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2007-41

Rural and Urban Safety Cultures:

Human-Centered Interventions Toward Zero Deaths in Rural Minnesota

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16. Abstract (Limit: 200 words)

The total number of annual traffic fatalities and the rate of fatalities per vehicle mile traveled are considerably higher in rural areas compared to urban areas. This project aimed to be one of the first studies to systematically explore the potential contribution of rural driver *attitudes* and *behavior* that may be a causal factor of these trends.

We first conducted a survey of self-reported driver behavior and traffic safety attitudes. The analysis of this survey examined differences between rural and urban drivers in terms of risk taking and attitudes toward safety interventions proposed as part of the Minnesota Comprehensive Highway Safety Plan. The results suggest that rural drivers engage in riskier behavior such as seatbelt noncompliance and DUI because they have lower perceptions of the risks associated with such behaviors. Moreover, rural drivers perceive lower value in government-sponsored traffic safety interventions than their urban counterparts.

We then measured driver behavior from a driving simulator comparing the driving behavior of rural and urban drivers during traffic scenarios that embodied common crash factors (distraction, speeding, car following, intersections). The results suggest that the rural environment may encourage less safe driving.

This study provides policy suggestions for developing safety interventions that are designed for the psychosocial factors that define the rural culture.

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Rural and Urban Safety Cultures: Human-Centered Interventions Toward Zero Deaths in Rural Minnesota

Final Report

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Executive Summary

The total number of annual traffic fatalities and the rate of fatalities per vehicle mile traveled are considerably higher in rural areas compared to urban areas (NHTSA, 2001). A number of explanations have been offered with respect to the higher fatal crash rate in rural areas: Road design; Emergency Medical Services; Human Factors. This project, comprised of two parts, aimed to be one of the first studies to systematically explore the potential contribution of rural driver behavior and attitudes that may be related to the increased rural fatal crash risk.

Part I of this study involved a survey of driver self-reported behavior and traffic safety attitudes sampled from rural and urban areas. The analysis of this survey examined differences between rural and urban drivers in terms of risk taking and attitudes toward safety interventions proposed as part of the Minnesota Comprehensive Highway Safety Plan. The results suggested that rural drivers, compared to urban drivers, engage in riskier behaviors such as not wearing seatbelts and "driving under the influence" (DUI) because they have lower perceptions of the risks associated with such behaviors. Moreover, rural drivers perceive the utility of government-sponsored traffic safety interventions to be lower than their urban counterparts.

Part II of this study involved the examination of driver behavior encountered in a driving simulator environment that incorporated variables of road environment (rural, urban), driver residency (rural, urban), and driver age (young, elderly). The analysis of this experiment compared the driving behavior between rural and urban drivers during traffic scenarios that embodied common crash factors in rural and urban driving environments (distraction, speeding, car following, intersections). The results suggested that the rural environment may encourage less safe driving in terms of unsafe speed choices and intersection crossing behavior, especially among high-risk groups such as teen drivers.

Overall, this study attempts to provide insights into the role of human factors in rural fatal crashes. Moreover, this study provides policy suggestions for developing safety interventions that are designed for the psychosocial factors that appear to define the rural (versus urban) culture:

- Education programs to improve seatbelt compliance in rural areas should focus on increasing the perception of danger associated with not using a seatbelt while driving

- The higher seatbelt noncompliance reported by rural drivers in this study suggests that seatbelt enforcement campaigns could target rural areas

- The higher seatbelt noncompliance reported by rural pickup truck drivers in this study suggests that seatbelt enforcement campaigns could specifically target rural pickup truck drivers

- In addition to education and publicity campaigns to increase the saliency of the dangers of driving while intoxicated, alcohol enforcement campaigns could target rural areas. Such enforcement and the cost of being apprehended would introduce additional salient costs for driving while intoxicated. These enforcement programs would need to have saturated advertisement so that the probability and cost of apprehension is apparent to drivers (Creaser, Aflleje, & Nardi, 2007)

- More cautious driving behavior may be afforded in both rural and urban areas by including speed calming measures in road design development

- There may be a general need for traffic safety policy directed at driver distraction to recognize the potential increased risk amongst elderly drivers in complex urban driving environments

- Given the low density and isolation of some rural roadways, enforcement (and education) may not always be a practical tool. In these instances, Intelligent Transportation Systems embedded in the infrastructure or fitted to vehicles may be of assistance, e.g. monitoring devices used in teen vehicles that not only support the choice of safe speeds, but also monitor compliance with speed limits (Brovold et al., 2007)

- The observation that rural (versus urban) residents were generally less favorable to all types of traffic safety intervention attests to the need for traffic safety policy to be guided by local cultural factors and to incorporate the psychosocial factors that govern driver behavior in rural communities (Ward, 2007)

Future research should examine methods of identifying and measuring the relevant psychosocial factors that influence driver attitudes with the goal of developing a model to change driver attitudes, thereby reducing risky driving behaviors and increasing acceptance of safety interventions.

A note on recommendations presented in this paper: General policy recommendations are presented as suggestions of possible solutions to the trends reported in the data. Any specific implementations described as examples of these recommendations are mentioned for the sake of example only. The authors emphasize that any specific implementation of the recommendations should be done in accordance with the target population or region and applicable laws and customs.

Introduction

The death rate from all causes is significantly higher in rural areas compared to urban areas, even accounting for the older age of the rural population (Wright, Champagne, Dever, & Clark, 1985). The higher mortality of rural residents can be attributed to a higher rate of unintentional injury and traumatic deaths (Muellenman, Walker, & Edney, 1993; Svenson, Spurlock, & Nypaver, 1996). Notably, whereas motor vehicle crashes predominate as the leading cause of fatal trauma in rural areas, homicide is a more prominent factor in urban areas (Wright et al., 1985).

Nationally, both the total number of annual traffic fatalities and the rate of fatalities per vehicle mile traveled are considerably higher in rural areas compared to urban areas (NHTSA, 2001). As seen in recent data from six representative Minnesota counties (Figure 1), urban areas tend to experience a greater number of crashes per vehicle mile traveled (VMT) while rural areas experience a greater number of fatalities per VMT (for further explanation of why these counties are representative for our study purposes, refer to the Methods section.). The types and conditions of the crashes in rural areas are also distinct from those in urban areas. For example, compared to urban fatal crashes, fatal rural crashes are typified by the following characteristics (Blatt & Furman, 1998; NHTSA, 2001; NHTSA, August 1996): (1) more than one fatality per crash; (2) daylight, or at night on unlit road; (3) male; (4) younger driver; (5) alcohol consumption; (6) truck involvement; (7) higher speed; (8) vehicle rollover; (9) head-on collision; and (10) ejected person.

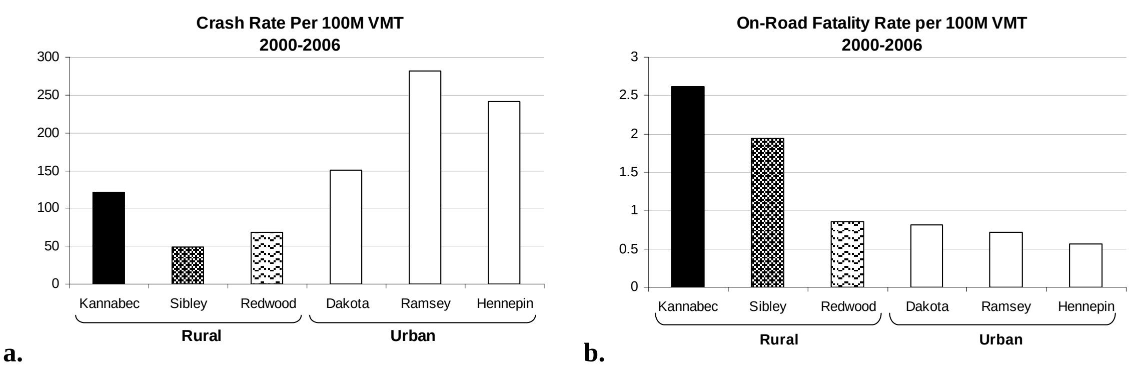


Figure 1. Crash and fatal crashes in selected Minnesota counties per 100M VMT from 2000 through 2006.

As may be expected from the fatality trends, rural traffic crashes are generally more severe than urban crashes (NHTSA, August 1996). For example, the impact from rural crashes disables 80% of involved vehicles, whereas only 65% of vehicles impacted in urban crashes are disabled (NHTSA, 2001). Perhaps as a result of this discrepancy, persons involved in a rural crash are three times more likely than those in an urban crash to suffer a fatality (NHTSA, August 1996), and more likely to require hospitalization (NHTSA, 2001). The effect of the greater severity and crash fatalities in rural areas is compounded by lower rates of seat belt use by rural vehicle occupants, resulting in twice as many ejected occupants as compared to urban crashes (NHTSA, August 1996).

Rural Traffic Crash Factors

A number of explanations have been offered with respect to the higher fatality crash rate in rural areas.

Road Design

Design elements related to the instance or outcome of a crash may distinguish rural and urban driving environments. For example, a majority of fatal crashes occur on high speed two-lane, two-way highways that are typically located through rural areas (Blatt & Furman, 1998). This means that rural crashes are more often at high speeds compared to urban crashes (NHTSA, 2001). Other road types (such as non-straight roads) also show a higher fatality risk to rural drivers. Although crashes on rural non-straight roads only account for 15% of all crashes, 30% of all fatal crashes occur on non-straight road types. (NHTSA, 2001). These design differences may suggest that the driving environment is more hazardous in rural than in urban areas, resulting in more fatalities.

Emergency Medical Services

Second, it has been proposed that the higher fatality rate in rural areas is due to the medical response to a crash. Medical treatment in the first "golden hour" after a traumatic crash is critical to increase the probability of patient recovery (Champion et al., 1999). Given the lower density of population and medical care facilities in rural areas, *proximity* to medical care can be a significant factor for outcome of fatal crashes (Svenson, Spurlock, & Nypaver, 1996), rather than the *quality* of medical care (Chen, Maio, Green & Burney, 1995). Indeed, it has been documented that response time to a rural crash by Emergency Medical Services (EMS) is longer than for urban areas (Svenson, Spurlock, & Nypaver, 1996). For example, Champion et al. (1999) noted that the average time from a crash to the notification of EMS in rural areas is 7 minutes compared to 3 minutes for urban areas, with the result that the elapsed time to arrive at the hospital is almost 20 minutes longer for rural areas. Indeed, between 1993 and 1997, it is estimated that approximately 30% of EMS crash responses in rural areas took longer than one hour compared to less than 8% for urban cases (Champion et al., 1999). As populations expand further into rural areas, it is worth noting that the rural dead-at-scene rate is also higher than for urban areas, with evidence of an increasing trend over recent years (Brown, Khanna, & Hunt, 2000).

Human Factors – Rural driver attitudes

It is often presumed that there are attitudinal and psychological differences between rural and urban drivers in terms of perceptions of risk factors and safety interventions. These rural attitudes are presumed to predispose rural drivers to engage in these behaviors that increase crash risk. It is also the case that most rural crashes involve rural residents while most urban crashes involve urban residents (Blatt & Furman, 1998). Moreover, rural crashes are over-represented by male and young drivers who reportedly demonstrate risk-taking behaviors and inappropriate attitudes toward traffic safety (Blatt & Furman). By understanding these psychological differences, it may be possible to target specific community interventions based on education and enforcement that may be more valid and effective for rural populations.

Human Factors – Rural driving behavior

A number of behavioral factors have also been identified as potential contributors to the higher rural fatal crash rate. For example, there are lower rates of seat belt and child safety seat use in rural areas, which may contribute to the seriousness of crash injuries and fatalities (NHTSA, August 1996). In Minnesota, rural areas tend to show lower levels of compliance with safety restraints in fatal and injury-related crashes than do urban areas, as shown in Figure 2 (MN DPS, 2007). There are indications that alcohol may also pose a greater risk in rural areas than in urban areas and that rural drivers in dry counties (those not permitting the sale of alcohol) have a higher risk of both alcohol and non-alcohol related crashes (Blatt & Furman, 1998). Quite possibly, the latter may be explained by the residents of dry counties having a greater average distance between the place of residence and the location of the crash than residents in neighboring "wet" counties (Gary, Aultman-Hall, McCourt, & Stamatiiadis, 2003).

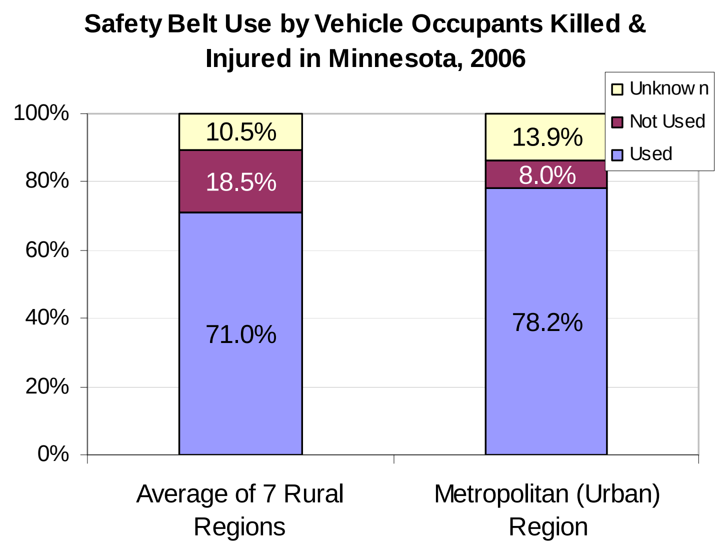


Figure 2. Safety belt use by vehicle occupants killed and injured in Minnesota, 2006, where the "Metropolitan Region" is composed of the counties in and surrounding the Minneapolis/St. Paul area.

This project, comprised of two parts, aimed to be one of the first studies to systematically explore the differences between urban and rural driver *attitudes* and *behaviors* that may be related to the fatal crash risk. Together, the two parts of this study attempted to provide insights into the role of the human factors in rural fatal crashes.

Part I of this study involved a survey of driver self-reported behavior and traffic safety attitudes sampled from rural and urban areas. The analysis of this survey examined differences between rural and urban drivers in terms of risk taking and attitudes toward safety interventions proposed as part of the Minnesota Comprehensive Highway Safety Plan.

Part II of this study involved the examination of driver behavior encountered in a driving simulator environment incorporating variables of environment (rural, urban), driver residency (rural, urban), and driver age (young, elderly). The analysis of this experiment compared the driving behavior of rural and urban drivers during traffic scenarios that embodied common crash factors in rural and urban driving environments (distraction, speeding, car following, intersections). Together, the two parts of this study attempt to provide insights into the role of the human factor in rural fatal crashes.

A note on recommendations presented in this paper. General policy recommendations which are underlined in the text are presented as suggestions of possible solutions to the trends reported in the data. Any specific implementations described as examples of these recommendations are mentioned for the sake of example only. The authors emphasize that any specific implementation of the recommendations should be done in accordance with the target population or region and applicable laws and customs.

Part I: Driver Survey

This part of the project allowed us to gain an understanding of how rural and urban residents perceive their own driving behavior and how they view traffic safety measures. The views of drivers from rural and urban areas of Minnesota were collected using a survey and compared in terms of self-reported crash history, fatality factors, and attitudes towards safety interventions.

Methods

Data for this study were collected with a mailed survey of a sample of Minnesota licensed drivers selected from representative urban and rural counties. The goal of the study was to obtain a minimum of 1,300 respondents. Recognizing that responses to postal questionnaires can be low the survey was mailed to 5000 drivers, of which 3000 would be sent to rural counties and 2000 to urban counties, as described below.

Minnesota County Crash History

Data for all 87 Minnesota counties were tallied between the years 2000 and 2004 to determine the fatality rates per 100 million vehicle miles traveled (100M VMT) for all counties. Relevant fatality rate summary data are presented in Table 1 (see Appendix A for population, fatality rate, and 100M VMT data from all counties).

Selection of Rural Counties

The rural counties were defined as those areas that did not have a major paved, non-divided road with a speed limit greater than 60 mph within their boundaries. They also did not contain a city with a population over 5000 which is the current accepted definition of a rural area by the Minnesota Department of Transportation (Zip codes for Redwood Falls have been excluded from the Redwood County sample, as this area has a recorded population just over 5000). Three specific rural counties were selected to represent a range of traffic fatality rates as shown in Figure 1b (see also Appendix A). In each rural county, 1002 surveys were mailed to randomly selected addresses:

- Kanabec (High risk) - 2.82 fatalities per 100M VMT, fourth highest fatality rate in MN

- Sibley (Medium risk) - 1.53 fatalities per 100M VMT, 40th highest fatality rate in MN

- Redwood (Lowest risk) - 0.64 fatalities per 100M VMT, 86th highest (i.e. second lowest) fatality rate in MN

Selection of Urban Counties

The urban counties were selected because they represented the most densely populated areas of Minnesota and have the highest total vehicle miles traveled. These counties also share three of the four lowest Minnesota fatality rates per 100M VMT as shown in Figure 1b (see also Appendix A). In order to sample people from the most populated areas, participants were only selected from the top ten populated cities within each selected urban county. In each urban county, approximately 650 surveys were mailed to randomly selected addresses:

- Dakota (666 surveyed participants) - 0.75 fatalities per 100M VMT
- Ramsey (651 surveyed participants) - 0.64 fatalities per 100M VMT
- Hennepin (651 surveyed participants) - 0.54 fatalities per 100M VMT

Table 1. Selected Minnesota counties and vital statistics per 100 persons and per 100 million.

Resident County	Fatality Rate 2000-2004 per…	
(Rural / *Urban*)	100 Persons	100M VMT
Kanabec	0.156	2.82
Sibley	0.098	1.53
Dakota	0.035	0.75
Ramsey	0.029	0.64
Redwood	0.043	0.64
Hennepin	0.025	0.54

Survey Participants

Age Group

Participants were selected equally (and randomly) from three age groups based on the 2000 Minnesota census population pyramids (Minnesota Department of Administration, 2006). The three age groups are:

- Young: 18 – 26 years old (birth years 1980 through 1987), representing approximately 12% of Minnesota population
- Middle: 30 – 50 years old (birth years 1955 through 1975), representing approximately 33% of Minnesota population
- Old: 65 years or older (birth years 1940 or earlier), representing approximately 12% of Minnesota population

The intent of selecting these groups and sampling an equal number in each was to avoid over-sampling from the middle age group and to get an adequate number of responses from the less populated (and typically higher risk) older and younger age groups. In this way, we felt we could make more meaningful comparisons by sampling over all three groups equally rather than focusing on differences between these distinct age groups.

Recipient Selection

Potential survey participants were selected from Minnesota driver's license data issued to the epidemiology department at the University of Minnesota in August of 2005. The cases were selected by age group and geographical area and then randomized. We excluded listed drivers if their license was expired or not valid, if they only held an ID card, or if they held a moped- or permit-only status.

Mailing Protocol

Participants were sent a postcard one week prior to receiving the questionnaire packet to tell them a survey is forthcoming (all materials from the mailing protocol can be found in Appendix B). The survey packet contained a letter of introduction, an instruction sheet, a questionnaire booklet (8 page booklet, folded and stapled), and a postage-paid return envelope. They were also sent a postcard a few weeks after receiving the packet to remind them about completing the survey. Participants who did not respond were sent a second questionnaire packet six weeks after the first packet.

The survey reminded participants of the voluntary nature of participation and of our confidentiality procedures. Participants were also asked (through means of the survey) if they wished to take part in a $50 Target gift card drawing with an opportunity of at least one in 5000; 20 winners were selected at random after all survey collection was completed.

Dependent Measures

These measures were intended to access urban and rural driver self-reported tendencies to engage in risky driving behaviors and their perceptions of the risk associated with these behaviors. The survey also assessed driver attitudes toward common traffic safety interventions that target risky driving behaviors. Finally, an attempt was made to characterize the personality and culture of rural and urban respondents.

Personality and Culture

Sensation Seeking Scale (SSS-V) – Thrill and Adventure Seeking SubScale. This ten-item survey is widely used and accepted to identify individual differences in sensation seeking. Specifically, this scale measures a person's "… desires to engage in sports or activities involving some physical danger or risk such as mountain climbing, parachute jumping, scuba diving, speeding in a car, etc" (Zuckerman, 1994). This scale has been found to be relevant to driving research in that individuals found to have high sensation seeking also often exhibit dangerous driving behavior (Jonah, 1997). The survey uses a forced response format in which respondents must identify the most desirable of two listed situations (see Appendix B). Higher scores on this scale represent higher thrill seeking tendencies.

Social Motivation Questionnaire (SMQ). This ten-item survey is used and accepted to identify mild social deviance (West, Elander, & French, 1993). This scale has been found to be relevant to driving research in that high SMQ scores are positively correlated with speed, driving violations, and number of accidents (crashes) and also negatively correlated with thoroughness, age, and being female (West et al., 1993). The survey asks drivers to read a list of behaviors and actions that usually require moral judgments. Respondents are asked how likely it is they would engage in that behavior or action if they knew they would not get caught and rate how likely they would be to do them on a three point scale; 1 = “Not at all likely”, 2 = “Somewhat likely”, and 3 = “Very likely”. Higher scores on this scale represent a lower social consciousness.

Driving Slips, Errors, and Violations (DBQ)

This 28-item survey is widely used and accepted in Europe to identify three categories of driver errors or mistakes that may be related to traffic safety (Reason et al, 1990). The survey was modified from its original British-dialect version in order to reflect a North American dialect (e.g., ‘junction’ was changed to ‘intersection’) and driving protocol (e.g., ‘right’ turns were changed to ‘left’ turns). Respondents were asked to indicate how frequently they remembered exhibiting examples of three categories of driver errors and mistakes. Items are aggregated in each category to produce a score of the tendency to exhibit each category of driver errors or mistakes:

1. *Lapses and slips* are unintentional errors and mistakes that are relevant to the driving context, but may not increase crash risk (see Appendix B, Page 2, items 2, 4, 12, 15, 19, 22, 26).

2. *Driver errors* are defined as unintentional mistakes made by drivers that can increase crash risk (see Appendix B, Page 2, items 5, 6, 8, 9, 13, 14, 16, 27).

3. *Deliberate violations* involve intentional violation of traffic regulations, rules, and laws that govern driving (see Appendix B, Page 2, items 3, 7, 10, 11, 17, 18, 20, 21, 23, 24, 25, 28).

Dangerous Driving Behaviors

A 16-item survey was created by the researchers in order to quantify the attitudes of respondents regarding types of high-risk driving behaviors that are targeted by the Minnesota Toward Zero Deaths (TZD) program and the Minnesota Comprehensive Highway Safety Plan. These represent driving activities that are often linked to fatalities on the road (e.g., alcohol use, speeding, and seat belt usage). Participants were asked how <u>frequently</u> they recalled engaging in the list of activities in the past 12 months on a 6-point scale from ‘Never’ to ‘Always’. They were also asked how <u>dangerous</u> the activities were perceived to be on a 6-point scale from ‘Not at all dangerous’ to ‘Extremely Dangerous’, to correspond with the majority of other surveys in this packet.

The frequency and dangerous scores were multiplied to produce a composite score of “risk-taking” for each item. The individual items were then grouped into categories of related behavior to produce an overall risk-taking score for each category of driving behavior:

- *Impaired and Aggressive risk taking* included driving behaviors that were associated with a high crash risk such as speeding and alcohol use

    - See Appendix B, Page 3, items 1, 2, 3, 4, 5, 6, 7, 15
- *Moving violations (other than speed)* included driving behavior that could be charged as moving violations, such as failure to yield or obey traffic signals – especially those that may be witnessed by other road users
    - See Appendix B, Page 3, items 8, 9, 10, 11, 16

- *Private violations* included driving behaviors that are violations, but can not normally be witnessed by other road users, such as not driving with a license or failing to use a seatbelt
    - See Appendix B, Page 3, items 12, 13, 14

In addition to the analysis of aggregated categories of dangerous driving, analyses were also conducted on the individual items commonly associated with the highest fatal crash risk: speeding above the limit; excessive speed for conditions; driving while intoxicated; and seatbelt non-compliance (Blatt & Furman, 1998; NHTSA, 2001; NHTSA, August 1996). For these primary risk factors, the measures of reported frequency and perceived dangerousness were analyzed separately.

Safety Attitudes Toward Interventions

A 20-item survey was created by the researchers to measure the perceived utility of common safety interventions that are proposed in the Minnesota Toward Zero Deaths program and the Minnesota Comprehensive Highway Safety Plan. Participants were asked how *effective* each intervention would be in their community on a 4-point scale from 'Ineffective' to 'Effective'. They were also asked how *desirable* each intervention would be for them in their community on a 4-point scale from 'Undesirable' to 'Desirable'. The ratings on these two scales were then multiplied to obtain a perceived utility score for each intervention. The interventions were then grouped into common types to produce aggregate scores for three categories (programs) of intervention:

- *Enforcement programs* involved traffic safety interventions that relied on traffic laws and law enforcement
    - See Appendix B, Page 5, items 1, 2, 3, 10, 11, 12, 13, 14, 20

- *Engineering programs* involved traffic safety interventions based on engineering solutions that target the road network and signal control devices
    - See Appendix B, Page 5, items 5, 7, 8, 9, 17, 18, 19

- *Education programs* involved traffic safety interventions based on informing and training the driving population
    - See Appendix B, Page 5, items 4, 6, 15, 16

Response and Data Cleaning

There was a 34.3% response from rural and 30.4% response from urban areas. Females (36.2%) responded more frequently than males (29.3%). By age, more responses were received from the Older age group (46%), than either the Middle (32%) or Younger (21%) age groups.

Responses were removed if they did not match the database records for age, gender, or zip code. Participants were also asked, "*In which **one** of the following areas do you consider your current home/residence to be? Rural, Suburban, or Urban City*." To ensure relevant responses from the respective geographic area, participants from rural counties who responded that they lived in an urban or suburban area were excluded; likewise participants from urban counties who responded that they lived in a rural area were also excluded. The total number of valid responses was 1399, which accomplished the goal set forth by the power analysis of 1300 respondents.

Table 2 shows some relevant demographics of the sample by rural and urban areas. There were no differences between the two regions in overall gender composition or the number of years since obtaining a driver's license. As expected, rural residents reported living in rural areas longer than urban residents. Rural residents also reported living in urban areas for less time than urban respondents reported. Urban residents reported living in their current residence for less time than rural residents.

Table 2. Sample demographics

Demographic Measure	Rural	Urban	
Number of Valid Responses	828	571	
Percent Responding…			
Female	55%	57%	
College degree	32%	**56%**	**
Mean…			
Age	51.7	**54.7**	**
Years lived at current residence	**19.7**	16.0	**
Years lived in rural areas	**38.5**	6.9	**
Years lived in urban areas	6.5	**21.1**	**
Years since obtained license	33.3	35.6	

Note: for significance, Wilcoxon Mann-Whitney Test (Z) was used for percentages, 2-Tailed t-Test for means. ** $p < 0.01$

There was a significant difference in the mean age between respondents from rural and urban counties, as shown in Table 3. A chi-square analysis also showed there was a significant difference between the observed and expected number of respondents by age group and geographic area [$X^2 = 10.176, p \leq 0.01$]. Overall, more older respondents were sampled than expected from urban areas, while more young and middle age respondents were sampled than expected from rural areas. Because of this, age effects on the dependent variables were controlled for by using age (birth year) as a covariate for all analyses.

Table 3. Age group distribution observed and expected by geographic area

Age Group	Observed (Expected) Rural	Urban
Young	**171 (163)**	105 (112)
Middle	**310 (289)**	178 (199)
Old	342 (371)	**285 (256)**

Results

A 2 (residence [county] type: rural, urban) x 2 (gender: male, female) between subjects fixed-factor ANCOVA was performed using age (birth year) as a covariate. Reported means were adjusted for age. Correlations are also reported to indicate the relationship (direction and magnitude) between age and each measure in the case of a significant covariate effect.

Driving Demographics

Table 4 summarizes the differences between rural and urban respondents for driving demographic measures. On average, rural drivers reported driving more miles per year than urban drivers, which is consistent with the fact that rural areas are often more remote and require longer trips to common destinations. Also, more rural drivers reported commuting in rural areas while more urban drivers commute in suburban and urban areas.

Table 4. Driving demographics of the survey sample.

Driving Demographic Measure	Rural	Urban
Mean…		
Days typically drive per week	5.4	**5.7**
Miles driven in the past year	**7125**	6275
Percent Responding…		
Drive as part of paid employment	**18%**	13%
Regularly commute in rural	**91%**	21%
Regularly commute in suburban	31%	**81%**
Regularly commute in urban	19%	**56%**

Note: all rural versus urban differences significant using Wilcoxon Mann-Whitney Test, all $p \leq 0.006$.

The types of vehicles driven were also examined by area, as shown in Table 5. Over half of all rural drivers and over two-thirds of urban drivers drove a passenger car as their primary vehicle. Almost one-fifth of rural respondents also reported driving a pickup truck as their primary vehicle, which is more than twice the percentage of urban drivers who reported driving trucks.

Table 5. Distribution of vehicle types by area and over all respondents.

	Area		
Primary Vehicle Type	Rural	Urban	All
Passenger Car	54%	67%	60%
Pickup Truck	19%	8%	15%
Sport Utility Vehicle (SUV)	10%	13%	12%
Van or Minivan	11%	8%	10%
Other	5%	4%	4%

Personality and Culture

There was a significant main effect of residence type in terms of reported *sensation seeking personality,* [F(1, 1326) = 33.90, p < 0.001]. Rural respondents reported significantly lower sensation seeking tendencies (M = 3.16) than the urban respondents (M = 3.93). The counties also differed significantly in terms of *social motivation* [F(1, 1391) = 7.00, p = 0.008]. Rural respondents reported significantly higher social motivation (shown by a lower mean score, M = 1.41) than the urban respondents (M = 1.45).

Overall, male respondents reported significantly more sensation seeking behaviors [F(1, 1326) = 121.52, p < 0.001] and reported significantly lower social motivation than females [F(1, 1391) = 11.11, p = 0.001]. Respondent age was a significant covariate and indicated that older respondents reported less sensation seeking tendencies (r = -.52, p < 001) and higher social motivation (r = -.45, p < 001).

Driving Slips, Errors, and Violations

There was a significant main effect of residence type in terms of reported *slips and lapses* while driving [F(1, 1384) = 12.03, p = .001]. Rural respondents reported a significantly lower tendency to commit slips and lapses (M = 1.64) than the urban respondents (M = 1.72). There was also a significant main effect of residence type in terms of reported *driver errors* [F(1, 1384) = 4.77, p = .029. Rural respondents reported a significantly lower tendency to commit driving errors (M = 1.43) than the urban respondents (M = 1.48). Finally, there was also a significant main effect of residence type in terms of reported *driving violations* [F(1, 1384) = 36.61, p < .001. Rural respondents reported a significantly lower tendency to commit driving violations (M = 1.59) than the urban respondents (M = 1.73).

Overall, male respondents reported significantly more driving violations than did female respondents [F(1, 1384) = 49.37, p < .001]. Respondent age was a significant covariate and indicated that older respondents reported fewer slips and lapses (r = -.13, p < .001), driver errors (r = -.14, p < .001), and driving violations (r = -.44, p < .001).

Dangerous Driving Behaviors

There was a significant main effect of residence type only in terms of reported *private violation behaviors* while driving [F(1, 1334) = 16.14, p < .01]. Rural respondents reported a significantly *higher* tendency to commit driving violation behaviors that generally are not witnessed by other road uses (M = 5.95) than the urban respondents (M = 5.53).

Overall, respondent age was a significant covariate and indicated that older respondents reported fewer instances of impaired and aggressive risk taking ($r = -.57$, $p < .001$), moving violations ($r = -.26$, $p < .001$), and private violations ($r = -.20$, $p < .001$).

Risk Factors

Speeding above Speed Limit. There was a significant main effect of residence type in terms of the frequency of speeding more than 10 mph above the posted speed limit [$F(1, 1382) = 24.94$, $p < .001$]. Urban respondents reported speeding more than 10 mph above the posted limit more frequently (M = 2.16) than the rural drivers (M = 2.45). However, the counties did not differ in terms of the perceived dangerousness of speeding.

Overall, male respondents reported a significantly <u>higher</u> frequency of speeding above the posted limit [$F(1, 1382) = 16.23$, $p < .001$] and <u>lower</u> associated perceptions of danger [$F(1, 1333) = 82.82$, $p < .001$] than did female respondents. Respondent age was a significant covariate and indicated that older respondents reported a lower frequency of speeding above the posted limit ($r = -.39$, $p < .001$) and a higher perceived dangerousness associated with this speeding behavior limit ($r = -.10$, $p < .001$).

Excessive Speed for Conditions. The counties did not differ in terms of either the reported frequency or the perceived dangerousness of excessive speed for conditions.

Overall, male respondents reported a significantly <u>higher</u> frequency of speeding above the posted limit [$F(1, 1372) = 47.41$, $p < .001$] and <u>lower</u> associated perceptions of danger [$F(1, 1333) = 58.58$, $p < .001$] than did female respondents. Respondent age was a significant covariate and indicated that older respondents reported a lower frequency of excessive speed for conditions ($r = -.36$, $p < .001$).

Driving While Intoxicated. The counties did not differ in terms of frequency of driving while intoxicated. However, there was a significant main effect of residence type in terms of the perceived dangerousness associated with driving while intoxicated [$F(1, 1324) = 7.14$, $p = .008$]. Rural respondents perceived driving while intoxicated to be <u>less</u> dangerous (M = 5.53) than the urban drivers (M = 5.70).

Overall, male respondents reported a significantly higher frequency of driving while intoxicated [$F(1, 1374) = 17.04$, $p < .001$] and lower perceived dangerousness associated with driving while intoxicated [$F(1, 1324) = 11.73$, $p = .001$] than did female respondents. Respondent age was a significant covariate and indicated that older respondents reported a lower frequency of driving while intoxicated ($r = -.26$, $p < .001$).

Safety Belt Non-compliance. There was a significant main effect of residence type in terms of the frequency of not wearing a seatbelt [$F(1, 1381) = 49.38$, $p < .001$]. Rural respondents reported not wearing a seatbelt more frequently (M = 1.90) than the urban drivers (M = 1.49). There was also a significant main effect of residence type in terms of the perceived danger associated with not wearing a seatbelt [$F(1, 1327) = 18.57$, $p < .001$]. Rural respondents reported less perceived danger associated with not wearing a seatbelt ($M = 4.47$) than the urban drivers ($M = 4.79$).

Overall, male respondents reported a significantly higher frequency of seat belt nonuse [$F(1, 1382) = 55.51$, $p < .001$] and lower associated perceptions of danger [$F(1, 1327) = 73.68$, $p < .001$] than did female respondents. Respondent age was a significant covariate and indicated that older respondents reported a lower frequency of seatbelt nonuse ($r = -.19$, $p < .001$).

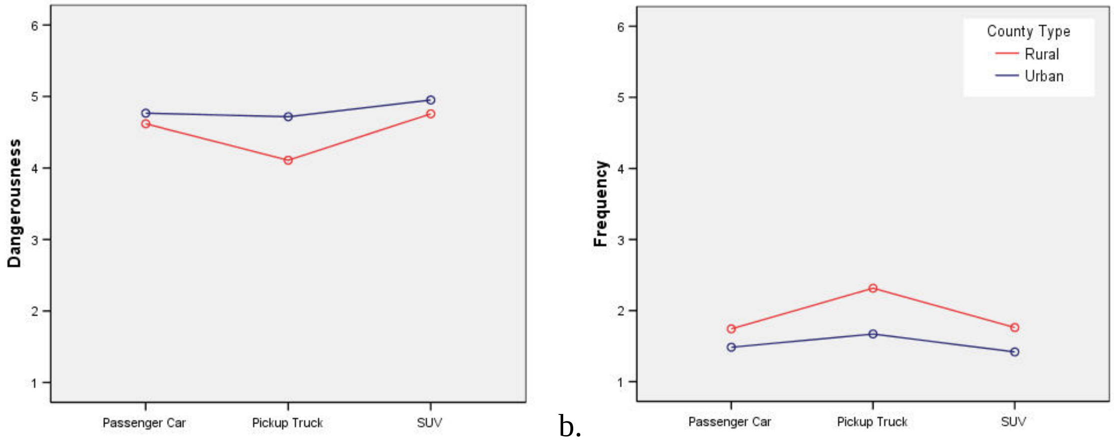
Safety Belt Non-compliance – by Vehicle Type

In recent fatal crash data (NHTSA, May 2006), NHTSA reported that, "…restraint use among fatally injured occupants of SUVs and pickup trucks is much lower compared to passenger cars and vans" (p.3). Thus, we conducted an additional analysis of seat belt nonuse as a function of the type of primary vehicle used by respondents.

Specifically, we examined differences in reported frequency of seatbelt nonuse and associated perceived dangerousness among the four main vehicle types represented: passenger car (60% of all respondents), pickup truck (15%), SUV (12%), and van or minivan (10%) drivers. This involved a 2 (residence type: rural, urban) x 4 (vehicle type: passenger car, pickup truck, SUV, van) x 2 (Gender: male, female) between-subjects fixed factor ANCOVA with age (birth year) as a covariate. Only the main effect of vehicle type and any interaction with the other factors is reported here since the previous analysis included the main effects of residence type and gender (and covariate effect of age). Planned comparisons compared (1) pickup truck drivers to drivers of other vehicle types, and (2) rural pickup drivers to urban pick up drivers.

There was a significant main effect of vehicle in terms of the *frequency of not wearing a seatbelt* [$F(3, 1297) = 4.84$, $p = .002$]. Based on the 95th percentile confidence intervals for mean frequency of seatbelt nonuse in each vehicle type, pickup truck respondents reported a significantly higher frequency of seat belt nonuse ($M = 1.99$) than passenger car respondents ($M = 1.61$), SUV respondents ($M = 1.58$), or van/minivan respondents ($M = 1.71$). Moreover, as shown in Figure 3, rural pickup drivers reported a significantly higher frequency of seatbelt nonuse ($M = 2.32$) than did urban pickup drivers ($M = 1.66$).

There was a significant main effect of vehicle in terms of the *perceived dangerousness of not wearing a seat belt* [$F(3, 1249) = 2.71$, $p = .044$]. Based on the 95th percentile confidence intervals for mean perception of dangerousness in each vehicle type, pickup truck respondents also reported a significantly lower perceived danger for seat belt nonuse ($M = 4.43$) than passenger car respondents ($M = 4.68$) and SUV respondents ($M = 4.84$). Moreover, as shown in Figure 3, rural pickup drivers reported a significantly lower perceived danger for seatbelt nonuse ($M = 4.12$) than did urban pickup drivers ($M = 4.74$).



a. b.

Figure 3. a.) Dangerous and b.) Frequency scores for driving without using a safety belt by vehicle type and residence (county) type.

Utility of Safety Interventions

Enforcement Programs

There was a significant main effect of residence type in terms of perceived utility of enforcement programs [$F(1, 1367) = 15.12$, $p < .001$]. Rural respondents reported <u>lower</u> perceived utility of enforcement programs ($M = 9.92$) than the urban drivers ($M = 10.53$).

Overall, male respondents reported a significantly lower perceived utility for enforcement programs [$F(1, 1367) = 59.03$, $p < .001$] than did female respondents. Respondent age was a significant covariate and indicated that younger respondents reported a lower perceived utility for enforcement programs ($r = .48$, $p < .001$).

Engineering Interventions

There was a significant main effect of residence type in terms of perceived utility of engineering interventions [$F(1, 1359) = 13.89$, $p < .001$]. Rural respondents reported <u>lower</u> perceived utility of engineering interventions ($M = 10.05$) than the urban drivers ($M = 10.66$).

Overall, male respondents reported a significantly lower perceived utility for engineering interventions [$F(1, 1359) = 33.54$, $p < .001$] than did female respondents. Respondent age was a significant covariate and indicated that younger respondents reported a lower perceived utility for engineering interventions ($r = .16$, $p < .001$).

Education Programs

There was a significant main effect of residence type in terms of perceived utility of education programs [$F(1, 1359) = 10.07$, $p = .002$]. Rural respondents reported <u>lower</u> perceived utility of education programs ($M = 10.49$) than the urban drivers ($M = 11.05$).

Overall, male respondents reported a significantly lower perceived utility for education programs [$F(1, 1359) = 15.75$, $p < .001$] than did female respondents.

Respondent age was a significant covariate and indicated that younger respondents reported a lower perceived utility for education programs ($r = .26$, $p < .001$).

Discussion

Consistent with previous research, this study confirmed that male and younger drivers are higher in sensation seeking tendencies and lower in social motivation (Jonah, 1997). They also tend to engage in riskier driving behaviors (Brovold et al., 2007). In addition, the results of this survey confirmed that the rural "culture" is generally more conservative (lower sensation seeking, higher social motivation) than the comparable urban culture (Ward, 2007). These consistencies, with previous published research, provide support for the methods used in this study.

This study provided new insights into the role of rural culture and behavior in relation to the higher rate of fatal crashes in rural areas (Figure 1). Despite the higher rural fatality rate, the rural respondents did not report significantly higher driver errors, driving violations, and risk-taking behavior. Indeed, the reported incidence of these factors was generally higher amongst urban respondents. Thus, it is difficult to relate characteristics of rural drivers and rural driving behavior to the higher rate of rural traffic fatalities.

However, rural drivers did report significantly more risk-taking in terms of specific behaviors related to the types of violations that are not apparent to other road users and are most strongly related to fatal crashes (Blatt & Furman, 1998; NHTSA, 2001; NHTSA, August 1996). Specifically, where rural driving behavior may not generally be more dangerous, rural drivers more frequently reported engaging in behaviors that involve the highest risk for motor vehicle fatalities – seatbelt non-compliance and alcohol consumption – than did urban drivers. It would appear that the higher incidence of risk-taking for these critical risk factors alone by rural drivers may be sufficient to increase the fatal crash rate in rural areas. That is, the incidence of drinking while intoxicated in rural areas may increase the probability of a crash and the higher incidence of seatbelt nonuse may increase the potential for serious injury or death in a crash.

Rural drivers perceived not wearing a seatbelt while driving to be less dangerous than did urban respondents. Drivers in all rural counties also reported driving while not wearing a seatbelt more frequently than did urban drivers (11% versus 4% of respondents, respectively). Indeed, the perception of danger associated with seatbelt nonuse was strongly and negatively correlated to the frequency of seatbelt noncompliance ($r = -.15$, $p < .001$). This suggests that traffic safety policy to improve seatbelt compliance in rural areas should focus on increasing the perception of danger associated with not using a seatbelt while driving.

Figure 4 presents an example of a method that has been adopted by insurance companies in Europe to affect perceptions of seatbelt use. These education (and publicity) programs invite drivers and passengers to wear seatbelts while sitting in a vehicle mounted on a rotating axis. The vehicle is then rotated with the belted drivers and passengers inside so they can experience the benefit of the seatbelts during a simulated crash. This experience is recorded for the participants to review. It is expected that this process will adjust their perceptions of the *value of wearing seatbelts*. Admittedly, this program does not directly affect perceptions of the *danger of* <u>*not*</u> *wearing seatbelts*, but the overall change in attitude toward seatbelts may be the same (Note that this same program directed at changing perceptions of the danger associated with seatbelt nonuse would require participants to be rotated in the vehicle without seatbelts. Obviously, this would prove to be too hazardous such that it could not ethically be administered).

Other education programs could focus on the dangers of seatbelt noncompliance by emphasizing fatal crashes that could have been survived if the seatbelt was used. <u>The higher seatbelt noncompliance reported by rural drivers in this study also suggests that seatbelt enforcement campaigns could be efficiently targeted in rural areas.</u>

Figure 4. Example of education campaign to reinforce perceived value of seat belts.

The analysis of vehicle type in relation to seatbelt noncompliance corroborates NHTSA findings that pickup truck drivers may wear seatbelts less often than drivers of other vehicles. What is interesting from these results is that pickup truck drivers may have an additional negative attitude toward seatbelts that is preventing them from wearing them. Indeed, there could be a "subculture" amongst pickup truck drivers that it is "normal" to not wear seatbelts while driving pickup trucks. This suggests that traffic safety policies should consider education and publicity campaigns that aim to alter the noncompliance norms that may be motivating pickup drivers to abandon the use of seatbelts.

For example, Figure 5 shows an example of a publicity campaign used in Montana state to retune the perceptions of drivers that most people do in fact wear their seatbelts. Whereas this campaign is directed at all drivers, this methodology could be tailored to focus on the specific subculture of pickup drivers in rural areas. <u>The higher seatbelt noncompliance reported by rural pickup drivers in this study also suggests that</u>

seatbelt enforcement campaigns could be efficiently targeted to rural owners of pickup trucks.

Figure 5. Example of publicity campaign to adjust perceived norms regarding seatbelt compliance (courtesy of Robert Foss).

The rural respondents also reported lower perceptions of danger associated with driving while intoxicated. In addition to education and publicity campaigns to increase the saliency of the dangers of driving while intoxicated, alcohol enforcement could be efficiently targeted in rural areas. Such enforcement and the cost of being apprehended would introduce additional salient costs for driving while intoxicated. However, these enforcement programs would need to have saturated advertisement so that the probability and cost of apprehension was apparent to resident drivers in the enforcement area. Currently, Minnesota's Operation NightCAP (Concentrated Alcohol Patrol) program runs saturation patrols in several rural counties. Although advertising related impaired driving is widespread, advertising about patrol activities in specific areas is limited. Recent findings indicated that awareness of NightCAP patrols in rural counties where these patrols operate was low, ranging from 13.5% to 27% (Creaser, Aflleje, & Nardi, in review).

Interestingly, the current survey did not find that risk-taking with regard to speed was higher for rural drivers. Notably, urban drivers reported speeding over the limit more frequently (19% of respondents) than did rural drivers (15%). This may be a result of the types of roads driven; urban roads tend to have lower speed limits than rural roads such that urban drivers have a lower threshold for speeding. Also, urban drivers tend to speed more often on freeways while rural drivers speed more frequently on (non-freeway) divided highways (MN DPS, 2006). This finding also alludes to why the fatality rate is higher in rural areas, since crashes in less protected areas (i.e., non-freeways) tend to be more serious in nature (NHTSA, 2001).

It is also possible that drivers in rural areas do not know what the speed limit is on many roads even though it is taught that non-marked rural roads are 55 miles per hour in the state of Minnesota. Drivers may not remember this over time, leading them to not realize they are driving at an unreasonable speed. This may also be an adaptive response to infrequently seeing other vehicles on the road and being able to proceed at whatever speed they like without receiving any form of negative reinforcement (e.g. speeding tickets). In extreme cases, their speed may result in the inability to react to unexpected changes in the road or environment leading to more intense impact forces and a fatal crash – the result being a fatal crash that they cannot learn from. Nevertheless, both urban and rural drivers seemed to believe that driving 10 mph faster than the speed limit is not dangerous.

The utility ratings of safety intervention types (enforcement, education, and engineering) showed that residents of rural areas felt all categories of interventions were less useful than respondents in urban areas. The lower rural rating of intervention utility may have resulted from the perception that these interventions are administered by the government, noting that the general rural culture can be characterized as distrustful of government involvement (Roth, Roth, & Elgert, 2003). Moreover, rural culture is also generally deterministic (Roth, Roth, & Elgert, 2003) in terms of its view about events impacting life such that interventions targeting traffic crashes may be seen as superfluous. <u>These results emphasize the need for traffic safety policy to be guided by local cultural factors and to incorporate the psychosocial factors that govern driver behavior in rural communities (Ward, 2007).</u>

Part II: Simulator Experiment

Crash factors can be related to driver state, driving behavior, and the road environment (Evans, 2004). Distraction is a *driver state* that is significantly related to crash risk (Klauer et al., 2006). Distraction resulting from engagement with secondary devices in the vehicle can lead to variability in driving performance such as speed (headway) and lane position (Ward et al., 2003). Excessive speed and speeding are forms of *driving behavior* that are also related to crash risk (Evans, 2004). Higher speeds increase the kinetic energy released in a crash (thereby increasing crash severity) and reduce the time and distance available to initiate and successfully complete a crash avoidance response. Thus, speed is related to both the probability and severity of a crash. Finally, certain elements of the *road environment* can be identified as a significant risk factor.

For example, thru-stop intersections at which a minor road with stop sign control intersects with a non-controlled highway with free flowing traffic are common in rural environments. Notably, crashes at thru-stop intersections are one of the most common types of intersection (fatal) crashes in rural environments (Laberge et al., 2006). Thus, it is the focus of the second portion of this study to examine behavior of different populations of drivers in these situations.

This part of the project observed the performance of rural and urban drivers within a driving simulator that consisted of traffic scenarios encompassing elements of these crash risk factors. Identical traffic scenarios were created in both rural and urban landscapes to examine the effect of road environment on driver performance. Rural and urban drivers were recruited from the counties selected for the survey in two age categories (young, elderly) to examine the effect of driver characteristics related to area of residency and age on driving performance.

Methods

Participant Sample

Participants were recruited from young (18 – 26 years) and old (65 years and older) age group respondents from the survey, as these ages represent the two most at-risk age groups of the entire driving population. Two recruitment attempts were made by mail from which a total of 56 responses were received out of 1082 possible respondents. Responses were lower in rural areas possibly due to the distance required to travel to the University of Minnesota. Only one female from a rural county responded which forced us to focus only on the 35 male respondents. From these we were able to run a total of 24 male drivers due to schedule conflicts and participant refusals. Due to participant withdrawal during the study (e.g., due to simulator induced discomfort), complete data were obtained for a final sample of 18 male drivers, as outlined in Table 6. The mean age of the young group of participants was 23.1 years (range = 20 – 26, standard deviation = 1.97). The mean age of the old group was 69.7 (range = 66 – 78, standard deviation = 4.06).

Table 6. Number of valid participant data sets / number of participants run by driver area and age group.

	Age Group		
Driver Area	Young	Old	Total
Rural	4 / 5	3 / 7	7 / 12
Urban	5 / 6	6 / 6	11 / 12
Total	9 / 11	9 / 13	18 / 24

Materials and Driving Simulator

The study used the Virtual Environment for Surface Transportation Research (VESTR) managed by the HumanFIRST Program, University of Minnesota. VESTR is an immersive motion-base driving simulator operating with SCANeR II simulation software (http://www.oktal.fr). VESTR is linked to a full-sized Saturn vehicle and a vehicle dynamics model operating at 100 Hz with the data sampling rate set to 20 Hz. The visual images are projected using Epson 7600 projectors (1024 x 768, 2200 lumens, 400:1 contrast, 24 bit color) at a frame rate greater than 30 Hz. The forward scene is comprised of a five-channel 210-degree field of view on white-painted flat panels with 2.5 arc-minutes per pixel resolution. The side and rear scenes are comprised of a single channel 50-degree field of view on a projection screen and color LCD panels mounted in the side mirror housings. VESTR provides auditory and haptic feedback using a 3D audio system, subwoofer, car body vibration, force feedback steering, and a three-axis electric motion system (roll, pitch, z-axis).

Simulator Scenarios

The driving environment in which the traffic scenarios were embedded was based on an exact replication of the road network around TH 52 and CR 9 in Southeastern Minnesota. Participants experienced the same road network twice (counterbalanced). As shown in Figure 6, each time they drove this route, they experienced a different geographical landscape with the same road network to represent rural and urban environments: plowed fields in the rural scenario, and buildings, sidewalks and pedestrians during the urban scenario. Signage for the roads included speed limit signs that would reflect that particular road environment (i.e. Rural- 55 mph for County Roads & 65 mph for the Trunk Highway; Urban- 35 mph for CRs & 55 mph for TH).

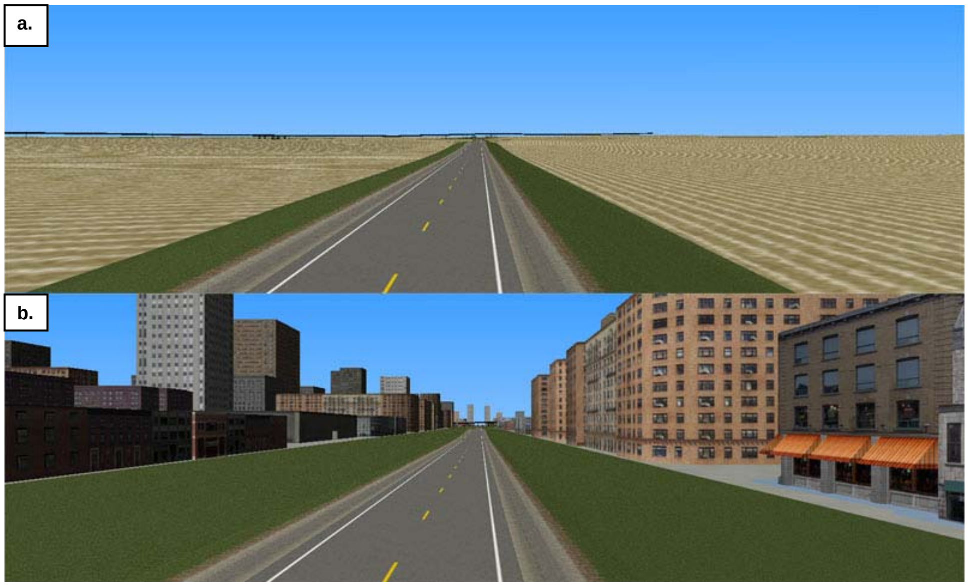


Figure 6. Appearance of the road geography, a. Rural scene, consisting of roads and fields around TH 52 and CH 9; b. Urban scene of the same area.

Traffic scenarios were created to represent the crash risk factors discussed in the introduction: distraction (driver state), speeding (driving behavior), and thru-stop intersections (environment).

Driver Distraction Scenario

The driver distraction scenario occurred during a period of highway car following. During this period the lead vehicle varied its speed in a random sinusoidal pattern, simulating real highway conditions. Unbeknownst to the participant, there was a 30 second practice period before a 4 minute experimental car following segment. During the scenario, participants were explicitly instructed that the primary goal was to constantly maintain a safe headway. The lead vehicle's taillights did not illuminate when it slowed because the decelerations were consistent with releasing the accelerator to decelerate mildly under real world highway driving conditions.

During the car following section, drivers were asked to complete a distraction task presented on a display mounted on the dash above the stereo. This task approximated the generic demands of common in-vehicle devices that may be presented to drivers and draw their attention away from the road (e.g. navigation system). This was a "self-paced" task as are most distractions inside a vehicle; the participant touched the screen to indicate their readiness to complete the task. As shown in Figure 7, the task then displayed a number of arrows with random orientations (up, down, left, right) and the participant was to count the number of arrows (out of 6) that matched the orientation of the center target arrow and select the correct number on the screen.

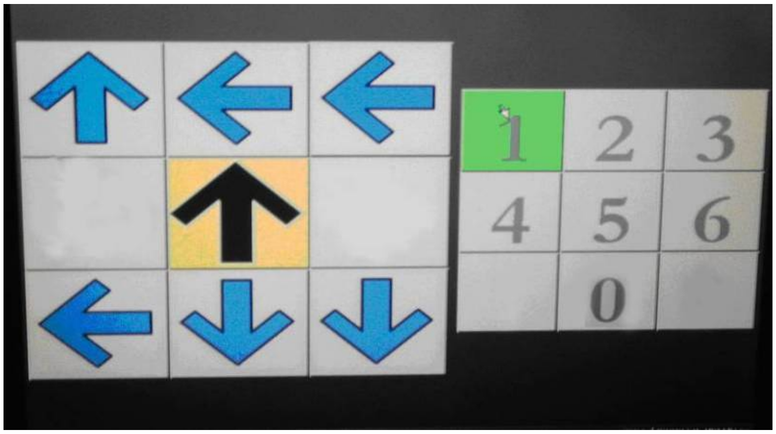


Figure 7. Arrow task display used during driver distraction scenario. The figure shows a correct response to the task.

Driving Speed Scenario

This scenario consisted of a straight segment of 2-lane (not divided) road where the driver was not instructed to do anything aside from drive. The speed limits were set based on the environment area, either 35 mph for the urban scenario or 55 mph for the rural scenario. Participants were to drive at a speed and in a manner that they felt safe and as they normally would.

Intersection Scenario (Thru-Stop)

This scenario consisted of approaching a thru-stop intersection and making a straight crossing maneuver. Participants approached from a minor road with stop sign control where the minor road intersects with a non-controlled highway with what appeared to be free flowing traffic. The main road traffic was controlled such that these cars all drove at a set speed and presented specific gap-lengths to the participant between 3 and 12 seconds. Once the participant crossed both directions of traffic, they continued driving on the minor road.

Performance Measures

Relevant performance measures were collected for each scenario.

Mental Workload

The Rating Scale of Mental Effort (RSME) was administered after each drive as a measure of overall mental effort. Participants mark the amount of effort they exerted on the drive they just completed on a single scale from 0 to 150, labeled periodically with descriptions from “Absolutely no effort” to “Extreme effort.”

Driver Distraction Scenario

- Distraction rate – count of distraction tasks completed
- Distraction accuracy – percentage of correct distraction tasks
- Distraction time – mean reaction time for completing distraction tasks

- Lateral vehicle control – standard deviation of lane position during car following

- Lateral safety margin – minimum (90^{th} percentile inverse of) time to line crossing (TLC) during car following

- Longitudinal vehicle control – standard deviation of time headway (TH) during car following

- Longitudinal safety margin – minimum (10^{th} percentile) TH during car following

Driver Speed Scenario

- Speeding – mean speed less the speed limit on a straightaway (speed limit was 35 for urban and 55 for rural areas)

- Speeding distance – distance traveled above the speed limit on a straightaway

- Lateral vehicle control – standard deviation of lane position on a straightaway

- Lateral safety margin – minimum (90^{th} percentile inverse of) time to line crossing (TLC) on a straightaway

Intersection Scenario

- Compliance – making a complete stop at a stop sign while approaching an intersection from the minor road

- Stopping distance – time to stop line at the time that the accelerator is released (accounts for people that "engine brake") while approaching an intersection from the minor road

- Gap acceptance – size of gap that was taken when crossing an intersection from the minor road

- Crossing safety margin – time-to-contact (s) when in the center of the lanes while crossing the intersection

- Crossing time – time to cross the intersection

Procedures

Upon arrival, participants were given a brief description of the test procedure and then read and signed a consent form. Drivers then entered the simulator and drove a 12 minute practice drive in order to get acclimated to the vehicle and experimental tasks.

Both experimental scenarios lasted approximately 18 minutes. After each drive, participants exited the simulator vehicle and answered questions on the computer. After all drives were completed, participants were then paid and excused. Experimental sessions lasted approximately 90 minutes.

Results

Data were analyzed using a 2 (Environment: urban, rural) x 2 (Resident: urban, rural) x 2 (Age: young, old) mixed factor analysis of variance (ANOVA). For significant interactions in this design, planned comparisons based on group 95th percentile confidence intervals were used to examine the simple effects of driver age or driver residency within each road environment condition. Box-plots were used to identify outliers.

Mental Workload (RSME)

As a measure of overall mental effort, there were no differences between the mental effort reported for scenario road type or between age groups. Rural drivers reported marginally less mental effort (M= 49) while driving in all scenarios than urban drivers (M= 53), $F(1,14) = 4.43$, $p = 0.054$.

Driver Distraction Scenario

Distraction Rate. There was a significant main effect of Age for the distraction task completion rate [$F(1,14) = 15.97$, $p < .001$] with the younger drivers completing a higher number of distraction tasks per drive (M = 31.7) compared to the elderly drivers (M = 12.04).

Distraction Accuracy. There was a significant interaction between Environment and Age for the percentage of accurate distraction tasks completed [$F(1,13) = 8.28$, $p < .013$]. As shown in Figure 8, whereas both groups had similar accuracy in the distraction task within the rural road environment, the accuracy of the elderly drivers was significantly lower than the younger group in the urban environment ($p < .05$).

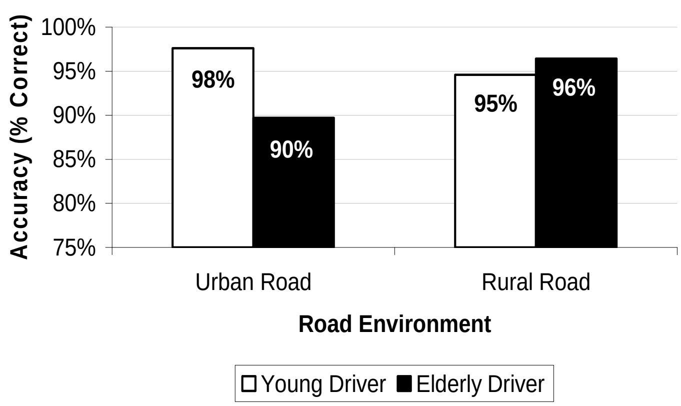


Figure 8. Interaction between driver age and driving environment for percentage accurate response for distraction task.

Distraction Time. There were no significant effects for response time to the distraction task.

Lateral Vehicle Control. There was a significant interaction between Environment and Age for the standard deviation of lane position in the car following scenario with the concurrent distraction task [$F(1,13) = 5.67$, $p < .033$]. As shown in Figure 9, the distraction task significantly increased the instability of lane position for the elderly drivers compared to the younger group only in the urban environment ($p < .05$).

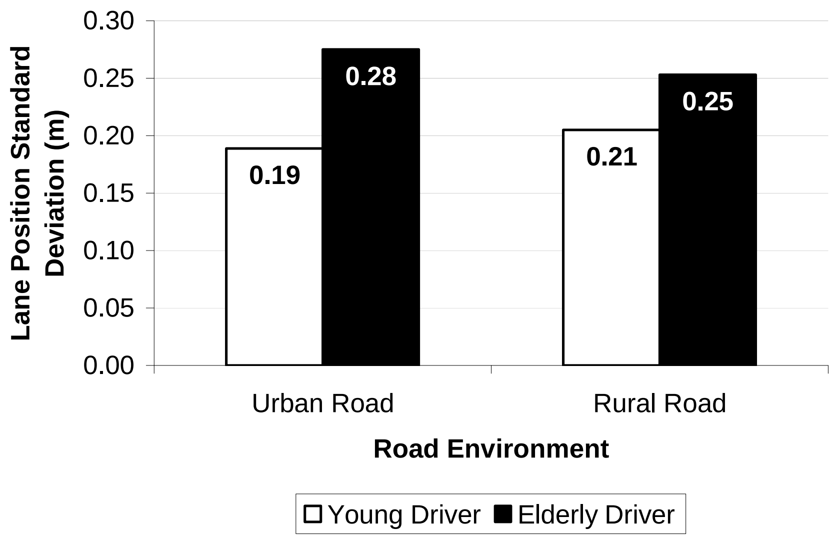


Figure 9. Interaction between driver age and driving environment for standard deviation of lane position during car following scenario with concurrent distraction task.

Lateral Safety Margin. There were no significant effects for the 90^{th} percentile inverse of TLC.

Longitudinal Vehicle Control. There was a significant main effect of Age for variability of time headway in the car following scenario [$F(1,13) = 10.86$, $p < .006$] with significantly greater variation evident by the elderly drivers (M = 1.47 m) compared to the younger drivers (M = 0.93 m).

Longitudinal Safety Margin. There was a significant main effect of Age for minimum time headway (10^{th} percentile) in the car following scenario [$F(1,14) = 8.19$, $p < .013$] with significantly shorter minimum THW adopted by younger drivers (M = 1.57 s) compared to the elderly drivers (M = 2.40 s).

There was also a significant interaction between Environment and Driver type [$F(1,14) = 4.78$, $p < .008$]. As shown in Figure 10, whereas urban and rural drivers maintained a similar minimum headway in the urban environment, the rural drivers *increased* their headway significantly in the rural environment compared to the urban drivers.

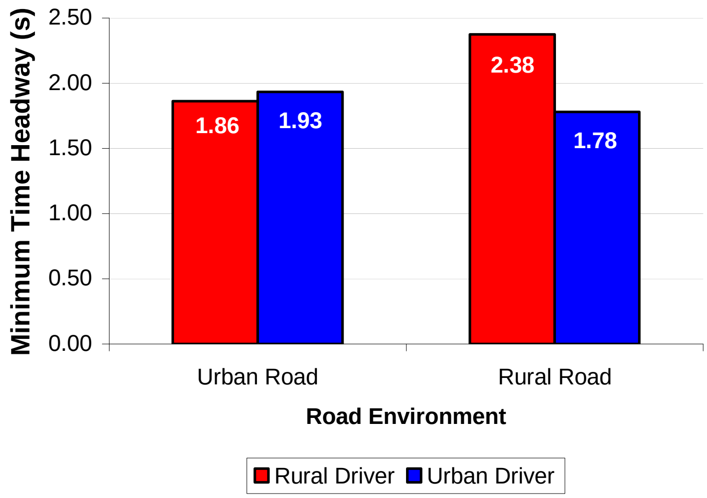


Figure 10. Interaction between driver type and driving environment for minimum time headway in car following (distraction) scenario.

Driving Speed Scenario

Speeding. There was a significant main effect of Environment for mean level of speed *above the posted speed limit* [$F(1,14) = 138.17$, $p < .000$] with significantly higher speeds above the posted limits in the urban environment ($M = 9.57$ mph) than in the rural environment ($M = -2.34$ mph, i.e. *below* the posted limit).

There was also a significant main effect of Age for mean level of speed [$F(1,14) = 28.07$, $p < .000$] with significantly faster speeds above the posted speed limit by the younger drivers ($M = 12.01$ mph) compared to the elderly drivers ($M = -4.78$ mph).

However, these main effects must be interpreted in the broader context of a significant interaction between Environment and Age [$F(1,14) = 4.43$, $p < .05$]. As shown in Figure 11, the younger drivers had a significantly higher average speed above the posted speed limit than the elderly group in both environments, especially in the rural environment ($p < .05$).

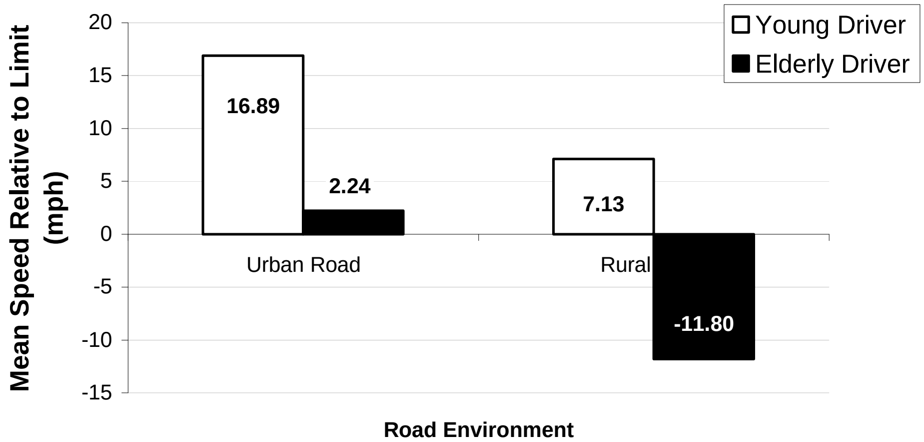


Figure 11. Interaction between driver age and driving environment for mean level of speeding in section 1.

Speeding Distance. There was a significant main effect of Environment for distance traveled while speeding above the posted limit [$F(1,14) = 25.87$, $p < .000$] with significantly more distance spent speeding while in the urban environment ($M = 2.20$ km) than while in the rural environment ($M = 1.20$ km).

There was also a significant main effect of Age for mean distance while speeding [$F(1,14) = 34.55$, $p < .000$] with significantly more speeding by the younger drivers ($M = 2.48$ km) compared to the elderly drivers ($M = 0.92$ km).

However, these main effects must be interpreted in the broader context of a significant interaction between Environment and Age [$F(1,14) = 10.23$, $p < .006$]. As shown in Figure 11, the younger drivers drove a significantly longer distance above the posted speed limit than the elderly group in both environments, especially in the rural environment ($p < .05$).

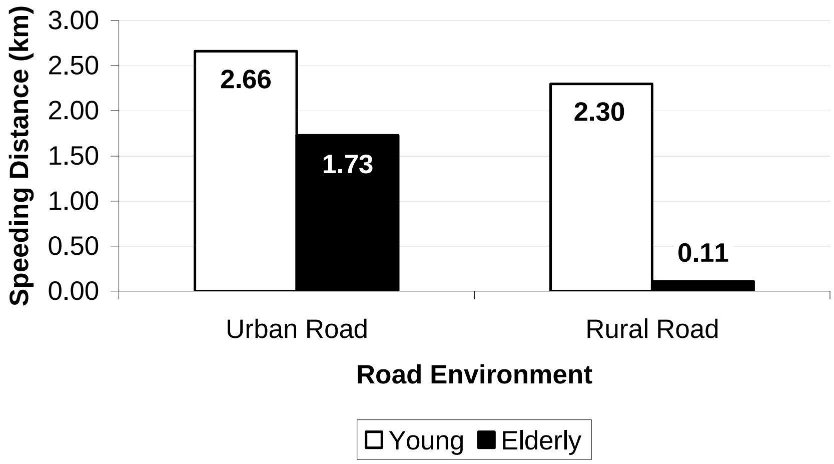


Figure 12. Interaction between driver age and driving environment for speeding distance in section 1.

Lateral Vehicle Control. There was a significant main effect of Environment (Section 1) for variation in lane position [$F(1,14) = 9.54$, $p < .013$]. Lane position was significantly less stable in the rural environment ($M = 0.22$ m) compared to the urban environment ($M = 0.18$ m).

Lateral Safety Margin. There was a significant main effect of Environment for variation in inverse time to line crossing [$F(1,14) = 20.40$, $p < .000$]. Lane boundary proximity (1/TLC) was significantly closer in the rural environment ($M = .101$ s) compared to the urban environment ($M = 0.088$ s); because small TLCs represent close proximity, while large values of 1/TLC mean close proximity.

There was also a significant main effect of Age for time to line crossing [$F(1,14) = 19.48$, $p < .001$] with significantly closer proximity to lane boundaries by younger drivers ($M = .110$ s) compared to the elderly drivers ($M = 0.080$ s).

Intersection Scenario

Compliance. There were no significant effects for compliance with the stop sign.

Stopping Distance. There was a significant interaction between Environment and Driver Age for time to the stop line at the point the accelerator was released [$F(1,13) = 4.76$, $p < .048$]. As shown in Figure 13, the elderly drivers released the accelerator later as they approached the intersection compared to the younger group in the urban environment ($p < .05$).

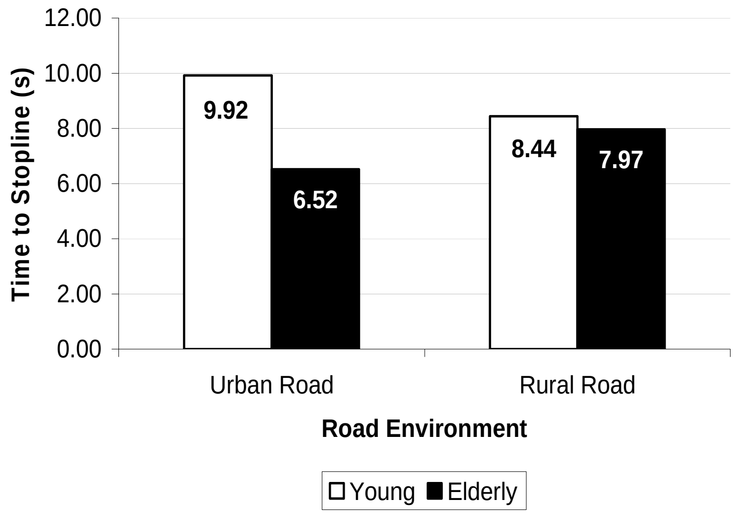


Figure 13. Interaction between driver age and driving environment for time from stop line when accelerator released (stop 3).

Gap Acceptance. Three subjects had missing data by virtue of waiting for the traffic to clear the intersection before crossing. There was a significant main effect of Age for accepted gap size [$F(1,11) = 23.39$, $p < .001$] with the younger drivers accepting a significantly smaller gap ($M = 5.86$ s) compared to the elderly drivers ($M = 7.45$ s).

Crossing Safety Margin. Three subjects had missing data by virtue of waiting for the traffic to clear the intersection before crossing. There was a significant main effect of Age for safety margin [$F(1,11) = 6.74$, $p < .025$] with the younger drivers crossing with a significantly smaller margin ($M = 3.40$ s) compared to the elderly drivers ($M = 4.83$ s).

Crossing Time. There was a significant main effect of Age for movement time to cross the entire intersection [$F(1,14) = 10.81$, $p < .005$] with the younger drivers crossing significantly quicker ($M = 19.12$ s) compared to the elderly drivers ($M = 28.13$ s).

Discussion

Most discussions about the higher fatal crash rate in rural areas attribute this rate to the geographical isolation and road designs that are typical within rural areas. In contrast, the purpose of this driving simulator study was to examine the potential effect of rural driver characteristics on driving performance. The specific driver characteristics included driver age as a demographic variable as well as driver residency as a proxy for the psychosocial variable of driver personality.

This selection of driver characteristics took account of the fact that rural environments have qualitatively different social and cultural influences that influence driver personality (Ward, 2007). Specifically, the effect on driving behavior was measured in the context of high-risk driving scenarios related to driver distraction (state), speeding (behavior), and intersection compliance (environment). These scenarios were represented in both urban and rural landscapes with identical types of road network. The results of this portion of the study are summarized in Table 7.

Table 7. Summary of Significant Road Environment and Driver Characteristics Effects (continued on next page).

		Variable Types		
Scenario	**Measures**	**Environment**	**Age**	**Residency**
Distraction	Distraction Rate		Younger drivers attempted more distraction tasks than the elderly drivers.	
	Distraction Accuracy	Interaction with AGE.	Elderly drivers completed fewer distraction tasks correctly than younger drivers in the urban environment.	
	Distraction Time			
	Lateral Vehicle Control	Interaction with AGE.	The distraction task destabilized lane position of the elderly drivers more than the young drivers in the urban environment.	
	Longitudinal Vehicle Control		Headway instability of elderly drivers was greater than young drivers while distracted.	
	Longitudinal Safety Margin	Interaction with RESIDENCY		Rural residents increased minimum headway in the rural environment compared to urban residents (whereas the headway of urban residents remained unchanged).

Table 7. Summary of Significant Road Environment and Driver Characteristics Effects (continued from previous page).

		Variable Types		
Scenario	**Measures**	**Environment**	**Scenario**	**Measures**
Speed	Speeding	Average speeds above the posted speed limits were higher in the urban environment.	Younger drivers had a higher average speed above the posted limits compared to the elderly drivers, especially in the rural environment.	
	Speeding Distance	The distance traveled above the posted speed limit was longer in the urban environment.	Younger drivers drove further above the posted speed limit compared to the elderly drivers, especially in the rural environment	
	Lateral Vehicle Control	Lane position was less stable in the rural environment.		
	Lateral Safety Margin	Proximity to the lane boundary was shorter in the rural environment.	The younger drivers had a shorter proximity to the lane boundary than did the elderly drivers.	
Intersection	Compliance			
	Stopping Distance	Interaction with AGE.	In the urban environment, the elderly drivers stopped closer than the younger drivers.	
	Gap Accept		The younger drivers accepted shorter gaps than the elderly drivers.	
	Crossing Safety Margin		The younger drivers accepted gaps with shorter oncoming traffic headway than did the elderly drivers.	
	Crossing Time		The older drivers took longer to cross than the younger drivers.	

As expected, the effect of road environment did have a significant effect on driving behavior. For example, lower speed limits posted in the urban environments resulted in more speeding than in the rural environment. This is consistent with the reported speeding in the survey (Part I) of this project. However, the higher posted limits in the rural environments naturally led to *faster speeds overall*. These faster speeds and the possible perception of fewer roadside hazards may have prompted the drivers in the rural environment to accept greater variation in lane position and closer proximity to lane boundaries than in the urban environment. This effect of the rural landscape on lateral control and safety margins is compelling given that road departure crashes are common in rural environments (Burgess, 2005). Moreover, since both the rural and urban road environments had the same road network, these observed differences in behavior can be attributed only to the differences in the landscape used (and not the type of road). That is, drivers appeared to change their behavior not just in response to the type of road, but also to the surrounding scenery. This suggests that the scenery that surrounds rural and urban road environments may itself be used by drivers to define their environment and trigger the corresponding style of driving.

One hypothesis is that in the absence of roadside objects in rural environments (pedestrians, sidewalks, building etc), rural drivers may behave more recklessly by assuming a lower perceived risk from a crash. Such a perception may be dangerous, especially at higher speeds that are typical of rural roads. One policy suggestion based on this hypothesis is to design rural roads to have a more apparent risk. For example, a recent European trend for road design uses features to give roads the appearance of demanding more driver attention and forgiving fewer driver errors (Shared-Space, 2007; Theeuwes & Godthelp, 1995). In effect, these designs tend to increase *perceived* (rather than *actual*) ambiguity and risk. In so doing, the driver must reduce speed and pay careful attention to resolve the ambiguity (Shared-Space, 2007). The driver also perceives that the consequence of risky driving is high, and so, adopts a more precautious attitude. As shown in Figure 14, this type of design philosophy is often used in urban environments. However, future research could examine the potential application of this type of design philosophy to rural roads.

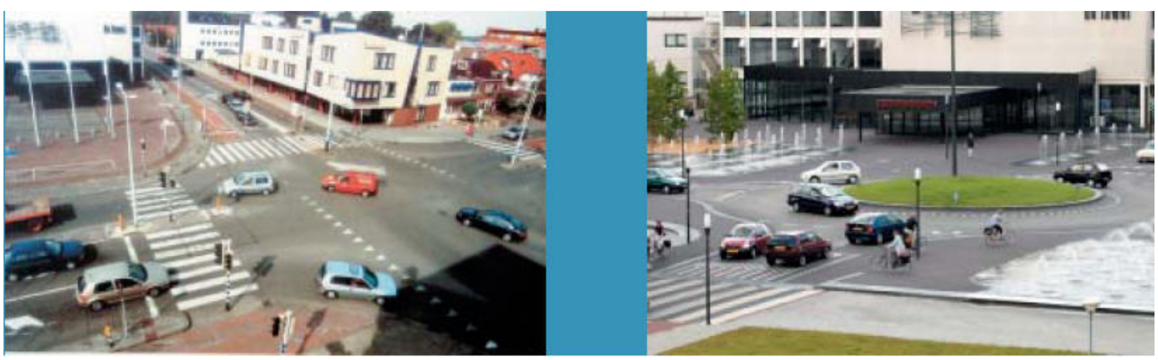


Figure 14. Example of design philosophy to demand more attention from driver (Shared-Space, 2007). Scene on left has traditional urban demarcations and signal controls. Scene on right is same intersection, but without demarcations and control signals.

The driver characteristic that had the broadest effect on driving behavior was age. For example, the young drivers engaged in more speeding and the elderly drivers had more varied headway. This again is consistent with the results from the self-reported speeding behavior in the survey (Part II). Interestingly, the effect of driver age was sometimes dependent on the type of road environment. For example, the elderly drivers attempted and correctly completed fewer distraction tasks than did the younger drivers, but only in the urban environment. This may be explained by a higher visual demand imposed by the urban landscape that increased the visual workload for the elderly drivers. Under such conditions, the elderly drivers may have felt they had fewer resources available to process the distraction tasks.

It is also notable that the distraction tasks that were attempted by the elderly drivers in the urban environment did interfere more with lateral control than for the younger drivers. This may suggest that the strategy of the elderly drivers to minimize distraction was not sufficient. It also suggests the need for traffic safety policy directed at driver distraction to recognize the potential increased risk amongst elderly drivers in complex urban driving environments.

Residency area as a proxy for driver personality appeared to have a modest effect influencing driving behavior. Overall, rural drivers reported less subjective effort applied to the driving scenarios. This may reflect a reduced commitment to either the driving tasks or to reporting subjective experiences. Regardless, there were also some differences in actual driving between rural and urban driving in the simulated driving environments. For example, rural drivers increased their minimum headway compared to the urban drivers in the distraction scenario, but only in the rural environment. Admittedly, this effect does not appear to have an obvious relationship to the higher fatal crash risk noted in rural environments (and by rural drivers). However, this effect does suggest that rural drivers may calibrate their safety margin when driving in a “familiar” road environment.

Conclusions

The survey methodology demonstrated that rural drivers have riskier attitudes than urban drivers toward two of the most dangerous risk factors in traffic safety: seat belt non-compliance and alcohol consumption. These findings suggest the need for education and enforcement directed at rural populations to increase seat belt compliance and reduce DUI events, especially amongst owners of pickup trucks. These interventions should focus not only on reducing the undesirable behavior, but also on increasing the perceived risk for engaging in these behaviors. Changing driver attitudes toward the risks of such behaviors will allow safer behavior to become self-regulated and to propagate within rural communities. Given that rural communities are least accepting of traffic safety interventions imposed on them by government agencies, care must be taken to develop interventions that incorporate relevant psychosocial factors of the rural culture. Indeed, it may be productive to explore intervention deployment through local mechanisms rather than relying on traditional government agencies that are perceived to be external to those communities. Future research should examine methods of identifying and measuring the relevant psychosocial factors that influence rural driver attitudes with the goal of developing a model to change driver attitudes, thereby reducing risky driving and increasing acceptance of safety interventions.

The driving simulator study also found that younger and male drivers engage in more risk taking behaviors than do older drivers, which has also been demonstrated in previous research (Brovold et al., 2007). However, the unique contribution of this study was that the riskier behavior of the younger drivers was most evident in the rural environment. For example, the higher relative degree of speeding amongst the young drivers compared to the older drivers increased from the urban to the rural environment (Figure 12). Not only do these trends relate to general crash statistics such as a higher fatal crash rate among younger drivers (Evans, 2005), but these behaviors measured in a driving simulator are also consistent with behaviors observed in the real world (Wright, Ward, & Cohn, 2002). For example, the evidence in this study that older drivers accept larger gaps and take longer to clear intersections is consistent with real-world observations (Laberge et al., 2002). This similarity demonstrates not only the validity of the driving simulator as a research tool, but also the power of the research design to detect significant effects.

The implication for policy from this result is that in addition to focusing traffic safety interventions on teen drivers, it is especially important to focus on specific risk behaviors such as speeding with interventions that are designed for rural environments. However, it is often difficult to enforce (or educate) in rural areas given the low density of the population and the distances of remote roadways. <u>A possible solution to this situation is the use of Intelligent Transportation Systems such as monitoring devices used in teen vehicles that not only support the choice of safe speeds, but also monitor compliance with speed limits (Brovold et al., 2007).</u>

The limited effect of "driver personality" in the driving simulator data may indicate that "residency area" is a weak proxy to represent this concept. Indeed, although geographic location is often used to define "ruralness" as a resident characteristic, such definitions can be ambiguous. For example, Miller and Luloff (1981) distinguished between rural and urban cultural classifications based on a composite measure of attitudes and beliefs for three cultural issues: civil liberties, abortion, and racial segregation. People were classified as a "conservative" rural type if they were in the lower quartile for all three factors. Conversely, people were classified as a "liberal" urban type if they were in the upper quartile for all three factors. These cultural classifications were then compared to a rural and urban demographic definitions using size of place of current residence. This analysis indicated that (1) a "pure" cultural type (consistently being in the defining quartile across all three factors) existed only for a small sample (12%); and (2) current residency did not match the cultural classification. For example, 9% of rural residents had an urban cultural type and 83% of urban residents had a rural culture type.

However, despite the ambiguity in defining ruralness "there is something to the idea of 'rural' that distinguishes it in intuitively and sociologically important ways from what is called 'urban'" (Weisheit, et al., 2006, p. 193). This suggests that future research should focus on defining the critical psychosocial factors that constitute rural culture. This will allow us to identify the primary attitude and personality traits that are engendered by that culture and encourage unsafe driving behavior and a reluctance to accept safety interventions.

Summary of Recommendations

The following is a brief summary of policy recommendations that are described in this report, underlined in the report text:

- Education programs to improve seatbelt compliance in rural areas should focus on increasing the perception of danger associated with not using a seatbelt while driving

- The higher seatbelt noncompliance reported by rural drivers in this study suggests that seatbelt enforcement campaigns could target rural areas

- The higher seatbelt noncompliance reported by rural pickup truck drivers in this study suggests that seatbelt enforcement campaigns could specifically target rural pickup truck drivers

- In addition to education and publicity campaigns to increase the saliency of the dangers of driving while intoxicated, alcohol enforcement campaigns could target rural areas. Such enforcement and the cost of being apprehended would introduce additional salient costs for driving while intoxicated. These enforcement programs would need to have saturated advertisement so that the probability and cost of apprehension is apparent to drivers (see Creaser, Aflleje, & Nardi, 2007 for specific suggestions and details on the effectiveness of Minnesota saturation patrols)

- More cautious driving behavior may be afforded in rural and urban areas by including speed calming measures in road design development

- There may be a general need for traffic safety policy directed at driver distraction to recognize the potential increased risk amongst elderly drivers in complex urban driving environments

- Given the low density and isolation of some rural roadways, enforcement (and education) may not always be a practical tool. In these instances, Intelligent Transportation Systems embedded in the infrastructure or fitted to vehicles may be of assistance, e.g. monitoring devices used in teen vehicles that not only support the choice of safe speeds, but also monitor compliance with speed limits (Brovold et al., 2007)

- The observation that rural residents were generally less favorable to all types of traffic safety intervention attests to the need for traffic safety policy to be guided by local cultural factors and to incorporate the psychosocial factors that govern driver behavior in rural communities (Ward, 2007)

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Appendix A

Minnesota County Background Statistics 2000-2004

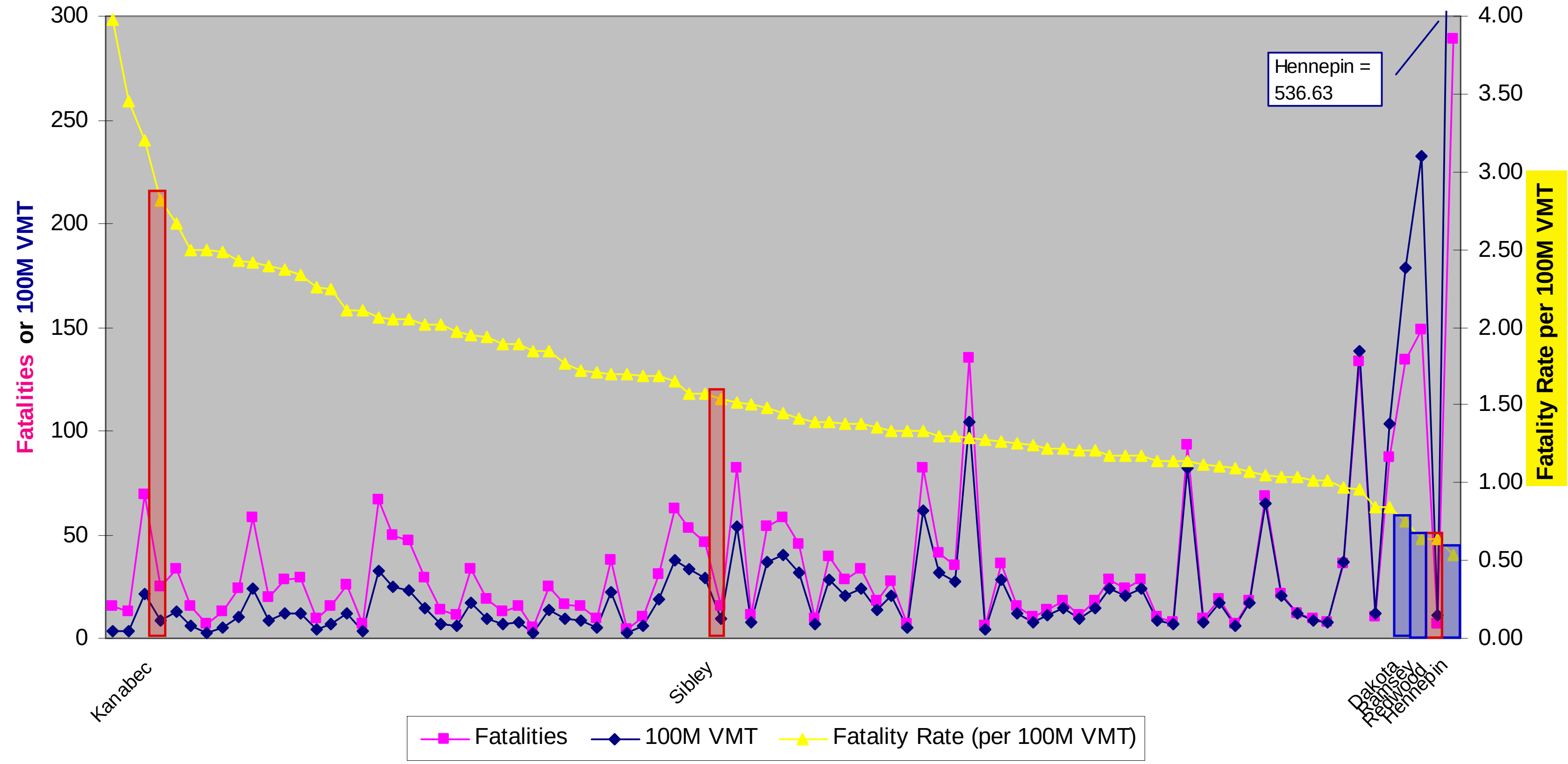


Figure 15. Annual fatalities, VMT, and fatality rate for all Minnesota counties from 2000 through 2004 with selected counties labeled.

Table 8. All Minnesota counties ordered by descending fatality rate per 100 M VMT (2000 – 2004).

Region	County	Population	Vehicle Miles Traveled	Fatalities	100M VMT	Fatality Rate (per 100M VMT)
NW	MAHNOMEN	36,198	376,928,370	15	3.77	3.98
SW	LINCOLN	6,179	376,588,548	13	3.77	3.45
NE	CASS	28,453	2,156,605,416	69	21.57	3.20
NE	KANABEC	16,054	886,370,877	25	8.86	2.82
NW	HUBBARD	18,856	1,239,946,533	33	12.40	2.66
NW	CLEARWATER	8,456	599,681,691	15	6.00	2.50
NW	LAKE OF THE WOODS	4,411	280,696,626	7	2.81	2.49
NW	NORMAN	7,128	522,582,291	13	5.23	2.49
SE	WABASHA	22,232	990,270,540	24	9.90	2.42
NE	MORRISON	32,822	2,401,730,352	58	24.02	2.41
NW	ROSEAU	16,303	836,130,204	20	8.36	2.39
SW	RENVILLE	16,838	1,180,353,447	28	11.80	2.37
NE	AITKIN	16,085	1,238,532,435	29	12.39	2.34
NW	KITTSON	4,856	398,307,924	9	3.98	2.26
NW	PENNINGTON	13,559	666,862,308	15	6.67	2.25
CENTRAL	MEEKER	23,267	1,233,762,138	26	12.34	2.11
CENTRAL	BIG STONE	5,603	332,925,075	7	3.33	2.10
SE	RICE	60,576	3,255,902,181	67	32.56	2.06
NE	ITASCA	44,242	2,436,642,495	50	24.37	2.05
CENTRAL	KANDIYOHI	41,398	2,293,422,138	47	22.93	2.05
CENTRAL	TODD	24,657	1,433,937,393	29	14.34	2.02
SW	YELLOW MEDICINE	10,656	695,984,688	14	6.96	2.01
SW	PIPESTONE	9,589	558,413,415	11	5.58	1.97
METRO	ISANTI	36,512	1,689,299,010	33	16.89	1.95
SE	DODGE	19,355	980,349,930	19	9.80	1.94
CENTRAL	POPE	11,221	686,330,820	13	6.86	1.89
NW	WADENA	13,600	794,282,769	15	7.94	1.89
NW	RED LAKE	4,298	270,068,967	5	2.70	1.85
SW	LE SUEUR	27,454	1,350,432,531	25	13.50	1.85
SE	HOUSTON	19,945	904,165,857	16	9.04	1.77
NE	LAKE	11,229	872,522,217	15	8.73	1.72
SW	MURRAY	8,992	526,862,952	9	5.27	1.71
CENTRAL	BENTON	38,018	2,230,571,511	38	22.31	1.70
CENTRAL	TRAVERSE	3,866	234,926,622	4	2.35	1.70
NW	GRANT	6,182	592,190,991	10	5.92	1.69
NW	BECKER	31,813	1,841,619,654	31	18.42	1.68
NW	OTTER TAIL	58,658	3,745,448,658	62	37.45	1.66
METRO	CARVER	81,618	3,365,447,274	53	33.65	1.57
SE	WINONA	49,827	2,926,214,550	46	29.26	1.57
SW	SIBLEY	15,320	977,724,531	15	9.78	1.53
METRO	SCOTT	112,623	5,398,834,329	82	53.99	1.52
NE	KOOCHICHING	13,832	732,462,570	11	7.32	1.50
NE	CROW WING	59,395	3,656,002,392	54	36.56	1.48
CENTRAL	SHERBURNE	79,030	4,000,170,825	58	40.00	1.45
NW	CLAY	52,994	3,184,062,714	45	31.84	1.41
CENTRAL	SWIFT	11,599	648,634,329	9	6.49	1.39
NE	PINE	28,071	2,813,523,363	39	28.14	1.39
NE	MILLE LACS	25,018	2,023,373,268	28	20.23	1.38
NE	CARLTON	33,748	2,385,861,030	33	23.86	1.38
SW	LYON	25,038	1,327,898,313	18	13.28	1.36
NW	BELTRAMI	42,271	2,023,848,288	27	20.24	1.33
SW	LAC QUI PARLE	7,754	524,882,484	7	5.25	1.33
SE	OLMSTED	134,282	6,154,910,874	82	61.55	1.33
SE	GOODHUE	45,679	3,142,876,653	41	31.43	1.30
SE	FREEBORN	31,997	2,697,633,099	35	26.98	1.30
NE	ST LOUIS	198,262	10,445,375,556	135	104.45	1.29
CENTRAL	STEVENS	9,874	469,911,708	6	4.70	1.28
SW	BLUE EARTH	58,118	2,856,945,672	36	28.57	1.26
SW	BROWN	26,905	1,197,720,909	15	11.98	1.25
NW	WILKIN	6,837	808,674,048	10	8.09	1.24
SE	FILLMORE	21,359	1,144,544,247	14	11.45	1.22
SW	MARTIN	9,996	1,472,209,389	18	14.72	1.22
SW	WASECA	19,450	909,822,249	11	9.10	1.21
SW	NOBLES	20,543	1,492,308,216	18	14.92	1.21
SE	STEELE	35,166	2,376,417,267	28	23.76	1.18
NW	POLK	31,092	2,051,942,067	24	20.52	1.17
NW	DOUGLAS	34,590	2,394,029,547	28	23.94	1.17
SW	WATONWAN	11,570	874,972,224	10	8.75	1.14
SW	COTTONWOOD	11,935	701,810,991	8	7.02	1.14
CENTRAL	STEARNS	140,841	8,188,584,768	93	81.89	1.14
SW	CHIPPEWA	12,694	805,062,069	9	8.05	1.12
SW	NICOLLET	31,147	1,727,245,800	19	17.27	1.10
NE	COOK	5,316	640,739,862	7	6.41	1.09
SW	MCLEOD	21,077	1,684,848,438	18	16.85	1.07
CENTRAL	WRIGHT	106,734	6,511,614,354	68	65.12	1.04
SE	MOWER	38,984	2,031,872,472	21	20.32	1.03
SW	FARIBAULT	15,618	1,161,261,297	12	11.61	1.03
SW	ROCK	9,590	886,562,712	9	8.87	1.02
NW	MARSHALL	5,079	788,094,720	8	7.88	1.02
METRO	CHISAGO	48,424	3,696,574,581	36	36.97	0.97
METRO	ANOKA	316,830	13,825,780,479	133	138.26	0.96
SW	JACKSON	11,214	1,184,961,141	10	11.85	0.84
METRO	WASHINGTON	217,435	10,343,703,006	87	103.44	0.84
METRO	DAKOTA	383,076	17,834,965,722	134	178.35	0.75
METRO	RAMSEY	515,411	23,267,111,742	149	232.67	0.64
SW	REDWOOD	16,245	1,096,468,569	7	10.96	0.64
METRO	HENNEPIN	1,144,037	53,663,144,598	289	536.63	0.54
State Totals 2000 - 2004:			269,631,290,880	3,072		1.14

Appendix B
Survey Materials

Postcards

Postcards were printed on standard white or off-white 40 lb card stock and cut to postcard dimensions (4” x 6”).

Shown below are the information sides of both postcards. On the opposite (address) side, recipient’s addresses were printed in the center, a nonprofit postage paid symbol appeared in the upper-right corner, and the return address read:
University of Minnesota
Department of Mechanical Engineering
111 Church St SE
Minneapolis MN 55455

<u>Pre Postcard</u>

Hello,

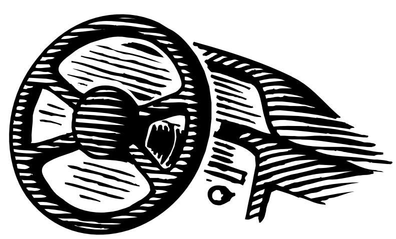
The University of Minnesota is conducting a research project to survey Minnesota drivers about their driving styles and attitudes toward road safety in their communities. It is hoped that this research will help support safer driving conditions in our state.

We are sending you this postcard to draw your attention to this study and hopefully increase your interest in participating. In the near future, a short survey will be mailed to you as part of this study. We hope you will be willing to participate. Thank you for your time and attention.

For more information about this study, please contact:
Dr. Nicholas Ward, or Michael Rakauskas at The HumanFIRST Program; University of Minnesota; 1100 Mechanical Engineering; 111 Church Street SE; Minneapolis, MN 55455. (612) 624-6524 or toll free (866) 421-9843.

<u>Reminder Postcard (image placement is tentative, format as appropriate)</u>

Hello,



The University of Minnesota is conducting a research project to survey Minnesota drivers about their driving styles and attitudes toward road safety in their communities. It is hoped that this research will help support safer driving conditions in our state.

Recently, we mailed a short survey to you as part of this study. We are sending you this postcard to remind you of this study and see if you are still willing to complete and return the survey to us. We hope you will be willing to participate. Thank you for your time and attention.

For more information about this study, please contact:
Dr. Nicholas Ward, or Michael Rakauskas at The HumanFIRST Program; University of Minnesota; 1100 Mechanical Engineering; 111 Church Street SE; Minneapolis, MN 55455. (612) 624-6524 or toll free (866) 421-9843.

Letter

The letter was printed on University of Minnesota letterhead, standard white or off-white 20 lb paper stock, with the HumanFIRST address and information included.

NOTE: The letterhead on the following page has been reformatted to fit within this document.

UNIVERSITY OF MINNESOTA

Twin Cities Campus

Program for Human Factors Interdisciplinary Research in Simulation and Transportation (HumanFIRST Program)

Department of Mechanical Engineering
Institute of Technology

1100 Mechanical Engineering
111 Church Street S.E.
Minneapolis, MN 55455

Phone: 612-624-6524
Fax: 612-625-8884
www.humanfirst.umn.edu

<<Date>>

<<Name>>
<<Address>>
<<Address>>

Dear <<Name>>:

We would like to invite you to participate in the University of Minnesota's Driving Study. The University of Minnesota is conducting this study to survey Minnesota drivers about their driving styles and attitudes toward road safety in their communities. It is expected that this research will help support safer driving conditions in our state.

We have enclosed an information sheet describing how to participate in this study and about the drawing of randomly selected individuals for $50 Target gift cards.

Participation in this study includes completing and returning the enclosed questionnaire. Your name will not be associated with your responses. Only the researchers at University of Minnesota will have access to your responses. Involvement in this study is voluntary.

We look forward to your potential contribution in this important study and would appreciate your completed and returned questionnaire within two weeks of receiving this packet. A postage-paid, return envelope is included for your convenience.

Thank you for your time and attention.

Sincerely,

Nicholas Ward, Ph.D.
Principal Investigator
HumanFIRST Program
ITS Institute, University of Minnesota
1100 Mechanical Engineering
111 Church Street SE
Minneapolis, MN 55455

Michael Rakauskas, M.S.
Co-Investigator

Survey Instructions

The instruction sheet was printed on goldenrod 20 lb paper stock.

Minnesota Driving Survey Instructions

Study Overview:

The purpose of this study is to survey Minnesota drivers about their driving styles and attitudes toward road safety in their communities in order to improve driving conditions in Minnesota. This research is being conducted by the University of Minnesota's HumanFIRST Program in the ITS Institute. Funding has also been provided by the Minnesota Local Road Research Board (LRRB) with the assistance by the Minnesota Department of Transportation (Mn/DOT) and Minnesota Department of Public Safety (DPS).

When completing the enclosed survey, try to be as honest as you can. Your responses will be kept anonymous by assigning you a participant barcode identifier. Participants will be selected to win gift cards using only this barcode identifier, separate from their responses. When you have completed the survey, please place the completed survey in the **enclosed postage-paid, return envelope** or return the materials to Michael Rakauskas; University of Minnesota; 1100 Mechanical Engineering; 111 Church Street SE; Minneapolis, MN 55455**. Please complete and mail your survey within two weeks of receiving this packet**.

$50 Target Gift Card Random Drawing:

A minimum of 20 randomly selected individuals will receive a $50 Target gift card. The opportunity for receiving a gift card will be *at least* 1 in 250 individuals; however, this will vary based on the number of respondents. Indicate if you would like to be included in the random drawing by completing the first page of the survey and returning it in the envelope provided. This will make you eligible whether or not you complete the survey. Individuals who are awarded a gift card will be notified at the completion of the data collection (approximately April 2006). Although we cannot supply the names of those chosen because of confidentiality issues, we will post a notice on our website (http://www.humanfirst.umn.edu/) when the individuals have been selected. After that notice is posted, you may call the numbers identified above and request further verification of the disbursement of the gift cards, if you wish.

Questions or Concerns:

If you have any questions or would like more information about this study, please contact Dr. Nicholas Ward or Michael Rakauskas at (612) 624-6524; toll free at (866) 421-9843; or use the contact address above. If you have any questions or concerns regarding this study and would like to talk to someone other than the researchers, you are encouraged to contact the Research Subjects' Advocate Line; D528 Mayo; 420 Delaware St. Southeast; Minneapolis, MN 55455; (612) 625-1650.

We look forward to your involvement in this important study!

Surveys

The questionnaire booklet was printed on two (2) 11" x 17" (double-sided) pages (the assembled booklet had four (4) 8-1/2" x 11" pages front & back). Each booklet had a serialized barcode (Code 39EightText) using our participant numbering, which appears as an empty rectangular box at the top of the following example pages.

UNIVERSITY OF MINNESOTA DRIVING SURVEY

Minnesota Driving Survey: Gift Card Random Drawing

To thank you for participating in this survey, we are providing a $50 Target Gift Card to 20 randomly selected participants.

You are not required to complete the questionnaire to be eligible for this random drawing; however, you do need to **mark (X) yes or no to the questions below**, and return this questionnaire in the enclosed postage-paid return envelope, or mail to: Attention-Michael Rakauskas, HumanFIRST Program; University of Minnesota; 1100 Mechanical Engineering; 111 Church Street SE; Minneapolis, MN 55455.

1. Are you the person to whom this questionnaire was sent?
   - ☐ Yes → Please continue to the next question and the rest of the survey
   - ☐ No → Please call (866) 421-9843 or (612) 624-6524 so we may clarify the situation

2. Would you like to be included in the gift card drawing?
   - ☐ Yes, include me in the random drawing
   - ☐ No, do not include me in the random drawing

3. What is today's date? ☐☐ - ☐☐ - ☐☐☐☐
   MONTH DAY YEAR

Voluntary Participation and Confidentiality

Participation in this survey is voluntary. Choosing not to participate will not affect your future relations with any of the persons or institutions involved in this effort. We are required to maintain confidentiality regarding your participation; results will be reported only in summary form and no individual will ever be identified. None of the information you provide will ever be identified with you; all of your responses are confidential and anonymous.

If there is any question you do not wish to answer, please mark an X on the question number, and continue to the next question.

Instructions:

Please read the directions before answering each question. We are interested in getting your general impressions, so give your best guess even if you are not sure. Try to be as honest as you can. Remember that your responses will be kept anonymous.

Note: When a question asks about your vehicle, it is referring only to your "primary personal vehicle." This means the vehicle you drive most often that is not part of your job if you are a commercial driver.

The following is a list of situations people have experienced while driving.

Please mark **(X)** the box in the appropriate column to indicate how often these things have happened to you. Your response should be based on actual events you remember during the **past 12 months** of driving your primary personal vehicle.

	Never	Hardly ever	Occasionally	Somewhat often	Frequently	Nearly all the time
1. While in reverse, hit something you had not previously seen						
2. Intending to drive to destination A, you "wake up" to find yourself on the road to destination B, perhaps because the latter is your more usual destination						
3. Drive even though you realize that you may be over the legal blood-alcohol limit						
4. Get into the wrong lane while approaching an intersection						
5. Lining up to turn right onto a main road, you pay such close attention to the main stream of traffic that you nearly hit the car in front						
6. Fail to notice pedestrians are crossing when turning into a side street from a main road						
7. Sound your horn to indicate your annoyance to another road user						
8. Fail to check your rear-view mirror before pulling out, changing lanes, etc.						
9. Brake too quickly on a slippery road, or steer the wrong way into a skid						
10. Pull out at an intersection so far that the driver with right-of-way has to stop and let you out						
11. Disregard the speed limit on a residential road						
12. Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers						
13. On turning right, nearly hit a cyclist who has come up on your inside						
14. Miss "yield" sign and narrowly avoid colliding with traffic having the right-of-way						
15. Turn off your car and attempt to take the keys out while it is still in Drive						
16. Attempt to pass someone you hadn't noticed to be signaling a left turn						
17. Become angered by another driver and chase them with the intention of giving him/her a piece of your mind						
18. Stay in a highway lane you know will be closed ahead until the last minute before forcing your way into the other lane						
19. Forget where you left your car in the parking lot						
20. Pass a slow driver on the inside lane						
21. Race away from traffic lights with the intention of beating the driver next to you						
22. Misread the signs and take the wrong highway off ramp, for instance Northbound instead of Southbound						
23. Drive so close to the car in front that it would be difficult to stop in an emergency						
24. Cross an intersection knowing that the traffic lights have already turned against you						
25. Become angered by a certain type of driver and indicate your hostility by whatever means you can						
26. Realize you have no clear recollection of the road you have just been traveling on						
27. Underestimate the speed of an oncoming vehicle when passing another vehicle						
28. Disregard the speed limit on a highway						

The following items include a number of activities **you** may have engaged in while driving during the **past 12 months.**

For each activity, answer Questions A and B by marking **(X)** a box in each column.

	A. How frequently do **you** engage in the following activities?						B. How **dangerous** are the following activities?					
	Never	Infrequently	Somewhat infrequently	Somewhat frequently	Frequently	Always	Not at all dangerous	Mostly not dangerous	Somewhat not dangerous	Somewhat dangerous	Dangerous	Extremely dangerous
0. EXAMPLE: Driving while chewing gum					X							X
1. Driving at excessive speed for the current road conditions *(e.g., in snow)*												
2. Driving more than 10 mph above the speed limit												
3. Driving when drunk above the legal limit												
4. Driving when very tired												
5. Driving aggressively to show frustration and anger toward other road users												
6. Driving while talking on a cell phone												
7. Driving with a vehicle fault *(e.g., bald tires, or low brakes)*												
8. Failing to yield at an intersection												
9. Rolling through a stop sign												
10. Running a red light												
11. Passing in a no passing zone *(crossing a double yellow line)*												
12. Driving young children who are not secured in a seat belt or a safety seat												
13. Driving without a valid license												
14. Driving without using my seat belt												
15. Driving during bad weather conditions.												
16. Stopping in the middle of the road *(e.g., to talk to someone or look at something)*												

The following items include a number of activities **other people** who live near you may have engaged in while driving during the **past 12 months.**

For each activity, answer Questions A and B by marking **(X)** a box in each column.

A. How frequently do **other people in your community** engage in the following activities?

B. What is the normal attitude of **other people in your community** towards the following activities?

	A: Never	A: Infrequently	A: Somewhat infrequently	A: Somewhat frequently	A: Frequently	A: Always	B: Very unaccepting	B: Unaccepting	B: Somewhat unaccepting	B: Somewhat accepting	B: Accepting	B: Very accepting
0. EXAMPLE: Driving while chewing gum					X							X
1. Driving at excessive speed for the current road conditions *(e.g., in snow)*												
2. Driving more than 10 mph above the speed limit												
3. Driving when drunk above the legal limit												
4. Driving when very tired												
5. Driving aggressively to show frustration and anger toward other road users												
6. Driving while talking on a cell phone												
7. Driving with a vehicle fault *(e.g., bald tires, or low brakes)*												
8. Failing to yield at an intersection												
9. Rolling through a stop sign												
10. Running a red light												
11. Passing in a no passing zone *(crossing a double yellow line)*												
12. Driving young children who are not secured in a seat belt or a safety seat												
13. Driving without a valid license												
14. Driving without using their seat belt												
15. Driving during bad weather conditions.												
16. Stopping in the middle of the road *(e.g., to talk to someone or look at something)*												

The following items ask you about different types of traffic safety interventions. Specifically, we would like to know how **effective** and how **desirable** you believe each intervention would be for your community.

For each type of intervention, answer Questions A and B by marking **(X)** a box in each column.

	A. How **effective** would this intervention be in your community?				B. How **desirable** is this intervention for you in your community?			
	Ineffective	*Somewhat ineffective*	*Somewhat effective*	*Effective*	*Undesirable*	*Somewhat undesirable*	*Somewhat desirable*	*Desirable*
0. EXAMPLE: Install fences along roads to reduce the number of animals and pedestrians hit by vehicles				**X**				**X**
1. Increase law enforcement presence on roads								
2. A law making seat belt usage mandatory								
3. Install cameras to automate enforcement of red light running and speed violations								
4. Implement stricter licensing requirements for novice drivers *(i.e. "graduated licensing")*								
5. Place additional road signs, lane markings, and barriers to help drivers stay on the road								
6. Provide public education efforts to increase awareness of traffic safety								
7. Form a legislative action committee and governor's traffic safety panel to develop traffic safety policies								
8. Improve road engineering such as clearing sight obstructions, increase lighting, adding speed bumps, upgrading traffic lights, and adding lanes at intersections								
9. Support increase in winter snow clearing and roadway maintenance								
10. Work with the courts to prevent the reduction or dismissal of charges or fines for traffic safety citations								
11. Focus existing law enforcement on speed limit offenders								
12. Focus existing law enforcement on offenders not wearing seat belts								
13. Focus existing law enforcement on offenders who have children not secured in a seat belt or a safety seat								
14. Focus existing law enforcement on Driving Under the Influence (DUI) offenders								
15. Enhance driver education instruction, training materials, and behind the wheel experience for teen drivers								
16. Enhance driver education instruction, training materials, and behind the wheel experience for older drivers								
17. Perform safety inspections of dangerous road segments								
18. Improve the state's capabilities to record crash data								
19. Implement a state-wide system to improve emergency response services for traffic crashes								
20. A law banning cell phone use while driving								

These items ask about some of your **preferences.** For each item, mark the box **(X)** by the statement that **best** describes your likes or dislikes, or the way you feel. If you do not like either choice, mark the choice you dislike least.

We are only interested in **your** likes or feelings, not how others feel or how one is supposed to feel about these things. There are no right or wrong answers.

1. ☐ I would not like to learn to fly an airplane.
   ☐ I would like to learn to fly an airplane.
2. ☐ I like to dive off the high board.
   ☐ I don't like the feeling I get standing on the high board *(or I don't go near it at all)*.
3. ☐ I would like to try surfboarding.
   ☐ I would not like to try surfboarding.
4. ☐ A sensible person avoids activities that are dangerous.
   ☐ I sometimes like to do things that are a little frightening.
5. ☐ Skiing down a high mountain slope is a good way to end up on crutches.
   ☐ I think I would enjoy the sensations of skiing very fast down a high mountain slope.
6. ☐ I prefer the surface of the water to the depths.
   ☐ I would like to go scuba diving.
7. ☐ I would like to try parachute jumping.
   ☐ I would never want to try jumping out of a plane, with or without a parachute.
8. ☐ I often wish I could be a mountain climber.
   ☐ I can't understand people who risk their necks climbing mountains.
9. ☐ Sailing long distances in small sailing crafts is foolish.
   ☐ I would like to sail a long distance in a small but seaworthy sailing craft
10. ☐ I would like to take up the sport of water skiing.
    ☐ I would not like to take up water skiing.

This is a list of things which people are tempted to do from time to time if they knew they would not get caught. Please mark **(X)** the box in the appropriate column to indicate how likely you are to do these things if you were completely certain of getting away with it.

	Not at all likely	*Somewhat likely*	*Very likely*
1. Ride on public transportation without paying a fare.	☐	☐	☐
2. Park your primary vehicle in a marked "no parking zone."	☐	☐	☐
3. Earn cash payments without paying income tax on them.	☐	☐	☐
4. Leave a shop with goods that you have not paid for.	☐	☐	☐
5. Make a fraudulent insurance claim.	☐	☐	☐
6. Drive down the shoulder of a highway when the other lanes are jammed while driving your primary vehicle.	☐	☐	☐
7. Keep a $50 bill you found on the street.	☐	☐	☐
8. Hit someone who has annoyed or upset you.	☐	☐	☐
9. Install and watch cable television without having paid for it.	☐	☐	☐
10. Take sick time off work when you have something more interesting to do.	☐	☐	☐

The following items ask for some information about you and your driving history.

Please complete each question by responding in the space provided or by marking **(X)** the appropriate box.

1. Your birthday: ☐☐ - ☐☐ - ☐☐☐☐
   MONTH DAY YEAR

2. What is your gender: ☐ Female ☐ Male

3. Do you drive as part of your paid employment? ☐ No *(if NO, go to Question 4)*
   ☐ Yes → If YES, what is your primary job?

4. What is the highest educational level you have completed?
   - ☐ Elementary / Junior High School
   - ☐ High School
   - ☐ College (Bachelor's Degree)
   - ☐ Post-Secondary

5. What is your current annual household income:
   - ☐ Less than $25,000
   - ☐ $25,001 - $50,000
   - ☐ $50,001 - $75,000
   - ☐ $75,001 - $100,000
   - ☐ Over $100,001

6. How many years have you lived at your current home / residence?
   ☐☐ Years

7. What is your postal code: ☐☐☐☐☐

8. In which **one** of the following areas do you consider your current home/residence to be?
   - ☐ Rural
   - ☐ Suburban
   - ☐ Urban City

9. How many years have you lived in **Rural** areas?
   ☐☐ Years *(if none, write 0)*

10. How many years have you lived in **Urban City** areas?
    ☐☐ Years *(if none, write 0)*

11. In what month and year did you obtain your full driving license:
    ☐☐ - ☐☐☐☐
    MONTH YEAR

12. Estimate roughly how many miles you have driven in the **past 12 months**:
    - ☐ Less than 5000 miles
    - ☐ 5001-10,000 miles
    - ☐ 10,001-15,000 miles *(average for U.S. drivers)*
    - ☐ 15,001-20,000 miles
    - ☐ Over 20,001 miles

13. During the **past 12 months**, estimate how many **days per week** you typically drove:
    - ☐ Days per week

14. Through which of the following areas did you regularly commute during the **past 12 months**? *(You may select more than one if appropriate.)*
    - ☐ Rural
    - ☐ Suburban
    - ☐ Urban City

15. What type of vehicle *(i.e. your "primary personal vehicle")* did you drive most often during the **past 12 months**?
    - ☐ Motorcycle
    - ☐ Passenger Car
    - ☐ Pickup Truck
    - ☐ Sport Utility Vehicle (SUV)
    - ☐ Van or Minivan
    - ☐ Other, briefly describe: ______________________________

16. During the **last three years**, in how many **minor road crashes** have you been involved as the driver? *(A minor crash is one in which no one required medical treatment AND costs of damage to vehicles and property were less than $1000.)*
    - ☐☐ Minor crashes *(if none, write 0)*

17. During the **last three years** in how many **major road crashes** have you been involved as the driver? *(A major crash is one in which EITHER someone required medical treatment OR costs of damage to vehicles and property were greater than $1000, or both).*
    - ☐☐ Major crashes *(if none, write 0)*

18. During the **last three years**, how many **traffic citations** have you received? *(A traffic citation includes receiving a ticket for speeding, dangerous or careless driving, driving under the influence of alcohol or drugs, etc., but not including parking tickets.)*
    - ☐☐ Traffic citations *(if none, write 0)*

End of Survey. Please mail your completed survey back to us by placing it in the *enclosed postage-paid return envelope*, or by mailing it to:

Attention-Michael Rakauskas
HumanFIRST Program
University of Minnesota
1100 Mechanical Engineering
111 Church Street SE
Minneapolis, MN 55455.

Thank you for your time completing this survey.