PDA messages on a freeway. However, it did result in more reluctance to key in a phone call on an arterial.
- Construction—The presence of a construction zone with a lane drop resulted in increased risk and decreased willingness for keying in a navigation system destination.
- Boredom and Fatigue—Under long boring driving conditions, participants indicated that keying in a phone call decreased risk and they were more willing to engage in the task than when not bored. Presumably this reflects a feeling that this activity might contribute to alertness. Under conditions of fatigue, there was also a somewhat greater willingness to answer a phone during freeway driving. However, fatigue led to less willingness to use a navigation system search feature.
- Urgency—Urgency had little effect on willingness or risk ratings.

Looking across the 15 situations, no obvious systematic patterns are evident. Participants saw some factors as negative under some conditions but not others. In some cases, the added factor actually increased the willingness to engage in the task. Only a few situations resulted in a substantial decrease in willingness to engage in a task. The most dramatic case was for keying in a phone call on an arterial road during heavy rain. The second largest shift in the willingness ratings was in the opposite direction: participants were more willing to key in a phone call during a freeway drive when the situation described them as bored during a long, familiar trip.

Table 16 presents the findings as difference scores that show the shift in rated willingness and risk as a result of the added factor. Each entry is the difference of the rating with the factor present minus the rating with the factor absent. Therefore positive numbers indicate an increase in willingness (or risk) when the additional factor is included and negative numbers indicate a decrease in willingness (or risk) when the factor is included. The table presents these difference scores for each age group, as well as for all participants. As noted earlier for Table 14, the magnitude of the effects of the added factor is generally similar, though of course opposite direction, for the willingness ratings and the risk ratings. This is even the case for those situations on the arterial road, thus again obviating the concern from the benchmarking comparison.

Added Factor	Situation	Shift in Willingness Rating				
		All	Teen	Young	Middle	Old
Rain	Arterial Mainline/Cell Phone Key in a Call	-1.31	-0.82	-1.14	-1.86	-1.41
	Arterial Mainline/Cell Phone Enter Text	-0.43	-0.64	-0.09	-1.09	0.05
	Freeway Mainline/Cell Phone Answer a Call	-0.07	0.50	-0.27	-0.23	-0.27
Peers	Arterial Mainline/Cell Phone Answer a Call	0.73	0.73	0.60	1.09	0.50
	Arterial Mainline/Cell Phone Enter Text	0.34	0.45	0.59	-0.09	0.41
Child	Arterial Mainline/Cell Phone Answer a Call	0.13	0.32	-0.31	0.86	-0.32
	Arterial Mainline/Non-Technology Eat a Taco	-0.88	0.09	-1.05	-0.73	-1.82
Night	Arterial Mainline/Cell Phone Key in a Call	0.10	0.32	0.32	-0.68	0.45
Congestion	Freeway Mainline/PDA Pick Up & Read	-0.20	1.64	-0.55	-1.23	-0.68
	Arterial Mainline/Cell Phone Key in a Call	-0.58	0.05	-0.36	-1.14	-0.86
Construction	Freeway Mainline/Nav Key In New Destination	-0.79	0.48	-0.83	-1.58	-1.55
Boredom	Freeway Mainline/Cell Phone Key in a Call	1.06	1.73	1.77	0.36	0.36
Fatigue	Freeway Mainline/Cell Phone Answer a Call	0.66	0.82	0.96	0.45	0.41
	Freeway Mainline/Nav Search for Starbucks	-0.53	-0.50	-0.23	-1.00	-0.45
Urgency	Freeway Entrance/Merge/PDA Pick Up & Read	0.16	0.36	0.55	0.55	-0.09

Mean	-0.11	0.37	0.00	-0.42	-0.35
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Added Factor	Situation	Shift in Risk Rating				
		All	Teen	Young	Middle	Old
Rain	Arterial Mainline/Cell Phone Key in a Call	1.33	0.95	1.18	1.64	1.55
	Arterial Mainline/Cell Phone Enter Text	0.68	0.82	0.45	1.14	0.36
	Freeway Mainline/Cell Phone Answer a Call	1.04	0.46	1.23	1.05	1.45
Peers	Arterial Mainline/Cell Phone Answer a Call	-0.41	-0.27	-0.01	-0.82	-0.55
	Arterial Mainline/Cell Phone Enter Text	-0.34	-0.36	-0.36	-0.09	-0.55
Child	Arterial Mainline/Cell Phone Answer a Call	0.18	0.18	0.77	-0.23	0.00
	Arterial Mainline/Non-Technology Eat a Taco	0.75	0.41	0.55	0.27	1.77
Night	Arterial Mainline/Cell Phone Key in a Call	-0.08	0.05	-0.55	0.45	-0.27
Congestion	Freeway Mainline/PDA Pick Up & Read	0.44	-0.73	0.59	1.05	0.86
	Arterial Mainline/Cell Phone Key in a Call	0.76	0.36	0.86	0.91	0.91
Construction	Freeway Mainline/Nav Key In New Destination	0.77	0.16	0.62	1.55	0.89
Boredom	Freeway Mainline/Cell Phone Key in a Call	-0.90	-1.50	-1.09	-0.73	-0.27
Fatigue	Freeway Mainline/Cell Phone Answer a Call	0.19	0.00	-0.14	0.41	0.50
	Freeway Mainline/Nav Search for Starbucks	0.61	0.55	0.68	0.64	0.61
Urgency	Freeway Entrance/Merge/PDA Pick Up & Read	0.10	0.59	-0.09	0.00	-0.09

Mean	0.34	0.11	0.31	0.48	0.48
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Table 16. Shifts in rated willingness and risk for added situation factors, for all participants and each age group

The means, across all fifteen situations, show that there were age differences in the degree of shift in willingness (and complementary shifts in risk). The shift toward less willingness was greatest for the middle and old groups and least for the teenage group. Comparing the age groups for various situations in Table 16, a few differences stand out. Middle and older

participants were more reluctant to key in a phone call on an arterial road under conditions of rain. Teenage and young drivers showed very substantial increases in willingness to key in a phone call when bored (shifts of 1.73 and 1.77 rating scale units); the middle and older groups showed only modest shifts in their mean ratings (0.36 rating scale units). Substantial age differences were also seen in the shift in willingness to eat a messy food (taco) when there was a child passenger in the car. Older participants showed much greater reluctance (shift of -1.82 units), young and middle age drivers showed less dramatic but still substantial shifts (-1.05, -0.73 units), while teenage drivers showed virtually no effect. The added factors of congestion and construction had a greater effect on middle and older groups.

3.4 General Ratings of Task and Location Factors

The ratings of willingness and risk presented so far have all been based on participant judgments about specific situations, defined by the combination of a particular driving maneuver, roadway location, and in-vehicle activity. The take-home booklet also asked participants more general risk ratings for a set of 32 in-vehicle tasks and a set of 10 general driving tasks.

Table 17 presents the mean risk ratings for each of the 32 in-vehicle tasks, for all participants and for each age group. Ratings were made on a 10-point scale, where 1 = “No additional risk beyond my normal driving” and 10 = “Very likely I would be involved in an accident.” Table 18 presents the results of a task-by-age group ANOVA on these data. The ANOVA indicates that there is a significant main effect for both the in-vehicle task and the age group, as well as a statistically significant interaction of these factors. Risk ratings increased with age (4.41, 4.48, 4.91, and 5.68, for the teen, young, middle, and older groups, respectively). The ratings in Table 17 are ordered from the lowest rated (least risk) activity to the highest rated (most risk) activity, based on the mean for all participants. While most of the lowest risk tasks do not involve the use of communication technologies, some non-technology tasks, such as map use or note taking, were rated among the riskier activities. In general, tasks involving cell phone use were not rated as risky as tasks involving navigation system use, which in turn were not rated as risky as PDA. Virtually all PDA-related tasks were seen as quite risky while driving (mean ratings of 7.51 to 8.93 on the 10-point scale). The general risk ratings shown in Table 17 are generally similar in order and magnitude to the situation-specific on-road ratings (Table 7). However, they are somewhat more extreme in that the lowest-rated tasks tend to be rated even lower in the general ratings and the highest rated tasks tend to be rated even higher. Probably the most noteworthy difference is for the task of answering a cell phone. The general rating of this task was 2.64. This was somewhat lower than the on-road rating on a minor residential street (2.95) and more substantially different than the ratings on the freeway (4.22), arterial (3.92), and two-lane highway (3.55). However, the general pattern of ratings for the set of in-vehicle tasks is quite similar for the general booklet ratings and the on-road ratings.

IN-VEHICLE TASK	All	Teen	Young	Middle	Old
Check the speedometer	1.37	1.41	1.18	1.29	1.59
Talk with a passenger	1.69	1.64	1.64	1.52	1.95
Adjust the loudness of a sound system	1.69	1.55	1.27	1.77	2.18
Turn up the temperature	1.77	1.82	1.50	1.52	2.24
Drink something cold	2.39	2.41	1.91	2.33	2.91
Eat something neat (like a cookie)	2.47	2.41	2.23	2.57	2.68
Answer a cell phone call	2.64	2.32	1.91	2.52	3.82
Place a cell phone call using speed dial	2.72	2.41	2.18	2.67	3.64
Have a brief phone "exchange of information"	2.74	2.64	2.38	2.57	3.38
Find radio station that is not pre-programmed	2.97	2.95	2.32	2.62	4.00
Insert a CD, tape, or video	3.14	2.68	2.82	3.24	3.86
Have an extended phone conversation	3.50	3.27	2.57	3.14	4.95
Drink something hot	3.59	3.59	2.68	3.36	4.73
Key in a cell phone call	4.17	3.59	3.23	4.00	5.86
Open and listen to voice mail on cell phone	4.41	3.86	3.77	3.90	6.09
Look up a stored phone number in a cell phone	4.50	3.77	3.76	4.62	5.82
Deal with children	4.53	4.32	4.05	4.41	5.38
View an electronic map on Nav System	5.51	5.45	5.36	5.24	5.95
Eat something sloppy (like a taco)	5.51	4.68	4.32	6.24	6.82
Retrieve a stored destination on Nav System	5.55	5.73	5.59	5.14	5.71
Search for the nearest Starbucks on Nav Sys.	6.29	5.86	6.23	5.76	7.33
Find an alternate route on Nav System	6.31	6.23	6.23	5.71	7.10
Alter your route preferences on Nav System	6.42	6.18	6.55	5.67	7.29
Read a paper map	6.92	6.00	6.09	7.67	7.95
Key a new destination into Nav System	6.93	6.55	7.19	6.48	7.50
Look up an entry in address book on PDA	7.29	6.05	7.05	8.43	7.68
Check your schedule on PDA	7.51	6.55	7.18	8.32	8.00
Take notes during a phone conversation	7.67	6.27	7.23	8.19	9.00
Open and read email on PDA	7.94	6.73	7.73	8.55	8.77
Schedule a meeting using PDA	8.24	7.00	8.05	9.05	8.95
Key in and send an email on PDA	8.33	7.14	8.45	8.73	9.00
Search the Internet using a PDA	8.93	8.00	8.68	9.62	9.45

Mean	4.86	4.41	4.48	4.90	5.67
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Table 17. Mean general risk ratings for 32 in-vehicle tasks, for all participants and by age group

RISK					
Source	DF	Anova SS	Mean Square	F Value	Pr > F
Age Group	3	710.33	236.78	65.26	<.0001
Task	31	14355.32	463.07	127.63	<.0001
Age Group x Task	93	505.58	5.44	1.50	0.0017

Table 18. Analysis of variance for general risk ratings of in-vehicle tasks

Some age-related differences are also evident in Table 17. Ratings from the older group were frequently distinctly higher than those of the other age groups. The middle age group differed from others in rating navigation system tasks as somewhat less risky. Teenage drivers were distinct in rating less risk than others for PDA-related tasks; this was true to a lesser degree for

the young group. For some other tasks, teen and young participants also differed from middle-age and older participants. They rated substantially less risk for tasks of eating something sloppy and reading a paper map. There were also moderate differences for inserting a CD/tape/video, keying in a cell phone call, and looking up a stored cell phone number.

Generally, for other than the older group, cell phone tasks, such as answering, speed dialing, and simple conversation, were seen as comparable in risk to non-technology tasks such as drinking something cold, eating something simple (cookie), or finding a radio station. Older participants generally saw cell phone use as more risky than eating or drinking. The more complex cell phone tasks, such as keying in a phone number, extended conversation, and number look-up, were rated roughly comparable to drinking something hot (again with the exception of the older group).

Table 19 shows how risk ratings for various tasks are related to familiarity with the technology. The top portion of the table presents cell phone tasks as a function of cell phone familiarity; the middle portion presents PDA tasks as a function of PDA familiarity; and the bottom portion presents navigation system tasks as a function of navigation system familiarity. For cell phones, none of the participants were “unfamiliar,” and only four were “somewhat familiar.” The four “somewhat familiar” participants rated higher risk for some phone tasks (key in call, look up number, take notes during conversation), but not so for others. For PDA tasks, there were substantial numbers of participants in all three familiarity categories. The range of mean ratings among the groups was not particularly large (less than one rating scale unit) for any PDA task. For the navigation system tasks, differences among familiarity groups were not particularly large (less than one rating scale unit) for five of the six tasks, although there was some tendency for the “familiar” group to rate risk as lower. For the tasks of viewing an electronic map, participants unfamiliar with navigation systems rated the risk as higher (6.00, vs. 4.80 for “somewhat familiar” and 5.27 for “familiar”).

CELL PHONE TASK	Unfamiliar (N = 0)	Somewhat Familiar (N = 4)	Familiar (N = 83)
Answer a cell phone call		3.25	2.61
Key in a cell phone call		6.00	4.08
Place a cell phone call using speed dial		3.00	2.71
Have an extended phone conversation		4.25	3.46
Have a brief phone ? exchange of information?		2.75	2.74
Look up a stored phone number in a cell phone		5.25	4.46
Take notes during a phone conversation		8.75	7.61
Open and listen to voice mail on cell phone		5.50	4.36

PDA TASK	Unfamiliar (N = 29)	Somewhat Familiar (N = 20)	Familiar (N=39)
Open and read email on PDA	7.55	7.90	8.26
Key in and send an email on PDA	7.86	8.30	8.69
Check your schedule on PDA	7.32	7.35	7.72
Schedule a meeting using PDA	7.75	8.40	8.53
Search the Internet using a PDA	8.52	8.95	9.24
Look up an entry in address book on PDA	7.10	7.15	7.50

NAVIGATION SYSTEM TASK	Unfamiliar (N =41)	Somewhat Familiar (N = 20)	Familiar (N=26)
View an electronic map on Nav System	6.00	4.80	5.27
Key a new destination into Nav System	6.78	7.50	6.72
Retrieve a stored destination on Nav System	5.78	5.35	5.32
Alter your route preferences on Nav System	6.73	6.35	5.96
Find an alternate route on Nav System	6.66	6.05	5.96
Search for the nearest Starbucks on Nav Sys.	6.51	6.10	6.08

Table 19. Risk ratings for in-vehicle tasks as a function of familiarity with the technology

Table 20 presents the mean ratings for each of the 10 driving tasks, for all participants and for each age group. Ratings were made on a 10-point scale, where 1 = “No risk at all of having a collision,” 5 = “An average driving situation,” and 10 = “High risk of having a collision.” Table 21 presents the results of a task-by-age group ANOVA on these data. The ANOVA indicates that there is a significant main effect for both the driving task and the age group. The interaction of these factors is not statistically significant. Risk ratings for the teen, young, and middle age groups were similar and the older group had higher ratings (4.78, 4.69, 4.4.84, and 5.63, for the teen, young, middle, and older groups, respectively). The very similar rank-ordering of the ten driving tasks for each of the age groups in Table 20 is consistent with the non-significant task-by-age interaction term. The table shows that participants felt that getting onto a freeway was the riskiest type of task; the two highest rated tasks were merging from one freeway to another and getting onto a freeway from an arterial road. Exiting a freeway was rated lower, and mainline freeway driving lower yet. An arterial left turn was seen as the next most risky task,

after the freeway merges. Comparing driving on various roadway types, the participants rated the two-lane curvy road (5.66) as riskier than the major freeway (5.02), which in turn was rated riskier than the arterial road (4.13), and least risky was the local/residential road (3.51). The substantial differences among the general ratings for two-lane roads, freeways, and arterials is in contrast to the insensitivity of the on-road ratings to roadway type, as was seen in Figure 4. Thus while the participants reportedly felt quite different degrees of driving risk for different road types, at least for the abstract task of rating general types of driving, this did not translate into reluctance to engage in a task when actually encountering such conditions on the road. This may be reflecting a difficulty participants have in making these more abstract judgments or a lack of sensitivity to roadway risk factors while considering in-vehicle tasks on the road.

The relationship of the general risk ratings for the in-vehicle tasks and driving tasks to the on-road ratings reflect the lesser sensitivity of the on-road ratings to the driving task. Of the 81 on-road situations included in the study, for 69 of them we could also obtain a corresponding general risk rating of both the in-vehicle task and the driving task. For these 69 situations, the correlation of the on-road willingness rating with the general risk rating for the in-vehicle task was $r = -0.85$. In contrast, the correlation of the on-road willingness rating with the general risk rating for the driving task was only $r = -0.27$. While both correlations are statistically significant, the in-vehicle task ratings predict close to three-quarters of the variance in the on-road ratings ($r^2 = 0.726$) while the driving task ratings predict only about seven percent of the variance ($r^2 = 0.072$). Thus the on-road ratings were strongly related to the perception of the general riskiness of the in-vehicle activity but only weakly related to the perception of the general riskiness of the driving task.

DRIVING TASK	All	Teen	Young	Middle	Old
Stopped at a red light on an arterial road	2.60	2.45	2.24	2.30	3.38
Driving on a local/residential road	3.51	2.64	3.33	3.65	4.41
Driving on an arterial road	4.13	4.18	4.29	3.63	4.36
Exiting a parking lot & turning right onto arterial road	4.75	4.27	4.43	4.85	5.45
Driving on a major freeway	5.02	5.00	4.81	4.43	5.82
Exiting a freeway onto an arterial road	5.41	5.36	5.24	4.75	6.23
Driving on a two-lane curvy road	5.66	5.55	5.76	5.35	5.95
Turning left across oncoming traffic f/arterial road	5.93	5.45	5.26	5.95	7.00
Getting onto a freeway from an arterial road	6.22	6.32	5.67	6.43	6.45
Merging from one freeway to another	6.62	6.59	5.81	6.90	7.18

Table 20. Mean general risk ratings for ten driving tasks, for all participants and by age group

RISK					
Source	DF	Anova SS	Mean Square	F Value	Pr > F
Age Group	3	124.78	41.59	10.84	<.0001
Task	9	1221.09	135.68	35.36	<.0001
Age Group x Task	27	74.14	2.75	0.72	0.8554

Table 21. Analysis of variance for general risk ratings of driving tasks

3.5 Stated Reasons Underlying Ratings

Two sections of the take-home booklet dealt with the stated reasons underlying the ratings. In the first portion of the booklet, eight situations from the on-road portion of the study were described, and the participant's on-road ratings of risk and willingness were shown. For each situation, the participant was asked to explain why they gave the rating they did. In Part 3 of the booklet, participants rated the risk associated with particular in-vehicle tasks (in general, without regard to the specific driving situation) and with particular driving situations (in general, without consideration of any in-vehicle activity). The participant was then asked to explain, for only the three most risky tasks and the two most risky driving situations, why these were considered the most risky.

Table 22 summarizes the stated reasons for the general ratings associated with the most risky general tasks and general driving situations (Part 3 of the booklet). The upper portion of the table shows the predominant reasons for risky in-vehicle tasks and the lower portion shows the predominant reasons for risky driving situations. The table shows the proportion of participants who cited a particular reason at least once. Data are shown for the entire group of participants as well as for each age group separately. For in-vehicle tasks, the most commonly cited reason was that the in-vehicle task took attention away from the driving task. While this was the most frequently cited reason for all age groups, it was cited by about half-again more teens and young participants (61%) than middle and older participants (42%). The second most frequently cited reason was that the visual requirements interfered with monitoring the road. About a third of participants explicitly indicated this answer. About a fourth of participants mentioned the physical requirements of interacting with the task. While the various age groups were similar in the frequency of citing the various factors, the major exception was that teenage drivers were much more likely (36%) to cite the length of the task (versus about 14% for the other age groups).

IN-VEHICLE TASK REASONS**% PARTICIPANTS CITING AT LEAST ONCE**

	All	Teen	Young	Middle	Old
Attention taken from driving task	52%	63%	59%	41%	43%
Interferes with visual monitoring of road	36%	36%	36%	32%	38%
Physical requirements	23%	18%	23%	27%	24%
Length of task	21%	36%	18%	14%	10%
Task characteristics (complexity, error, type of task)	11%	18%	14%	5%	10%
Other	8%	14%	5%	5%	10%
Demands of reading	3%	0%	14%	0%	0%

DRIVING SITUATION REASONS**% PARTICIPANTS CITING AT LEAST ONCE**

	All	Teen	Young	Middle	Old
Merging/interacting with other traffic	32%	44%	27%	26%	29%
High speed of traffic	26%	32%	27%	26%	19%
Behavior of other drivers (improper, risky, hard to predict)	24%	18%	32%	5%	19%
Difficulty of visual and temporal judgments	20%	9%	27%	11%	33%
Maneuver requires concentration, awareness	20%	27%	18%	21%	14%
Opposing traffic	19%	32%	18%	11%	14%
Limited sight distance	13%	14%	18%	5%	14%
Demands of vehicle control, staying on path	13%	13%	18%	5%	14%
Volume of traffic	11%	5%	23%	5%	10%
Other	10%	18%	5%	16%	0%
Limited maneuver time	5%	5%	5%	5%	5%
Presence of children, pedestrians	4%	5%	0%	11%	0%
Slow or stopped vehicles	2%	0%	0%	11%	0%
Unfamiliarity	2%	0%	5%	0%	5%
Presence of roadside hazards (e.g., trees)	2%	5%	5%	0%	0%

Table 22. Percentage of participants citing a given reason for “most risky” general ratings of in-vehicle tasks (upper portion of table) and driving situations (lower portion of table)

For the general ratings of driving situations, merging or otherwise interacting with other traffic was the most frequently cited reason, followed by the high speed of traffic and the behavior of other drivers. In general, reasons related in some way to traffic characteristics (interaction, speed, predictability, volume) were much more predominant than reasons related to roadway features (such as maneuver demands, sight distance, roadside hazards, pedestrians). Young, but not teenage, drivers cited the behavior of other drivers much more frequently than the other age groups. Teenage drivers cited merging traffic and opposing traffic more frequently. Older drivers differed in citing the difficulty of visual and temporal judgments more often. This was the most frequently cited reason by the older group.

Table 23 summarizes the stated reasons for the on-road ratings for the selected set of eight situations (specific in-vehicle task at a specific roadway/maneuver location). Unlike the explanations for the most risky general tasks and driving situations, above, these explanations dealt with situations that the participant may, or may not, have considered among the more risky. Therefore stated reasons might address why risk was perceived as low as well as why it might be perceived as high. The table shows the percentage of all participants who cited a particular reason at least once among the set of situations. It also shows the mean number of citations per participant, for those who cited it at all. The data are summarized at three different levels of categorization of the answers. At the broadest level, reasons were sorted into three categories: factors related to task execution; factors related to the driving environment; and factors related to task motivation. Within each of these broad categories, a set of more specific subcategories was defined. For example, factors related to task execution included attention, the need to take hands off the steering wheel, duration of the in-vehicle task, and so forth. Finally, for each of these subcategories, there is a more specific reason. Often these specific reasons are opposite in direction. For example, the factor of “difficulty of the task” could refer to the fact that the task was easy to perform or to the fact that the task was difficult to perform.

In discussing these findings, it must be recognized that the frequency with which various factors are cited is related to the specific set of situations included in the set. Thus the relative rate at which one factor is cited compared to another factor should not necessarily be generalized to all situations. The eight on-road situations included in the take-home booklet for explanation of the reasons for the ratings were selected to provide a range of in-vehicle tasks and driving tasks. The eight situations in the set were:

- Key in a cell phone call, freeway
- Cell phone conversation, freeway merge
- Key in cell phone text message, arterial road
- Key in cell phone text message, two lane winding road
- Check and read PDA email, stopped at right light on arterial
- Recall stored destination in navigation system, freeway
- Key in new destination in navigation system, residential road
- Eat a taco, freeway

Reasons for On-road Ratings	Percent of Participants Citing Reason	Mean Citations per Participant Citing
Factors Related to Task Execution	99	7.1
Attention	66	2.6
Sufficient attention given to road	23	2.1
Insufficient attention given to road	56	2.2
Hands off steering wheel	40	1.4
One hand on steering wheel	32	1.3
No hands on steering wheel	13	1.4
Duration of task	44	1.6
Quick	19	1.4
Extended	31	1.4
Visual attention	61	2.6
Eyes on road enough to be safe	25	2.1
Eyes off road too much for safety	55	1.9
Complexity of task	33	1.4
Simple & straightforward	16	1.4
Complex & involved	17	1.3
Difficulty of task	52	1.9
Easy to perform	42	1.6
Difficult to perform	22	1.4
Experience with task	42	1.8
Familiar	40	1.5
Unfamiliar	9	1.4
Cleanliness of task	32	1.0
Sloppy	31	1.0
Neat	1	1.0
Factors Related to Task Environment	97	6.3
Curvature	51	1.5
Straight	16	1.6
Winding	47	1.1
Width	15	1.1
Narrow (≤ 2 lanes)	15	1.0
Wide (> 2 lanes)	1	1.0
Topography	3	1.0
Flat	0	0.0
Hilly	3	1.0
Amount of traffic	83	3.2
Light	69	2.4
Heavy	58	1.6
Speed	56	1.8
High	39	1.6
Low	32	1.6

Table 23. Percentage of participants citing given reasons for their on-road ratings for a set of eight on-road situations

Reasons for On-road Ratings	Percent of Participants Citing Reason	Mean Citations per Participant Citing
Non-vehicle hazards in road	33	1.2
Children	13	1.3
Pedestrians	9	1.1
Pets	1	1.0
Bikes	1	1.0
Deer	3	1.0
Stoplights	10	1.1
Roadside hazards	17	1.2
Mailboxes	0	0.0
Trees	1	1.0
Parked cars	10	1.2
Driveways	7	1.0
Experience with environment	31	1.8
Familiar	16	1.2
Unfamiliar	17	1.4
Restricted	3	2.0
Unrestricted	2	1.0
Behavior of other drivers	24	1.5
Entering	7	1.0
Exiting	1	1.0
Merging	11	1.3
Opposing traffic	7	1.2
Tailgating	1	1.0
Demands of vehicle control	3	1.0
Shoulder	1	1.0
Present	0	0.0
Absent	1	1.0
Factors Related to Task Motivation	99	3.3
Hunger	22	1.0
Hungry	20	1.0
Not hungry	1	1.0
Importance	35	2.0
Important	25	2.0
Unimportant	17	1.3
Immediacy	68	1.5
Hurried	13	1.1
No rush	11	1.9
Stopped	63	1.0
Opinion of device/task	39	1.7
Against use/performance of in vehicle	34	1.7
Indifferent	1	1.0
Avid user	3	1.7
Alternative Actions	47	1.6
Would pull over	26	1.2
Other	11	1.6
Uncodable	7	1.3
Irrelevant	10	1.7

Table 23 (continued). Percentage of participants citing given reasons for their on-road ratings for a set of eight on-road situations

At the highest level of generalization, the reasons listed in Table 23 were grouped under three headings: task execution, task environment, and task motivation. Nearly all participants included reasons from each category among their answers (percent of participants citing ranged from 97-99%). However, factors related to executing the in-vehicle task were cited more often than the other categories. Of those including these reasons, task execution factors were cited 7.1 times per person, compared to 6.3 times for the driving environment and 3.3 for task motivation. It should also be noted that while the on-road experiment could place the driver in the actual driving situation, it could not reproduce the range of motivational factors that might influence decisions. Thus the participant might be told in the situation description that they are hungry (in the eating situation) or that they are in a hurry, but the actual motivation did not exist.

Although task execution factors were the most-cited category, the most frequently cited specific factor was the amount of traffic. This factor was cited by 83% of participants, and they averaged 3.2 citations per participant. Light traffic was cited as a decision factor somewhat more often than heavy traffic for this set of situations. Within the task execution factors, sufficiency of attention and visual distraction were cited by the most participants (66%, 61%) and were cited more frequently as well (2.6 times, by those who cited the factor at all). Speed and curvature were both cited by slightly more than half of the participants.

Table 24 shows the frequency of various citations for each of the eight situations included. For each situation, the table shows the percent of participants who cited reasons within each of the three general categories of task execution, task environment, and motivation. The table also lists within each of these categories those particular reasons that were cited by at least 15% of the participants. The situation in which the driver was stopped at a traffic signal (for the task of picking up and reading a PDA message) was clearly very different from the others, which all occurred while the vehicle was in motion. Motivation factors were the least cited for all other situations, but the most cited for this situation. That was primarily due to the reason of “immediacy” (64%), and within this category, the subcategory of “stopped” (61%). This reason might equally well have been included as an “environment” factor as a motivation factor. Excluding this “stopped” situation, task execution factors were cited by a clear majority of participants (67-79%), except for the residential street situation (49%). Task environment factors were very frequently cited for the residential road and two-lane winding road situations (78%, 73%), and cited by about half the participants for the other five situations (excluding the “stopped” situation). The amount of traffic was frequently cited for all seven situations in which the vehicle was moving. For motivational factors (excluding the “stopped” situation), there were few cases where any one individual factor was frequently cited. One exception was for the text messaging task, where a number of participants expressed opposition to any performance of this task in an automobile. Overall, 18% of participants mentioned this for one or both of the scenarios that included entering a text message. However the frequency of citing this varied with age (teen = 5%, young = 18%, middle = 23%, old = 27%). The other exception was for the residential road navigation system use, where the importance of the task was mentioned by 15% of participants.

Scenario	Task Execution	Task Environment	Motivation
Freeway Entrance/Merge Cell Phone, Personal conversation	62% Attention =23% Difficulty of task=15%	53% Amount of traffic=34%	29%
Arterial Stopped at Signal PDA, Pick up and read message	38% Duration of task=17%	7%	85% Immediacy=64%
Freeway Mainline Non-Technology, Eat taco	77% Cleanliness of task=33% Difficulty=18% Hands off wheel=17% Visual attention=15%	51% Amount of traffic=32% Speed=18%	37%
Freeway Mainline Cell phone, Key in call	79% Experience w task=34% Visual attention=27% Difficulty of task=24%	56% Amount of traffic=37% Speed=24%	33%
Arterial Mainline Cell phone, Enter text message	73% Attention=34% Visual attention=30%	53% Amount of traffic=48%	32% Opinion of device/task=16%
Freeway Mainline Nav system, Call up stored desintation	69% Visual attention=24% Attention=18% Complexity of task=16% Difficulty of task=15%	49% Amount of traffic=33% Speed=16%	27%
Minor Local/Residential Nav system, Key in destination	49% Attention=22% Visual attention=17%	78% Amount of traffic=45% Speed=23% Non-vehicle hazards=22% Roadside hazards=16%	33% Importance=15%
Monor 2 Lane/Winding Cell phone, Enter text message	67% Attention=31% Visual attention=22%	73% Curvature=44% Amount of traffic=31%	27%

Table 24. Percentage of participants citing general factors, and frequently cited ($\geq 15\%$) specific reasons, for each of eight on-road situations.

In general, the citation rates for various factors were similar among the age groups. A few noteworthy differences among age groups were observed. Teenage drivers cited road curvature more often (77% of participants), and older drivers less often (27%) than the young and middle aged groups (45%, 55%). High speed was cited as a reason somewhat more frequently by teen (50%) and older (45%) participants than by young (32%) and middle aged (27%) participants. There was a systematic relationship of age to the rate of citation of the reason of being stopped: 82% of teens, 68% of young, 55% of middle, and 45% of older. Thus the opportunity afforded by a red traffic signal appeared to be more of an inducement for younger participants than older ones. There was also a systematic relationship of age to statements about being against the use of the device/task while in the vehicle and statements about the need to pull over in order to do the task. Statements against the use of the device/task were made by 18% of teens, 23% of young drivers, 41% of middle aged drivers, and 55% of older drivers. Statements about pulling over were made by 14% of teens, 23% of young drivers, 32% of middle aged drivers, and 36% of older drivers.

3.6 Driver Behavior and Decision Making

The final portion of the take-home booklet collected information on driving behavior and decision making style. Seven questions dealt with the intensity or aggressiveness of one's driving. Three questions dealt with perceived ability and desire for multitasking while driving. Six questions dealt with how impulsive or deliberative the person was in his or her general decision making. The specific questions may be found in Part 5 of the take-home booklet (Appendix C). Each participant was given a score for each of these attributes, by summing the participant's rated level of agreement (5-point scale) with each question (with the scale adjusted where necessary so that higher numbers indicated more of the attribute). Thus for "driving intensity," a range of scores from 7 to 35 was possible; for "driving multitasking," a range from 3 to 15 was possible; and for "deliberativeness," a range from 6 to 30 was possible.

Figure 8 plots the cumulative relative frequency of "driving intensity" scores. The figure shows the cumulative percentage for the entire group of participants, and also for each of the four age groups. Figure 9 shows comparable data for the "driving multitasking" scores and Figure 10 shows comparable data for the "deliberateness" scores. The teen and young age groups showed a much greater tendency toward intense, aggressive driving styles. The median score for the teen group was 19.0 and for the young group 20.0. In contrast, the median for the middle age group was 15.4 and for the older group 14.7. Only 17% of middle age participants, and 5% of older participants, had scores higher than the median (20) for the young group. Age was also related to the multitasking scores. The young group had the highest median score (11.0), the teen and middle age groups had medians of 9.0 and 9.29, respectively, while the older group had a much lower median of 6.2. While almost no older participants had a multitasking score over 10, half of the young group had scores of 12 or more out of the maximum of 15. Older participants appear averse to having to multitask while driving; young drivers (even more so than teens in these data) appear to enjoy the challenge of multitasking. For decision style, middle and older groups reported more deliberative and less impulsive decision making. Median scores for the teen and young groups (21.0, 20.9) were lower than for the middle and older groups (23.5, 22.8). Teens and young participants had many more scores toward the lower ("impulsive") end of the scale. Over a fourth of the teens (27.4%) and 18.2% of the young group had scores of 20 or lower; this contrasts with only 9.3% of middle age participants and none of the older participants. At the other ("deliberative") end of the scale, 46% of the middle age group and 41% of the older group had scores of 25 to 30 (the maximum possible). In contrast, only 9% of teens and 5% of young participants had scores this high. In summary, then, teen and young groups reported more aggressive driving styles, more tendency to multitask, and less deliberative decision making styles. For driving intensity and multi-tasking, the young group appeared somewhat more extreme than the teenage group.

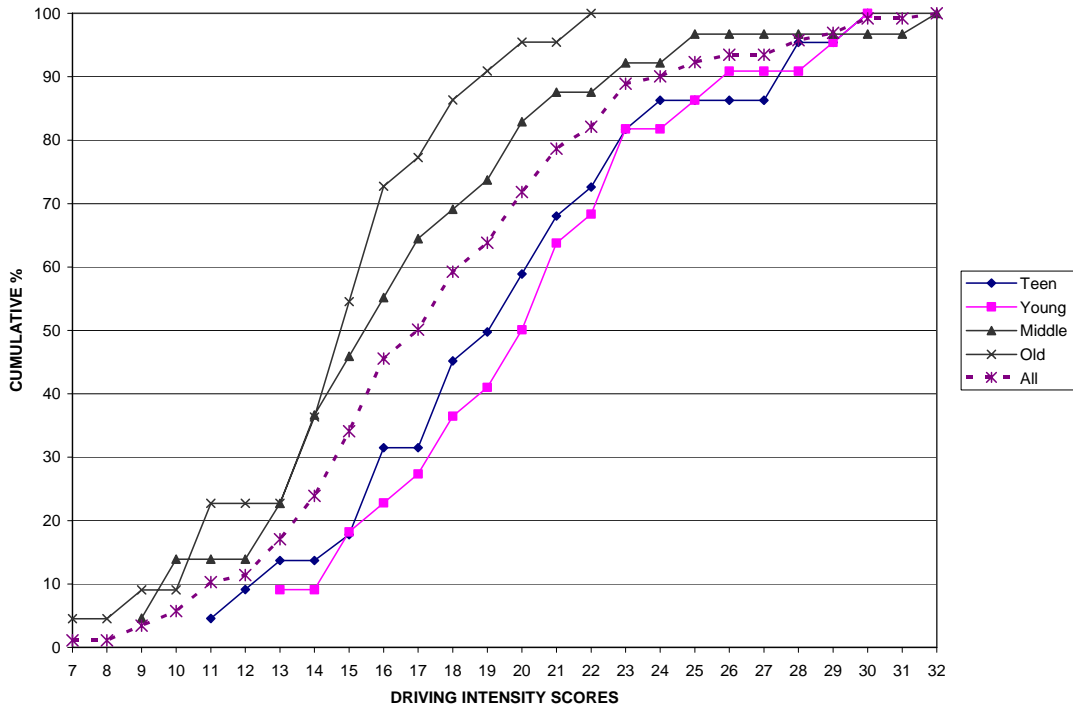


Figure 8. Cumulative relative frequency of “driving intensity” scores, for all participants and for age groups

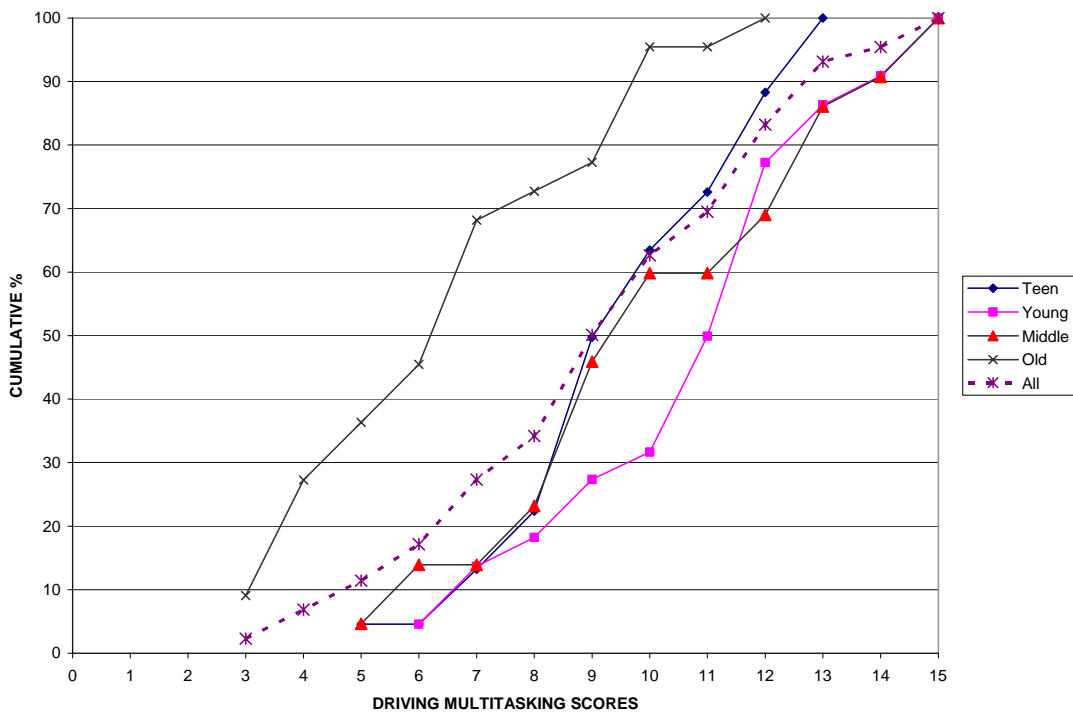


Figure 9. Cumulative relative frequency of “driving multitasking” scores, for all participants and for age groups

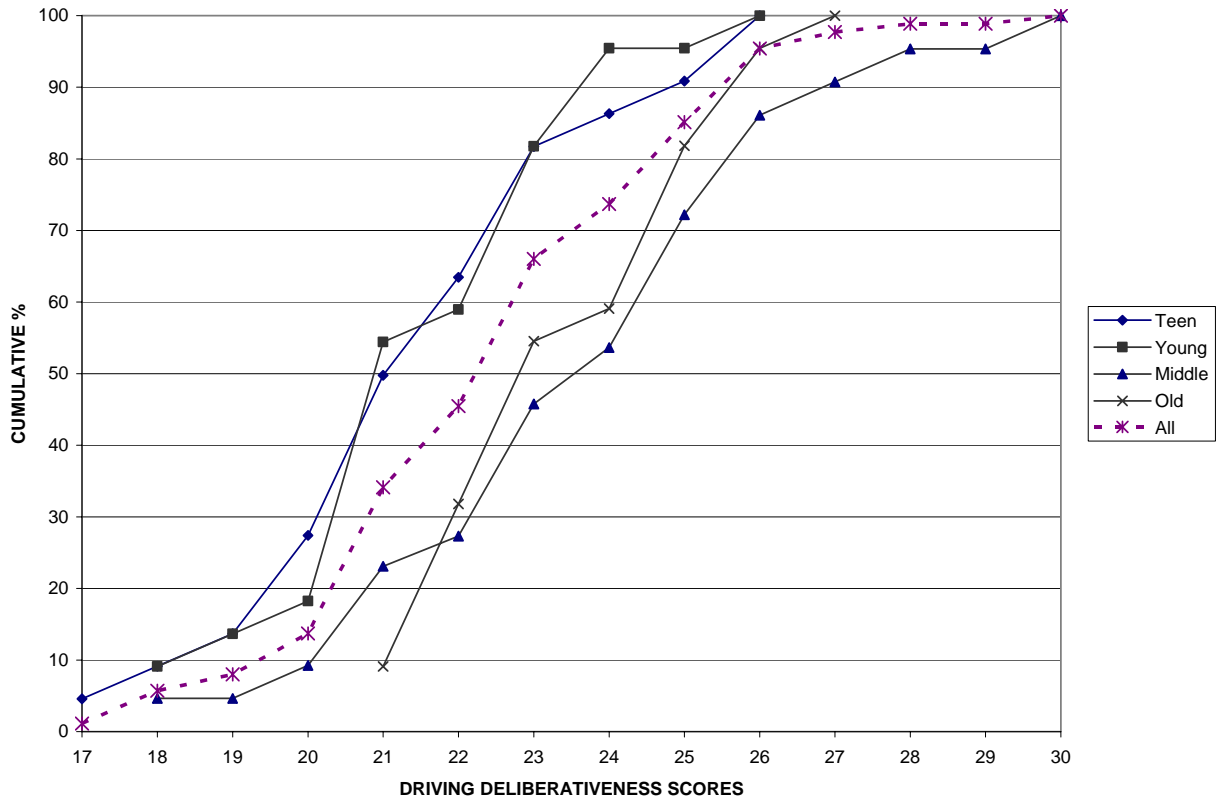


Figure 10. Cumulative relative frequency of “deliberativeness” scores, for all participants and for age groups

Table 25 shows the relationship of self-reported driving intensity, multi-tasking, and deliberativeness to ratings of willingness to engage in tasks and ratings of the risks associated with situations. For each driver measure, participants were grouped into “low,” “medium,” or “high” categories for the factor. The categories were defined by the distribution of scores for the set of all participants, breaking it into lower, middle, and upper thirds. For each attribute (driving intensity, multitasking, deliberativeness), a “low” score was one at or below the 33rd centile for the group; a “high” score was one above the 66th centile; and “medium” scores were those between “high” and “low.” For each category, the table shows the mean ratings for participants within that category. For different ratings are provided in the table: on-road ratings of willingness to engage in tasks; on-road ratings of the risk associated with engaging in the task; booklet ratings of the risks associated with various in-vehicle activities; and booklet ratings of the risks associated with different driving locations and maneuvers. For each of these, the table presents the overall mean rating, computed across all of the different situations involved.

ALL ON-ROAD SITUATIONS BOOKLET GENERAL RATINGS

DRIVING INTENSITY	Mean Willingness	Mean Risk	Mean Risk All Tasks	Mean Risk All Locations
High	6.46	4.57	4.22	4.57
Medium	5.63	5.07	4.89	5.18
Low	4.75	6.17	5.79	5.27

DRIVING MULTI-TASKING	Mean Willingness	Mean Risk	Mean Risk All Tasks	Mean Risk All Locations
High	6.55	4.47	4.27	4.75
Medium	5.80	5.08	4.79	4.77
Low	4.47	6.19	5.76	5.56

DELIBERATENESS	Mean Willingness	Mean Risk	Mean Risk All Tasks	Mean Risk All Locations
High	5.61	5.33	4.85	5.25
Medium	5.74	5.09	4.99	5.02
Low	5.94	4.97	4.28	4.74

Table 25. Relationship of driver behavior/attitude scores to ratings of willingness and risk

Willingness ratings systematically increased, and risk ratings systematically decreased, as driving intensity scores went from low to middle to high. Thus more intense, aggressive drivers saw generally less risk in both driving situations and in-vehicle activities, and were more willing to engage in activities while driving. A similar relationship is seen with the multi-tasking scores. High multi-taskers generally saw less risk in both driving situations and in-vehicle activities, and were more willing to engage in activities while driving. The effects of driving intensity and multi-tasking scores on the ratings was quite substantial. The difference between High and Low groups for on-road ratings of willingness and risk ranged from 1.6 to 2.1 rating scale units. Ratings of risks associated with in-vehicle tasks were comparably affected. Ratings of risk associated with general driving situations were in the same direction, but not as large.

The effects of decision-making style on the ratings were less evident. Those who were more deliberate in their decision styles showed generally lower willingness ratings and higher risk ratings, but the differences between groups was not as pronounced as for driving intensity and multi-tasking. The on-road ratings of the High and Low groups differed by only about one-third of a rating scale unit.

4.0 Discussion

4.1 This Experiment within the Broader Context of the Distracted Driving Problem

The degree of risk associated with some in-vehicle technology is the product of (a) how use of the device disrupts the driving task, and (b) what strategies drivers employ about when and how to use the device. Most of the research to date on driver distraction has addressed the first issue. Studies have investigated how some in-vehicle activity, such as placing a cell phone call, relates to measures of driving performance (e.g., positional control, hazard recognition) or crash involvement. There has been little research on the second issue. Drivers can influence risk by choosing where and when to engage in potentially distracting tasks. If their decision making is effective, the technology will have fewer safety consequences. In order to best manage the highway safety issue of driver distraction, there must be sufficient understanding of several inter-related concerns: how a task influences driving; how drivers compensate for the distraction; and how drivers make decisions about whether to engage in the task. The present study specifically addressed the concern of driver decision making about whether to engage in some in-vehicle task.

A variety of factors will influence driver decision strategies about engaging in distracting tasks. The present experiment only addressed some of these factors. The factors studied in this on-road experiment should be viewed in the broader driver decision-making context. An earlier phase of the full project conducted a series of driver focus groups. Based on the focus groups, as well as other literature, a “working model” of the decision process was developed (Lerner and Balliro, 2003a). Figure 11 presents the conceptual model diagrammatically. The heavy rectangle has been added to the diagram to indicate the portions of the process that are addressed within the on-road experiment.

The model can be viewed as having three general phases. At the top of the diagram are the “pre-trip factors” that may influence decisions. These include such things as expectancies about device needs (e.g., am I expecting a phone call?), preparations for device use (e.g., placement of the phone, pre-programming navigation destinations), and on-going activities that are already in progress when the driver begins the trip (e.g., having a phone conversation, eating something). The middle portion of the diagram deals with the immediate decision process about whether to initiate some in-vehicle task, given the existence of some current motivation to engage in the activity. It shows the various factors that feed into the perceptions of opportunity, risk, and incentive, which together produce a decision. The lower portion of the diagram addresses what happens after the in-vehicle activity has been initiated. There is a process of monitoring self-performance, adapting behavior (both driving behavior and task behavior), and if necessary, suspending or terminating the task. As area within the heavy rectangle in the diagram indicates, the on-road experiment did not deal at all with the pre-trip factors or with the post-initiation factors. It dealt specifically with the immediate decision about whether to engage in the activity. Even within this portion of the diagram, the experiment did not deal with all of the factors. The focus groups found that a set of considerations, which we termed “non-specific technology use factors,” were often quite important determinants. These factors are “non-specific” in that they do not relate to the particular information content of the communication. For example, some

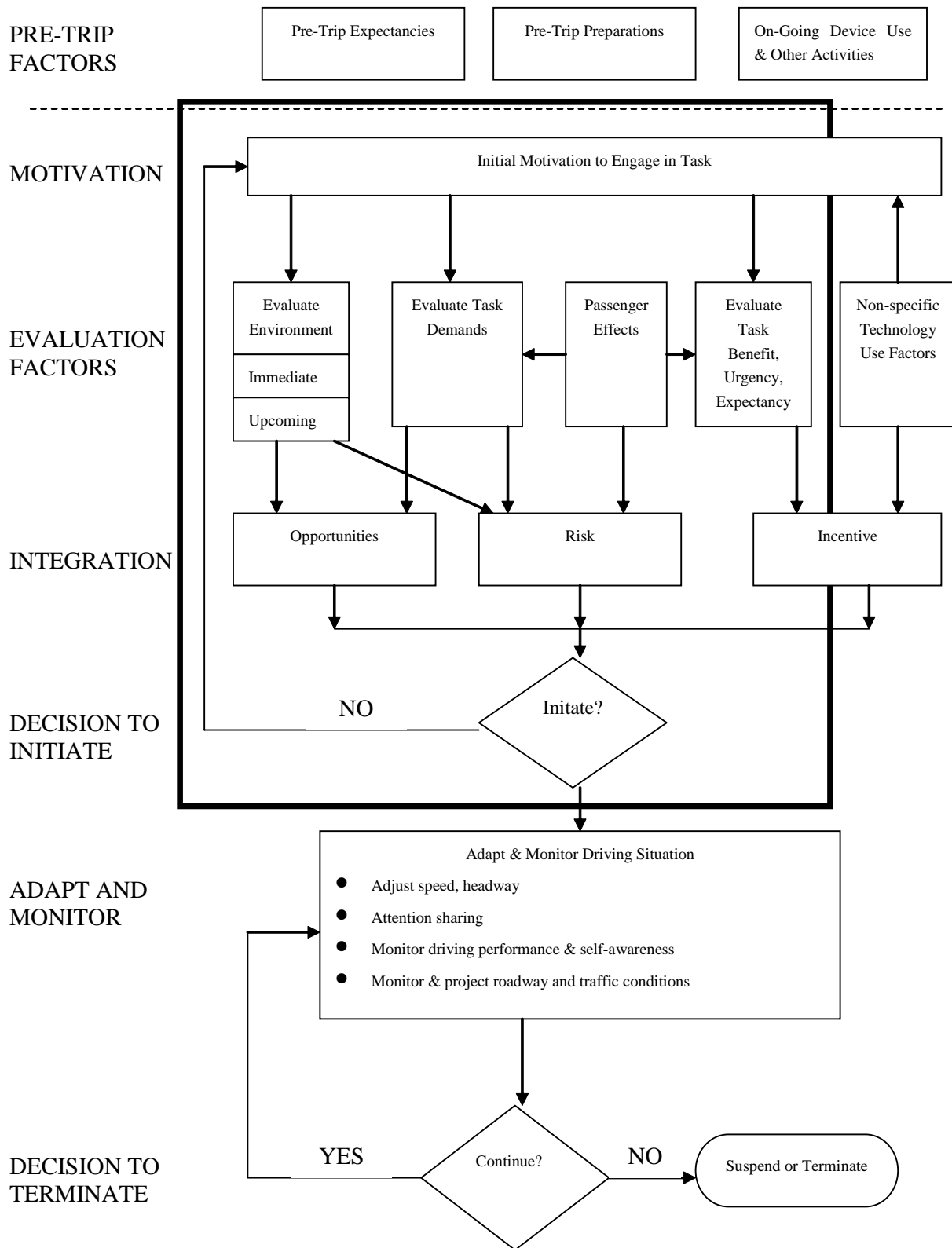


Figure 11. Conceptual model of decision making

phone use is motivated by a desire to use the remaining time on a monthly telephone plan, or to take advantage of limited time during the day for conversations. Also, although “initial motivation to engage in task” is included within the heavy rectangle portion of the diagram, it is not well-captured by the procedure of the on-road experiment. For each rating situation, participants were basically told what their motivation was, but did not actually experience any motivation to engage in a task.

The intent of Figure 11 is to help place the on-road experiment in proper context. Driver willingness to engage in a task is only one part of the distracted driving problem, and the factors studied in this experiment address only a portion of the “willingness” aspect. The study focused on aspects of the in-vehicle task and the driving situation, but this should not be considered to represent the full decision context. None the less, these are important factors for driver strategies and little previous research has addressed how drivers consider these factors in their decision strategies.

4.2 General Willingness to Engage in Tasks

Participants indicated their *willingness* to engage in a given task using a ten-point scale (1 = I would absolutely not do this task now; 10 = I would be very willing to do this task now with no concerns at all). Participants also rated the *risk* of engaging in the task on a ten-point scale (1 = no additional risk beyond my normal driving; 10 = very likely I would be involved in an accident). Across the 81 on-road scenarios, participants tended to use the full range of the rating scales. For willingness, means for the entire participant sample ranged from a low willingness of 2.76 (pick up and read a PDA message during a freeway merge) to a high of 9.24 (conversing with a passenger while on an arterial road). One interest of the experiment was in how people’s willingness to engage in a task related to their subjective sense of risk. The linear relationship between these sets of ratings was exceptionally strong. The correlation for the entire sample was $r = -0.98$, and this strong linear relationship was true for each of the four age groups individually ($r \geq -0.96$). As Figure 3 illustrated, there were no aberrant data points where a rating deviated substantially from the regression line. The finding that no single data point deviated strongly from the regression line indicates that there were no activities (within our sample of tasks) for which people were more willing to engage in the task in spite of the level of risk. The strong linear relationship indicates that willingness, at least as measured in this experiment, is incrementally related to perceived risk across the span of risk levels. There was no threshold, below which risk did not matter, nor any ceiling, above which willingness was capped. However, it should also be noted that this could also be a phenomenon of group averaging. If individual participants have different thresholds, group mean functions might appear linear.

Most of the high willingness ratings were for non-technology tasks. Phone-related scenarios ranged as high as 8.57, while the highest rated navigation system scenario was 5.68 and the highest rated PDA task was 4.74. Ratings were related to the in-vehicle task, the driving situation, and driver attributes. The details for each of these factors are discussed in sections that follow. There was some suggestion that task attributes had a stronger influence than roadway and environment attributes. This was indicated by several findings. Considering the matrix of on-road scenarios in Table 6, there is typically a greater range of scores within the rows of the

matrix (i.e., from task to task) than in the columns (i.e., from site to site). General risk ratings for the various in-vehicle tasks (Table 16) were more variable and extreme than general risk ratings for the roadway situations (Table 19), although it should be noted that the scale anchors are differently defined. General ratings for various in-vehicle tasks correlated more strongly with on-road ratings than did general ratings for driving locations. In reviewing the reasons why participants rated on-road situations as they did, factors related to task execution were cited more often than factors related to the driving situation, although the difference was only about 15%. Although the range of tasks and driving situations included in the experiment was reasonably representative, the detailed findings are specific to the set of scenarios evaluated. Thus in these findings we have the suggestion, though not conclusively, that in-vehicle task factors tend to influence willingness and risk judgments more strongly than do the driving situation factors. This is consistent with the findings of previous focus groups (Lerner and Balliro, 2003a).

4.3 Tasks and Task Factors

Three in-vehicle technologies were included in this experiment: cell phones, PDAs, and navigation systems. Cell phone use is of particular interest because it is widespread and has been studied most frequently in driver performance experiments and crash analyses. Participants saw very little risk involved in cell phone conversation and were quite willing to engage in phone conversation under all circumstances included in the experiment. In the on-road portion of the study, only conversation with a passenger was viewed as less risky than personal conversation on the phone. While participants rated on-road willingness somewhat lower for the common cell phone tasks of answering a call or keying in a call, ratings were still quite high (>6.0) for most situations. Even in the worst case (answering a call while making a U-turn at an arterial intersection), willingness ratings were still around mid-scale (4.51). On the road, answering a cell phone call was rated comparably to drinking something hot. Keying in a call was generally rated slightly more risky (and slightly less willing) than answering a call. Both of these tasks were seen as less risky than locating a CD and inserting it into the CD player. In contrast, keying in a text message by cell phone was seen as quite risky, comparable to PDA use. Thus the on-road data indicate that participants had very little reluctance to engage in phone conversation and saw minimal risk in it. Placing or receiving calls were seen as somewhat riskier, but with relatively little reluctance to engage under most conditions.

The general risk ratings of in-vehicle tasks from the booklet portion of the study (Table 17) produced generally similar findings to the on-road ratings, although with some exceptions. It may be noted that in a previous phase of this project (Lerner and Balliro, 2003a), focus group participants were asked to make risk ratings of the same set of tasks. The mean risk ratings from the focus groups and the take-home booklet of the on-road experiment were very strongly correlated ($r = 0.95$), with no substantial disagreements. Thus these appear to be reliable judgments. Comparing the on-road ratings with the booklet ratings, the most striking difference was that answering a call was rated as much less risky in the general ratings than on the road. The reason for this is not evident. There was also a substantial difference in on-road and booklet ratings for the “insert CD” task. However, this difference is more understandable, since the on-road scenario explicitly included searching for the CD in the glove box (or wherever normally stored), while the booklet general rating was only for “insert a CD, tape, or video.” Because the

general ratings included more cell phone tasks, and more non-technology tasks, than were included in the on-road portion, there is an opportunity to compare the participants' perceived risk for cell phone activities with a range of common non-technology activities. Figure 12 portrays these ratings. Ratings for several cell phone tasks – answering a call, speed dialing, and brief “information-exchange” conversation – cluster between 2 and 3. This is seen as more risky than conversation with a passenger, checking the speedometer, or turning up the temperature, and roughly comparable with eating something neat or drinking something cold. Radio tuning was at the higher end of this cluster of ratings. Extended cell phone conversation was seen as somewhat riskier, comparable to drinking something hot. Opening and listening to cell phone voicemail, and looking up a stored number, were rated somewhat more risky, although still moderately on the ten-point scale. The risk was seen as comparable to dealing with children. None of these cell phone activities was seen as risky as eating a messy food such as a taco. One cell phone related activity was seen as quite risky. That was the task of taking notes during a phone conversation.

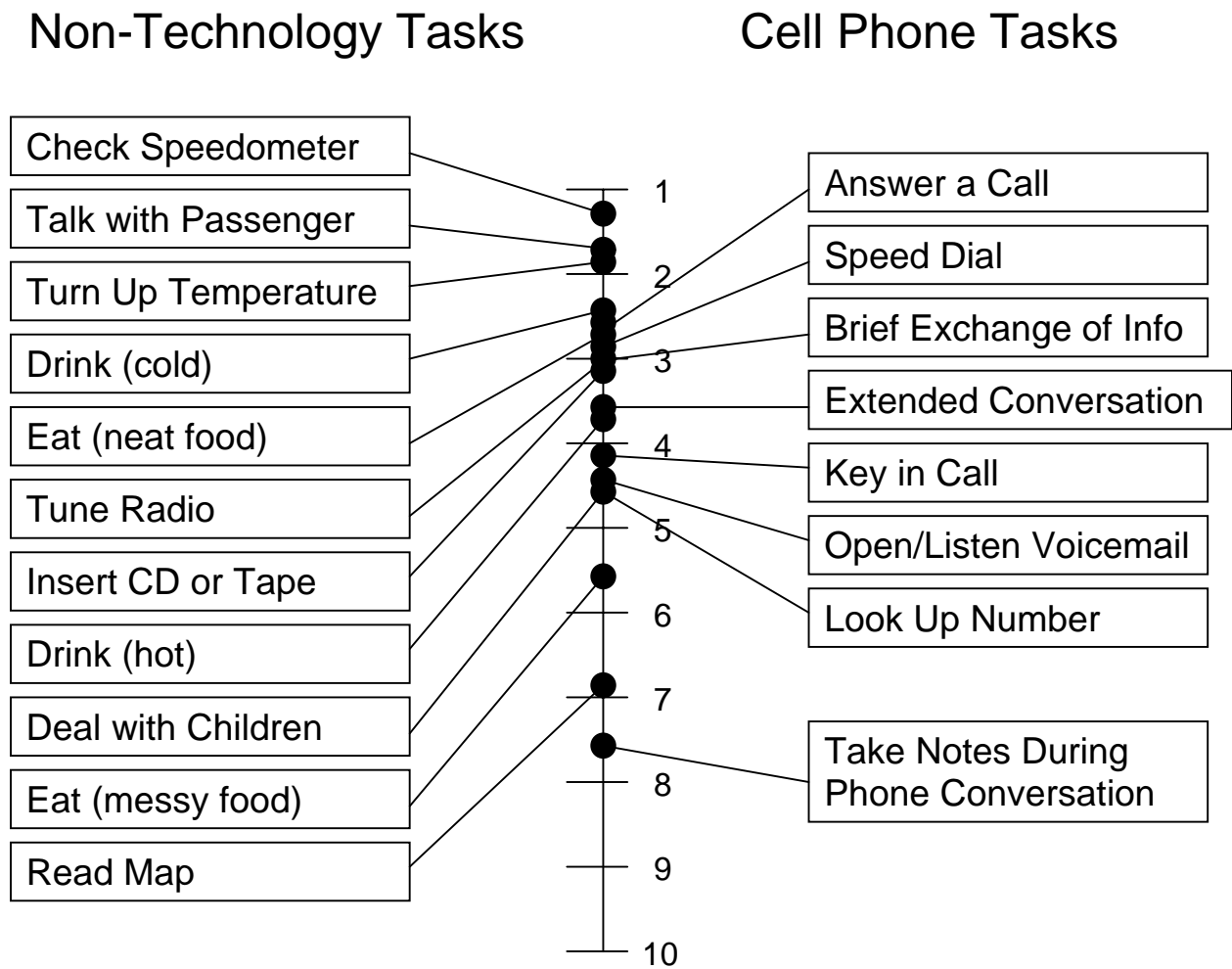


Figure 12. General risk ratings for all cell phone tasks and comparison non-technology tasks.

PDA activities generally were rated as the most risky/least willing of technology tasks. Except when the vehicle was stopped or in low speed situations (parking lot, residential road), the group on-road mean willingness to pick up a PDA message or key in and send a PDA message was quite low (rating <4.0). There was moderate willingness to look up a stored number on a PDA. General task ratings from the booklets confirmed this finding of high perceived risk for PDA tasks, with highest-rated risk for the tasks of opening/reading an email and keying in/sending an email (as well as tasks of scheduling a meeting and searching the internet).

Navigation system tasks were generally rated intermediate between cell phone tasks and PDA tasks. It should be kept in mind that close to half of the participants indicated that they were unfamiliar with navigation system use. Although some familiarity was provided by the training video prior to data collection, ratings for many participants will be more speculative than for cell phone use. Participants indicated greater willingness to call up a destination than to key in a destination or use a search feature. General task risk ratings from the booklet had similar results. The general task ratings also included the task of reading a paper map while driving. This was seen as quite risky (6.9), rated comparable to keying in a new destination and considerably more risky than reading an electronic map display (5.5).

In providing explanations of *why* they rated situations as they did, the predominant task-related reasons given by participants had to do with the amount of attention required by the task and the direction of visual attention away from the road. Other commonly cited task factors included physical requirements (e.g., hands off steering wheel), task complexity, and difficulty. While the written answers in the booklets provided useful general findings, they did not result in deeper insights into the decision process. Structured interviews may be required to understand this better. Various reports in the technical literature have pointed to the potential importance of a number of task attributes that are not really addressed by the data. For example, these include: the ability to decompose the task into discrete subtasks (“chunking”); potential for “cognitive capture”; ability to self-monitor the level of distraction (awareness); potential for incidents/errors (e.g., drops, spills, mis-entries) and the demands of error-recovery; and driver control over task initiation and pacing. It would be useful to have some feature-based taxonomy of tasks or a feature-based model of task demand. One could then link driving performance measures (e.g., path tracking, hazard awareness) and driver willingness to engage to various task characteristics. Such taxonomies and models do not exist, although there have been various calls for research to develop them (e.g., Westat, 2000) and there are figure-of-merit models that incorporate at least some task elements (e.g., DEMAND model, Hankey, Dingus, Hanowski, Wierwille, and Andrews, 2000). There have been some studies of crash records and naturalistic driver behavior that have resulted in “taxonomies” of distracting activities (e.g., Stutts, Feaganes, Rodgman, Hamlett, Meadows, Reinfurt, Gish, Mercandante, and Staplin, 2003; Wierwille and Tijerina, 1996). However, these are actually hierarchically organized lists of distracters (e.g. vehicle interior source of distraction>dash/console>radio). They are not structured around task attributes. It would be revealing to map driver willingness to engage in a task to task attributes, and to identify differences for a similar mapping of driver performance to task attributes. That might reveal task factors that drivers under-appreciate or over-value. However, an adequate basis for doing so with the data of the present experiment is not available.

4.4 Driving and Environmental Factors and Driver Attributes

Participant on-road ratings were essentially identical for mainline driving on freeways, arterials, and two-lane highway (with the exception that the teen group was less willing on the freeway than on the other roads). Less risk was seen, and willingness was greater, on a minor road in a residential neighborhood with little traffic. In the booklet ratings of risk for general driving locations, arterials (4.13), freeways (5.02), and two-lane “curvy” roads (5.66) were discriminated, in contrast to the on-road judgments. Willingness to engage in a task was reduced during maneuvers related to freeways (exit, merge) and arterials (left turn, U-turn). One scenario in the on-road portion of the experiment involved the situation where a driver is in a parking lot and about to exit onto a major arterial road. Even though a turning and merging situation was about to be required, participants indicated a relatively high willingness to engage in tasks, higher than for “mainline” arterial driving. The ordering of driving situations for general risk ratings was generally similar to the order seen in the on-road ratings, except that the winding two-lane road was rated substantially higher in risk for the general (booklet) ratings.

The booklet scenarios allowed various features, or environmental factors, to be added to the driving situation. In this portion of the procedure, we attempted to include a range of factors and driving situations. The design did not include any formal design that allowed comparison of the effects of some factor across a broad range of driving situations. Rather it simply provided a sampling of situations. The experiment did however consider driver attributes as factors that may influence risk and willingness ratings. With respect to driving and environmental factors, driver age appears to show a significant effect. Among the more interesting effects observed for the added factors were the following:

- Participants indicated substantially more risk, and reduced willingness, for keying in a phone number on an arterial road when the factor of rain was added with the middle and old groups showing the greatest shift and the teenage groups showing the least. However, essentially no effect of rain was seen for the task of answering a phone during freeway driving.
- The presence of age peers had very little effect on the ratings. This was true for teenage participants as well as other age groups, and is interesting in light of research that indicates teenagers may be at especially enhanced risk when there are peer-age passengers.
- The presence of a toddler in the vehicle had minimal effect on the ratings for answering a cell phone call. In contrast, this factor did have an effect on ratings for eating a taco.
- Being in a construction zone reduced the willingness of participants to key in a destination in a navigation system. However, this was not the case for the teenage driver group, for whom the group mean willingness rating actually increased somewhat when this factor was added.
- All of the on-road data collection was done under daylight conditions. The factor of night driving was included in only one of the booklet scenarios (keying in a cell phone number during arterial driving). There was minimal effect of this factor, even for older drivers, who might be expected to be particularly sensitive to visual issues at night.

- While the effects were not especially large (except for the middle age group), adding the factor of traffic congestion reduced the willingness ratings for all but the teenage group. In fact, the teens rated greater willingness, and less risk, for congestion in the freeway situation.
- Adding the factor of construction substantially reduced willingness ratings for middle aged and older drivers. The effect for young drivers was minimal, and there was virtually no evidence of decreased willingness for teenage drivers.
- When boredom was added as a factor in freeway driving, participants were much more willing to key in a phone call, and saw doing this as less risky as well; the teenage and young drivers showing a very substantial increase compared to the middle and older groups.

While the study design does not allow for a systematic way to interpret the effects of the added factors, the findings suggest that the influence of a factor may be quite situation-specific, depending on the task and/or the driving location. More systematic manipulation of these factors will be required to understand this. There were also some notable differences among age groups for some factors.

For the general ratings of ten driving situations, participants indicated the reasons why they rated the two most risky situations as they did. The most frequently cited reasons had to do with interactions with other traffic, followed by the speed of traffic, and the behavior of other drivers. Teenage drivers much more frequently cited merging/interaction with other traffic and opposing traffic. For the eight on-road situations indicated in Part 1 of the take-home booklet, participants were asked to explain why they rated each situation as they did. The most commonly cited reason for all age groups was that the in-vehicle task took attention away from the driving task, but it was cited by half-again more teens and young participants than middle and older participants. Also, teenage drivers cited road curvature more often and older drivers less often than the young and middle aged groups. For seven of the eight scenarios, the amount of traffic (whether light or heavy) was the most frequently cited factor. Only for the task of entering a cell phone text message while driving on a curvy two-lane road, was another factor (curvature) more frequently cited. Of course, these explanations were provided retroactively. Data on reasons were not collected during the on-road portion of the study itself, and there is an assumption that participants could accurately recall the driving experience.

Driving behavior and general decision making style scores also indicate a significant difference among the age groups. Teen and young groups reported more aggressive driving styles, more tendency to multitask, and less deliberative decision making styles. For driving intensity and multi-tasking, the young group appeared somewhat more extreme than the teenage group. When these relationships were compared to willingness and risk ratings it was found that the effects of driving intensity and multi-tasking scores on the ratings were quite substantial. More intense, aggressive drivers, teenage and young drivers, saw generally less risk in both driving situations and in-vehicle activities, and were more willing to engage in activities while driving.

Through a gender wise comparison of participants it was observed that males rate higher willingness and lower risk than females. Gender effects are pronounced for willingness for the

older group and for risk for both the middle age and older groups. However, there is little effect of gender for the teenage and young driver groups.

The comparison of the driver age groups confirmed the known associations of teenage drivers as being more risk willing and older drivers as being more risk averse. In general, for the on-road ratings, “Willingness” decreased with age and “Risk” increased with age. One exception was that this was not seen for the on-road mainline freeway driving ratings. This might reflect differences in freeway driving experience, since teen drivers do a smaller proportion of their travel on freeways (Lerner et al., 1999). Teenage drivers also saw themselves as aggressive and impulsive drivers and gave themselves high scores for a tendency to multi-task. Crash rates for teenagers are higher than for any other age group and it has been found that inexperience and risk taking have contributed to the high incidence of unsafe driving practices in the teen population. The results of this study support the evidence that teens underestimate the dangers of hazardous situations as they were more likely to give higher willingness ratings and lower risk ratings in practically all of the findings.

4.5 Methodological Considerations

This experiment represents an initial attempt to collect data on the task and situation factors that influence driver decision strategies about engaging in distracting tasks. The method had various limitations and included various untested assumptions. One limitation was in the experimental design itself. A relatively large number of in-vehicle tasks and driving situations were of interest, and it was not practical to fully cross all of these in the design. Therefore only a subset of the 154 possible combinations (14 in-vehicle tasks X 11 driving locations) was encountered on the road. This set of 81 on-road ratings allowed us to look at a variety of situations of interest, but did not allow a formal analysis of task and location as independent factors for the full set of 81 situations. However, this sort of analysis was possible for a subset of the data.

The experiment was based around actual on-road driving situations. Participants were drivers in their own vehicles, placed in the actual driving context of interest. They did not actually engage in the in-vehicle distractions, in part for safety reasons. However, another reason was that actual engagement in the task was not necessary, because the decision of interest was whether or not to *engage* in the task. To the extent the participants had a good sense of what the task involved, these “what if” judgments were meaningful. This assumption is more warranted for some tasks than others. Drivers in our sample were generally highly familiar with most aspects of cell phone use as well as with the non-technology tasks. Familiarity with navigation and PDA use was more varied, although pre-training was provided to familiarize participants with what was involved in every task considered in the experiment.

A variety of factors can influence a person’s decision about whether to engage in a potentially distracting task. Some factors relate to the distracting task and some relate to the driving situation. Both of these categories of factors could be manipulated directly in this experiment. However, other factors are also important that were not easily controlled. Previous focus group analyses (Lerner and Balliro, 2003a, 2003b) identified these as including personal time control, cost considerations, social aspects, mental state, and motivations specific to the task (e.g., is a

phone call expected or unexpected). While the experimental method attempted to control for motivational factors to some degree, the decision making by participants did not really include manipulation of some of these important factors. This experiment, then, focused on how the willingness to engage in an activity was influenced by task and roadway factors, and to some extent, driver factors. It was not an attempt to quantify the actual likelihood of engaging in a distracting activity, which is strongly influenced by additional factors beyond experimental control. It may also be noted that the experimenter was present in the vehicle. While this would likely influence drivers actual engagement in the task, it is unknown how it might influence the judgments made in this experiment. Interaction between the driver and the experimenter was kept minimal during the data collection portion of the drive, other than communicating the task scenarios and providing route guidance. It is conceivable that this interaction could influence judgments about passenger conversation tasks.

The on-road data were supplemented by additional data from a take-home booklet. The booklet had participants rate additional situations, including factors not manipulated on the road (e.g., weather, congestion). Some “benchmark” situations were included that were in common for the on-road and booklet ratings. These indicated reasonably good agreement between the sets of ratings, although some differences were observed. The take-home booklets also asked participants to explain the reasons underlying some of their on-road ratings. This required some recall of the on-road situation. Participants were asked to fill in the booklets as soon as convenient, and most did so quickly. While this makes the assumption of good recall reasonable, the validity of these stated reasons is not known. They may or may not differ from reasons that might have been given at the actual moment of the decision. Participants were not asked for underlying reasons while they were driving because there was a concern that forcing this type of analytic explanation might actually alter the way drivers rate the situations. Also, the procedure was already demanding and time consuming, so that adding additional aspects to the task might have compromised the procedure. None the less, the retrospective ratings made later in the booklets may be different from what would have been obtained at the time of the rating.

The findings about how drivers make decisions will depend in part on the sample of participants used in the study. For this experiment, we recruited people who were at least occasional cell phone users and who in most cases had some familiarity with another technology. It was felt that judgments made by individuals who do not own or use technologies would not be meaningful, and, as non-users, their decisions are not safety-relevant anyway. If the sample was restricted only to those who reported very high use of a range of new technologies, the sample would likewise be biased toward those who were most willing to engage in technology use while driving. The sample used in this study may be best described as ranging from limited technology users to avid technology users, with most being moderate users.

4.6 Implications for Safety Programs

An understanding of how drivers make decisions about the use of potentially distracting technologies may help direct countermeasures to reduce the problem of distracted driving. These safety countermeasures might include public education, driver training, user interface design, needs for warnings and information, criteria for function lock-outs, function allocation for driver

assist systems, or criteria for safety assessments. One of the goals of this research is to identify implications for safety countermeasures. This on-road experiment is only one portion of a larger project investigating the strategies used by drivers in making decisions. The ultimate objective is to integrate and synthesize the findings of all project activities (including focus groups and the analysis of driver behaviors from existing databases), along with related findings in the published literature, to derive a comprehensive description of the driver decision process regarding distracting activities. This integrated picture will then serve as a basis for countermeasure recommendations.

At this point, we wish to highlight some of the findings of the on-road experiment that may relate to countermeasure development. Full consideration of these factors, and an expansion into specific recommendations, will occur after completion and integration of all of the project activities. The following points may be relevant considerations for developing countermeasures:

- People appear to show little appreciation of the risk associated with basic cell phone tasks – dialing, answering, and conversing. While the actual risk associated with phone use remains controversial and difficult to quantify, there is at least good evidence of interference with certain driving performance measures. Although participants rated extended cell phone conversation as somewhat riskier than simply conversing with a passenger, they were still very willing to converse on the phone under virtually all driving conditions studied. Placing or receiving calls was seen as somewhat riskier, but again there was only moderate reluctance to do these tasks under almost any condition.
- At least as measured in this experiment, feelings about “willingness” and “risk” were essentially the same; one set of ratings very closely mirrored the other. This suggests that any treatment that modifies risk perception may lead to a commensurate change in willingness to engage in a task.
- Drivers may not appreciate some of the task aspects that might contribute to risk, such as self-paced vs. externally driven, chunkability, cognitive capture, and susceptibility to incidents and errors. Drivers are sensitive to attention demand (especially visual). Some tasks rated similar to phone conversation, such as eating something neat, drinking a cold beverage, or tuning a radio, are tasks that can be easily interrupted or suspended at any point, while aspects of phone use might be less easily controlled.
- Drivers do not seem to be very sensitive to the type of roadway they are on. The on-road portion of the experiment included a major arterial with significant traffic, a suburban freeway, and a two-lane winding road. The challenges of each of these roadway types is different (traffic interactions; high speed; path control). Ratings were essentially identical on each type of road with the exception that teen drivers showed less willingness on the freeway. People were sensitive to making particular maneuvers, although not always dramatically so.
- People were quite willing to initiate activities when about to exit from a parking lot into a major arterial road. This would appear to be a demanding maneuver, requiring visual search, gap acceptance, turning, and accelerating into traffic. There seems to be little anticipation of the upcoming demand. It is not evident whether this lack of anticipation is a general problem or particular to this scenario.
- Individual differences in willingness to engage in in-vehicle tasks are related to more general differences in driving style and multi-tasking. These were quite strong effects.

Participants inclined to more intense driving (speed and aggressiveness) rated substantially less risk (and more willingness), across the range of tasks, than those inclined to less intense driving. Likewise, those who feel they are skilled at and enjoy multitasking see less risk in engaging in in-vehicle activities. Risk and willingness were also related to general decision making style, although not nearly as strongly as for driving intensity and multi-tasking. The finding that risk perception and willingness for in-vehicle activities are related to more general driving attitudes and behaviors may have implications for safety countermeasures.

- The presence of age peers did not have much influence on driver risk perception or willingness. This was true for the teenage group as well as for the adult groups, even though there is evidence suggesting that there is substantially increased crash risk when there are multiple teenagers in the vehicle. Teens may lack an appreciation of the risks.
- Teenagers are a group that merits particular consideration. Teenagers show the least perceived risk and greatest willingness to engage in in-vehicle tasks. No age-by-situation interaction was seen in the findings, which means that teens see the *relative* risks of various tasks and driving locations in a manner similar to other drivers. The greater willingness is therefore general across all situations. The age-by-task-by-location analysis on the subset of the data that included only “mainline” driving on the freeway, arterial, and two-lane highway locations did find some interactions with age. However, the only notable interaction for the teen group was that they saw relatively more risk in the freeway situation than was true for other groups. With this exception, it is reasonable to describe the findings as showing a relatively uniform higher willingness, and lower perceived risk, for teens across the range of situations. This is of concern because crash statistics make it clear that this group is at greater risk, not lesser, and less experienced drivers also appear to be more susceptible to attention-sharing difficulties (Lerner, Tornow, Freedman, Llaneras, Rabinovich, and Steinberg, 1999). The safety ratings portion of this study also found teen and young drivers were more aggressive in their driving and more inclined to multitasking while driving. The “added factors” portion of the booklet ratings suggested that teens might be less influenced by traffic congestion or construction zone activity. The teen group also differed from others to some degree regarding the reasons given for their ratings. However, while the findings of the on-road experiment point to special considerations for teenage drivers, it would be misleading to cast their data as radically different from more mature groups. In the previous focus groups (Lerner and Balliro, 2003b), teenage driver attitudes and behaviors contrasted with older groups in a number of ways. However, many of these related to aspects of decision making that were outside the focus of the on-road experiment (see Figure 9). Teenage drivers may be especially distinguished from other drivers in motivational and incentive factors, and general driving considerations, even though there are also differences in risk perception of in-vehicle activity. The distinct differences of the teen group suggest that distracting technology use may merit consideration in graduated licensing programs.

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Appendix A

Experimenter's Guide to Driving Route and Locations for Ratings

Driving Route

Connections:

- From WESTAT to arterial:
 - Turn left onto Research Blvd.
 - Turn right onto West Gude Dr.
 - Turn left onto 355

- From WESTAT to minor:
 - Turn left onto Research Blvd.
 - Turn right onto West Gude Dr.
 - Turn left onto 355
 - Turn right onto Redland Rd.

- From WESTAT to freeway:
 - Turn left onto Research Blvd.
 - Turn right onto Shady Grove Rd.
 - Merge onto I-270 North to Frederick

- From arterial to minor:
 - Head south on 355
 - Turn left onto Redland Rd.

- From arterial to freeway:
 - Head south on 355
 - Turn right onto Shady Grove Rd.
 - Merge onto I-270 North to Frederick

- From minor to arterial:
 - From Redland Rd., turn right onto 355

- From minor to freeway:
 - From Redland Rd., turn right onto 355
 - Turn left onto Shady Grove Rd.
 - Merge onto I-270 North to Frederick

- From freeway to arterial:
 - Head south on I-270 toward Washington
 - Exit at Shady Grove Rd.
 - Turn left onto Shady Grove Rd.
 - Turn left onto 355

- From freeway to minor:
 - Head south on I-270 toward Washington
 - Exit at Shady Grove Rd.
 - Turn left onto Shady Grove Rd.
 - Turn right onto 355
 - Turn left onto Redland Rd.

Notes on ratings:

- Mainline ratings should be taken while the vehicle is moving at constant speed.
- Parking lot ratings should be taken as the driver approaches the exit to the lot.
- Stoplight ratings should be taken while the vehicle is completely stopped.
- Left turn ratings involving the phone should be taken after the vehicle begins to move, but before the driver begins to turn (i.e., as the vehicle enters the intersection).
- Left turn ratings involving other devices should be taken as the vehicle is approaching the left turn.
- Inside lot ratings should be taken while the vehicle is moving between aisles of parked cars
- Entrance and exit ratings should be taken as the vehicle moves into the exit lane.
- When in doubt, use your best judgment.

Arterial: (14 mainline ratings, 10 parking lot, 4 stoplight, 2 protected left, 2 unprotected left)

- Drive north on 355 *Take mainline and stoplight ratings as applicable*
- Turn right at N. Westland Dr. (just after 7-11 sign)
 - Make an immediate right into the supermarket parking lot
 - Drive up and down several aisles of parking lot *Take inside lot rating*
 - Circle the parking and exit onto 355 heading north *Take parking lot rating*
 - Repeat twice more
- Continue north on 355
- Make a u-turn at Education Dr. (Entrance to Gaithersburg High School) *Take protected left rating*
- Drive south on 355 *Take mainline and stoplight ratings as applicable*
- Turn left at East Deer Park Dr. *Take unprotected left rating*
 - Make an immediate right into funeral home parking lot
 - Turn left onto East Deer Park Dr.
- Turn left onto 355
- Continue south on 355 *Take mainline and stoplight ratings as applicable*
- Turn right on Rosemont Dr.
 - Make an immediate right into Gaithersburg Presbyterian Church parking lot
 - Circle the parking lot and exit onto 355 heading south *Take parking lot rating*
 - Repeat twice more
- Continue south on 355 *Take mainline and stoplight ratings as applicable*
- Make a u-turn at Redland Rd.
- Repeat

Minor: (14 winding ratings, 6 residential)

- Drive northeast on Redland Rd. toward Muncaster Mill Rd. *Take winding ratings after Needwood Rd. as applicable*
- Turn left onto Founders Mill Dr.
 - Proceed through development *Take residential ratings*
- Turn right onto Redland Rd. *Take winding ratings as applicable*
- If needed, turn around at Redland Park Pl. and repeat

Freeway: (14 mainline ratings, 6 entrance, 4 exit)

- Drive north on I-270. Proceed in second lane from right. *Take mainline ratings as applicable. Take exit rating as you pass Middlebrook Rd. (exit 13)*
- Exit at Father Hurley Blvd. (Exit 16) *Take exit rating*
- *Explain procedure for “imaginary” ratings. Do a practice loop around Father Hurley Blvd. before beginning to take ratings for real.*
 - Go west on Father Hurley Blvd. *Take entrance ratings*
 - Make a u-turn at Crystal Rock Dr.
 - Drive east on Father Hurley Blvd. *Take entrance ratings*
 - Make a u-turn at Observation Dr.
 - Repeat as needed
- Merge onto I-270 heading south toward Frederick *Take exit rating as you pass Mont. Village Ave. (exit 11)*
- *Take exit rating as you exit at Shady Grove Rd.*

Appendix B
Detailed Experimenter Protocol

Instructions and Protocol

Welcome

- Thank you for participating in our study. My name is _____ and I will be working with you today.
- The purpose of our study is to see how people go about making decisions to engage in certain tasks while driving. Let me give you a brief overview of what we will be doing. You will drive your own vehicle along a specified route with me in the back seat. At different times, I will ask you to verbally rate your willingness to complete certain tasks and the risk of completing those tasks, such as placing a phone call, at that point in time and location. You will not actually have to engage in any of these tasks while you are driving. Driving the test route will take about two hours to complete and the total session should not exceed 2.5 hours.
- After driving the test route you will be given a booklet to take home, complete, and mail back to Westat. The booklet should take approximately 1 hour to complete.
- You will receive (for teens: \$100; for adults: \$200) for completing the entire study: (teens: \$20; adults: \$50) after driving the test route and the additional (teens: \$80; adults: \$150) when the completed booklet is received by Westat. It is very important that you complete the full study.
- Your participation is completely voluntary and you may withdraw at any time.
- Before we get into the details about the study there are a few necessary items to take care of.

Informed Consent

- I would like you to read and familiarize yourself with the informed consent form. It basically describes the study and outlines your role and rights as a participant. Please sign two copies. One is for your records and one is for ours.

License Check

- Also, I'll need to get a copy of your driver's license and proof of car insurance for our insurance purposes. Please read the consent form while I make a copy of the license. Let me know if you have additional questions after you've read the form, otherwise please sign the consent form.
- *While the participant is reading the form photocopy their driver's license and proof of insurance, and return both to the participant. Collect the Signed Informed Consent form.*

Task Overview

- When we go out on our drive, I will periodically ask you to rate your willingness to perform certain tasks while you are driving.
- So that there isn't any confusion once we are on the road, we are going to watch a brief video that goes over all of the possible tasks that I may ask you to rate. If you do a task differently than it is shown in the video, don't worry. When you are asked to rate different tasks on the road, imagine executing the task **as you normally would**. If you have no experience executing certain tasks, then it will be helpful to reflect on the video.

- Please let me know if you have any questions concerning these tasks so that I can pause the video and answer your questions.
- *Start the video and allow the participant to watch it.*
- Do you have any questions or uncertainty about the tasks? *Answer any questions the participant might have.*
- Alright, then let's head out to your car and start the next part of the study. You may wish to visit the rest room before we leave, as we will be out on the road for approximately two hours. *Go down to participant's car.*

Vehicle Check

- I just have to check to make sure your vehicle is in a safe working condition.
- *Complete checklist.*
 - ❑ Working seat belts for both driver and researcher
 - ❑ Functional mirrors
 - ❑ Sufficient amount of fuel (at least half tank)
 - ❑ Tires (Note bald patches)
 - ❑ Brake lights
 - ❑ Note any damage to dash board

Study Overview

- Okay, now for the details about what we will be doing today. I will give you a destination and tell you how to get there. Do not worry if you do not know the way. I will direct each move you make on the way to our destination. For example, if we were driving North on Route 355, I might tell you to make a left onto Shady Grove Road. All you would need to do is drive along Route 355 until you found Shady Grove Road, and then make a left turn. Then I would tell you what to do next. **We urge you to drive as you normally would.**
- While you are driving I will be asking you about a wide range of tasks that someone might do while they are driving. You will rate each task several times under all sorts of driving conditions. We are not asking you to tell us what people should do, but rather what you would do at that moment, in that specific situation, using a 10 point scale.
- The first thing you will be asked to rate is your **willingness** to engage in a certain task. For example, how willing would you be to answer your phone if it rang right now? You will rate your answer on a scale of 1-10.
 - A **1** means: I would absolutely not do this task now.
 - A **10** means: I would be very willing to do this task now with no concerns at all.
- Remember that the bigger the number, the more willing you are to perform the task.
- Please remember that we are not asking what people should do. We want to know how willing you would be to do this task at a given time and place. Imagine that you are actually in this situation and base your answers on what you would honestly do under these circumstances.
- The second thing you will be asked to rate is the **risk** of completing certain tasks. By risk we mean the possibility of involving harm or danger. For example, how risky would it be to answer the phone at this time and location? Again, you will rate your answer on a scale of 1-10.
 - A **1** means: No additional risk beyond my normal driving.
 - A **10** means: Very likely I would be involved in an accident.

- Remember that the bigger the number, the riskier you see the task to be.
- Again, please answer these questions as honestly as possible.
- The procedure for rating tasks will be as follows. I will describe a situation and the task for you, then when I say “now”, I would like you to rate your willingness to perform the task described, followed by your opinion of the degree of risk involved in performing the task described. **Remember that I want your ratings of the situation as soon as I say “now”.**
- Give your ratings quickly, based upon your first impression; don’t over-analyze the tasks.
- We will practice using the rating scales and getting ratings during a practice run. Do you have any questions now?
- Conditions such as weather and traffic sometimes influence a person’s ratings of willingness and risk. During this study, the conditions are whatever currently exists. In other words, if it is raining while you are driving, you may consider it in your decision.

Practice Runs

- Before we start the actual study, we are going to do a few practice runs so that you know exactly what to expect. First I’d like to go over the rating scale one more time.
- Remember that when you rate your **willingness** to engage in a task
 - A **1** means: I would absolutely not do this task now.
 - A **10** means: I would be very willing to do this task now with no concerns at all.
- And when you rate the **risk** of completing a task
 - A **1** means: No additional risk beyond my normal driving.
 - A **10** means: Very likely I would be involved in an accident.
- Now use these practice runs to become familiar with the rating scales, the tasks, and the road.
- Remember to wait until I say “now” to make your ratings.
- *Repeat practice runs until participant seems completely comfortable with rating scales. Preferably, try to complete at least two successful practice runs (i.e., participant understands rating system and gives ratings which properly convey their willingness and risk)*

Practice run no. 1: Consider this scenario: You are running late to meet a friend. You know your friend’s phone number by memory.

- Rate your willingness to place a call. *Pause Now. Wait for rating.*
- How risky would you find this task? *Wait for rating.*

Provide feedback to the participant. For example, “Very good. That is exactly what we are looking for. Let’s try two more,” or “Very good, but try to give the rating a little faster. Let’s try it on the next one.” Also use feedback to confirm participant’s comfort with and understanding of the rating scale. For example, if the participant rates a situation as one for willingness and 8 for risk, say “So you would be very unwilling to perform this task, and consider it to be very risky?”

Practice run no. 2: Consider this scenario: You have left your house in a rush and are heading toward an unfamiliar destination. .

- Rate your willingness to enter a destination into your navigation system. *Pause Now.*
- How risky would you find this task?

Provide feedback again.

Practice run no. 3: Consider this scenario: You would like to hear a CD that you have in your glove compartment.

- Rate your willingness to find and insert the CD. *Pause* Now.
- How risky would you find this task?

Provide feedback again.

Practice run no. 4: Consider this scenario: You are expecting an e-mail message from a co-worker.

- Rate your willingness to check PDA for new mail and read e-mail if it has arrived. *Pause* Now.
- How risky would you find this task?

Provide feedback again.

Practice run no. 5: Consider this scenario: You have a hot drink with a lid on it.

- Rate your willingness to drink it. *Pause* Now.
- How risky would you find this task?

Provide any final feedback and constructive advice.

- Great, you did fine. We are about to start the actual study now. Are there any last minute questions before we begin?
- If you feel the need for a break at any time, just let me know and we can pull over and rest, or find a restroom as needed.
- A very important point to keep in mind is that there are no “right” or “wrong” answers or “good” or “bad” answers. We are here to learn from you. It is very important that you make your decisions just as you would if you were driving by yourself.
- During the study you may notice me writing down your ratings or taking notes. You do not need to pay attention to this. Just drive as you normally would and wait for my prompts.

Driving Trip/Data Collection

Debriefing

- Okay, we are now done with the driving segment of the study. You did a great job and we appreciate your volunteering for our study.
- *Encourage relevant comments from the participant. Look over the results and ask questions about any discrepancies, or any results that need further elaboration. Consider such topics as thinking/factors, willingness/risk relationships, any problematic situations not addressed, confidence in predictions, presence of others in car, and any close calls the participant might have had previously as a result of in-car technologies.*

Questionnaire

- I would like to briefly go over the take-home booklet with you.
Fill in participant's ratings in Part I of the questionnaire. Give participant booklet and self addressed, stamped envelope. Make sure that the participant's subject number is written on the upper right hand corner of the booklet.
- Please follow all directions very carefully, as they may change from section to section. Please give complete and accurate answers whenever possible.
- The booklet should take approximately 1 hour to complete. When it is complete, please place it in the pre-addressed postage-paid envelope that we have provided. If you happen to lose the envelope, Westat's address is written on the first page of the booklet.
- Please complete and return the booklet as soon as convenient, but within two weeks of this date. Many of the questions in the booklet ask about your on-the-road trip. Therefore it is best if you can complete this booklet as soon as possible, while your memory is fresh.
- This booklet is a critical part of the overall study and it is very important that you return it. Also, you want to be sure to return the booklet so that you can receive full payment for your time in today's study.

Payment

- Here is (teens: \$20; adults: \$50). Please sign this receipt stating that you have received the money. You will receive the remaining (teens: \$80; adults: \$150) within two weeks after the date Westat receives the completed booklet. Thank you so much for your time and cooperation in today's study.

Appendix C

Take-home Booklet

Date _____

Subj #

Thank you for taking part in Westat's study on how drivers make decisions about engaging in various tasks while they are driving. This research is sponsored by the National Highway Traffic Safety Administration (for drivers 18 and older) and by the National Institutes of Health/NICHHD (for drivers 16 and 17).

You already completed the on-the-road portion of the study. Now you need to complete this questionnaire and return it to Westat in the envelope provided. When we receive the completed questionnaire from you, Westat will send you your payment for completion of the study. The check will be for \$80. This is in addition to the \$20 you already received when you took part in the on-the-road portion of the study.

Many of the questions in this questionnaire ask about your on-the-road trip. Therefore it is best if you can complete this questionnaire as soon as possible, while your memory is fresh.

INSTRUCTIONS FOR RETURNING THIS QUESTIONNAIRE

- Complete all parts of the questionnaire- it should take about 1 hour to complete.
- Use the pre-addressed, postage-paid envelope to return the questionnaire to Westat. Just drop it in the mail.
- Please complete and return the questionnaire as soon as convenient, but within two weeks of this date.
- Westat will process the questionnaire and send you a check for \$80 within 2 weeks.

If you have any questions, contact:

Cori Simmons, Westat

301-294-2884

1650 Research Blvd.

Rockville, Maryland 20850-9973

Please fill in the information below, and then turn to the instructions on the next page. Please do not write your name on this questionnaire.

1. Age:

2. Gender:

3. DOB:

4. Years or months licensed:

GENERAL INSTRUCTIONS

Please complete these questions in the order they are presented to you. Read the instructions for each section carefully, because they change for each section. Please complete the sections in order. Do not go back and change your answers once you move on to the next question.

PART 1: QUESTIONS ABOUT YOUR ON-THE-ROAD TRIP

INSTRUCTIONS FOR PART 1

In this section of the questionnaire, we want you to explain to us why you rated situations the way you did when you were doing the on-the-road part of this study. During the on-road portion of the study, you used the rating scale to tell us how willing you would be to do some task and to tell us how risky you thought that would be. Now we would like some idea of what went into your thinking when you made those ratings. We have chosen eight situations from your trip. For each one, tell us as clearly as you can why you came up with the rating numbers you did. The ratings you gave the situation are shown for each situation.

Recall that you made two different ratings for each situation, each using a 10-point rating scale. You rated how willing you would be to engage in a certain task and you rated how risky it would be to engage in that task at that time and place. The rating scales were:

Willingness:

1= I would absolutely not do this task now

10= I would be very willing to do this task now with no concerns at all

Risk

1=No additional risk beyond my normal driving

10=Very likely I would be involved in an accident

To answer these questions effectively, please try to imagine yourself back in the situation and the reasons behind your ratings. Use the pictures and descriptions of the site and the task to help jog your memory.

For each of the eight situations that follow, there is a space for you to write down why you rated the situation as you did. Be sure to let us know all the factors that might have influenced your decision. These might be factors about the road, the task, the environment, traffic, or anything else that mattered to you. You can also mention why certain factors did not have an influence on you, if you think that is important to mention. Please spell out your logic in clear, simple terms as though you were explaining something to a child. We need you to paint a complete picture for us, so we can understand why you felt the way you did.

1. **Where you were:** Driving on Father Hurley Blvd. (arterial road), about to merge on to I-270.

What the task was: You are engaged in a personal phone conversation with a close friend. The task is continuing with your phone conversation.

The ratings you made on the road were:

Willingness to engage in this task now: _____

Risk in doing this task now: _____

Explain exactly why you rated the situation as you did, for both willingness and risk. Be sure to let us know all the factors that might have influenced your decision. These might be factors about the road, the task, the environment, traffic, or anything else that mattered to you.

2. **Where you were:** On Rockville Pike, stopped at a red light.

What the task was: You are expecting an email message from a co-worker. The task is to check your PDA for new messages and read the email that arrived.

The ratings you made on the road were:

Willingness to engage in this task now: _____

Risk in doing this task now: _____

Explain exactly why you rated the situation as you did, for both willingness and risk. Be sure to let us know all the factors that might have influenced your decision. These might be factors about the road, the task, the environment, traffic, or anything else that mattered to you.

3. **Where you were:** Driving on I-270.
What the task was: You bought a taco and are hungry. The task is to unwrap and eat the taco.
The ratings you made on the road were:
 Willingness to engage in this task now: _____
 Risk in doing this task now: _____

Explain exactly why you rated the situation as you did, for both willingness and risk. Be sure to let us know all the factors that might have influenced your decision. These might be factors about the road, the task, the environment, traffic, or anything else that mattered to you.

4. **Where you were:** Driving on I-270.
What the task was: You are running late to meet a friend. You know your friend's phone number by memory. The task is to key in the phone call.
The ratings you made on the road were:
 Willingness to engage in this task now: _____
 Risk in doing this task now: _____

Explain exactly why you rated the situation as you did, for both willingness and risk. Be sure to let us know all the factors that might have influenced your decision. These might be factors about the road, the task, the environment, traffic, or anything else that mattered to you.

5. **Where you were:** Driving on Rockville Pike.
What the task was: You want to remind your friend/family member of your dinner plans for this evening. The task is to key in a short text message on your cell phone.
The ratings you made on the road were:
 Willingness to engage in this task now: _____
 Risk in doing this task now: _____

Explain exactly why you rated the situation as you did, for both willingness and risk. Be sure to let us know all the factors that might have influenced your decision. These might be factors about the road, the task, the environment, traffic, or anything else that mattered to you.

6. **Where you were:** Driving on I-270.
What the task was: You are unfamiliar with the area you are in and you want to head home. The task is to recall directions to a stored destination (your home) on your navigation system.
The ratings you made on the road were:
 Willingness to engage in this task now: _____
 Risk in doing this task now: _____

Explain exactly why you rated the situation as you did, for both willingness and risk. Be sure to let us know all the factors that might have influenced your decision. These might be factors about the road, the task, the environment, traffic, or anything else that mattered to you.

7. **Where you were:** A local residential street (Founders Mill Road).
What the task was: You left your house in a rush and are heading toward an unfamiliar area. The task is to key a new destination into your navigation system.
The ratings you made on the road were:
 Willingness to engage in this task now: _____
 Risk in doing this task now: _____

Explain exactly why you rated the situation as you did, for both willingness and risk. Be sure to let us know all the factors that might have influenced your decision. These might be factors about the road, the task, the environment, traffic, or anything else that mattered to you.

8. **Where you were:** Driving on a winding, two-lane road (Redland Road).
What the task was: You want to remind your friend/family member of your dinner plans for this evening. The task is to key in a short text message on your cell phone.
The ratings you made on the road were:
 Willingness to engage in this task now: _____
 Risk in doing this task now: _____

Explain exactly why you rated the situation as you did, for both willingness and risk. Be sure to let us know all the factors that might have influenced your decision. These might be factors about the road, the task, the environment, traffic, or anything else that mattered to you.

PART 2: NEW SITUATIONS TO RATE

INSTRUCTIONS FOR PART 2

We want you to rate some new situations using the same procedure that you used for the on-the-road ratings. You will be told the driving situation and exactly what the task is. Then you will provide two ratings for the task: how willing you are to engage in the task and how risky it would be to engage in the task.

Since you are not really driving this time, you will have to imagine that you are in the situation. For each situation, there will be a description of where you are driving and a description of the traffic and roadway environment. There will also be a complete description of the task you are to rate.

The descriptions of the scenes are similar to what you encountered during your drive, but they also include some situations that you did not encounter on the road, such as rainy weather or heavy traffic congestion. Read each description very carefully before you give the ratings, because some situations may be quite similar to each other but differ in some way that might be important to you.

As you are making your ratings, remember to rate how willing you would be to actually do the task at that moment. We are not asking you to tell us what people should do, but what you would actually do. When you rate the riskiness, think about the likelihood and potential severity of an accident. Getting a ticket is not part of the risk rating.

4,2A

Situation 1.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Raining hard	Key in a friend's phone number on your cell phone. You have the number memorized. You want to let your friend know that you are running late.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

Situation 2.

Trip Conditions	The Task You Want To Do
Location: I-270 freeway; there is road construction going on and one lane is closed Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Key a new destination into your navigation system. You are in a rush and heading toward an unfamiliar destination.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

1,1A

Situation 3.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Raining hard	Answer a call on your cell phone. You are not expecting any calls.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

1,1H

Situation 4.

Trip Conditions	The Task You Want To Do
Location: I-270 freeway Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Answer a call on your cell phone. You are not expecting any calls. You have been up very late the last few nights and you are feeling fatigued.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

Situation 5.

Trip Conditions	The Task You Want To Do
Location: Shopping center parking lot on Rockville Pike Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Key in a friend's phone number on your cell phone. You have the number memorized. You want to let your friend know that you are running late.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

4,1C

Situation 6.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: A three-year old (your child or other relative) is with you Time: Weekday afternoon Traffic: Moderate Weather: Clear	Answer a call on your cell phone. You are not expecting any calls.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

4,2E

Situation 7.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: You are by yourself Time: Weekday at 5:00 PM Traffic: Heavy, congested traffic Weather: Clear	Key in a friend's phone number on your cell phone. You have the number memorized. You want to let your friend know that you are running late.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

Situation 8.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: Two friends of your age Time: Weekday afternoon Traffic: Moderate Weather: Clear	Key in a short text message on your cell phone. You want to remind a friend/family member about dinner plans for this evening.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

1,10H

Situation 9.

Trip Conditions	The Task You Want To Do
Location: I-270 freeway Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Search for the location of the nearest Starbucks' coffee shop using your navigation system search feature. You have been up very late the last few nights and you are feeling fatigued.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

1,6

Situation 10.

Trip Conditions	The Task You Want To Do
Location: I-270 freeway Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Check your PDA for new messages and read email if it has arrived. You are expecting an email message from a co-worker.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

Situation 11.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Raining hard	Key in a short text message on your cell phone. You want to remind a friend/family member about dinner plans for this evening.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

4,1

Situation 12.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Answer a call on your cell phone. You are not expecting any calls.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

4,2D

Situation 13.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: You are by yourself Time: Weekday at 9:00 PM; it is dark Traffic: Moderate Weather: Clear	Key in a friend's phone number on your cell phone. You have the number memorized. You want to let your friend know that you are running late.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

Situation 14.

Trip Conditions	The Task You Want To Do
Location: Redland Road (two lane, winding road) Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Find a particular CD from a collection in your vehicle. Insert the CD in the CD player.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

2,6I

Situation 15.

Trip Conditions	The Task You Want To Do
Location: Approaching the entrance to I-270 from Father Hurley Blvd (arterial) Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Check your PDA for new messages and read email if it has arrived. You are expecting an email message from a co-worker. The message may be very urgent and important to your work.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

4,1B

Situation 16.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: Two friends of your age Time: Weekday afternoon Traffic: Moderate Weather: Clear	Answer a call on your cell phone. You are not expecting any calls.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

Situation 17.

Trip Conditions	The Task You Want To Do
Location: Rockville Pike (arterial) Passengers: A three-year old (your child or other relative) is with you Time: Weekday afternoon Traffic: Moderate Weather: Clear	Eat a taco. You are hungry and just purchased a taco, which is wrapped.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

1,6E

Situation 18.

Trip Conditions	The Task You Want To Do
Location: I-270 freeway Passengers: You are by yourself Time: Weekday at 5:00 PM Traffic: Heavy, congested traffic Weather: Clear	Check your PDA for new messages and read email if it has arrived. You are expecting an email message from a co-worker.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

2,8

Situation 19.

Trip Conditions	The Task You Want To Do
Location: Approaching the entrance to I-270 from Father Hurley Blvd (arterial) Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Key a new destination into your navigation system. You are in a rush and heading toward an unfamiliar destination.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

Situation 20.

Trip Conditions	The Task You Want To Do
Location: I-270 freeway Passengers: You are by yourself Time: Weekday afternoon Traffic: Moderate Weather: Clear	Key in a friend's phone number on your cell phone. You have the number memorized. You want to let your friend know that you are running late. You are in the middle of a long, boring drive that you have made many times.

How willing are you to engage in this task at this time and place? _____

How risky would it be to engage in this task at this time and place? _____

PART 3: COMPARING TASKS

INSTRUCTIONS FOR PART 3A

Now we would like you to compare different tasks in terms of how risky they are. In the previous section, you made your ratings for a particular time and place and driving situation. This time, we want you to come up with a more general rating. For driving in general, how risky is it to engage in each of these tasks?

Use the same rating scale as before:

- 1 = No additional risk beyond my normal driving
- 10 = Very likely I would be involved in an accident

<u>Rating</u>	<u>Task</u>	<u>Rating</u>	<u>Task</u>
(1-10)		(1-10)	
_____	Answer a cell phone call	_____	Retrieve a stored destination on Nav System
_____	Key in a cell phone call	_____	Alter your route preferences on Nav System
_____	Place a cell phone call using speed dial	_____	Find an alternate route on Nav System
_____	Have an extended phone conversation	_____	Search for the nearest Starbucks on Nav Sys.
_____	Have a brief phone "exchange of information"	_____	Talk with a passenger
_____	Look up a stored phone number in a cell phone	_____	Deal with children
_____	Take notes during a phone conversation	_____	Find a radio station that is not pre-programmed
_____	Open and read email on PDA	_____	Adjust the loudness of a sound system
_____	Open and listen to voice mail on cell phone	_____	Insert a CD, tape, or video
_____	Key in and send an email on PDA	_____	Read a paper map
_____	Check your schedule on PDA	_____	Drink something cold
_____	Schedule a meeting using PDA	_____	Drink something hot
_____	Search the Internet using a PDA	_____	Eat something sloppy (like a taco)
_____	Look up an entry in address book on PDA	_____	Eat something neat (like a cookie)
_____	View an electronic map on Nav System	_____	Turn up the temperature
_____	Key a new destination into Nav System	_____	Check the speedometer

For each of the three tasks you rated as most risky, tell us why you consider them the most risky.

INSTRUCTIONS FOR PART 3B

Now we would like you to do the same thing for various driving situations. For each driving situation, tell us how risky it is to engage in distracting tasks in general. You will make your rating by comparing each situation to an average situation for all the driving you do. That average situation will be rated a "5." Rate each of the situations below based on how they compare to this average.

Use this rating scale:

1 = No risk at all of having a collision

5 = An average driving situation

10 = High risk of having a collision

Rating Task

(1-10)

- _____ Driving on a major freeway
- _____ Getting onto a freeway from an arterial road
- _____ Merging from one freeway to another

- _____ Exiting a freeway onto an arterial road

- _____ Driving on a two-lane curvy road

Rating Task

(1-10)

- _____ Driving on an arterial road
- _____ Stopped at a red light on an arterial road
- _____ Turning left across on coming traffic
from an arterial road
- _____ Exiting a parking lot and turning
right onto an arterial road
- _____ Driving on a local/residential road

For each of the two sites you rated as most risky, tell us why you consider them the most risky.

PART 4: YOUR FAMILIARITY WITH THE TECHNOLOGIES

INSTRUCTIONS FOR PART 4

Now we want to know how familiar you are with various tasks that involve cell phones, PDAs, and navigation systems. Please note that familiarity **does not** relate to whether or not you use the technology while driving. Familiarity refers to your personal knowledge or ability with each device or task. Familiarity does not depend on how often you use a device or how often you perform certain tasks. Also, familiarity does not depend on whether or not you own these technologies. You can become familiar with a task or device from using someone else's device or observing someone else use a device or complete a task.

When answering the following questions, please refer to the following rating scale:

- 1 = Very unfamiliar
- 2 = Somewhat unfamiliar
- 3 = Somewhat familiar
- 4 = Familiar
- 5 = Very familiar

Do you have a cell phone? Yes _____ No _____

1. How familiar are you with your phone's functions/capabilities? _____
2. How familiar are you with using a cell phone while you drive? _____
3. How familiar are you with using a hands-free earpiece with your phone? _____
4. How familiar are you with keying in a call manually? _____
5. How familiar are you with keying in a call using speed dial? _____
6. How familiar are you with using voice activation to place a call? _____
7. How familiar are you with answering a call? _____
8. How familiar are you with retrieving a stored number? _____
9. How familiar are you with checking your voice mail? _____
10. How familiar are you with keying in a text message? _____

Do you have a personal digital assistant (PDA)? Yes _____ No _____

11. How familiar are you with your PDA's functions and capabilities? _____
12. How familiar are you with using a PDA while you drive? _____
13. How familiar are you with opening and reading an email on a PDA? _____
14. How familiar are you with keying in an email on a PDA? _____
15. How familiar are you with checking your schedule on a PDA? _____
16. How familiar are you with searching the internet from a PDA? _____
17. How familiar are you with looking up an entry in an address book on a PDA? _____
18. How familiar are you with reading downloaded maps or direction from a PDA? _____

When answering the following questions, please refer to the following rating scale:

- 1 = Very unfamiliar
- 2 = Somewhat unfamiliar
- 3 = Somewhat familiar
- 4 = Familiar
- 5 = Very familiar

Do you have a navigation system? Yes____ No____

- 19. How familiar are you with the system and its functions/capabilities? _____
- 20. How familiar are you with using the system while you drive? _____
- 21. How familiar are you with programming (keying in) a destination? _____
- 22. How familiar are you with reading an electronic map? _____
- 23. How familiar are you with retrieving a stored destination? _____
- 24. How familiar are you with altering you route preference? _____
- 25. How familiar are you with finding an alternate route? _____
- 26. How familiar are you with searching for businesses or attractions? _____

PART 5: GENERAL CHARACTERISTICS OF DRIVER

INSTRUCTIONS FOR PART 5A

Please respond to the following statements expressing your own feelings. The following set of statements address your thoughts on driving. Use the following scale to answer the questions:

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Undecided
- 4 = Agree
- 5 = Strongly agree

1. I have the ability to control my automobile at high speeds. _____
2. I like to do other tasks while I am driving. _____
3. I like to drive at relatively high speed. _____
4. Using a cell phone while I drive is part of my life style. _____
5. I like to pass cars when driving at relatively high speeds on two-lane roads. _____
6. When avoiding a hazard, I steer around it rather than use my brakes. _____
7. Compared to the average driver, I am very good at handling multiple activities while I drive. _____
8. I believe traffic regulations are designed for unskilled drivers. _____
9. From time to time, I enjoy finding myself in a situation that challenges my driving skills. _____
10. When driving, I sometimes become "wild and crazy" and do things that other people might not like. _____

INSTRUCTIONS FOR PART 5B

Please respond to the following statements expressing your own feelings. This next set of statements concerns your general characteristics and **is not specific to driving**. Use this scale to answer the questions:

- 1 = Strongly agree
- 2 = Agree
- 3 = Undecided
- 4 = Disagree
- 5 = Strongly disagree

1. When I am presented with a problem, I grab at the nearest possible solution. _____
2. When I am presented with a problem, I make decisions based on my gut instincts. _____
3. When I am presented with a problem, I hold off making a decision as long as possible. _____
4. When I am presented with a problem, I do whatever I want and leave everything up to chance. _____
5. When I am presented with a problem, I clearly assess the benefits and disadvantages for each possible solution. _____
6. When I am presented with a problem, I stop and think things through before I act. _____

Appendix D

Means and Standard Deviations of Willingness and Risk Ratings

SITUATION	WILLINGNESS		RISK	
	Mean	SD	Mean	SD
Cell Phone/Answer Call - Freeway - mainline	6.79	3.08	4.22	2.49
Cell Phone/Answer Call - Freeway - entrance, merge	6.42	3.14	4.45	2.81
Cell Phone/Answer Call - Freeway - exit	6.07	3.14	5.00	2.88
Cell Phone/Answer Call - Arterial - mainline	7.13	2.83	3.92	2.53
Cell Phone/Answer Call - Arterial - left turn, unprotected	5.47	3.37	5.67	3.15
Cell Phone/Answer Call - Arterial - U turn, protected	4.51	3.23	6.42	3.12
Cell Phone/Answer Call - Arterial - stopped at signal	8.06	2.87	2.39	2.08
Cell Phone/Answer Call - Parking Lot - exit	7.03	2.98	4.09	2.81
Cell Phone/Answer Call - Parking Lot - aisle	6.50	2.86	4.09	2.39
Cell Phone/Answer Call - Minor - 2 lane proceeding	7.26	2.81	3.55	2.32
Cell Phone/Answer Call - Minor - Residential	7.82	2.81	2.95	2.25
Cell Phone/Key in Call - Freeway - mainline	6.78	2.76	4.59	2.48
Cell Phone/Key in Call - Freeway - entrance, merge	5.33	3.02	5.59	2.69
Cell Phone/Key in Call - Freeway - exit	5.22	3.03	5.92	2.90
Cell Phone/Key in Call - Arterial - mainline	6.80	2.80	4.74	2.57
Cell Phone/Key in Call - Arterial - stopped at signal	8.11	2.70	2.66	2.11
Cell Phone/Key in Call - Parking Lot - exit	6.27	3.17	4.50	2.94
Cell Phone/Key in Call - Parking Lot - aisle	6.13	3.00	4.49	2.70
Cell Phone/Key in Call - Minor - 2 lane proceeding	7.01	2.70	4.15	2.29
Cell Phone/Key in Call - Minor - Residential	7.41	2.89	3.41	2.46
Cell Phone/Pers.Conversation - Freeway - mainline	7.94	2.62	3.67	2.56
Cell Phone/Pers.Conversation - Freeway - entrance, merge	7.55	2.81	3.98	2.45
Cell Phone/Pers.Conversation - Arterial - mainline	8.05	2.54	3.43	2.40
Cell Phone/Pers.Conversation - Parking Lot - exit	7.33	2.78	3.78	2.68
Cell Phone/Pers.Conversation - Minor - 2 lane proceeding	7.98	2.72	3.32	2.54
Cell Phone/Pers.Conversation - Minor - Residential	8.57	2.32	2.63	2.19
Cell Phone/Enter Text Msg - Freeway - mainline	3.44	2.34	7.07	2.26
Cell Phone/Enter Text Msg - Freeway - entrance, merge	3.32	2.63	7.44	2.38
Cell Phone/Enter Text Msg - Arterial - mainline	3.75	2.48	7.09	2.27
Cell Phone/Enter Text Msg - Minor - 2 lane proceeding	3.92	2.60	6.68	2.49
Cell Phone/Enter Text Msg - Minor - Residential	4.83	2.94	5.48	2.82
PDA/Look up phone number - Freeway - mainline	4.55	2.47	6.44	2.38
PDA/Look up phone number - Arterial - mainline	4.49	2.43	6.10	2.42
PDA/Look up phone number - Minor - 2 lane proceeding	4.74	2.69	6.26	2.49
PDA/Pick up & read Msg - Freeway - mainline	3.45	2.47	7.16	2.40
PDA/Pick up & read Msg - Freeway - entrance, merge	3.25	2.61	7.38	2.56
PDA/Pick up & read Msg - Freeway - exit	2.76	2.19	7.73	2.24
PDA/Pick up & read Msg - Arterial - mainline	3.75	2.48	6.89	2.45
PDA/Pick up & read Msg - Arterial - U turn, protected	3.01	2.17	7.38	2.33
PDA/Pick up & read Msg - Arterial - stopped at signal	6.20	2.85	4.28	2.87
PDA/Pick up & read Msg - Parking Lot - exit	4.00	2.75	6.11	2.79
PDA/Pick up & read Msg - Parking Lot - aisle	4.05	2.72	6.09	2.66
PDA/Pick up & read Msg - Minor - 2 lane proceeding	3.69	2.40	6.84	2.50
PDA/Pick up & read Msg - Minor - Residential	4.74	2.84	5.69	2.83
PDA/Key & send email - Freeway - mainline	3.01	2.27	7.59	2.34
PDA/Key & send email - Arterial - mainline	3.26	2.44	7.27	2.20
PDA/Key & send email - Minor - 2 lane proceeding	3.32	2.37	7.25	2.43
NAV/Key in new destination - Freeway - mainline	4.70	2.83	6.48	2.51
NAV/Key in new destination - Freeway - entrance, merge	3.94	2.57	6.74	2.35

continued:

SITUATION	WILLINGNESS		RISK	
	Mean	SD	Mean	SD
NAV/Key in new destination - Freeway - entrance, merge	3.26	2.53	7.67	2.23
NAV/Key in new destination - Arterial - mainline	4.52	2.56	6.36	2.41
NAV/Key in new destination - Arterial - left turn, unprotected	4.11	2.94	6.37	2.85
NAV/Key in new destination - Arterial - stopped at signal	6.92	2.81	3.78	2.59
NAV/Key in new destination - Parking Lot - exit	5.22	3.01	5.45	3.02
NAV/Key in new destination - Minor - 2 lane proceeding	4.85	2.78	6.16	2.60
NAV/Key in new destination - Minor - Residential	5.60	2.82	5.47	2.56
NAV/Call up stored destination - Freeway - mainline	5.50	2.65	5.69	2.42
NAV/Call up stored destination - Arterial - mainline	5.65	2.81	5.28	2.45
NAV/Call up stored destination - Parking Lot - exit	5.58	3.04	4.98	2.85
NAV/Call up stored destination - Minor - 2 lane proceeding	5.68	2.68	5.13	2.68
NAV/Search for Starbucks - Freeway - mainline	4.98	2.64	6.09	2.45
NAV/Search for Starbucks - Arterial - mainline	4.47	2.52	6.28	2.37
NAV/Search for Starbucks - Minor - 2 lane proceeding	4.74	2.61	6.03	2.60
NON TECH/select & insert CD - Freeway - mainline	5.98	3.04	5.45	2.79
NON TECH/select & insert CD - Arterial - mainline	5.86	2.88	5.27	2.73
NON TECH/select & insert CD - Parking Lot - exit	6.43	2.94	4.34	2.83
NON TECH/select & insert CD - Parking Lot - aisle	5.36	3.23	4.91	2.75
NON TECH/select & insert CD - Minor - 2 lane proceeding	6.09	2.90	5.23	2.73
NON TECH/Converse w/Passenger - Freeway - mainline	9.19	1.62	2.33	2.03
NON TECH/Converse w/Passenger	9.24	1.63	2.13	1.71
NON TECH/Converse w/Passenger - Parking Lot - exit	8.99	1.90	2.27	1.81
NON TECH/Converse w/Passenger - Minor - 2 lane proceeding	9.23	1.65	2.03	1.82
NON TECH/Hot Drink - Freeway - mainline	6.91	2.96	4.08	2.63
NON TECH/Hot Drink - Arterial - mainline	6.97	2.76	4.17	2.52
NON TECH/Hot Drink - Parking Lot - exit	6.07	3.00	4.60	2.68
NON TECH/Hot Drink - Minor - 2 lane proceeding	7.47	2.65	3.68	2.39
NON TECH/Eat Taco - Freeway - mainline	5.83	2.83	5.17	2.64
NON TECH/Eat Taco - Arterial - mainline	6.00	2.56	4.94	2.41
NON TECH/Eat Taco - Freeway - entrance, merge	6.42	3.14	4.45	2.81
NON TECH/Eat Taco - Parking Lot - aisle	5.27	3.13	4.99	2.76
NON TECH/Eat Taco - Minor - 2 lane proceeding	6.00	2.92	5.10	2.56

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