The Use of a Driving Simulator to Determine How Time Pressures Impact Driver Aggressiveness

SAFETY RESEARCH USING SIMULATION
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Abstract

Speeding greatly contributes to traffic safety with approximately a third of fatal crashes in the United States being speeding-related. Previous research has identified being late as a primary cause of speeding. In this driving simulator study, a virtual drive was constructed to evaluate how time pressures, or hurried driving, affected driver speed choice and driver behavior. In particular, acceleration profiles, gap acceptance, willingness to pass, and dilemma zone behavior were used, in addition to speed, as measures to evaluate whether being late increased risky and aggressive driving behaviors. Thirty-six drivers were recruited with an equal male/female split and a broad distribution of ages. Financial incentives and completion time goals calibrated from a control group were used to generate a *Hurried* and *Very Hurried* experimental group. As compared to the control group, *Very Hurried* drivers selected higher speeds, accelerated faster after red lights, accepted smaller gaps on left turns, were more likely to pass a slow vehicle, and were more likely to run a yellow light in a dilemma zone situation. These trends were statistically significant and were also evident with the *Hurried* group, but a larger sample would be needed to show statistical significance. The findings from this study provide evidence that hurried drivers select higher speeds and exhibit riskier driving behaviors. These conclusive results have possible implications in areas such as transportation funding and commercial motor vehicle safety.

1 Introduction

In the United States, approximately 30,000 people every year die in traffic crashes [1], and crashes are the leading cause of death for 15- to 24-year-olds [2]. Globally, traffic crashes claim the lives of 1.2 million people per year [3]. In the United States, "the driver behavior of exceeding the posted speed limit or driving too fast for conditions" is designated as "speeding-related" by the National Highway Traffic Safety Administration (NHTSA).

In both rural and urban areas, the risk of a crash is greatly increased as speed increases [4]. The severity of crashes involving pedestrians [5] and not involving pedestrians [6] increases because of increased speed. Nearly a third of fatal crashes in the United States are speeding-related [7], highlighting the importance of understanding and quantifying a person's speed choice.

A variety of survey studies have been performed to try to determine why people speed. In 2011, NHTSA conducted a nationwide survey of 6,144 households to ask people the reasons why they did, or did not, speed [8]. The survey results included 30% of people admitting to being "speeders" with an additional 40% classifying themselves as "sometime speeders." When asked why they sped, the most common response was "I'm late," which accounted for 35% of all responses. "Emergency/illness" was the next most common, which tallied to 31% of all responses. "In a hurry" and "traffic flow" each accounted for 7% of the responses.

Beck et al. [9] conducted a telephone survey of 796 licensed drivers to compare hurried drivers to unhurried drivers. They found that hurried drivers were more likely to admit to risky behaviors such as speeding and not wearing a seat belt. This work was followed up by another survey of 769 college students [10]. The results of this survey indicated that hurried drivers were more likely to be frustrated with other drivers, were more impatient and aggressive, and took more risks. Additionally, drivers who self-reported a ticket in the previous month were more likely to be hurried drivers. While these surveys point to reasons for speeding, there is a need to quantify how time pressures impact driver performance.

To date, several studies have been conducted to investigate this time phenomenon from a variety of perspectives, including the type of driver, roadway elements, and surrounding vehicles. Lee et al. [11] focused on how proposed stress-induction manipulations on newly licensed young drivers effectively produced negative emotions and behavior in a simulated drive. Another study [12] focused on the role of negative emotions on a subset of drivers, those with Attention Deficit Hyperactivity Disorder (ADHD), using a simulated drive. While there was no difference in operational driving skills, those with high ADHD symptoms reported more frustration and more impairment at the tactical level of driving.

To examine the impact of different road signs on driver patience levels, Naveteur et al. [13] showed participants films and used guided imagery to induce a time pressure. Overall, stop-length estimates and emotions altered the evolution of impatience, and time pressure as a contextual factor influenced impatience. Stephens and Groeger [14] compared anger levels of drivers based on the lead driver in a simulated drive. Drivers showed higher levels of anger when slowed down by a car marked "learner" versus an unmarked sedan and when slowed down by a work van versus an ambulance.

There has also been limited work in conducting simulated drives where driving performance can be directly monitored under different time-pressure situations. Driving simulation is an ideal mechanism to study time pressures because aggressive driving maneuvers can be induced without putting drivers at risk. Bertola et al. [15] constructed a study that investigated how driver inattention, familiarity, and time pressure affected driving performance on rural two-lane horizontal curves. The study consisted of 14 participants, of which 6 were subjected to two different time-pressure methods. The first was simply a scenario where drivers were to imagine that they were running late for a doctor's appointment. The second method added to that scenario a timer and small ($4) financial incentives for meeting goal completion times. The results indicated that the drivers with the time pressure had a higher mean average speed than the control group. However, possibly due to the small sample size, there was no difference between the methods. The lack of penalties, either for crashes or excessive speeding within the scenarios, may have resulted in a biased result as speeds would go unchecked. Additionally, the only aggressiveness metric that was evaluated was mean average speed across the drive. While the results of this study began to quantify how time pressures impact speed choice, there is a need for a more robust driving simulator study that can investigate speed in more detail along with additional driver aggressiveness measures.

1.1 Objectives

The objective of this current study was to determine how time pressures influence speed choice and driver aggressiveness. This objective was addressed by subjecting participants to varying time pressures and investigating the different outcomes. There were three overarching hypotheses:

1. Drivers in the control group, who are given no incentives, will make appropriate speed choices based on roadway conditions and posted speed limits and will not exhibit overly risky behaviors.
2. Drivers who are given an incentivized completion time goal, based on the 85th percentile completion time from the control group, will choose higher speeds and exhibit more aggressive driving behaviors than the control group as a whole.
3. Drivers who are given an incentivized completion time goal, based on the 15th percentile completion time from the control group, will similarly choose higher speeds and make riskier maneuvers than the control group but not the aggressive group.

2 Methods

A between-subjects experimental design was developed based upon existing literature to examine how time pressures influenced driving behavior. The following section outlines the research tasks that were employed to address the objectives of this study.

2.1 Participants

Before recruiting participants, three years of crash data (2012-2014) from the state of Massachusetts were analyzed to determine a logical distribution of participant ages. Since speed and driver aggression were a large focus of this study, the proportion of speeding-related crashes as a function of age was examined. While the proportion of crashes caused by speeding declined with age for both males and females, there seemed to be an inflection point around 30 years old when the decline became less pronounced. This inflection point is visualized in Figure 2.1 by linear best fit lines for before and after 30 years old. Based on this data, participants were recruited to achieve an equal split of participants under 30 years old and over 30 years old in addition to an equal male/female split. This age distribution of participants was important due to the financial incentives, which are explained below, that were used to simulate time pressures. A financial incentive may have a larger impact on college-aged participants than middle-aged participants.

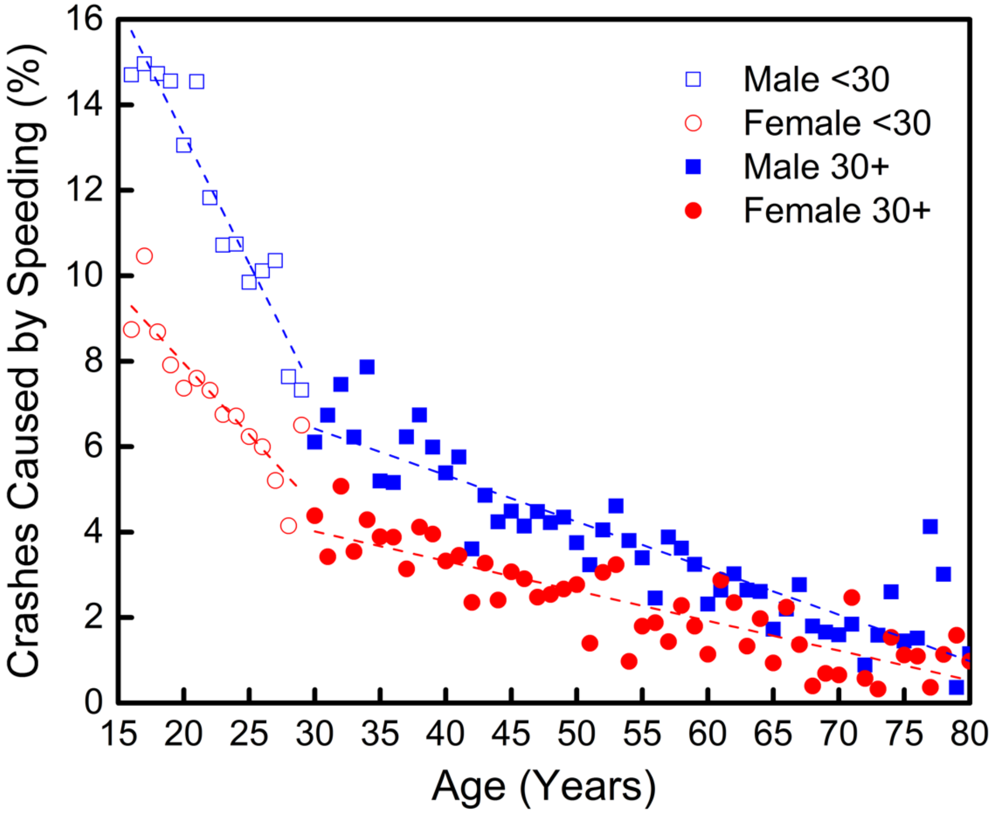

Figure 2.1 Proportion of crashes caused by speeding by age for males and females

A total of 36 licensed drivers (18 years and older; 18 males and 18 females) from the greater Amherst, MA, area were recruited as simulator participants. During recruitment, it was advertised that participants would be paid $15-30 compensation for their time. Participants were provided five minutes to drive in a practice training scenario to become familiar with the performance capabilities of the driving simulator prior to their experimental drive.

The experiment consisted of three groups (Table 2.1), all of which drove the same virtual scenario. The first 12 subjects were placed in the control group. The overall travel times from the control group were then utilized to determine the incentive times used in the experimental groups. Each group consisted of three males and three females under 30 years old and three males and three females over 30 years old. One participant in the *Very Hurried* experimental group withdrew due to simulator sickness, resulting in a partial dataset. A full comparison of participant demographics by group is shown in Table 2.1.

Table 2.1 Participant demographics

Group	Male Participants	Female Participants	Driver Age (yr) Mean ± Std. Dev.	Driving Experience (yr) Mean ± Std. Dev.
Control	6	6	31.1 ± 12.0	14.9 ± 12.1
Experimental (Hurried)	6	6	32.9 ± 13.9	15.9 ± 14.3
Experimental (Very Hurried)	6*	6	30.6 ± 9.2	13.3 ± 9.5

(*) A male participant in the *Very Hurried* group dropped out mid-drive, resulting in partial data.

Before the virtual drive, participants completed a questionnaire that evaluated the frequency at which they exhibited aggressive driving tendencies. Participants were asked to rate each question either "Never," "Rarely," "Sometimes," or "Often." The questionnaire included 13 actions, such as "Tailgate others to force move" and "Deliberately prevent other from passing." By assigning a value of 1-4 for "Never" to "Often," a mean aggressiveness score could be computed for each participant and thus each group. The mean scores, with a lower value meaning less aggressive, were 1.74 (control), 1.56 (*Very Hurried*), and 1.72 (*Hurried*). None of these differences were statistically significant. When coupled with the balancing of age and sex, the lack of statistical differences in the aggressiveness scores suggests that each of the groups was identical.

2.2 Apparatus

A Realtime Technologies Inc. (RTI) driving simulator, depicted in Figure 2.2, was used in the current study. It is a full-cab, fixed-base setup that includes a fully equipped 1996 Saturn sedan, with three screens subtending 135 degrees horizontally. At a resolution of 1024 x 768 pixels and a frequency of 60Hz, the virtual environment is projected on each screen through a network of four advanced RTI simulator servers equipped with high-end multimedia chips. The participant sits in the driver's seat and operates the controls, just as he or she would in a normal car. A Dolby surround system consisting of side speakers and two subwoofers located under the hood of the car provides realistic wind, road, and other vehicle noises with appropriate direction, intensity, and Doppler shift. Previous studies involving this simulator found that participants perceived their travel speed approximately 5 mph higher in the driving simulator, but speeds observed in the field closely matched speeds observed in a simulator environment that replicated the field drive [16, 17].

Figure 2.2 Driving simulator at the University of Massachusetts Amherst

2.3 Scenarios and Experimental Design

The entire drive consisted of a rural two-lane roadway with a 40-mph posted speed limit and contained nine signalized intersections (Figure 2.3)**.** At two of the intersections, drivers were instructed to turn left, and oncoming vehicles were scripted to test participants' gap acceptance while making a left turn. Four intersections were scripted to remain red until drivers reached the stop line and then would turn green. Sensors were built in so that participants' acceleration profile could be easily measured after each intersection. Two intersections near the end of the virtual drive were scripted so that the light turned from green to yellow when drivers were four seconds away, putting the driver in a dilemma zone situation.

There were five left horizontal curves and three right horizontal curves. Each curve had a length of 157 m and radius of 100 m. Lanes were 3.66 m wide (12 ft) with a 0.30 m shoulder (1 ft). There were no significant roadside objects or hazards.

Near the halfway point of the drive, a truck pulled out in front of the participants and traveled at 35 mph along a straightaway. A "Pass with Care" sign reminded participants that passing was allowed at that segment. After about a quarter mile, the slow-moving truck turned right at an unsignalized intersection, which allowed participants who chose not to pass the truck to resume traveling at a free-flow speed. Ambient traffic throughout the drive was individually scripted so that oncoming traffic was consistent for all participants.

Progress updates were placed at the 25, 50, and 75% points of the drive, and speed collection points were placed at fixed points to capture speeds before and after each of these three updates. The total drive lasted 14-16 minutes. A full layout of the virtual drive is depicted in Figure 2.3**.**

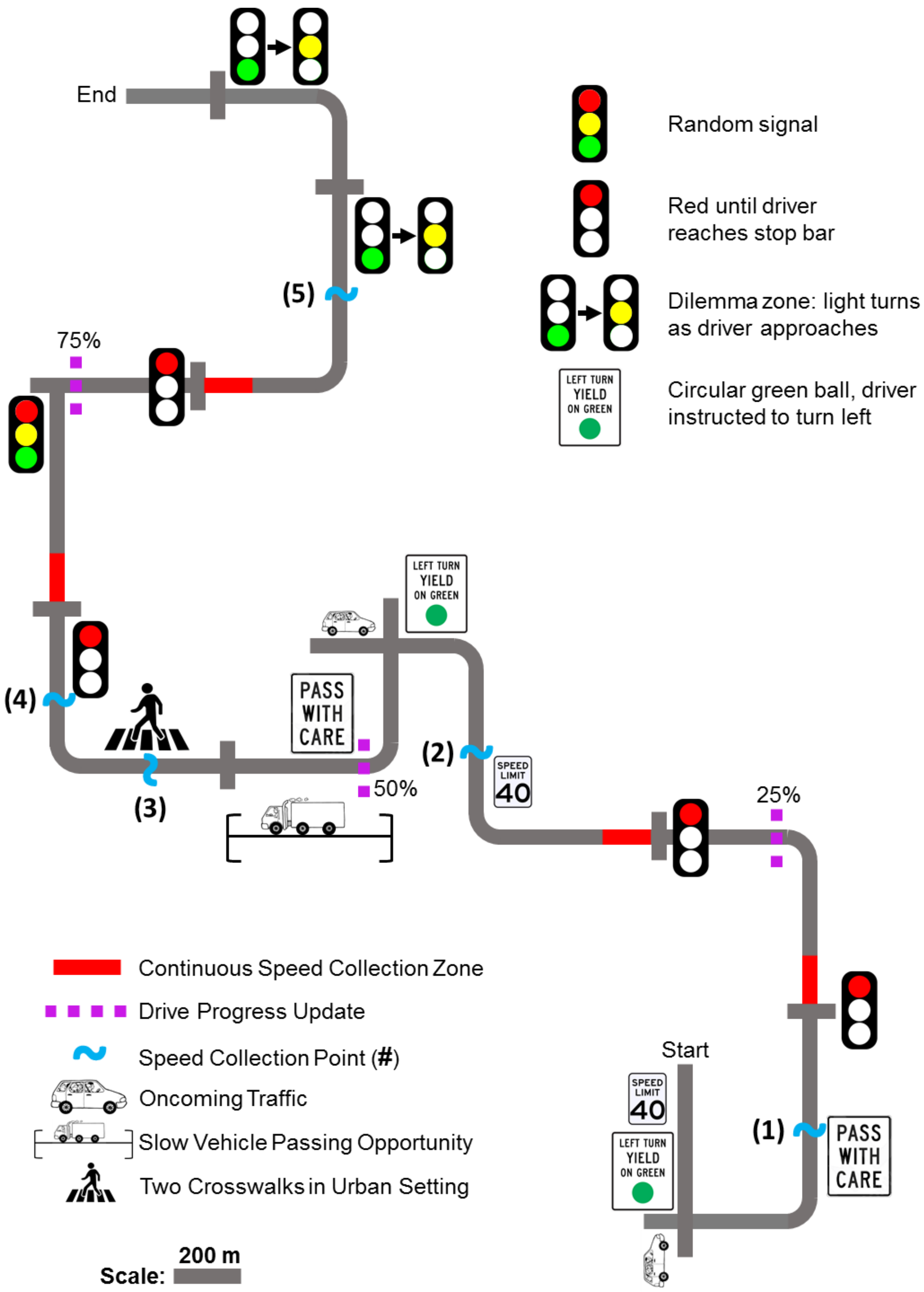

Figure 2.3. Schematic of virtual drive depicting various elements participants encountered

The independent variables were elements within the virtual drive, listed in Table 2.2, which were the same for both the control and experimental groups. These various elements were used to evaluate drivers' aggressiveness and included: unprotected left turns with oncoming vehicles, red lights, a slow lead vehicle within a passing zone, progress updates throughout the drive, and dilemma zones. The dependent variables were the participants' reactions to these situations. Table 2.2 contains the independent and dependent variables along with the hypothesized results from these variables.

Table 2.2 Variables and associated hypotheses

Independent Variable	Dependent Variable	Hypothesized Result
Speed checkpoints	Speed	Drivers in the experimental groups would select higher speeds.
Red lights	Acceleration profile after light turned green	Drivers in the experimental groups would accelerate faster after a red light.
Unprotected left turn with oncoming vehicle gaps: 3s, 3s, 1.5s, 2s, 2.5s, 3s, 3.5s, 4s, 4.5s, 6s, 10s	Size of gap accepted	Drivers in the experimental groups would accept smaller gaps than the control group.
Slow lead vehicle in passing zone	Willingness to pass	A larger percentage of drivers in the experimental groups would be willing to pass.
Dilemma zones	Willingness to abruptly stop for yellow light	A higher percentage of drivers in the experimental groups would be willing to run a yellow light in a dilemma zone situation.

2.4 Procedures

As described earlier, each of the 36 participants was randomly placed into one of three groups: control, *Hurried*, or *Very Hurried*. The following is a description of the groups and the specific instructions given to participants within each group.

Control group: Participants in the control group were given verbal instructions to drive as they normally would and were informed that the compensation range was simply used for recruiting purposes and that they would receive the full $30. Drivers in the control group saw pop-up notifications throughout the drive at 25%, 50%, and 75% drive progress. These notifications only displayed the percentage of drive complete and made no mention of time elapsed. The total drive times from the control group were used to calibrate the incentive times for the experimental groups. The 85th percentile drive time, representing the faster drivers, was approximately 14 minutes, and the 15th percentile time, representing the slower drivers, was approximately 16 minutes. These values were used as the incentive times for the *Very Hurried* and *Hurried* experimental groups, respectively.

Experimental groups: Participants were given verbal instructions that they would receive $30 if they i) avoided getting in any crashes, ii) avoided any "tickets" and iii) finished the drive in under 14 minutes (*Very Hurried* group) or under 16 minutes (*Hurried* group). Otherwise, they would receive the baseline $15 as compensation. The "tickets," in fact, were not coded into the drive, but the mention of them to participants gave the sense that police enforcement may be present. In order to conform to Institutional Review Board (IRB) requirements, all participants in the experimental group had to receive the full $30 compensation regardless of driving performance. However, this information was withheld from participants until after the drive to ensure that the incentive remained. Participants in these groups were also informed that they would see progress markers pop up on the simulator screen at 25%, 50%, and 75% drive progress. In addition to the drive progress, these pop-ups displayed the percentage of the 14/16 minutes that had elapsed and allowed participants to quickly evaluate whether they needed to speed up to meet the 14- or 16-minute deadline. These pop-ups would be analogous to drivers comparing their time remaining from GPS navigation to their clock.

All procedures, including informed consent, payment, and participant recruitment, followed Protocol ID#: 2016-3343 as approved by the IRB of the University of Massachusetts Amherst.

3 Results

The current driving simulator study examines how time pressures impact driving performance. A between-subjects experimental design was utilized where each participant was placed in either the control group, the *Hurried* experimental group, or the *Very Hurried* experimental group. The controlled laboratory settings allowed for the consistent manipulation of critical variables as well as the direct measurement of dependent variables. All statistical tests conducted were unpaired two-sample Student's t-tests using the software package Minitab. All error bars represent 95% confidence intervals, and a statistically significant difference ($p < 0.05$) from the control group is denoted by (*). Statistical significance ($p < 0.05$) between checkpoints within a group is denoted by a black bar.

3.1 Speed and Acceleration

The mean speed collected at five separate checkpoints is displayed in Figure 3.1. The drivers in the control chose a consistent speed throughout the duration of the drive, only statistically increasing their speed after the urban crosswalk section of the drive; checkpoint three ($M = 39.8$, $SD = 5.1$), checkpoint four ($M = 45.3$, $SD = 4.7$); $t(21) = -2.74$, $p = 0.012$. Participants within the *Hurried* group chose similar speeds as the control group and also only statistically increased their speed after the urban crosswalk setting; checkpoint three ($M = 41.1$, $SD = 5.0$), checkpoint four ($M = 46.5$, $SD = 5.0$); $t(21) = -2.69$, $p = 0.017$. This indicates that the time pressure placed on *Hurried* drivers was not enough to significantly alter their speed choice. Similar to the control and *Hurried* groups, *Very Hurried* drivers also statistically increased their speed after the urban crosswalk setting; checkpoint three ($M = 46.6$, $SD = 5.7$), checkpoint four ($M = 50.8$, $SD = 3.2$); $t(15) = -2.13$, $p = 0.050$.

In the control and *Hurried* experimental groups, participants reduced their speed in the urban area with two crosswalks (speed checkpoint #3) as compared to their initial speed choice (speed checkpoint #1). By contrast, participants in the *Very Hurried* experimental group still selected a higher speed in the urban crosswalk setting as compared to their initial speed choice. While these differences were not statistically significant, this observation supports the overall hypothesis that *Very Hurried* drivers would be more likely to engage in riskier behavior.

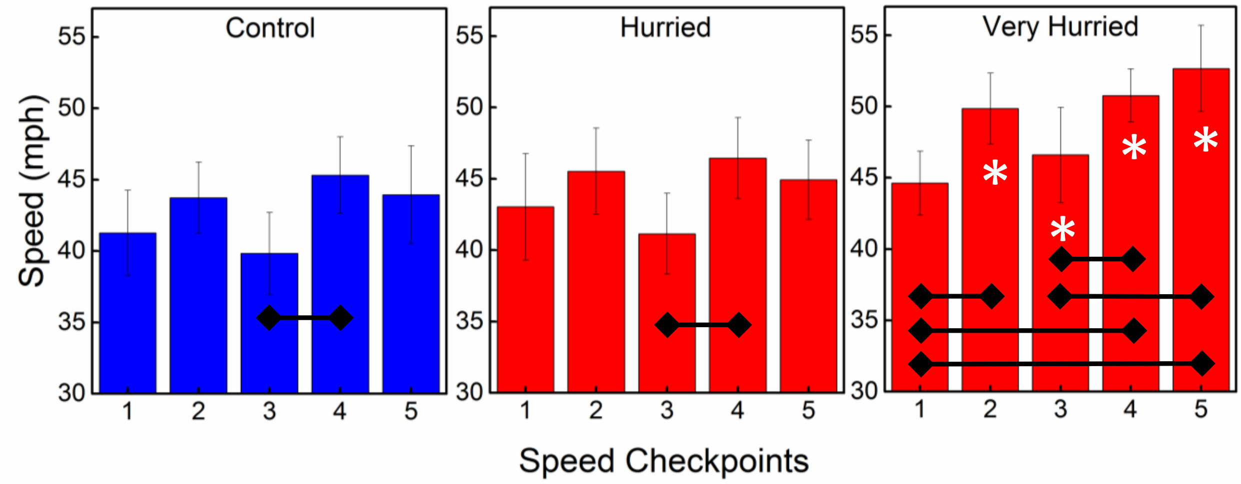

Figure 3.1 Mean speeds for each group at the five speed checkpoints

The *Very Hurried* drivers initially selected a speed similar to both the control and *Hurried* drivers, indicating that all drivers initially had the same perception of time. After the first progress update, the *Very Hurried* participants drove at statistically higher speeds than the control group for the rest of the drive (see checkpoints 2-5 in Table 3.1).

Table 3.1 Statistical speed checkpoint comparison versus control group

Checkpoint	*Hurried*			*Very Hurried*		
	df	T	P-Value	df	T	P-Value
1	22	-0.72	0.478	22	-1.76	0.093
2	22	-0.90	0.381	22	-3.40	0.003*
3	22	-0.64	0.528	21	-3.01	0.007*
4	22	-0.57	0.573	21	-3.27	0.004*
5	22	-0.44	0.666	21	-3.74	0.001*

(*) indicates statistical significance at 95% confidence.

With the exception of within the urban crosswalk setting, *Very Hurried* drivers statistically increased their speed after the first speed checkpoint (see Table 3.2). The increased speed selection can be attributed to drivers gaining a better perception of time from the first progress update.

Table 3.2. Statistical speed checkpoint comparisons within *Very Hurried* group

	1 vs. 2	1 vs. 3	1 vs. 4	1 vs. 5	2 vs. 3	2 vs. 4	2 vs. 5	3 vs. 4	3 vs. 5	4 vs. 5
df	21	17	20	18	18	19	19	15	19	16
T	-3.06	-0.96	-4.13	-4.19	1.53	-0.57	-1.40	-2.13	-2.64	-1.05
P-Value	0.006*	0.349	0.001*	0.001*	0.143	0.575	0.176	0.050*	0.016*	0.310

(*) indicates statistical significance at 95% confidence.

Vehicle speeds were continuously collected 600 feet downstream of the four red lights, resulting in four data points per driver (two data points for the participant who dropped out), enabling average acceleration to be calculated over that segment. Participants in the control group accelerated slower after red lights (M = 1.579, SD = 0.34) than participants in the *Very Hurried* experimental group (M = 1.963, SD = 0.32); t(91) = -5.63, p = 0.000. Participants in the *Hurried* experimental group accelerated faster than the control group but not as fast as the *Very Hurried* group; however, these differences were not statistically significant (see Table 3.3**).**

Table 3.3. Mean accelerations after red lights and inferential statistics

Group	Sample Size	Mean Acceleration after Red Light (ft/sec^2)	Statistical Comparisons to Control		
			df	T	P-Value
Control	48	1.579	-	-	-
Hurried	48	1.658	93	-1.10	0.273
Very Hurried	46	1.963	91	-5.63	0.000*

(*) indicates statistical significance at 95% confidence.

3.2 Gap Acceptance

Drivers in all three groups encountered two unprotected left turns with oncoming vehicles with fixed gap sizes that became progressively larger. The critical gap, defined as the gap size that 50% of drivers will accept and 50% will reject, was found by plotting the cumulative acceptance rate of the nine gap sizes presented to participants in the virtual drive (Figure 3.2). Similar to speed and acceleration results, drivers in the *Very Hurried* group were the most aggressive and had the smallest critical gap (4.8 sec). *Hurried* drivers had a critical gap (6.0 sec) that was higher than the *Very Hurried* group but lower than the control goup (6.4 sec).

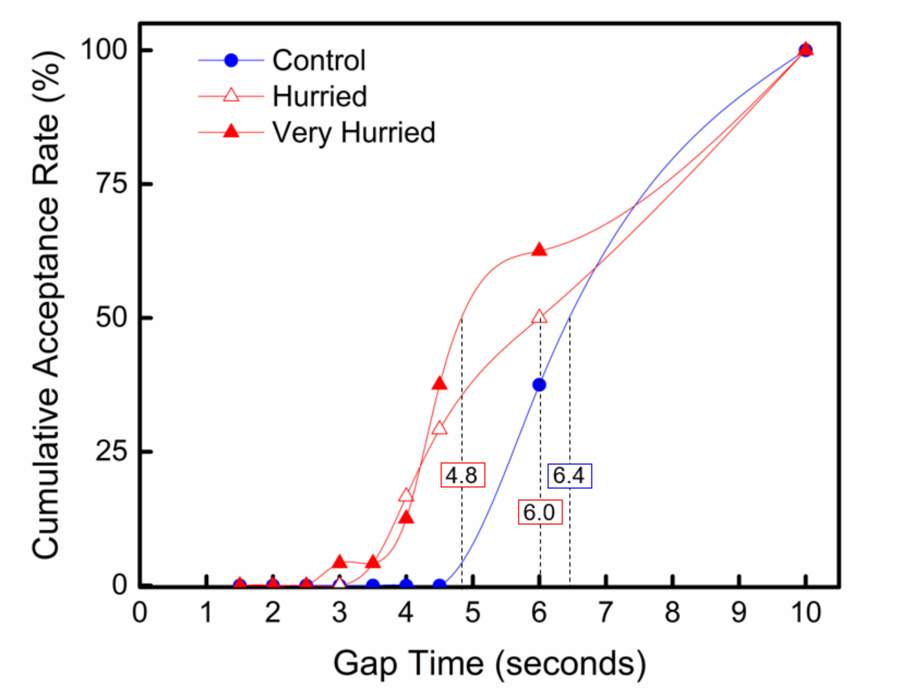

Figure 3.2 Cumulative gap acceptance rate for unprotected left turn with calculated critical gaps

Since a statistical test of the critical gap is not possible, a further examination of the differences was conducted by calculating the mean accepted gaps for the three groups (Table 3.4). For all three groups, the mean accepted gap was higher than the critical gap, which was likely due to the scripting of oncoming vehicles. If 7-, 8-, or 9-second gaps had been scripted, the mean for all three groups would likely have been lower. Nevertheless, the mean accepted gaps followed the same trends as the critical gap, with the *Very Hurried* group selecting the most aggressive gap, which was statistically different from the control.

Table 3.4 Mean accepted gaps for unprotected left turns

Group	Mean Accepted Gap (sec)	Statistical Comparisons to Control		
		df	T	P-Value
Control	8.5	-	-	-
Hurried	7.5	42	1.53	0.134
Very Hurried	6.7	41	2.68	0.011*

(*) indicates statistical significance at 95% confidence.

3.3 Other Aggressiveness Measures

In addition to speed, acceleration, and gap acceptance as dependent measures, participants had the opportunity to pass a slow-moving vehicle and were subjected to dilemma zones **(**Figure 3.3**)**. These scenarios further tested how time pressures affect driver performance. Around the halfway point of the virtual drive, a truck turned out in front of participants and drove at 35 mph, below the posted speed limit of 40 mph, and the participants did not know that the truck was going to turn off the road in a quarter mile. In the control group, only one driver chose to pass the slow-moving truck (8.3%). In the experimental groups, 4 of 12 *Hurried* drivers and 5 of 11 *Very Hurried* drivers passed the truck before it turned off the roadway, with the latter representing a statistically significant difference from the control (p = 0.029).

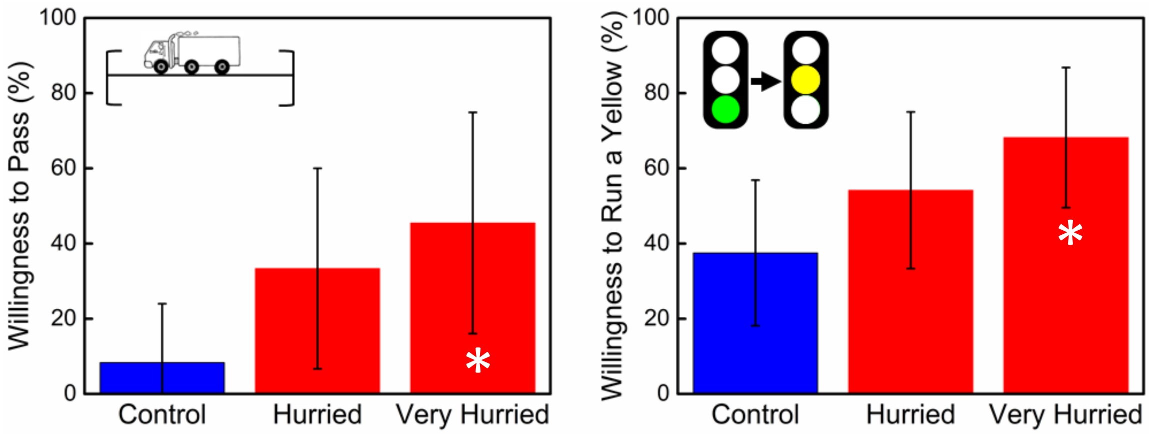

Figure 3.3 Willingness to (left) pass a slow-moving vehicle and (right) run a yellow light

When drivers were nearing the end of the drive, two signalized intersections put drivers in a dilemma zone situation, forcing a stop-or-go decision and resulting in two data points per driver. Specifically, these final two intersections were coded to be green as the drivers approached but turn yellow when the driver was four seconds from the intersection. Participants in the control group ran the yellow light 9 of 24 times (38%), *Hurried* drivers ran the yellow 13 of 24 times (54%), and *Very Hurried* drivers ran the yellow 15 of 22 times (68%). While *Hurried* drivers displayed riskier tendencies than the control group, this difference was not statistically significant. However, the difference between *Very Hurried* drivers and the control group was statistically significant (p = 0.029).

4 Discussion

The results of this study, with respect to speed, were not unexpected. Drivers who were *Very Hurried* drove faster. However, what was more interesting was that these *Very Hurried* drivers also selected smaller gaps, were more likely to pass a slow-moving vehicle, and were more likely to run a yellow light. This is interesting because speed choice is a conscious choice. If a driver knows they are traveling 60 miles and the speed limit of the road is 60 mph, but they need to arrive in 45 minutes, then they can choose a speed of 75 mph. What is less of a conscious choice are the small and instant decisions, such as whether or not to pass, that are made during a drive. This study has shown that time pressures not only increase driver speeds, but also increase aggressive driving maneuvers that could pose safety risks.

While there were no statistical differences between *Hurried* drivers and the control group or between *Hurried* drivers and *Very Hurried* drivers, *Hurried* drivers were always between the control and the *Very Hurried* group, showing a trend. An effect may have been present, but a larger sample size would have been needed to reveal statistical significance. If an effect were present, this indicates that even if the driver would arrive on time with non-aggressive driving, he or she might still alter his or her driving behavior due to the presence of a time pressure.

4.1 Limitations & Future Work

In this study, for the experimental groups, the consequences of getting in a crash or getting a ticket were equal to the consequence of not making the goal time, a loss of $15. In real life, the consequence of a crash would be demonstrably higher than being a few minutes late, and the consequences of a ticket would also be higher. This alignment of risks and benefits likely exaggerated some of the results of this study. While it is not possible in a driving simulator to simulate physical harm from a crash or financial hardship from a speeding ticket, future studies could use different incentive and penalty structures in an attempt to validate the findings from this study.

An instrumented driver study could further investigate the impacts of time pressures by pairing the naturalistic driving data with a journal or log of the participant's daily schedule. Such a log would enable the linkage of the participant's time pressure on a specific day with their recorded driving performance.

5 Conclusions

Thirty-six drivers participated in a driving simulator study that evaluated how time pressures impacted driving behavior. Travel times from a control group were used to determine the incentive thresholds for the experimental groups. The *Hurried* group had a goal time based on the passive drivers in the control, and the *Very Hurried* group had a goal time based on the aggressive drivers in the control. Speeds, accelerations, gap acceptance, dilemma zones, and a passing zone all tested participants' aggressiveness and risk tolerance.

The overarching hypothesis of this study was that drivers would choose higher speeds and make riskier decisions when subjected to greater time pressures. The hypotheses examined in this study all showed that time pressures placed on drivers resulted in more aggressive, riskier behavior. The most notable statistical differences came from a comparison of the control and the *Very Hurried* group. When compared to the control group, the *Hurried* group, who had less of a time pressure, also displayed the same qualities the *Very Hurried* drivers displayed, such as increased speeds and accelerations, a smaller critical gap, and increased willingness to pass and run a yellow light. These findings between the *Hurried* and control would most likely become statistically significant with a larger sample size.

5.1 Practical Implications

The practical implications of this research are abstract but nonetheless significant. The findings from this research indicate that drivers who are in a hurry select higher speeds and make riskier driving decisions. With the proliferation of GPS, drivers can monitor their projected arrival time in real-time and reroute themselves through local or neighborhood roads to avoid congestion. Projects primarily focused on relieving congestion may also yield safety benefits on surrounding roads in the network, as drivers may make more aggressive decisions based on the difference between their remaining projected travel time and their desired remaining travel time. This finding is important as funding agencies often have one pot of money for congestion projects and another pot of money for safety projects. The results of this study indicate that a project aimed to reduce congestion may also legitimately claim safety benefits.

Finally, the findings from this study may have implications to the field of commercial motor vehicle (CMV) safety. Truck drivers often operate with financial incentives tied to meeting certain delivery time goals. These incentives lead to time pressures on the driver and may lead to an increase in CMV crashes. Future research should explore how time incentives impact CMV safety.

6 References

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