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DECIDING TO BE DISTRACTED

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Summary: This project investigated the decision process involved in a driver's willingness to engage in various technology-related and non-technology tasks. The project included focus groups and an on-road study, both employing participants who used in-vehicle technologies to at least some degree, from four age groups: teen, young, middle, and older. The focus groups discussed the perceptions, motivations, attitudes, and decision factors that underlie driver choices. The on-road study had two phases: an on-road drive and a take-home booklet. Participants drove their own vehicles over a specified route. They did not actually engage in in-vehicle tasks, but at specified points they rated their willingness to engage in some specific task at that time and place. Eighty-one different situations (combination of in-vehicle task and driving circumstances) were included. Further information was collected in the take-home booklet regarding 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. Together, the focus groups and on-road study provided complementary findings about how drivers decide when to engage in potentially distracting tasks. Driver willingness to engage in various in-vehicle tasks was related to technology type, specific task attributes, driving conditions, personal motivations, driving style, and decision style. Specific project findings were related to potential countermeasure approaches, including public education; driver or device user training; user interface design; needs for warnings and information; criteria for function lock-outs; and driver assist system criteria.

INTRODUCTION

In-vehicle technologies that can be used by motorists while driving have the potential to distract drivers, and this has become a major concern in the highway safety field (e.g., Lee and Strayer, 2004). We use the term "in-vehicle technology" to refer 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, PDAs, and route guidance systems are examples, and they are increasingly available in vehicles. Many studies have now been conducted indicating that in-vehicle tasks can impair various aspects of driving performance (see Goodman, Barker, and Monk, 2005, for an extensive recent bibliography of this research area).

Although the term "driver distraction" is somewhat ambiguous (Sheridan, 2004), clearly many of these in-vehicle devices are not distracting in the sense that they impel some immediate, reflexive reaction in the driver, as some loud noise or roadside movement might "distract." Rather, these in-vehicle activities draw attention from the driving task because the user *chooses* to engage in the in-vehicle technology task. An in-vehicle device 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 use of that device interferes with driving and the circumstances under which drivers are willing to use it. The focus of the research presented here concerns the factors influencing a driver's willingness to engage in certain non-driving tasks. If we recognize that engaging in some distracting technology use is a choice, then we may ask what may be done to improve driver decisions or to mitigate the problems of poor decision making.

METHOD

This research project incorporated two complementary methods to help uncover important factors in driver decision making. First, a series of focus groups was conducted. This qualitative technique was useful for an initial recognition and understanding of the perceptions, motivations, attitudes, and decision factors that underlie driver choices. Following this, an on-road study was conducted, in which drivers operated their own vehicles in a variety of actual driving situations and indicated their willingness to engage in specific tasks at specific times. Full detail on the research methods may be found in the project final report (Lerner, 2005).

Focus Groups

Six discussion groups, with 45 total participants (23 male, 22 female), were conducted. Participants were recruited from the greater Washington, DC, area and all used in-vehicle technologies to at least some extent. The focus groups were distinguished by the age group of the participants. There was one group of teens (17-18), one group of young (19-24), two groups of middle (30-55), and one group of older drivers (60+). The sixth group was comprised of navigation system users, since navigation system use was not as prevalent as initially hoped for in the other groups. All of the participants in the navigation user group were in the middle age category

The focus group followed a structured question path. Instructions to participants emphasized the need to discuss, in a non-judgmental way, what they actually do, rather than what they consider ideal or proper behavior. The general structure of the focus group proceeded along the following sequence of topics: *Decision factors* (factors that go into deciding whether or not to do some task while driving); *Errors/close calls* (close calls that people might have experienced as drivers, or even as passengers, and what factors went into those driving decisions); *Motivation and awareness* (a sense of awareness among participants as to whether or not they are distracted); *Risk taking* (factors that seem important when accepting risk); *Specific driving situations* (a last chance to recall any factors that go into decision making after presenting a few special cases; *Relative risks* (comparison of risk for doing various distracting tasks while driving); *Process* (mental process by which participants make decisions and how all of the decision factors that were discussed come into the process); *Recommendations* (improvements to technologies and overall driving safety).

On-Road Study

The on-road study followed up on the qualitative methods of the focus groups to provide a more systematic and quantitative investigative approach to the factors related to driver willingness to perform in-vehicle tasks. The study investigated driving situation variables, distracting task

variables, and driver characteristics. It included an on-road driving portion and a follow-on take-home booklet portion.

Participants. Eighty-eight licensed drivers (43 males, 45 females) in the Washington, DC, area participated in the study. They were evenly divided among 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 booklet. All drivers reported using a cell phone in their vehicles. Lower rates of familiarity were reported for PDA or navigation system use.

On-Road Procedure. 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. Both willingness and risk were rated on a scale of 1 to 10. For willingness ratings, a "1" corresponded to "I would absolutely not do this task now" and a "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 "1" corresponded to "No additional risk beyond my normal driving" and a "10" corresponded to "Very likely I would be involved in an accident."

During the drive, 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. Ratings were requested at 11 locations that differed from one another in terms of road type and maneuver. The set of in-vehicle tasks and driving situations is presented in Table 1. The 14 tasks and 11 driving situations defined 154 possible combinations. A subset of 81 of these was included in the study. The subset was chosen to provide a broad sampling of sites and tasks and to allow for some driving situations to be paired with the full range of in-vehicle tasks.

Table 1. In-Vehicle Tasks and Roadway Situations for On-Road Ratings

In-Vehicle Tasks Rated On-Road	Driving Situations (Location/Maneuver)
Cell phone: answer a call	Freeway: proceeding on mainline
Cell phone: key in a call	Freeway: entrance/merge
Cell phone: hold personal conversation	Freeway: exit
Cell phone: key in text message	Arterial: proceeding on mainline
PDA: look up stored phone number	Arterial: unprotected left turn
PDA: Pick up and read email	Arterial: protected U-turn
PDA: key in and send email	Arterial: stopped at red traffic signal
Navigation system: key in new destination	Parking lot: exiting to arterial
Navigation system: call up stored destination	Parking lot: searching for parking space
Navigation system: search for Starbucks	Two-lane highway: proceeding, curvy road
CD player: select and insert CD	Residential street: proceeding
Passenger: hold personal conversation	
Beverage: drink hot beverage	
Food: unwrap and eat taco	

The experimenter had a list of tasks that included the location where each task should be presented. A precise 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 main-line 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. Pre-training was provided prior to going on the road so that participants had a clear understanding of all tasks. Lerner (2005) provides more complete descriptions of the precise tasks.

Take-home booklet procedure. 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. Most booklets were returned within about a week of the on-road session. The take-home booklet was comprised of five sections. Part 1 presented eight scenarios from the on-road drive, and the participant's rating of each, and asked for an explanation of why they rated the situation as they did. Part 2 had participants rate additional scenarios, including some with factors (e.g., weather, passengers) that could not be easily incorporated in the on-road procedure. Part 3 had participants rate how risky each of 32 in-vehicle tasks and each of ten driving conditions are. They also indicated reasons for the highest ranked tasks and conditions. Part 4 had participants indicate their familiarity with particular technologies and specific tasks using those devices. Part 5 asked participants to make various self-ratings regarding the intensity of their driving, multitasking while driving, and their general decision-making style.

SELECTED FINDINGS

The richness of the focus group discussions and the range of variables included in the on-road study resulted in far more findings of interest than can be presented in this short paper. Lerner (2005) provides full detailed findings. The findings of the on-road research and the impressions from the focus groups generally converged on consistent themes. Figure 1 shows the mean "willingness" ratings from the on-road study for each of the 14 in-vehicle tasks. The three bars for each task correspond to the three "mainline" driving conditions: freeway, complex arterial, and winding two-lane road. This figure helps illustrate some points that emerged from the study. Willingness varied substantially as a function of the task but was rather insensitive to roadway characteristics. This was also seen in focus group discussion, where task motivations appeared to be the predominant decision factors, followed by task attribute factors, and least by driving-

related issues. Participants also showed relatively little concern for impending (up-road) conditions. The focus group discussions, on-road ratings, and general task ratings all agreed in indicating that most drivers had relatively little reluctance regarding cell phone use under most driving conditions. Participants appear to show little appreciation of the risk associated with basic cell phone tasks—dialing, answering, and conversing. As Figure 1 shows, there was generally less willingness to use PDA and navigation systems.

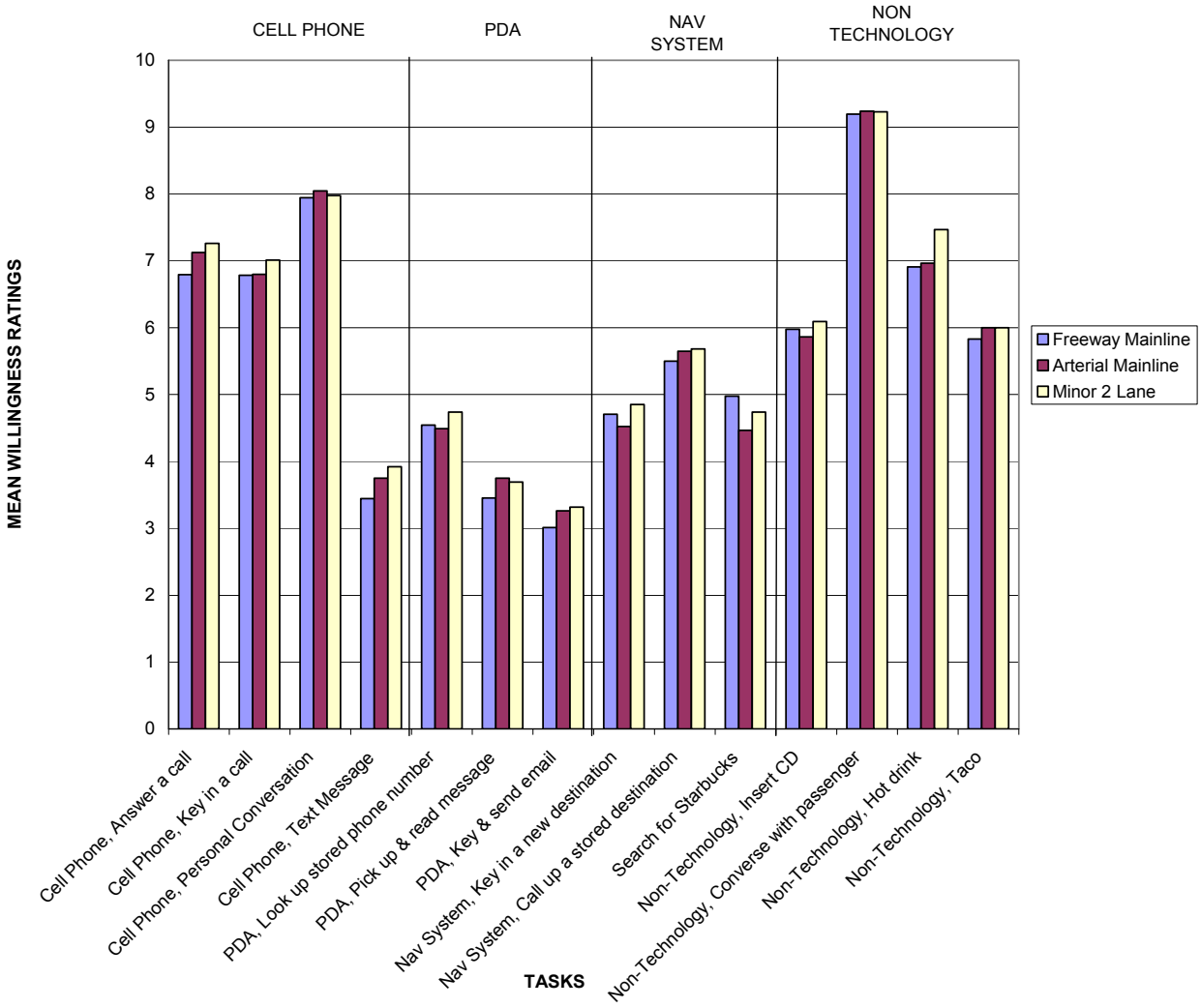

Figure 1. Mean willingness ratings for 14 in-vehicle tasks during mainline driving on freeway, arterial, and two-lane roads

Figure 2 portrays the general risk ratings for cell phone tasks and non-technology tasks (data are from the take-home portion of the on-road experiment). Ratings for several cell phone tasks—answering a call, speed dialing, and brief "information-exchange" conversation—cluster between 2 and 3 on the 10-point scale. 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 (<5) 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.

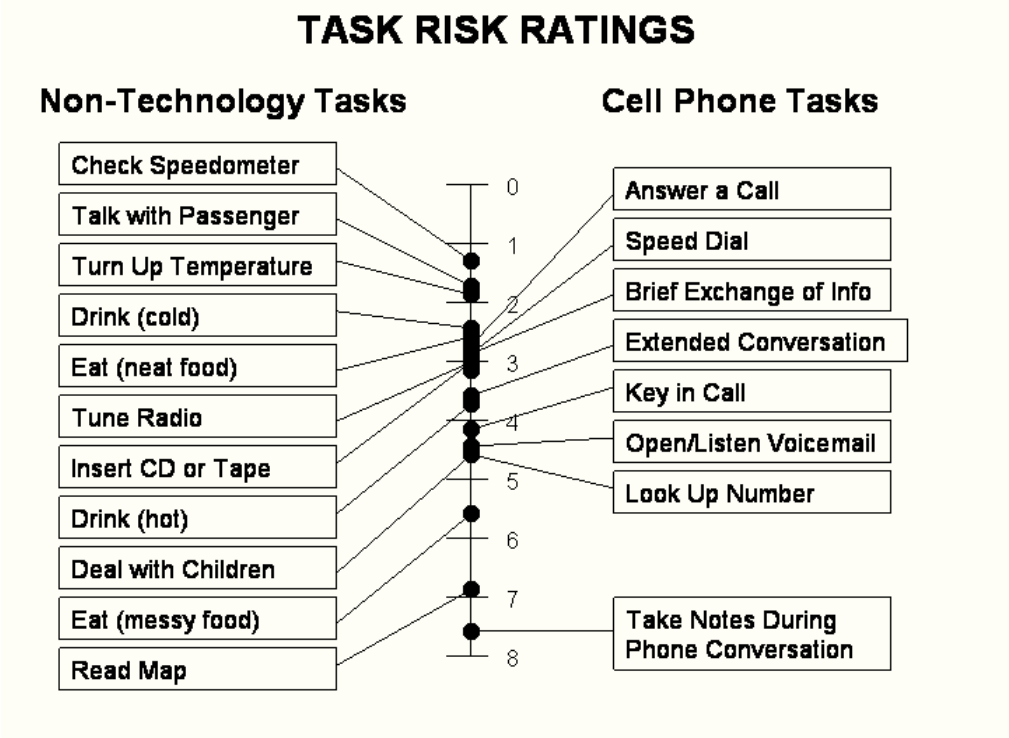

Figure 2. General risk ratings for cell phone tasks and comparison non-technology tasks.

The study revealed a range of important motivations. Some motives to engage in a task are externally driven by events (e.g., phone rings, navigation help is needed); others are internal to the driver (e.g., socializing). Some motives are driving-related, some unrelated. Some motives are specific to the content of the communication (e.g., call a business client); others are non-specific (e.g., want to use up remaining minutes on phone plan). Important to many drivers were control over personal time, desire to socialize, enjoyment of technology use, efficient use of resources/costs, and a more general attitude about a "wired" lifestyle. Non-communication-specific, non-driving motivations were a major point of focus group discussion. Such motives may not appear very essential or urgent to an outside observer but are often a major element in prompting distracting behaviors. When considering the in-vehicle task attributes that were important for decisions, the focus group discussion and the take-home booklet responses agreed in emphasizing visual attention demands. Physical demand requirements were also raised. Other potentially important task attributes received little or no consideration (e.g., temporal aspects, chunking, error potential/error recovery, and ability to self-monitor distraction).

Various driver attributes were found to be associated with decisions about in-vehicle activity. These included driver age, gender, familiarity with the technology, general driving style, decision style, and attitudes about multi-tasking. As anticipated, risk-related behavior was associated with age, with the teen drivers rating least risk (and greatest willingness) and the older drivers rating most risk (and least willingness). Quantitatively, the on-road study found teen

drivers to see uniformly less risk across the range of situations than other drivers; thus the tendency for more willingness was not limited to certain tasks but was broadly true for all types of tasks. Qualitatively, the focus groups found the teen drivers to be quite distinct from other groups in their degree of in-vehicle technology use, their attitudes about safety, their motivations, their decision making style, and their assessment of their multi-tasking capabilities. In general, across all participants, general driving style (driving "intensity") and attitudes about multi-tasking correlated with the willingness to engage in in-vehicle tasks.

IMPLICATIONS FOR COUNTERMEASURES

The findings of this research suggest a variety of possible safety countermeasures. As a means of mapping solutions to various concerns identified in the research, a matrix was created. The rows of the matrix correspond to specific findings, grouped under five headings: task attributes, driving environment, user motivations, decision making, and driver attributes. The columns of the matrix correspond to countermeasure categories. There were six countermeasure categories, two related to the user interface (need for warnings, interface attributes), two related to interactive vehicle control (function lock-out, driver assist), and two related to education and training (safety campaigns, driver or user training or licensing). Using this structure, a wide range of suggestions was generated for improving devices, intelligent systems, and user behavior. Thirty-six specific research findings (rows) were included and some suggestion was indicated for 93 of the 216 cells in the 36X6 matrix. Lerner (2005) presents the specifics. While these suggestions may vary in their ultimate efficacy or practicality, the range of suggestions illustrates the potential benefits of a deeper understanding of driver decision making about engaging in in-vehicle tasks. There is very little research on this important issue, and hopefully more sophisticated research and theory will follow up on the preliminary efforts of this project.

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