

Motivations for Speeding

Volume I: Summary Report



U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**



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16. Abstract This is Volume I of a three-volume report. It contains the results of a study that examined the speeding behavior of drivers in their own vehicles over the course of three to four weeks of naturalistic driving in urban (Seattle, Washington) and rural (College Station, Texas) settings. The purpose of this research was to (1) identify the reasons why drivers speed, (2) model the relative roles of situational, demographic, and personality factors in predicting travel speeds, (3) classify speeders, and (4) identify interventions, countermeasures, and strategies for reducing speeding behaviors. Data collected from 164 drivers included 1-Hz recordings of vehicle position and speed using a GPS receiver, responses to a battery of a personal inventory questionnaires, and daily driving logs that captured trip-specific situational factors. Vehicle speed and position data were combined with road network data containing validated posted speed information to identify speeding episodes. The descriptive analysis of speeding data provided evidence for different types of speeding behaviors among individual drivers including (1) infrequent or incidental speeding, which may be unintentional; (2) trip-specific situational speeding; (3) taking many trips with a small amount of speeding per trip (i.e., casual speeding); and (4) habitual or chronic speeding. Regression models were developed to identify predictors of "any" speeding (logistic regression) and amount of speeding (linear regressions). Significant predictors included demographic variables such as age and gender, situational factors such as time-of-day and day-of-week, and key personal inventory factors such as attitudes towards reckless driving. In addition, focus group discussions were conducted with a subset of study participants who were classified as "speeders" and "non-speeders" to identify key attitudes and beliefs towards speeding and the effectiveness of potential countermeasures.			
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BACKGROUND AND INTRODUCTION

Although speeding is one of the most significant contributors to crash severity and traffic fatalities, attempts to address this problem through a variety of approaches have not led to a significant reduction in speed-related fatalities (National Highway Traffic Safety Administration (NHTSA), 2005). NHTSA's (2007) report, "Countermeasures That Work," lists speeding countermeasures that have been demonstrated to be effective, most of which focus on enforcement or punishment to reduce speeding. A limitation with these types of countermeasures is that they may not be as effective with some driver groups, such as risk-taking young males, who rarely consider the potential consequences of their behaviors (McKenna & Horswill, 2006). Similarly, National Cooperative Highway Research Program (NCHRP) Report 500 provides several engineering-based countermeasures to address speeding (NCHRP, 2005). These countermeasures can be effective in reducing speeding at specific locations, but they can be expensive and only cover small parts of the transportation network, and other non-speeding drivers are also affected by these countermeasures. Thus, there is a strong interest in new countermeasures to better target identifiable groups of speeders using approaches that specifically and effectively address the reasons for their speeding.

The purpose of this research effort was to:

- Identify the reasons why drivers speed;
- Model the relative roles of situational, demographic, and personality factors in predicting travel speeds;
- Classify speeders; and
- Identify interventions/countermeasures and strategies for reducing speeding behaviors.

Specifically, this effort focused on identifying "who" is speeding, "what" contributes to their decisions to speed, and it attempted to identify "which" countermeasures can be most effectively focused at those drivers who account for a significant proportion of the speeding problem.

The research involved a comprehensive approach for studying speeding in drivers and identifying appropriate countermeasures (see Figure 1 below). The field data collection portion drew upon existing research to identify driver and situational factors associated with speeding, and used this information to develop data collection tools, including a personal inventory questionnaire, a Global Positioning System (GPS)-based, on-road speed recorder, and daily driving logs that capture situational factors. The information provided by these tools was used to address the objectives listed above. Following Phase 1 (the field data collection), information about speeder subtypes was used to conduct focus group studies (Phase 2) on a subset of participants that matched speeder subtypes. This qualitative information addresses the broader project goal of obtaining driver attitudes and behaviors related to countermeasures.

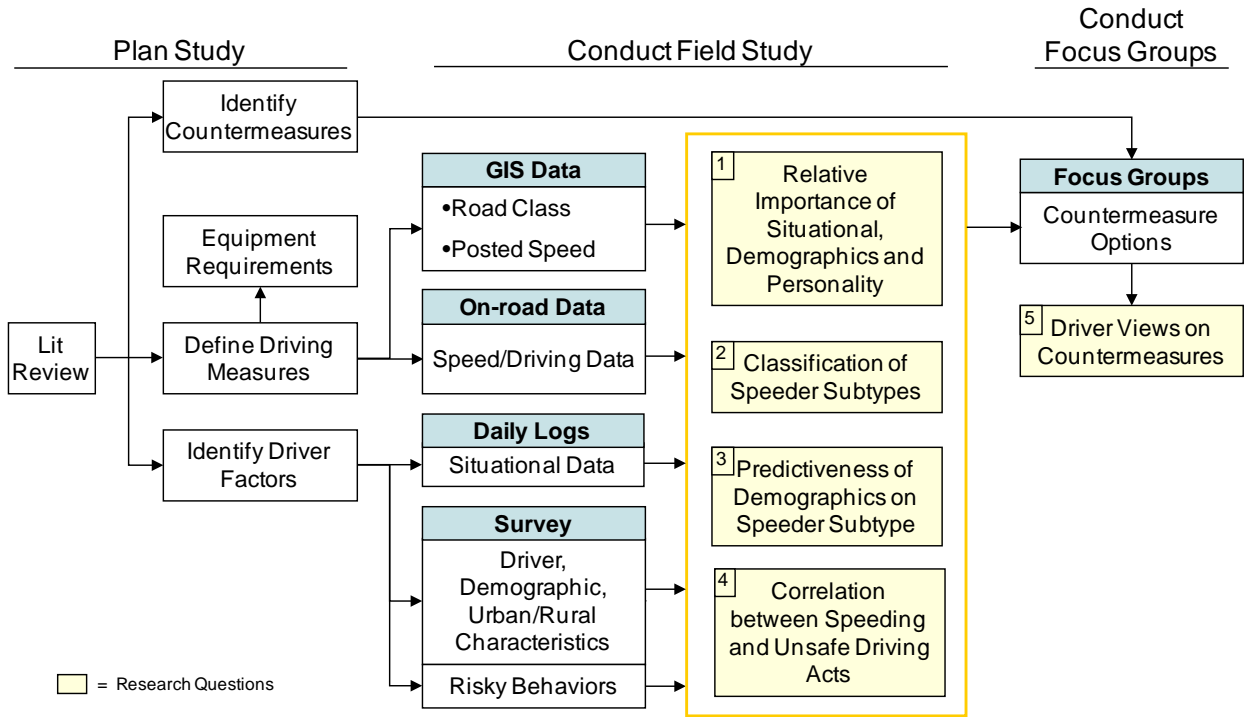


Figure 1. Overview of the approach for studying speeding in drivers and identifying countermeasures.

GENERAL TECHNICAL APPROACH

Overview

This research was a naturalistic field study in which volunteer drivers from Seattle, Washington, and College Station, Texas, agreed to have a GPS unit installed in their vehicles for 3 to 4 weeks. The GPS data obtained in the study was used to compare the drivers' speeds to the posted speed limits, referred to here as the posted speeds (PSs), associated with the roads that they were driving on at any given point in time. These comparisons between actual speeds and posted speeds formed the basis for the analyses and findings described in this report.

A total of 164 participants fully completed the study requirements in Seattle and College Station. Table 1 shows the number of subjects as a function of age, gender, and location.

Table 1. Study design and allocation of participants.

Geography	Urban (Seattle, Washington)				Rural (College Station, Texas)			
Gender	Male		Female		Male		Female	
Age	18-25	35-55	18-25	35-55	18-25	35-55	18-25	35-55
Subjects	21	25	21	21	20	16	21	19

Defining speeding and selecting speed thresholds

A critical activity in this study was to develop a framework and rationale for defining *speeding*, and then to develop a way to implement the definition using the current data set. As a starting point, we focused on developing a behavioral framework that could segment driving into different categories reflecting different attitudes about speeding. In particular, four different behavior types were identified that correspond to different speed bands relative to the posted speed. These include:

- **Type 1:** Driver is intentionally trying to stay below posted speed, which forms the control condition (ranges up to posted speed + natural speed variability).
- **Type 2:** Driver is not concerned with or constrained by posted speed, but is trying to avoid getting a speeding ticket (ranges from posted speed to enforcement speed).
- **Type 3:** Driver is unconcerned or consciously willing to accept some risk (safety and speeding ticket) to drive faster (ranges from enforcement speed to what is clearly unsafe).
- **Type 4:** Driver is traveling at a speed that most other drivers would clearly identify as “reckless” or too fast for conditions with a clear disregard for the posted speed.

These four types, translated into actual speed ranges (for a 60 mph posted speed), are shown in Figure 2 below (blue arrow bars), with hypothetical distributions showing speed variability around those ranges.

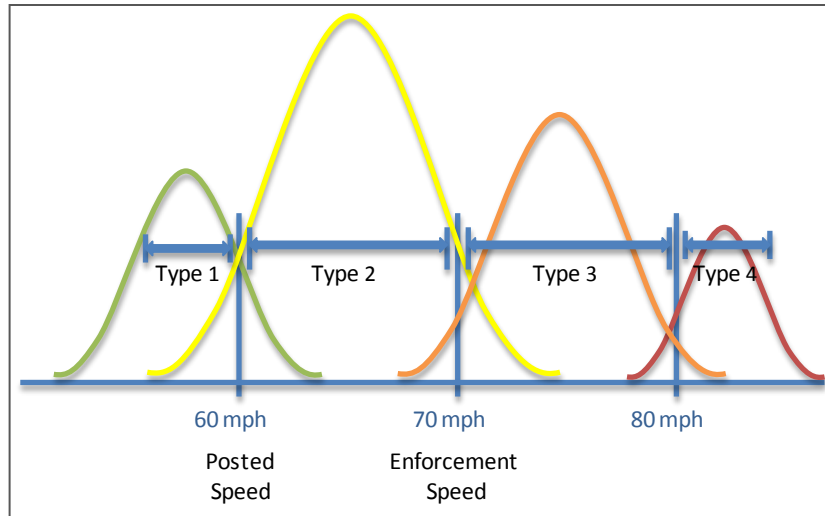


Figure 2. Theoretical speed ranges.

The speeding of interest in this study was defined to be Type 3 speeding (driving 10-20 mph above the posted speed) and Type 4 speeding (driving over 20 mph above the posted speed). These values were chosen primarily to provide round numbers to define the speeding categories, and give reasonable cutoffs for the underlying attitudes and motives that we were trying to capture. As described in more detail in Volume II of this report, the initial analyses of the data determined that there were too few Type 4 speeding events to be analyzed. Therefore, although they likely represent different behaviors, Type 3 and Type 4 speeding events were combined and are referred to simply as “speeding events” or “speeding time” hereafter. Accordingly, the threshold for categorizing driving as “speeding” in this report is 10 mph above the posted speed.

Defining “speeding” was a necessary first step of the data analyses. However, it still lacks a way to reflect exposure and raises the question, “*amount of speeding relative to what?*” Without a way to estimate overall exposure, directly comparing the amount of speeding across drivers, roadway types, geographic locations, etc., becomes problematic. To address this problem, a new variable was constructed from the data set—“*free-flow time*”—that could serve as the denominator to the “*speeding time*” numerator in our subsequent analyses. The free-flow time variable was carefully defined and constructed, with the objective of making sure that the measure reflected a driver’s *opportunity* to speed. For example, time spent warming up a vehicle was not included, nor was time spent idling at a stoplight. A less obvious consideration is that a drivers’ decisions about speed selection include many instances in which the vehicle’s speeds are constrained by traffic control devices or traffic congestion—instances in which drivers clearly have no opportunity to speed. If not accounted for, travel time that represents stopped time or slower driving could end up being overrepresented in terms of chronological time relative to episodes in which drivers are able to select their desired speed, since drivers take longer to travel the same distance in the former case. Consequently, comparing the time that drivers spent speeding to the total amount of time they drove likely underestimates their speeding exposure by a substantial amount because their trip data is “diluted” by a large amount of inconsequential time when they were stopped or had no chance to speed.

The approach used to address this dilution of data was to remove from the data set all of the recorded time in which drivers clearly had no opportunity to speed. To generate the free-flow driving time variable, all driving that was 5 mph or more *below* the posted speed was removed (e.g., on a roadway with a posted speed of 35 mph, only driving time in which the vehicle was traveling at 30 mph or greater was retained). Relative to the complete data set, driving time was also filtered to remove driving that occurred on unvalidated (i.e., uncertain posted speed) roads, and due to other data-integrity issues, such as missing GPS data points.

In addition, preliminary reviews of the data set using speeding time divided by free-flow time to generate a “*percentage time speeding*” measure revealed considerable variation in speeding behavior across trips and trip-level factors such as time-of-day, day-of-week, as well as (as expected) drivers, speed bands, and locations. Thus, the inferential analyses examined speeding, in which individual trips were nested within drivers.

Definition of Speeding

Figure 3 below provides an illustration of how driving data are extracted from a trip and categorized into free-flow and speeding time. The topmost bar shows a hypothetical trip, with the purple-shaded regions representing free-flow driving on 30 to 35 mph roads, and the green-shaded regions representing free-flow driving on 55 to 60 mph roads. The dark purple and green show the time during which drivers are speeding. The unshaded portions of the trip bar represent driving that is excluded from the data for a variety of reasons (e.g., driving too slow, driving on roads with unvalidated posted speeds, or roads with ineligible posted speeds). The middle set of bars shows the driving periods that are counted as free-flow time. Free-flow driving that occurred on different parts of the trip is combined into a single value per trip (i.e., part A in the figure). Note that speeding time is also counted as free-flow driving. The bottom set of bars represents the speeding time during a trip. All speeding, even if it occurred at different times, is combined into a single value per trip (i.e., part B in the figure).

Speeding on a single trip was specifically defined as:

$$\text{Speeding}_{(\text{speedband})} = \left(\frac{\text{Speeding Time}_{(\text{speedband})}}{\text{Freeflow time}_{(\text{speedband})}} \right) \text{ for each trip}$$

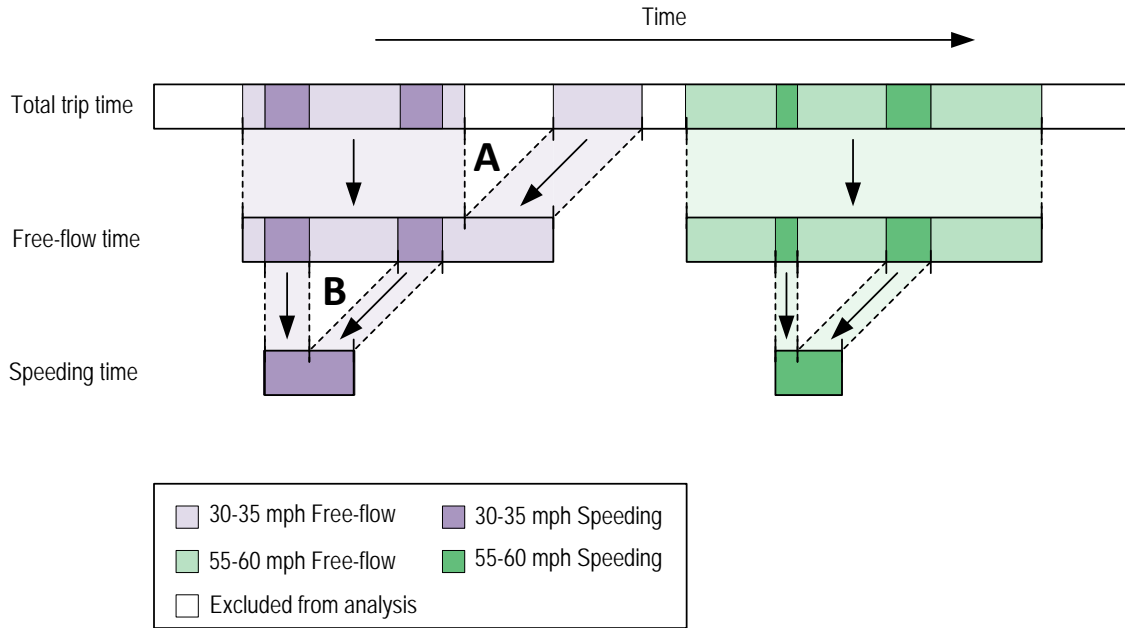


Figure 3. Illustration of how driving data are extracted from a trip and categorized into free-flow and speeding time.

The speeding measure was used to calculate average speeding for individual drivers. The specific definition of this measure is shown below:

$$\text{Average Speeding}_{(\text{speedband})} = \text{Average} \left(\frac{\text{Speeding Time}_{(\text{speedband})}}{\text{Freeflow time}_{(\text{speedband})}} \right) \text{ for all trips}$$

Average speeding across all of an individual's trips provides a global measure of the amount of speeding those drivers did in a speed band for the entire data collection period. In some ways, it is an incomplete measure because it does not count every second of driving in the same way (i.e., it gives short and long trips the same weight in the calculation of overall time speeding). We found, however, that this aspect actually leads to a better representation of regular driving patterns relative to pooling speeding and free-flow time across all trips (i.e., weighting each second across trips the same). The reason for this is that very long trips that reflect atypical driving patterns (i.e., like recreational travel) can skew the results by contributing as many seconds of driving as potentially dozens of short, more-typical trips.

RESULTS OF THE DESCRIPTIVE ANALYSES

Seattle – Percentage of “free-flow” driving time spent in different speed bands relative to the posted speed

Table 2 shows the distribution of speeds relative to the posted speed across all of the Seattle drivers in a demographic group--shown in 5-mile-per-hour bands (e.g., for the category combining 30 mph and 35 mph roads, “PS+5” represents driving at speeds between 35 to 39.99 mph on a 30 mph road and between 40 to 44.99 mph on a 35 mph road). The bold line between the “PS-5” (mph) and “PS” categories indicates the posted speed. Table 2 indicates that the majority of driving occurred within ± 5 mph of the posted speed. The speeding that did occur was predominately between 10 and 15 mph above the posted speed. Almost no speeding occurred at speeds faster than 20 mph above the posted speed. In terms of this overall characterization of driving speed, there are some differences between demographic groups, but these differences are small.

Table 2. Percentage of “free-flow” driving time in Seattle spent in different speed bands relative to the posted speed for each demographic group on 30 to 35 and 55 to 60 mph roads.

<u>30-35 mph Roads</u>		Travel Speed (mph)					
	PS-5	PS	PS+5	PS+10	PS+15	PS+20	PS+25
Older Females	38.8%	43.7%	14.8%	2.5%	0.2%	0.0%	0.0%
Older Males	34.0%	43.5%	17.8%	3.7%	0.8%	0.1%	0.0%
Younger Females	33.2%	42.3%	20.7%	3.5%	0.2%	0.0%	0.0%
Younger Males	31.9%	44.9%	19.6%	3.1%	0.4%	0.0%	0.0%
Overall	34.4%	43.6%	18.3%	3.2%	0.4%	0.0%	0.0%
<u>55-60 mph Roads</u>							
	PS-5	PS	PS+5	PS+10	PS+15	PS+20	PS+25
Older Females	34.8%	42.4%	19.9%	2.6%	0.3%	0.0%	0.0%
Older Males	31.6%	46.2%	17.6%	3.6%	0.7%	0.1%	0.0%
Younger Females	25.1%	39.9%	28.2%	5.9%	0.7%	0.1%	0.0%
Younger Males	24.1%	42.4%	27.3%	5.1%	0.8%	0.2%	0.0%
Overall	28.9%	42.8%	23.1%	4.4%	0.7%	0.1%	0.0%

Texas – Percentage of “free-flow” driving time spent in different speed bands relative to the posted speed

Table 3 shows the distribution of speeds relative to the posted speed across all Texas drivers in a demographic group—shown again in 5-mile-per-hour bands. Table 3 indicates that the majority of

driving occurred within ± 5 mph of the posted speed. As in Seattle, the speeding that did occur was predominately between 10 and 15 mph above the posted speed. Almost no speeding occurred at speeds faster than 20 mph above the posted speed in the 30 to 35 and 70 mph speed bands. Although the differences were still small, it does appear that the 55 to 60 mph speed band had higher amounts of speeding at 15 to 20 and 20 to 25 mph above the posted speed. One aspect of the driving environment that may have contributed to the faster driving on 55 to 60 mph roads is that many of these roads are physically similar to 70 mph roads in terms of road geometry and design, but they have a lower posted speed (e.g., because they are in rural-urban transition areas). Thus, based on roadway characteristics and cues, drivers may feel like they can travel at faster speeds on those roads.

Table 3. Percentage of “free-flow” driving time in Texas spent in different speed bands relative to the posted speed for each demographic group on 30 to 35, 55 to 60, and 70 mph roads.

<u>30-35 mph Roads</u>		Travel Speed (mph)					
	PS-5	PS	PS+5	PS+10	PS+15	PS+20	PS+25
Older Females	42.7%	45.1%	10.3%	1.7%	0.1%	0.1%	0.0%
Older Males	37.4%	42.8%	16.9%	2.5%	0.3%	0.0%	0.0%
Younger Females	44.7%	43.5%	10.9%	0.9%	0.1%	0.0%	0.0%
Younger Males	51.4%	39.3%	7.2%	0.8%	0.6%	0.3%	0.3%
Overall	44.0%	42.6%	11.5%	1.5%	0.3%	0.1%	0.1%
<u>55-60 mph Roads</u>							
	PS-5	PS	PS+5	PS+10	PS+15	PS+20	PS+25
Older Females	27.9%	44.8%	13.6%	10.0%	3.5%	0.2%	0.0%
Older Males	31.9%	40.6%	19.3%	6.5%	1.7%	0.1%	0.0%
Younger Females	38.8%	39.2%	16.5%	4.5%	1.0%	0.0%	0.0%
Younger Males	31.6%	40.8%	20.9%	5.5%	1.0%	0.1%	0.1%
Overall	30.9%	42.5%	16.4%	7.8%	2.4%	0.1%	0.0%
<u>70 mph Roads</u>							
	PS-5	PS	PS+5	PS+10	PS+15	PS+20	PS+25
Older Females	47.4%	47.0%	4.8%	0.6%	0.1%	0.0%	0.0%
Older Males	48.0%	41.6%	9.7%	0.6%	0.1%	0.0%	0.0%
Younger Females	49.1%	42.1%	8.1%	0.5%	0.1%	0.0%	0.0%
Younger Males	41.2%	42.3%	15.1%	1.2%	0.2%	0.1%	0.0%
Overall	47.3%	44.7%	7.2%	0.6%	0.1%	0.0%	0.0%

Note: The bold line represents the posted speed limit.

Types of Speeding – Seattle and Texas

Information about driver speeding patterns was obtained using two different speeding measures, including (1) the percent of trips with any speeding, and (2) the average speeding per trip. These measures provide complementary information about driver speeding since they differently reflect persistent and situational elements of speeding behavior. Accordingly, we used the two measures to characterize different types of speeding at the level of individual drivers. This was done by plotting individual driver values for each of the two measures in a scatter plot (for each speed band separately).

A generic example of this approach is provided in Figure 4. In particular, the scatter plot can be divided up into different zones that reflect different types of speeding behavior. Zone boundaries are set at 20 percent, but these are arbitrary at this point. They are only included to illustrate potential differences between groups of drivers. These boundaries divide the drivers into four groups, described below:

- *Zone A:* Speeding occurs on a small number of trips and for only a small portion of those trips, if at all. Speeding here could be unintentional or incidental.
- *Zone B:* A high level of speeding per trip exists, but it only occurs on a small proportion of trips taken. These drivers usually do not speed, but have a few trips with a lot of speeding. This could reflect situational speeding (i.e., being late).
- *Zone C:* Speeding happens on a larger proportion of trips. However, speeding generally occurs for just a small part of the trip. This may reflect more systematic behaviors or tendencies.
- *Zone D:* In this zone, drivers speed regularly and for relatively large portions of their trips. These drivers may be characterized as habitual speeders.

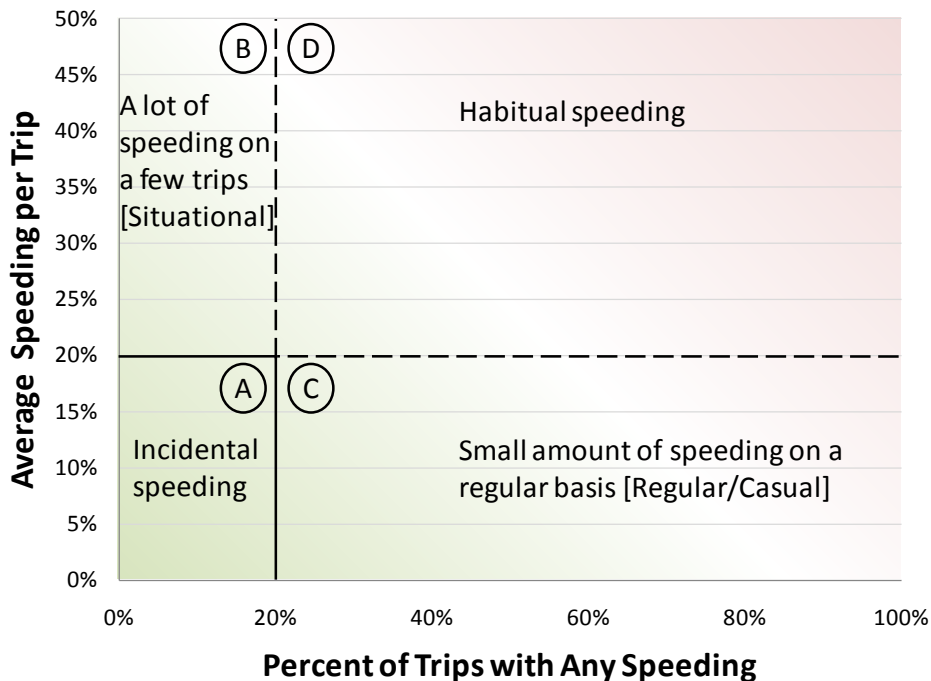
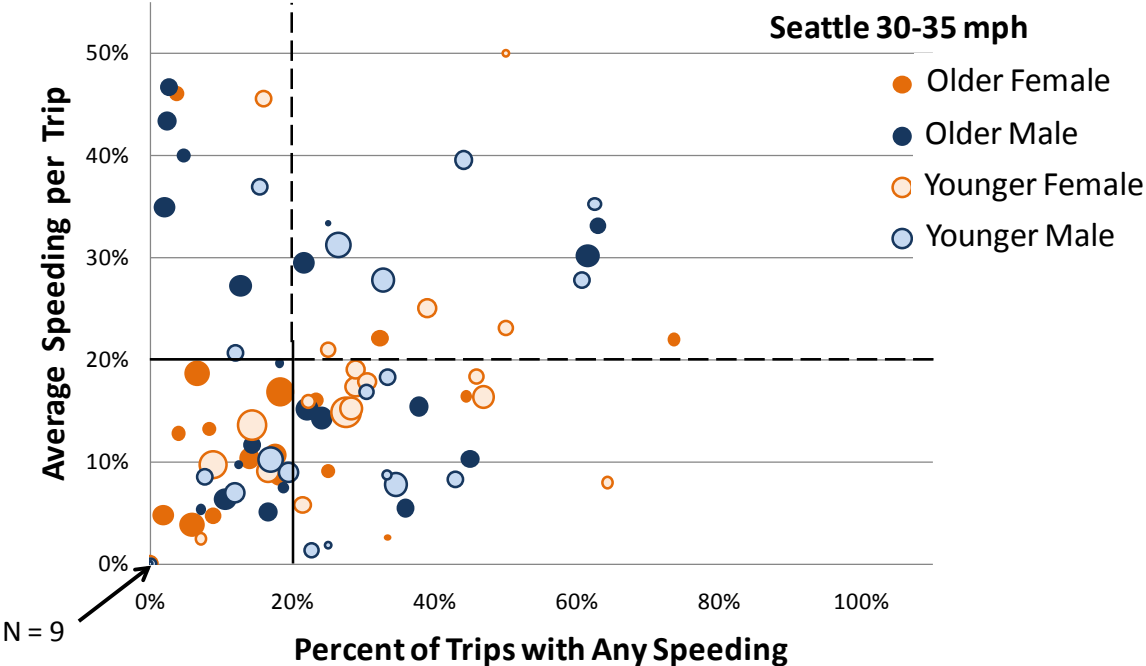


Figure 4. Types of speeding based on the scatter plot of the primary dependent measures.

Using this approach, the corresponding scatter plots for the two Seattle speed bands are shown in Figure 5, below. Individual drivers are plotted as separate circles on the graphs. An important element in these graphs is that the size of each data point corresponds to the number of trips with driving in the relevant speed band for that driver. This makes it easier to discount “spurious” data points that may not reflect true behavioral patterns because they represent just a small number of observations. Another informative element of the scatter plots is the text that indicates the number of points at the origin (i.e., “N=9” for the 30 to 35 mph roads and “N=5” for the 55-to-60 mph roads), which represents the number of drivers that had no speeding on any trips in that speed band. In Seattle, there were 9 drivers with no speeding on 30 to 35 mph roads and 5 drivers that had no speeding on 55 to 60 mph roads.



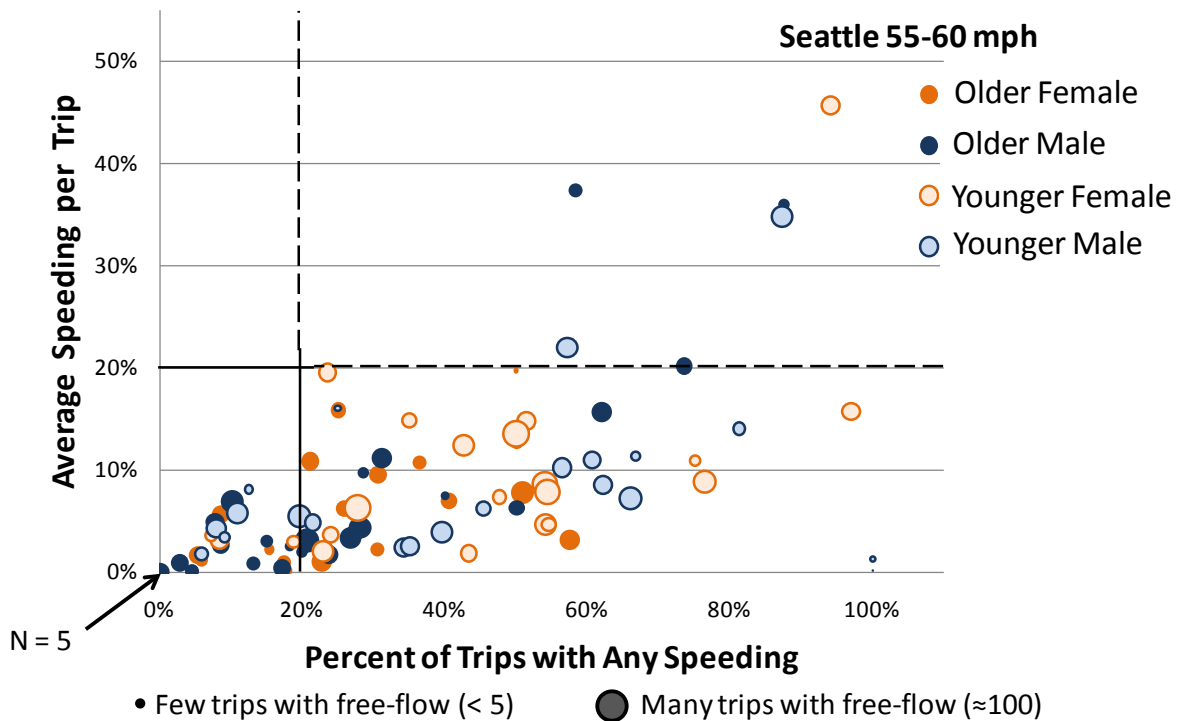


Figure 5. Seattle – Scatter plots of types of speeders in each zone.

A distinguishing pattern of the 30 to 35 mph scatter plot is that there are multiple drivers in each zone. Another finding is that the counts of males are higher in both the “Situational” (Zone B) and “Habitual” (Zone D) speeder zones, females are higher in “Incidental” (Zone A), and males and females are fairly equally distributed in the “Regular/Casual” zone (Zone C).

The pattern on 55 to 60 mph roadways is clearly different from the pattern on the lower speed roads. In particular, most drivers have many trips with a little speeding on those trips. Longer trips in this speed band can increase the likelihood of a driver having any speeding, which may account for the higher concentration of drivers in Zone C. Nevertheless, engaging in some speeding on a trip is a regular occurrence for many drivers. There is also no evidence of “Situational” speeding among the group of drivers that speed infrequently (i.e., Zone B is empty), but there is a small group of “Habitual” speeders.

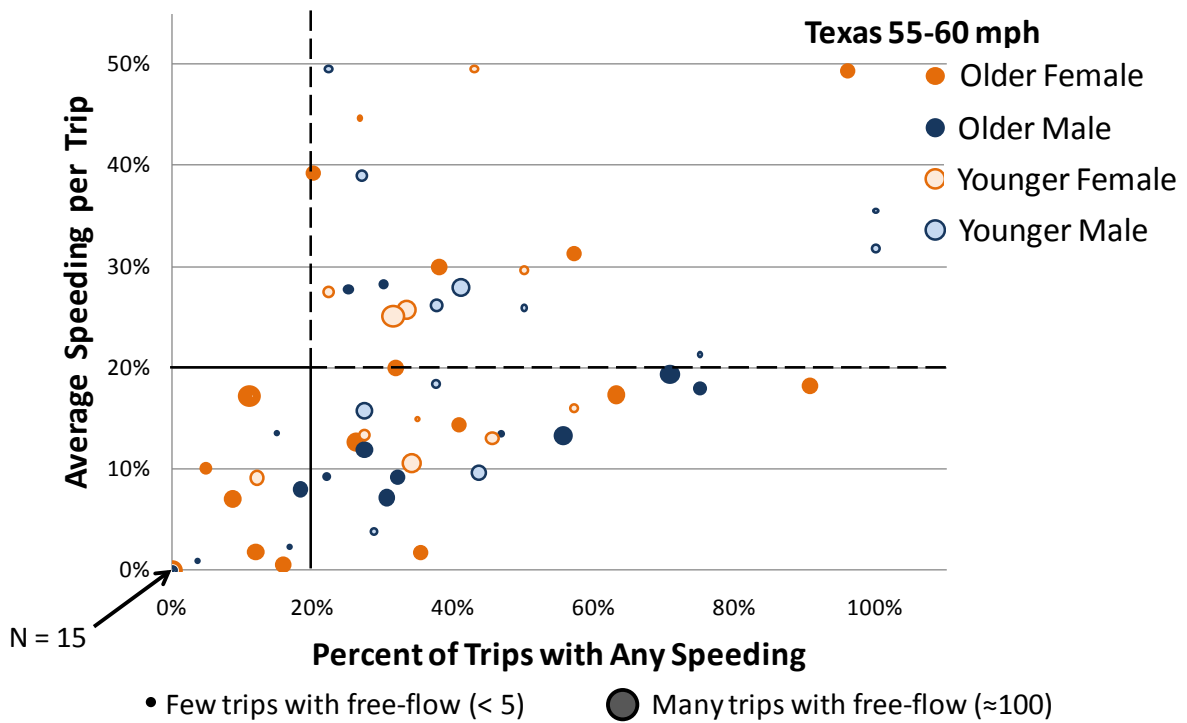
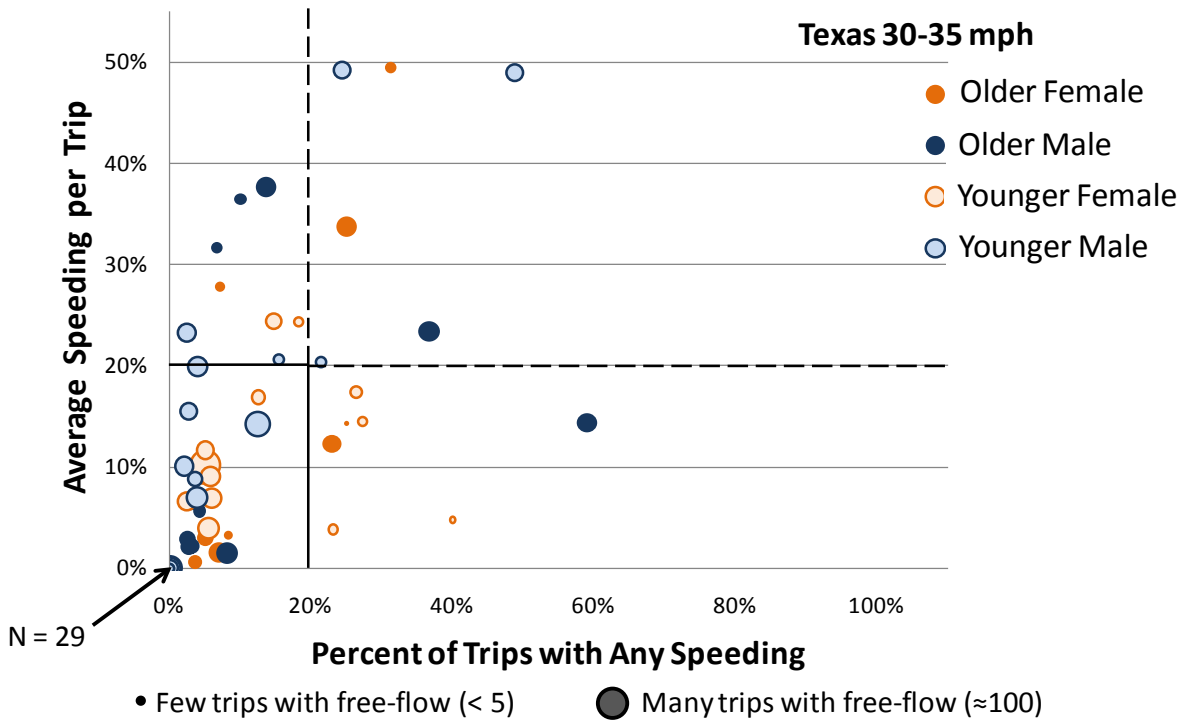
The scatter plots for Texas are shown in Figure 6, below. A notable finding for this location is that the scatter plot pattern for each speed band is markedly different from the others. Over one-third of the sample had no speeding on these 30 to 35 mph roads. There is also more of a “vertical” distribution of data points, which indicates that speeding is relatively uncommon on these roads. However, some drivers made a few trips where they sped for significant portions of the trips.

On 55 to 60 mph roadways, most drivers have fewer trips compared to the 30 to 35 mph speed band (i.e., smaller dots). In general, the speeders occupy a more central part of the graph than in other speed bands, with moderate amounts of speeding per trip occurring on a fairly regular basis (30-50% of trips). Another finding is that females make up the bulk of the “incidental” speeder group (i.e., Zone A).

Similar to the Seattle 55 to 60 mph speed band, there is *no* evidence of “situational” speeding among the group of drivers that speed infrequently (i.e., Zone B is empty).

On 70 mph roadways, most drivers also have fewer trips compared to the 30 to 35 mph speed band (i.e., smaller dots). Speeding per trip was substantially lower in this speed band than in any other. The lower speeding per trip numbers may reflect the possibility that these averages are depressed by longer trips taken on these roads.

In summary, the scatter plots show clear evidence for different types of speeding. Moreover, these types are expressed differently based on the types of driving they are associated with (i.e., different locations and speed bands), which suggests that roadway and driving conditions have an important impact on speeding behavior.



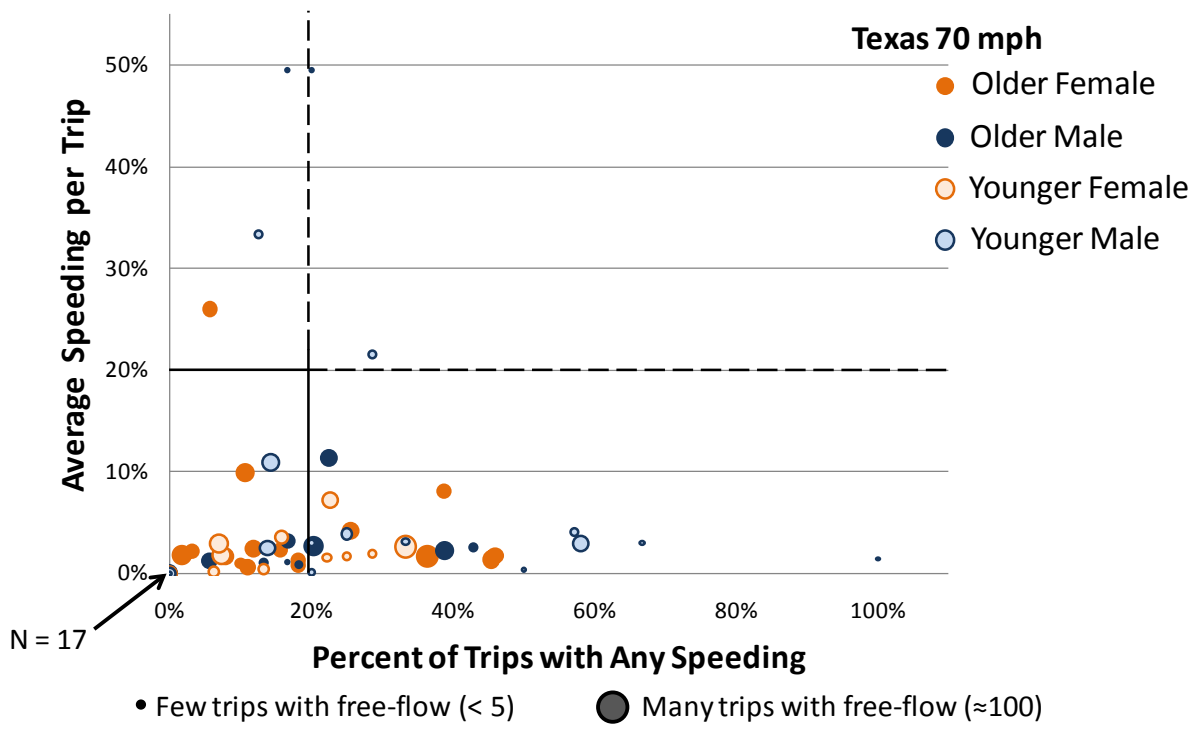


Figure 6. Texas – Scatter plots of types of speeders in each zone.

RESULTS OF THE INFERENTIAL ANALYSES

A summary of the regression modeling

A mix of logistic and linear regression approaches were used to address two key questions: (1) *who is speeding?* (logistic regression using a binary variable that describes whether or not any speeding occurred on a given trip), and (2) *who speeds the most?* (linear regression using the amount of speeding per trip, only on trips with any speeding, as the dependent measure). For each of these two approaches, we conducted two sets of analyses, the first using demographic (age and gender) and trip (time-of day, day-of-week) variables only, and the second using personality inventory variables as well.

Below, the models for the five speed-bands are combined into a single table for each type of regression conducted (logistic and linear regression), to facilitate direct comparisons of the findings. An abbreviated nomenclature is used to indicate which predictor variables are significantly greater than the comparison levels (i.e., Younger Male > Older Female means Younger Males were significantly more likely than Older Females to have any speeding in the logistic regression). In addition, to provide a better comparison of which personal inventory items are significant across models, each item was characterized using a brief phrase. More precise descriptions are available in the main inferential statistics results section and the complete personal inventory with response scales is provided in Appendix C in Volume III of this report.

Basic logistic regression: Who is speeding?

A summary of the five logistic regression models conducted with trip and demographic variables is shown in Table 4 below. Because this is an exploratory study with a relatively small sample size, we have also included some variables in the tables that are borderline statistically significant at $p < .10$. This is useful for comparing results across analyses, especially since the linear regression models in later sections had lower statistical power because several drivers had to be excluded for having no speeding.

Table 4. Summary of the five logistic regression models conducted with trip and demographic variables.

	Seattle 30-35 mph	Seattle 55-60 mph	Texas 30-35 mph	Texas 55-60 mph	Texas 70 mph
Demographic variables	<ul style="list-style-type: none"> – Younger Males > Older Females* – Younger Males > Older Males* – Younger Females > Older Females† 	<ul style="list-style-type: none"> – Younger Males > Older Females** – Younger Males > Older Males* – Younger Females > Older Females** – Younger Females > Older Males** 	<ul style="list-style-type: none"> – None 	<ul style="list-style-type: none"> – Younger Males > Older Females** 	<ul style="list-style-type: none"> – Younger Males > Older Females* – Older Males > Older Females† – Younger Males > Younger Females*
Trip variables (MR=morning rush hour) ^a	<ul style="list-style-type: none"> – Wkend > Wkday* – 9am-3pm > MR† 	<ul style="list-style-type: none"> – Wkend > Wkday** – MR > 12am-5am*** – 9am-3pm > MR† – MR > 7pm-12am† 	<ul style="list-style-type: none"> – Wkend > Wkday* – MR > 9am-3pm** – MR > 3pm-7pm** – MR > 7pm-12am* 	<ul style="list-style-type: none"> – None 	<ul style="list-style-type: none"> – None

*** $p < .001$; ** $p < .01$; * $p < .05$; † $p < .10$

^alogFFT (amount of Free-flow time per trip was significant in all models)

Demographic Variables: A general pattern in the logistic regression models is that Young Males and Young Females (in Seattle) are more likely than older drivers to have any speeding in a trip. This pattern is more consistent with Young Males in both locations, and it appears that Young Females may exhibit qualitatively different speeding behavior in Seattle and Texas (i.e., Young Females drive more like Young Males in Seattle, but more like Older Females in Texas).

Trip Variables: The odds of having any speeding are greater on weekend trips in the more built-up areas (Seattle and in-town in Texas). There are also some time-of-day effects in these areas, in which there is more likely to be any speeding during the morning rush hour comparison time period than during certain other times (this finding is discussed later). An exception to this is the midday time period in Seattle, which sometimes is more likely to have speeding than the morning rush hour. Another pattern is that trip variables were not significant predictors on Texas high-speed roads (55 to 60 and 70 mph). This might reflect generally lower traffic volumes on these roads.

Logistic regression with personal inventory variables: Who is speeding?

A summary of the five logistic regression models conducted with demographic, socioeconomic, trip, and factor-score variables is shown in Table 5 below.

Table 5. Summary of the five logistic regression models conducted with trip, demographic, and factor-score variables.

	Seattle 30-35 mph	Seattle 55-60 mph	Texas 30-35 mph	Texas 55-60 mph	Texas 70 mph
Demographic variables	– Younger Males > Older Females** – Younger Females > Older Females**	– Younger Females > Older Females***	– None	– Younger Males > Older Females†	– Younger Females > Older Females* – Older Males > Older Females†
Socioeconomic variables	– None	– Family Vehicle > Truck or Sports Car†	– None	– Income [15-45K] > Income [0-15K]* – Income [45-75K] > Income [0-15K]*** – Income [75K+] > Income [0-15K]***	– College Degree > No College Degree* – Truck or Sports Car > Family Vehicle*
Trip variables (MR=morning rush hour) ^a	– Wkend > Wkday†	– Wkend > Wkday** – MR > 12am-5am***	– Wkend>Wkday**	– 9am-3pm > MR* – 3pm-7pm > MR†	– None
Factor score variables associated with <i>increased</i> odds of any speeding	– Reckless/Road Rage* – Inattention***	– Bad Driving*	– Safety†	– Reckless* – Normative Beliefs***	– Reckless** ^b – Road Rage*** ^b – Normative Beliefs**
Factor score variables associated with <i>decreased</i> odds of any speeding	– Subjective Norms† – Opportunity***	– Temptation*** – Subjective Norms* – Opportunity*	– None	– Bad Driving* – Temptation*** – Dangerous Driving**	– None

***p<.001; **p<.01; *p<.05; †p<.10

^alogFFT (amount of free-flow time per trip was significant in all models)

^bReckless and Road Rage were two separate factors in Texas

Demographic variables: The inclusion of the socioeconomic variables and factor scores did not affect most of the significant demographic predictors in Seattle and Texas; however, some significant variables were eliminated on the high-speed roads in both locations (particularly Young Males). Additionally, when the socioeconomic and factor scores were considered, Younger Females were significantly more likely to speed relative to Older Females in the Texas 70 mph model.

Socioeconomic variables: A range of socioeconomic variables were significant in the different speed bands. Owning a family vehicle was a significant predictor of decreased odds of any speeding on 55 to 60 mph roadways in Seattle. Significant predictors of decreased odds of speeding in Texas were lower income (\$0 to \$15K, 55 to 60 mph speed band only), no college degree (70 mph speed only), and driving a family vehicle (70 mph speed band only).

Trip Variables: Fewer trip variables were significant than in the base models without the factor scores. The same pattern of significance for weekend trips still occurred. In addition, the mid-morningtime periods were significant in the Texas 55 to 60 mph speed band, and the evening time period began to approach significance.

Factor-score variables: Controlling for demographic variables, several factor-score variables were significant predictors of whether or not there was any speeding on a trip. As factor-score variables associated with increased odds of speeding, Reckless and/or Road Rage¹ were significant in three of the five speed bands. On the higher speed roads in Texas, Normative Beliefs² was also associated with increased odds of speeding. This may be an indication that drivers who reported being influenced by those individuals did not drive with them during the study.

Multiple factor scores were also associated with decreased odds of speeding. In Seattle, Subjective Norms (people who are important to them think they should keep near the speed limit) and Opportunity (likely to drive the speed limit when there is a limited opportunity to speed) indicated decreased odds of speeding in both speed bands. Another interpretation of the latter finding is that those drivers who reported being likely to speed when there was not a good opportunity to do so, had greater odds of having any speeding on a trip. The factor representing behavior and control beliefs related to temptation to speed (Temptation)³ was a predictor in both 55 to 60 mph speed bands, suggesting that drivers who indicated resisting the temptation to speed had lower odds of speeding.³ Bad Driving and Dangerous Driving⁴ also appeared on 55 to 60 mph roadways in Texas. This is a somewhat counterintuitive result, since Bad Driving and Dangerous Driving suggest that poorer driving skills and dangerous driving habits indicate a decreased likelihood of speeding. However, it could also reflect the possibility that speeders believe that they are better drivers than everyone else.

¹ Reckless Driving is defined as more frequently committing dangerous violations such as racing, driving drunk, and tailgating; Road Rage is defined as expressing hostile or angry actions towards other drivers. Note: these definitions are based on question wording in the Personality Inventory Questionnaires used in this study.

² Normative Beliefs are how different groups of people such as parents/kids, spouses, police, etc., would influence drivers to comply with the speed limit.

³ Temptation refers to being more likely to drive near the speed limit in situations when roadway factors provide temptation to speed.

⁴ Bad Driving refers to more frequently making driving mistakes that show a lack of skill; Dangerous Driving refers to risk taking behaviors (higher factor loadings indicate more dangerous driving behaviors).

These patterns illustrate a practical difficulty in broadly applying the current modeling approach in all of the speed-band conditions. In particular, drivers in Texas were more heterogeneous than in Seattle in terms of their driving patterns across participants. For example, Older Females did substantially more driving in outlying rural areas, while many younger drivers did most of their driving in-town on lower speed roads. The personal inventory questions, however, do not make specific references to either driving environment. Thus, participants may answer the questions with one type of driving/speed band in mind (e.g., they may be cautious drivers in town on 30 to 35 mph roads), but if they behave differently in other driving environments/speed bands (e.g., driving faster to cover longer rural distances on 55 to 60 mph roads), those same questions could be associated with different types of behaviors. An example of this could be the Texas 55 to 60 model in which the Bad Driving factor was associated with decreased odds of speeding. The specific items associated with this factor (i.e., red-light running, missing yield signs, etc.) are actions that would be more commonly expected to occur in-town on 30 to 35 mph roads rather than on 55 to 60 mph roads in rural areas.

Basic linear regression: Who speeds the most?

A summary of the five linear regression models conducted with trip and demographic variables is shown in Table 6 below.

Table 6. Summary of the significant variables in the five linear regression models conducted with trip and demographic variables.

	Seattle 30-35 mph	Seattle 55-60 mph	Texas 30-35 mph	Texas 55-60 mph	Texas 70 mph
Demographic variables	– None	– None	– None	– None	– None
Trip variables (MR=morning rush hour) ^a	– MR > 3pm-7pm*	– Wkend > Wkday** – MR > 12am-5am*	– None	– MR > 12am-5am*	– None

***p<.001; **p<.01; *p<.05; †p<.10

^alogFFT (amount of free-flow time per trip was significant in all models)

Demographic variables: None of the demographic variables were significant predictors of the proportion of speeding on a trip. This finding is discussed further in the section on linear regression models with factor-score variables below.

Trip variables: There is an inconsistent set of trip variables included across the speed bands at both sites. In Seattle and Texas on the 55 to 60 mph roadways, there was a higher proportion of speeding in morning rush hour trips than in nighttime trips. On 30 to 35 mph roadways in Seattle, there was a larger proportion of speeding during the morning rush hour than during the afternoon period. In the Seattle 55 to 60 mph speed band, trips taken on the weekend had more speeding than those during the weekdays, but otherwise this variable was not a significant predictor in other speed band models.

Linear regression with personal inventory variables: Who speeds the most?

A summary of the five linear regression models conducted with demographic, socioeconomic, trip, and personal inventory variables is shown in Table 7 below.

Table 7. Summary of the significant variables in five linear regression models conducted with trip, demographic, and factor-score variables.

	Seattle 30-35 mph	Seattle 55-60 mph	Texas 30-35 mph	Texas 55-60 mph	Texas 70 mph
Demographic variables	– None	– None	– None	– None	– None
Socioeconomic variables	– None	– None	– None	– None	– None
Trip variables (MR= morning rush hour)**	– MR > 9am-3pm [†] – MR > 3pm-7pm* – MR > 7pm-12am*	– Wkend > Wkday** – 12am-5am > MR** – 9am-3pm > MR** – 3pm-7pm > MR** – 7pm-12am > MR**	– None	– MR > 12am-5am*	– None
Factor variables associated with <i>larger</i> proportion of any speeding:	– None	– None	– Reckless [†] – Road Rage**	– Normative Beliefs**	– None
Factor variables associated with <i>smaller</i> proportion of any speeding:	– Temptation [†] – Subjective Norms [†]	– Temptation*** – Subjective Norms**	– Dangerous Driving*	– Bad Driving [†]	– None

***p<.001; **p<.01; *p<.05; [†]p<.10

[‡]logFFT (amount of Free-flow time per trip was significant in all models)

Demographic variables: The demographic variables were poor predictors of the proportion of speeding in a trip. Part of this may arise from the loss of statistical power that occurred once drivers and trips with no speeding were removed from the data set. However, another factor may be that the set of “high speeders” in each location contains drivers from all demographic categories (see also the scatter plots presented above). Taken together, this pattern of results suggests that the factors that predict how much speeding a driver does are more complicated than a simple demographic-category membership.

Socioeconomic variables: None of the socioeconomic variables were significant predictors of the proportion of speeding.

Trip variables: In Seattle, more of the trip variables were significant in the linear regressions, whereas in Texas they stayed the same. For the time-of-day variables in Seattle, more time periods were associated with a decreased proportion of speeding compared to morning rush hour, on 30 to 35 mph roadways. This may be related to the type of trips that drivers make during this time. In particular, drivers going to work may be under greater pressure to avoid being late and consequently more willing to drive faster if they get any opportunity to do so. However, on the 55 to 60 mph roadways in Seattle, driving at other times was associated with more speeding than driving during morning rush hour.

Factor-score variables: Most of the models had factor variables that were significant predictors of the proportion of speeding during a trip. Many of these variables are the same as they are in the logistic regression models, though in general the majority of the factors from the logistic regression models were not significant in the linear regression models. In Seattle, both speed bands had the same predictive factors. Temptation (resisting temptation to speed) and Subjective Norms (people who are important to them think they should keep near the speed limit) predicted a smaller proportion of speeding. The Texas

30 to 35 mph model showed that the Reckless factor (dangerous violations) and Road Rage (hostility and anger toward others) both predicted a greater proportion of speeding, while Dangerous Driving (dangerous driving habits) predicted a smaller proportion of speeding. The inclusion of Dangerous Driving as a predictor of a decreased proportion of speeding is counterintuitive.

Another finding is that the Texas 70 mph model had no significant factor predictor variables. This suggests that different types of variables may be stronger predictors of the proportion of speeding on these roads (i.e., geometry, roadway design, driving comfort, vehicle power) than the ones investigated in the current analysis.

FOCUS GROUPS

In Phase 2 of the Motivations for Speeding project, focus groups were conducted to gain insight about drivers' attitudes, beliefs, and motivations regarding speeding. The focus groups also gathered data on driver opinions about the challenges and benefits of various countermeasures to identify those that would be most effective with both risky speeders and opportunistic speeders. The objectives for the focus groups were to:

- Add to our understanding of speeding and speeders, over and above what was learned in Phase 1.
- Develop a more accurate taxonomy of high/low speed driver subgroups.
- Better understand the motives—as well as attitudes and habits—of these subgroups.
- Explore attitudes and behavioral influences pertinent to various countermeasures (e.g., increased enforcement, engineering and in-vehicle countermeasures, automated enforcement, and speed awareness courses) as well as the acceptance and potential effectiveness of the countermeasures.
- Descriptions of key motivations, attitudes, normative commitment to law, driving habits relevant to speeding and speeding countermeasures.

These objectives were addressed in four focus groups held in the two on-road data collection locations (two in each location) using drivers that participated in Phase 1 of this project. As best as possible, the sessions at each location were separated by speeder type. The methodology and findings are discussed in more detail in Volume II of this report. A summary of the key themes of the focus group responses to the countermeasures are presented in Table 8, below.

In the focus groups, there were differences in how some drivers interpreted the posted speed limits. In particular, the most common views were that the posted speed was either a maximum speed (firm limit), a target speed, or more of a minimum speed. Drivers in all groups understood the posted speed technically to be a maximum speed, and non-speeders in both locations reported that they considered it to be a hard limit. A contrasting view, shared by some drivers in all groups, was that the posted speed was more of a target speed than a maximum. A related view, only mentioned in the speeder groups, was that the posted speed was more of a minimum speed. In summary, the posted speed is technically perceived as a limit, but drivers have different interpretations of how fast it means they can drive.

Almost all drivers believed that they could exceed the posted speed limit before having to worry about getting a speeding ticket; however, there were differences in opinions regarding how far above the posted speed they could travel (referred to as the Ticket Speed), especially on different types of roads. Some drivers in most groups mentioned the relationship between speeding and safety. As their speed increases, their safety risk generally increases, but drivers in all groups believed that there was often a disconnect between the posted speed/ticket speed, and how fast they thought they could safely travel.

Drivers identified a few factors that caused them to drive faster. These included situational or trip-specific factors (such as being late for work), social pressure from other drivers, inattention to driving, and positive feelings about driving fast. Focus group participants also identified several factors that made them less likely to speed. These included ticket or crash risks, social pressure, and critical events that they had experienced in the past.

Table 8. Summary of driver responses to the countermeasures presented in the focus groups – participants’ views on how and why countermeasures may be effective or ineffective in reducing speeding.

Counter-measure	Effective	Ineffective	Comments
<i>Higher Penalties and Increased Enforcement</i>			
Higher Penalties	Target habitual, deliberate speeders	One-time higher bill is paid and then forgotten	Would be more effective if insurance rates increased or licenses were lost
Increased Enforcement	Seeing police officers or police cars seems to cause speed reductions; interaction with police officers is very unpleasant	None	Erratic driving around police officers may increase; could involve a positive action such as a free license renewal if they've received no tickets
<i>Engineering Countermeasures</i>			
Speed Tables	Cause discomfort; unavoidable; can't habituate	Can drive around them in a parking lane; can find an alternate route; not always effective at higher speeds (particularly in an SUV/truck)	May lead to rear-end collisions due to unnecessary slowing
Pavement Markings	May make noise so police can hear that you're driving too fast	Seem ineffective; may cause speed increases due to their design	None
Speed Displays	Very noticeable; more salient than regular speed limit signs; can lessen or increase social pressure to reduce speed; counter inattention	Forgotten soon after passing them; increase speed after passing them	Could be moved around to be in unfamiliar locations; should target specific areas with many hazards
<i>Vehicle-based Countermeasures</i>			
Speed Limiter	Good for target populations such as teens or habitual speeders	None	Perhaps the licenses of habitual speeders should just be taken away; sometimes extra speed is needed to pass or avoid hazards; violates driver rights and independence
Speed Limit Display	Is useful and provides positive reinforcement; informs drivers of the posted speed when it's unknown or when signs are blocked; helps drivers manage their speed choice risk	GPS locations are sometimes inaccurate; drivers go with the flow of traffic anyway; if drivers have decided to speed then they'll still speed; redundant with the roadway signs	Might cause driver distraction; vehicles could auto-report speeders to the police with this kind of information
Fuel Economy Display	Like a game; saves drivers money; provides real-time driving feedback	Some vehicles just get bad mileage; wealthy drivers won't care	Might cause driver distraction
<i>Automated Enforcement</i>			
Automatic Enforcement	Drivers would be unable to anticipate signs in random locations	The fixed location cameras might just lead to speed in other areas; the length of time between the infraction and the ticket reception is too long	Drivers don't have a chance to state their case with a police officer; cameras are not always accurate (e.g., red light cameras); may cause driver distraction; drivers may get tickets when someone else was driving their vehicle
<i>Speed Awareness Course</i>			
Speed Awareness Course	Raises awareness of speeding behavior	Drivers don't take the courses seriously	Need a higher time or monetary cost; should require mandatory in-person attendance; should show more graphic crash footage; educational for all drivers (not just speeders)

CONCLUSIONS

This study sought to gather information about driver speeding behavior. Using naturalistic driving data combined with data from focus groups, several basic questions about driver speeding patterns were examined. These include:

1. What is the relative importance of situational factors, demographics, and personality in predicting episodes of speeding?
2. What are the subtypes of drivers with respect to speeding?
3. To what extent are these classes of speeders defined by demographics?
4. To what extent is the predilection to speed correlated with the tendency towards other unsafe driving acts?
5. What attitudes, habits, and behaviors are directly or indirectly related to possible countermeasures (e.g., points systems, points reduction classes, checkpoints, automated enforcement, crackdowns, traffic calming measures, etc.), so that subgroups can be compared on these measures?

The findings related to each of these questions are discussed below.

What is the relative importance of situational factors, demographics, and personality in predicting episodes of speeding?

Using the criterion of 10 mph above the posted speed as the working definition of “speeding,” drivers engaged in speeding behavior during approximately 1 to 10 percent of their free-flow driving. However, that amount depended on a number of factors. For example, in Seattle, drivers sped during less than 5 percent of their free-flow driving time overall, and this amount was slightly higher on 55 to 60 mph roads than on 30 to 35 mph roads. In Texas, there was very little speeding on 30 to 35 mph ($\approx 2\%$) and 70 mph roads ($\approx 1\%$), but substantially more on 55 to 60 mph roads ($\approx 10\%$).

These findings provide a useful frame of reference for speeding behavior, but they obscure a more important finding, which is the variability in speeding across situational/trip-specific factors, demographic groups, and individual driver/personal characteristics. The majority of the analyses in the current report were focused on finding ways to quantify speeding behavior and identify different speeding patterns. This is a significant challenge with naturalistic data because of the wide range of driver-related, roadway-related, and situational/trip factors that cannot be controlled—or even fully documented—but are strong determinants of speeding behavior during a trip. Despite this challenge, some key trends in terms of speeding behavior were identified, including:

- It is relatively common for drivers to have at least some speeding on a given trip; however, there are some drivers that rarely speed.

- Younger drivers, especially Young Males, are more likely to have at least some speeding on a trip than other demographic groups.
- Certain driver beliefs and attitudes (described below) are associated with increased odds of any speeding, and a greater amount of speeding on individual trips.
- In general, there was a small set of habitual speeders in both Seattle and Texas, but this group seemed to be defined more by certain beliefs and attitudes, rather than by their demographic category.
- There is evidence for different types of speeding behaviors (i.e., situational, habitual, casual, and incidental speeders), and their relative prevalence—at least in part—depends on road type.
- Weekend and morning trips are more likely to be associated with speeding.

It is also interesting to consider some common views about speeding that were not borne out by the data:

- Speeding does not appear to be limited to a small group of drivers defined primarily by age (i.e., young) and/or gender (i.e., males).
- Speeding does not appear to be limited to a small group of drivers defined primarily by attitudes (i.e., reckless, risk-seeking, etc.).
- Speeding does not appear to be limited to rural or high-speed roadways (i.e., 55 to 60, 70 mph).

Speeding is clearly a complex behavior that is strongly influenced by a number of factors. Some of the specific situational, demographic, and personal inventory factors related to speeding behavior are discussed below.

Situational factors

As listed above, there were a number of significant effects associated with pervasive variables like age/gender and personality, but it seems likely that situational variables play a key role as well (e.g., type of trip, length of trip, presence of others in the car, presence of enforcement, opportunities to speed, road conditions, geographic location, etc.). Opportunity to speed is undoubtedly a key factor in this, as evidenced by the prevalence of the free-flow time (logFFT) and weekend predictors of speeding. In addition, the focus groups indicated that speed seems to be a deliberate choice made with consideration of outcomes (tickets, safety, approval of others, thrills, etc.), which highlights the influence of situational factors. We have paid the least attention (in terms of our data analyses) to these situational variables; some of them cannot be properly measured or characterized with the existing data set. But some can, and should be looked at in future analyses.

Demographic factors

A key objective of this research was to examine the extent to which speeding behavior can be predicted based on demographics. In terms of the descriptive analyses, this study found that Older Females as a group are typically not among the high speeders, whereas Males in general are more likely to speed. These findings should be interpreted cautiously; however, since driving patterns differ among the

demographic groups and the inferential analyses indicate that, once trip variables and driving patterns are accounted for, these relationships change.

In terms of the inferential analyses, clear and consistent results were found with regard to the percentage of trips with any speeding. A summary of the significant demographic predictors of any speeding is shown in Table 9 below. It is clear from this table that younger drivers, especially Young Males, have significantly greater odds of having any speeding than most other demographic groups. In Seattle, Young Females show similar significant effects to the Young Males as compared to Older Males and Older Females, but not in Texas (as compared to any other group). In Texas, Young Males also have significantly higher odds of speeding than Older Females on both 55 to 60 mph roads and 70 mph roads, and Older Males exhibited higher odds of speeding relative to Older Females on the 70-mph roads. There were also other effects that approached significance. In Seattle, Young Females had greater odds of speeding than Older Females. In Texas, Older Males were more likely than Older Females to speed.

Table 9. Summary of demographic differences based on the likelihood of any speeding on a trip.

Speed Band	Likelihood of Any Speeding	
	Seattle	Texas
30-35 mph	<ul style="list-style-type: none"> – Younger Males 2.4 times more likely than Older Females* – Younger Males 2.1 times more likely than Older Males* – Younger Females 1.9 times more likely than Older Females† 	– None
55-60 mph	<ul style="list-style-type: none"> – Younger Males 4.0 times more likely than Older Females** – Younger Males 3.2 times more likely than Older Males* – Younger Females 4.5 times more likely than Older Females** – Younger Females 3.6 times more likely than Older Males** 	– Younger Males 4.1 times more likely than Older Females**
70 mph		<ul style="list-style-type: none"> – Younger Males 3.0 times more likely than Older Females* – Older Males 2.0 times more likely than Older Females† – Younger Males 2.8 times more likely than Younger Females*

***p<.001; **p<.01; *p<.05; †p<.10

These patterns, however, only seem to hold for the speeding measure related to percentage of trips with any speeding. More specifically, the linear regression analyses conducted on speeding per trip indicated that none of the demographic variables were significant predictors of the amount of speeding per trip, in any speed band. It is unclear at this time why demographic variables are relatively poor predictors of the amount of speeding, although the low statistical power arising from the relatively small number of trips with any speeding was likely a factor.

A consistent pattern across most speed bands is that the clusters of habitual-speeders are often comprised of drivers from all demographic groups. In this case, it seems plausible that large amounts of speeding on a trip reflect certain personality traits, attitudes, or situational variables, rather than simple demographic category memberships. This is consistent with the findings from the linear regression analyses (i.e., there were significant personal inventory factor predictors found in most linear regression models) and the focus groups (i.e., drivers described a wide range of situational variables that affect their speeding behavior).

An additional set of variables examined in the regression models were the socioeconomic variables such as income, education, and vehicle type. In some way, the different sites represent demographic differences based on differences in driving experiences and cultural views. The analyses indicated that some socioeconomic variables were significant predictors of speeding in the logistic regressions that included personal inventory factors, but not the linear regressions. Also, different patterns of results were obtained between Seattle and Texas. For example, in Texas, driving a truck or sports car was associated with higher odds of any speeding, whereas the opposite was true in Seattle. Additionally, having completed a college degree and higher income levels were also associated with increased odds of any speeding in Texas. It is unclear if the vehicle-type measure reflected vehicle power or cost, but if it is the latter, either directly or indirectly, then there is a trend towards speeding being associated with affluence in Texas.

Personality

Driver motivations, beliefs, and attitudes were found to be highly significant predictors of both the odds of any speeding on a trip (*who speeds*), and the amount of speeding on a trip (*who speeds the most*). In some instances, these variables were generally stronger predictors than the demographic variables; when adding these personality variables to the regression models, many of the demographic variables were eliminated from the final regression models.

The Seattle regression models that incorporated factor score variables were more interpretable than the Texas models. In Seattle, factors related to dangerous/aggressive driving, inattentive driving, and bad driving habits were associated with increased odds of any speeding (see Table 10 below). In contrast, agreement that important people would approve of their driving near the speed limit and tendencies to resist the temptation to speed were associated with decreased speeding (both odds and amount of speeding) for this location.

The Texas regression models found some of the same factors to be significant as the Seattle regression models. Factors related to dangerous/aggressive driving were associated with increased odds of speeding and those related to resisting the temptation to speed were associated with a decreased odds of speeding (in some speed bands). However, the Texas data yielded regression models that also had a few counterintuitive predictors. In particular, some factors that might be expected to be associated with increased odds of speeding were actually associated with decreased odds, and vice versa. For example, reporting more frequently making driving mistakes (e.g., missing yield signs, misjudging the road surface) that show a lack of skill was associated with decreased odds of speeding and a smaller proportion of speeding on 55 to 60 mph roadways. Also, more frequently engaging in dangerous driving habits (e.g., accelerating at yellow lights, taking more risks when in a hurry) was associated with decreased odds of speeding on 55 to 60 mph roadways and a smaller proportion of speeding on 30 to 35 mph roadways (see Table 10). However, this pattern of results could also be explained if speeders simply believe that they are better drivers than everyone else and do not view their own driving as unskilled or dangerous.

As detailed in the discussion of these findings in *Results* chapter in Volume II of this report, these patterns in the Texas data illustrate some of the practical difficulties in trying to apply global measures of driver factors (i.e., personal inventory questions) to speeding behaviors that occur in specific contexts. If participants answered the personal inventory questions with one type of driving in mind (e.g., they

may be cautious drivers in town), but then behave differently in other driving environments (e.g., driving faster to cover longer rural distances), then the counterintuitive results could be explained. However, the personality predictors become more difficult to interpret for this speed band, since they may reflect attitudes and beliefs about a different driving environment than that in which the speeding was measured. In other words, when completing the personal inventory, participants may have had some specific driving context in mind that was not specified in the inventory questions; however, when we examine these personal inventory items in the context of driving on a specific road type, it may not be the same context the participant had in mind when doing the inventory.

Table 10. Summary of factor-score variables that were significant predictors of speeding behavior and variables that approached significance.

	Seattle 30-35 mph	Seattle 55-60 mph	Texas 30-35 mph	Texas 55-60 mph	Texas 70 mph
Logistic Regression (Predicting likelihood of any speeding on a trip)					
Factor score variables associated with <i>increased</i> odds of any speeding	– Reckless/Road Rage* – Inattention***	– Bad Driving*	– Safety†	– Reckless* – Normative Beliefs***	– Reckless** – Road Rage*** – Normative Beliefs**
Factor score variables associated with <i>decreased</i> odds of any speeding	– Subjective Norms† – Opportunity***	– Temptation*** – Subjective Norms* – Opportunity*	– None	– Bad Driving* – Temptation*** – Dangerous Driving**	– None
Socioeconomic variables	– None	– Family Vehicle > Truck or Sports Car†	– None	– Income [15-45K] > Income [0-15K]* – Income [45-75K] > Income [0-15K]*** – Income [75K+] > Income [0-15K]***	– College Degree > No College Degree* – Truck or Sports Car > Family Vehicle*
Linear Regression (Predicting average amount of speeding on a trip, for trips that have speeding)					
Factor variables associated with <i>larger</i> proportion of any speeding:	– None	– None	– Reckless† – Road Rage**	– Normative Beliefs**	– None
Factor variables associated with <i>smaller</i> proportion of any speeding:	– Temptation† – Subjective Norms†	– Temptation*** – Subjective Norms**	– Dangerous Driving*	– Bad Driving†	– None
Socioeconomic variables	– None	– None	– None	– None	– None

***p<.001; **p<.01; *p<.05; †p<.10

Nevertheless, although the previous section shows that demographic variables may be sufficient to predict some speeding trends, the significance of the personal inventory factors suggests a more complicated relationship between speeding and demographics. It is likely that there are some attitudes and beliefs—which may be thought of as primarily age related—that are more relevant to speeding than age alone. This was apparent in the focus group discussions of some older drivers who speed. In contrast to the more safety-conscious views of their non-speeder peers, the older speeders expressed views

usually associated with prototypical young speeders – such as describing speeding as an adrenaline rush. However, the number of participants in each demographic category was not large enough to examine personal inventory predictors of speeding separately within each group and to better map out the relationship between these views and speeding behavior.

Another notable finding is that demographic groups also differed in terms of their answers to several of the personal inventory questions. This finding was not examined in detail, but the sample personal inventory questions presented in the descriptive statistics section show stereotypical differences across groups in terms of risk-taking, attitudes, motivations, and behaviors. These differences may explain some of the patterns found in the regression models that included factor score variables.

What are the subtypes of drivers with respect to speeding?

Another interesting set of findings involved characterizing drivers based on scatter plots of the proportion of trips with any speeding versus the average speeding per trip. Different combinations of these measures generally can be mapped to different types of speeders reflecting:

- Incidental/non-speeders: drivers who speed on a small number of trips and for only a small portion of those trips, if at all;
- Situational speeders: drivers who speed a lot on a small number of trips;
- Regular/casual speeders: drivers who speed a small amount on a large proportion of their trips; and
- Habitual speeders: drivers who speed regularly for relatively large portions of their trips.

It may be possible to map these speeder types to specific situational aspects, such as being late, or more enduring factors, such as personality traits associated with chronic speeding. There was also some evidence of these speeder types found in the focus group discussions. For example, incidental/non-speeders, which were targeted in the non-speeder sessions, were more likely to describe the posted speed as a maximum limit. Non-speeders also described how if they sometimes ended up speeding because they got caught up with the flow of traffic, they would likely slow down once they realized they were doing so. A couple of drivers also described engaging in “situational” speeding on long trips only, since only on those trips would speeding result in an appreciable time savings.

However, it should be noted that on 55 to 60 mph roadways in both Seattle and Texas, there were no situational speeders. There are multiple possible explanations for this finding. The drivers who fall into this group may be pragmatic about their decision to speed, and only speed when they can save a noticeable amount of time (i.e., on longer trips). These trips were likely excluded from the analysis set because they occurred on roadways that were very far away from the installation sites, and therefore on roadways for which the speed limits were not validated and, therefore, the data could not be included in the analysis. Another explanation could be that the demarcation for situational speeding indicated in these graphs is set too high for this speed band. Alternatively, drivers may be taking advantage of only shorter duration speeding in these zones, which may not appear on the graphs due to how this measure (speeding per trip) is calculated.

At this time, the demarcation into these categories is somewhat arbitrary; however, the relative distribution of individual points within the scatter plots is fixed, providing a useful indication of general

patterns. On the other hand, if it were possible to develop a defensible speeding-type classification scheme, then this approach could form the basis for a classification-based analyses that could identify the personal inventory, driving behavior, and/or other variables that form the defining characteristics of each speeder type.

To what extent are these classes of speeders defined by demographics?

The classes of speeders described above are not well defined by demographics. Drivers from most demographic groups are represented in all of the speeder classes. There were differences across speed bands in the distribution of drivers across categories; however, with the exception of Older Male Situational speeders on Seattle 30 to 35 mph roads, it is difficult to identify clear clustering in speeder categories based on demographic group.

Another related finding is that the distributions of individuals across the different speeder types depended greatly on the particular speed band. Specifically, different speed bands in each location tended to show systematic patterns in terms of where individuals ended up in the scatter plots. These patterns may reflect global driving conditions (e.g., trip duration, roadway design) that lead to fast driving. The consistency of the classification of individual drivers across different speed bands was not examined.

To what extent is the predilection to speed correlated with the tendency towards other unsafe driving acts?

The primary measures of unsafe driving acts collected in this project were the self-report personal inventory factors calculated from related item responses on the personal inventory instruments. Three factors that had relatively direct mappings to unsafe acts included the following:

- *Reckless Driving*: Items that deal with dangerous violations such as racing, driving drunk, and tailgating
- *Road Rage*: Items that involve showing hostility and anger to other drivers
- *Dangerous Driving*: Items related to risk taking behaviors such as accelerating through a yellow light, taking risks when in a hurry, and cutting off other drivers

Overall, the findings regarding the relationship between these factors and the predilection towards speeding are mixed. In particular, the Reckless Driving and Road Rage factors were among the better predictors of increased speeding behavior, across all factors (see Table 11). However, the Dangerous Driving factors, based on the DeJoy/Cards Risky Driving Scale's risk taking items, were associated with lower odds of speeding in some of the Texas models, but not associated with higher odds speeding in any of the models.

Table 11. List of models in which self-report personal inventory factors related to unsafe acts were predictors of speeding.

Factor	Positive Correlation With Speeding	Negative Correlation With Speeding
Reckless Driving	<ul style="list-style-type: none"> – Seattle 30-35 mph Logistic Regression* – Texas 55-60 mph Logistic Regression* – Texas 70 mph Logistic Regression** – Texas 30-35 mph Linear Regression† 	– None
Road Rage	<ul style="list-style-type: none"> – Texas 70 mph Logistic Regression*** – Texas 30-35 mph Linear Regression** 	– None
Dangerous Driving	– None	<ul style="list-style-type: none"> – Texas 55-60 mph Logistic Regression** – Texas 30-35 mph Linear Regression*

***p<.001; **p<.01; *p<.05; †p<.10

Interestingly, the comments from the focus groups do not support the mapping between speeding and other unsafe driving acts. When drivers (particularly speeders) discussed their speeding behavior, they described how—when they were speeding—they felt that it was safe for the condition of the roadway on which they were travelling (e.g., good visibility, wide roads). The crashes or near-misses that they experienced generally changed their driving behavior in related driving environments, but not in all situations. Additionally, some drivers expressed the opinion that the posted speed is more of a minimum speed, or that it is set by considering the worst drivers in the population. Very few drivers expressed frustration at other slower-moving vehicles (Road Rage). Therefore, there were some factors correlated with speeding behavior that drivers did not mention in the focus groups. However, the focus groups were primarily a discussion of general speeding behavior, rather than unsafe acts specifically.

What attitudes, habits, and behaviors are directly or indirectly related to possible countermeasures, so that subgroups can be compared on these measures?

The analyses conducted in this project do not provide a satisfactory answer to this question. There was simply too much diversity in the factors that were associated with speeding, either in the regression analyses, or in the qualitative focus group discussions. Part of this may be due to our decision to select participants from a broad driver population, including groups such as Older Females that are not typically thought of as speeders. While this decision was consistent with the exploratory nature of this study, it likely made it difficult for potentially strong predictors of speeding to stand out among other factors because they may have been represented by only a small proportion of participants. Related to this is the fact that participants were not screened for markers of speeding behaviors, such as previous speeding tickets or certain attitudes. Consequently, there were no more than a few potentially “egregious” speeders that might have represented the rebellious or risk-taking attitudes typically associated with chronic speeding. Another contributing issue is that the small number of drivers participating in the focus groups makes it difficult to sort out central, commonly-held opinions from esoteric, isolated views. This leaves us with insufficient information to evaluate adequately the relative merits of different countermeasures.

However, one thing that the findings show—in terms of countermeasures—is that no single “catch all” solutions emerged in the focus group discussions that could address the multiple facets of speeding as a whole. A repeated theme in the focus groups was that countermeasures were limited in terms of their

geographic distribution (i.e., dynamic speed signs and police officers cannot be everywhere that people speed all the time). However, there are some ways to improve on these limitations by introducing unpredictability into where these measures are located. Another, related limitation of other countermeasures is that they are fixed in time rather than location. These include speeding awareness classes, public education campaigns, and to some extent infrequent encounters with police. The impact of these measures on drivers likely diminishes over time as drivers experience repeated trips without new reinforcement of the associated safety beliefs. For example, if a new driver leaves driver education successfully “scared” of the risks of speeding, repeated exposure to driving above the posted speed in harmless situations (i.e., inattention or keeping up with traffic) may undermine this driver’s original concerns.

The one class of countermeasures that is less affected by the limitations described above is in-vehicle devices. Since these devices are with the driver all the time, their “impact” is immediate and more relevant in time and location, assuming that drivers do not ignore them (in the case of the displays). The speed limiter (described to focus group participants as an instrument installed in the engine that would limit engine speeds) had low acceptance and is probably impractical to deploy on a wide scale. However, the speed limit and fuel efficiency displays are intriguing for three reasons. The first is that the participants in the focus groups liked the idea of speed limit and fuel efficiency displays and these displays seemed to address some of their desires for countermeasures to provide a reward rather than just a punishment (Note: none of these countermeasures were used in this study). The second is that they appear to indicate that situational factors may play a greater role in speeding than we originally anticipated; specifically, they provide useful and relevant information to the driver at all times, regardless of the specific circumstances. And third, they have not been deployed extensively in the United States, and at least have the merit of being a new approach to addressing the speeding problem. They have been shown to provide a significant mean reduction in vehicle speeds in some posted speed zones (Regan et al., 2006).

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