Self-Management for Safety: Impact of Self-Monitoring versus Objective Feedback

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Abstract

Altering driver's goals and motives for at-risk driving is likely to reduce the frequency of at-risk driving behaviors and their associated crashes and injuries. However, most driving occurs when people are alone with little supervisions or accountability. Thus, a self-management for safety (SMS) intervention may be the most appropriate technique to decrease at-risk driving behaviors. The current research evaluated an SMS process with college students on a simulated driving task. Participants included 93 university students (41 males, 52 females) randomly assigned to one of three groups (31 participants per group). Participants in the Control group did not receive any of the intervention materials; they were instructed to drive as they normally drive on each trial. Participants in the Self-Monitoring + Objective Feedback group received objective feedback from the experimenter about their actual performance on the target driving behavior as well as personal feedback from their self-monitoring forms. These participants recorded their individual improvement goals on the targeted driving behavior. Participants in the Self-Monitoring group recorded their individual improvement goals on the targeted driving behavior, but received only personal feedback from their self-monitoring forms. Similar to past self-management interventions directed at increasing safety-related driving behavior (Hickman & Geller, in press; Krause, 1997; Olson & Austin, 2001), SMS led to clear improvement in subsequent safety performance. Based on the recorded driving behaviors of 93 participants, SMS was effective in increasing the mean percentage of total driving time traveling below the posted speed limit compared to a Control group that did not receive any of the SMS components. Across the four trials, participants in the SM and SM + OFB group significantly increased the percentage

of total driving time traveling below the posted speed limit by 13.4 (18.3%) and 14.5 (19.8%) percentage points, respectively, compared to participants in the Control group.

Acknowledgments

I dedicate this dissertation to my dissertation committee, friends, and beloved family. Thank you all for being there for me during this difficult time. The dissertation was easy compared to the personal hell I went through right before my dissertation defense. You all made this possible. There were times I didn’t think I had the strength or sanity to make it, but you all had faith in me. I never dreamed that people could be so supportive, caring, encouraging, and trusting during my darkest hour. I just wish this momentous occasion was not forever scarred by my personal tragedy. I’ve been preparing for this moment for over 10 years; I will never know or experience the joy of passing my dissertation defense and being congratulated by my dissertation committee members as an equal. I hope this is the only regret I have in my life. I’m reminded of a quote by Locke and Latham (1990), “Life without elements of challenge can be rather boring.” The last two months have been anything but boring.

I learned a lot about myself during this time. I can thank Ashleigh for that. If it wasn’t for her I wouldn’t have been able to change. I can never repay all the support, time, and faith you all placed upon me. I’m forever indebted to you all. I love you all, thank you!

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Background and Significance

More persons aged 1 to 34 years die as a result of unintentional injuries than any other cause of death. Additionally, unintentional injury is responsible for more years of potential life lost before the age of 65 than cancer and heart disease combined. Across all ages, 101,537 persons died in 2001 as a result of unintentional injuries. Motor vehicle crashes account for approximately one-half (n = 43,788) of these deaths (National Center for Health Statistics, 2004).

Motor vehicle crashes and their associated injuries and fatalities are often predictable and preventable. For example, increased use of safety belts and reductions in driving speed are two of the most effective behaviors that can reduce motor vehicle-related crashes and their associated fatalities and injuries (Insurance Institute for Highway Safety, IIHS, 1998). Yet, many drivers choose to drive in ways that put themselves and others at risk for vehicle crashes and serious injury.

Minor changes in driver behavior can prevent injury and save lives. The dramatic risk of vehicle speed is illustrated by the estimated annual savings of 2,000 to 4,000 lives and 2,500 to 4,500 serious injuries as a result of the nationwide reduction in the highway speed limit to 55 mph in 1974 (Waller, 1987). When the national speed limit was later raised to 65 MPH, the occurrence of vehicle crashes showed a marked increase (Evans, 1991). Moreover, it is estimated that safety-belt use saved 135,102 lives since 1975 and 11,889 lives in 2000 alone. If all passenger vehicle occupants over the age of four used safety belts, 21,127 lives could have been saved in 2000 (National Highway Transportation Safety Administration, NHTSA, 2003). In fact, it has been calculated that for every one percent increase in the use of safety belts nationwide, 200 lives are saved each year. Given this, it is alarming that nationwide belt use is still below 70% (NHTSA, 2004b).

Approaches to Reducing Traffic Crashes and Fatalities

It wasn't until the early sixties that transportation safety experts began directing their research efforts at making vehicles and our nation's roadways safer (IIHS, 2001). The implementation of these technical advances has dramatically increased survivability in crashes. For example, the addition of safety belts, air bags, safety glass, crumple zones, anti-lock brakes, and improved roadway surfaces have dramatically reduced fatality and injury rates. In fact, it has long been known that wearing a safety belt can reduce vehicular fatalities and serious injuries by as much as 50% (Federal Register, 1983). The safety benefits provided by these advances are illustrated in Figure 1 on the following page. Figure 1 displays the number of million vehicle miles traveled (VMT) and the fatality rate per million VMT by all vehicles from 1992-2002. While the number of million VMT by all vehicles has increased by 21.4% since 1992, the fatality rate per million VMT has decreased by 18.1% over the same time period (NHTSA, 2004a).

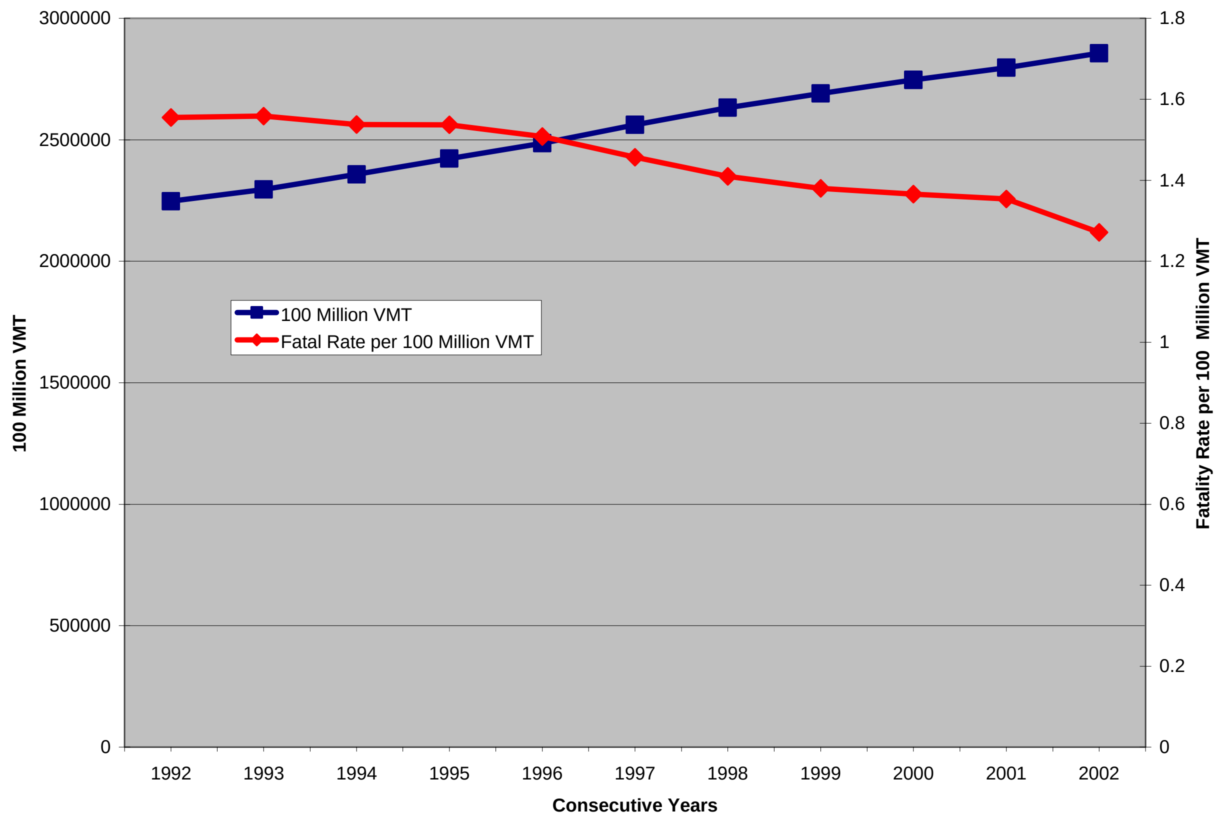

Figure 1. Number of Million VMT and Fatality Rate per Million VMT by all Vehicles From 1992- 2002.

Education and Training

Training and education programs have long been the standard for reducing vehicle crashes. Unfortunately, most of these training programs are geared toward drivers obtaining their driving license. Yet, some programs focus on increasing psychomotor skills and physiological functions and mastering traffic situations. The rationale behind training and education programs is that increased driving skill will translate into safe driving, thereby reducing crashes and their associated injuries and fatalities.

However, some studies have found that attempts to improve safety by increasing driving skills have little effect on crash rates (Christensen & Glad, 1996), while others have found both positive and negative results (Katila, Keskinen, & Hatakka, 1996). Williams and O'Neil (1974) found that race car drivers (arguably the most skilled drivers) had higher vehicle crash rates than the population in general. Hatakka, Keskinen, Gregersen, and Hernetkoski (2002) cite research by Renge (1983) that shows drivers who easily achieved the required level of skill on a driving test were involved in more crashes and violations after the driving test than those who took longer to master the same driving skills. In Ker, Roberts, Collier, and Bunn's (2004) review of 24 studies that assessed post-license non-commercial driver education programs found "no evidence that post-license driver education is effective". Thus, prior research does not always support the claim that improved driving skill decreases vehicle crashes.

Many driving behaviors (such as using safety belts and driving below the speed limit) are often performed intentionally. Recent studies indicate that education and training programs have little, if any, effect on these behaviors. While education is likely to increase knowledge, the expanded knowledge rarely results in behavior change (IIHS, 2001). On the surface, drivers are aware that driving without a safety belt and faster than the speed limit are wrong, yet these behaviors occur with some frequency (NHTSA, 2004a). While both knowledge and skill may be *necessary* components for safe driving, they are often not *sufficient*.

Näätänen and Summala (1974) indicated that adequate psychomotor skills and physiological functions may not be sufficient for safe driving performance. They suggested that drivers' motivational and attitudinal factors (i.e., their goals and motives for driving) are more influential in increasing safe driving performance. Hatakka et al. (2002) indicated that a hierarchal approach describes driver behavior best. Figure 2, shown on the following page, illustrates Hatakka et al's. (2002) hierarchal levels of driver behavior.

Figure 2. Hatakka et al's (2002) Hierarchy of Driving Behavior.

At the bottom level is vehicle maneuvering, such as controlling vehicle speed, direction, and position. Followed by the next hierarchal level, mastering traffic situations, such as adapting to the demands of the traffic environment. The second highest level is related to goals and the context of driving, such as the purpose, environment, and social context. The highest level in the driving hierarchy, related to the person's broad goals and motives for living, includes the importance of vehicles on personal development and skills for self-control.

Training and education programs target the bottom two levels of the hierarchy. However, these skills are performed under the guidance of higher goals and motives. Thus, additional skills and knowledge will do little if they are not related to the person's goals. For example, if a driver's goal is to get from point 'A' to point 'B' as fast as possible, then training and education programs are likely to have little effect on safe driving. In fact, hazard skills training may actually increase at-risk driving behavior in some drivers because the increase in skill may cause some drivers to believe they can travel more safely at higher speeds. This is what Katila, Keskinen, and Hatakka

(1996) hypothesized after they found a negative effect after training drivers to master slippery road conditions.

This is not to say the hierarchy is a top-down process. As Hatakka et al. (2002) state, “Changes in lower levels also have effects on the whole system” (p. 203). This can be both positive and negative. For example, what if increases in driving skill (even if imagined) satisfy the need for maintaining a higher speed. It may also be that training and education programs, while increasing driving skill, make some drivers realize the negative consequences of at-risk driving. It would appear that altering the driver’s goals and motives for at-risk driving are likely to reduce the frequency of at-risk driving behaviors and their associated crashes and injuries.

Self-Management for Safety

Geller and Clarke (1999) suggest a self-management approach to increase safety-related work behaviors with solitary workers or workers with little accountability. A self-management for safety (SMS) intervention motivates employees to choose the safe alternative and holds them accountable for selecting the safe alternative. Similarly, when Knipling, Hickman, and Bergoffen (2003) reviewed effective safety management techniques for commercial motor vehicles, they also suggested a SMS process may be the only practical behavior-based technique that will work with professional truck and bus drivers who work alone. A SMS process is self-directed and motivates safe driving behavior through the selection of individual safety-related driving goals. Thus, a SMS process attempts to alter the highest two levels of Hatakka et al’s. (2002) driving hierarchy.

Self-regulatory capabilities. People are presumed to have self-regulatory capabilities allowing them to motivate and regulate their behavior through internal standards and self-evaluation of their behavior (Bandura, 1986, 1997). Self-regulation operates through three subfunctions: a) self-observing one’s behaviors, determinants, and effects, b) judgment of behavior compared to a standard, and c) affective self-reaction. More specifically, the process of self-regulation follows the general order of: a) self-observation of one's behavior, b) comparing the behavior to personal standards, norms, and the behavior of others, c) determining the value of the activity, d) attributing the performance to control within or external to the person, and e) reacting positively or negatively toward the self with rewards or penalties (Bandura, 1986, 1991, 1997).

The practical benefits of self-management processes have been documented in numerous clinical settings, including the reduction of alcohol consumption (Garvin, Alcorn, & Faulkner, 1990; Sitharthan, Kavanagh, & Sayer, 1996), the control of personal weight (Baker & Kirschenbaum, 1993), exercise (Konradi & Lyon, 2000; Norman, Abraham, & Conner, 2001; Saelens et al., 2000), and the cessation of smoking (Curry, 1993; Shiffman, 1984). While the health literature is replete with successful applications of self-management interventions, the potential benefits of using self-management techniques to improve safety-related work behaviors have received little attention. The author could only find three published studies that have successfully used self-management techniques to increase the safety-related driving behaviors of: a) bus divers (Olson & Austin, 2001), b) short-haul truck drivers (Hickman & Geller, in press), and c) metropolitan bus drivers (Krause, 1997). Hickman and Geller's (2005) review of successful SMS techniques indicated that a successful SMS process should include goal setting, self-monitoring, and objective feedback. These are briefly described below.

Goal setting. A goal is an object, aim, or endpoint of action that describes what people are trying to accomplish. The basic theory proposes that goals and performance have a linear relationship (i.e., higher goals lead to higher performance). This assumption holds true only if the individual has accepted the goal and is committed to achieving the goal. Specific, difficult goals lead to higher performance than vague, “do your best” goals (Locke & Latham, 1990). Several reviews and meta-analyses have supported the basic tenets of goal-setting theory (Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Latham & Yukl, 1975; Locke, Shaw, Saari, & Latham, 1981; Tubbs, 1986; Wood, Mento, & Locke, 1987). Goals affect performance through four mechanisms, including: a) energizing people to commit resources to the demands of the goal, b) motivating people to persist over time to achieve the goal, c) focusing attention on the task at hand, and d) developing appropriate task strategies (Locke & Latham, 1990).

The current research required participants to set a personal goal for improvement on the targeted driving behavior. While Hickman and Geller (2004) used goal-setting techniques in their SMS intervention, they didn’t control for differences in each participant’s individual goal nor assessed the amount of variance in safe-driving behavior attributed to personal goals. The current research addressed these limitations by using goal setting as a covariate in the analyses and as an independent variable in a regression analysis.

Self-monitoring. Self-monitoring refers to an individual observing and recording occurrences of his/her own behavior (Nelson, 1977). Self-monitoring enables people to discriminate the occurrence of behavior better than casual self-observations and self-reports (Nelson & Birkimer, 1978). Positively-valued self-monitored behaviors are likely to increase and negatively-valued self-monitored behaviors are likely to decrease; whereas neutrally-valued behaviors are likely to show no behavior change (Kopp, 1988). Self-monitoring provides people with information that allows them to gauge their progress, but is likely to fail if people do not have a standard to compare prior behavior. Goals add value to behavior, but are presumed to influence behavior only with the addition of feedback (Locke & Latham, 1990; Tubbs, 1986).

Traditional self-management interventions advise the reporting of results (i.e., feedback) from personal observations (i.e., from self-monitoring). Self-monitoring, however, may lack the accuracy and reliability available from a more objective observational system, as well as a context that makes the observations meaningful by providing standards of acceptable behavior. Indeed, people need to learn how to observe and record their own behavior (Bandura, 1986).

People's subjective interpretations can be influenced, thus altering self-monitoring in several ways, including: a) lack of sustained effort and focused attention, b) affective experiences that distort self-perceptions, c) impaired recall, and d) schemas that alter or filter information (Bandura, 1986). Further, Bandura (1986) states, "Since people's attentiveness to their ongoing behavior fluctuates widely, they are not always all that self-observant" (p. 337). As many safety-related driving behaviors are repetitive and habitually performed, concurrent events may compete for attention and result in inaccurate self-observations. Critchfield, Tucker, and Vuchinich (1998) found that people are most likely to make overly positive self-reports for behaviors that occur frequently and to make overly negative self-reports for behaviors that occur infrequently.

Objective feedback. In contrast, objective behavioral observations enable the delivery of feedback that is reliable and accurate, providing valid information about an individual's deviance from a standard or acceptable performance. The addition of objective feedback to self-monitoring can influence the accuracy of subjective interpretations. For example, the feedback used by Hickman and Geller (2003) allowed miners to compare their individual self-monitored feedback with individual feedback obtained from obtrusive observers. By comparing self-monitoring with objective observations, the researchers found that miners became progressively more accurate with more intervention experience. They hypothesized the miners were using the objective feedback to alter their self-monitoring. In fact, a regression analysis showed a significant correlation between accuracy scores and safety improvement (from baseline to intervention). Other researchers have found the addition of objective feedback to increase the accuracy of self-monitoring (Kopp, 1988; McCann & Sulzer-Azaroff, 1996; Sharp et al., 1995).

The addition of objective feedback is beneficial for two reasons: a) employees can make comparisons between actual and self-reported safety performance to increase the accuracy of their self-observations, and b) an accurate evaluation of program effectiveness is provided. It may be inadvisable to rely solely on the data from self-observations to evaluate the impact of intervention effectiveness because of the inaccuracies and overly positive self-observations inherent in self-monitored data (Bandura, 1986, 1997; Critchfield, Tucker, & Vuchinich, 1998). The current research compared a group of participants who received individual objective feedback on a targeted driving behavior (in addition to personal feedback from self-monitoring) to a group of participants who received only personal feedback from self-monitoring.

Summary

Research has shown that personal goals are a potent motivator of human behavior (Bandura, 1986, 1990, 1991, 1997; Bandura & Cervone, 1983, 1986). Yet, these goals have little effect without information regarding progress toward these goals. The current research altered participant's immediate goals for driving, thereby influencing the second highest level in Hatakka et al's (2002) driving hierarchy. To accomplish this, the current research evaluated the SMS process with college students on a simulated driving task. As this was one of the first studies to systematically assess various SMS techniques, the current setting (a driving simulator) and population allow greater control over environmental events compared to a real-world setting. Thus, the current intervention sacrificed external validity for increased internal validity. However, the results obtained from the current research can inform future treatment approaches in a variety of applied settings.

Driving Simulator Research

The premise behind interactive driving simulators is that drivers can be placed in hazardous, cognitively complex driving scenarios without any physical risk to the driver (Allen et al., 2003). Driving simulators are useful because they provide a safe, reproducible, and economical way to study driver behavior. Driving simulators are also excellent research tools because they allow researchers to have exact control over experimental variables (Watson, Papelis, & Chen, 2003). In fact, NHTSA has funded a large effort, called SimVal, to assess the efficacy of using a driving simulator in commercial motor vehicle driver training (Knipling & Neale, 2004).

Driving simulators have been around for over 30 years, but not until the last decade has the technology progressed to the point where it is affordable and realistic enough to mimic real-world driving scenarios. To date, most driving simulator research studies have assessed driving performance: a) when drivers are fatigued (Oron-Gilad, Gronen, Shinar, & Cassuto, 2001; Thiffault & Bergeron, 2003), b) when drivers are intoxicated (Burian, Hensberry, & Liguori, 2003; Howat, Robinson, Binns, Palmer, & Landauer, 1992), c) with new emerging technologies (Hollnagel & Kallhammer, 2003), d) in divided attention and distraction tasks (Bhise, Dowd, & Smid, 2003; Ross-Flanigan, 2002; Strayer & Johnston, 2001), e) with age-related differences (Lee, Cameron, & Lee, 2003), f) when drivers are exposed to hazardous or dangerous situations (Fancher et al., 2002; Jamison & Smith, 2003), and g) in driver education and training programs (Allen et al., 2003; Ivancic & Hesketh, 2000; Strayer & Drews, 2003). However, the author could not find any published studies that assessed the effectiveness of self-management techniques using a driving simulator.

External validity of simulated driving. The external validity of studying driving behavior on a simulated driving task can be questioned. In other words, will people drive similarly on a driving simulator compared to on-road driving? Several studies have attempted to answer this question. For example, Hoffman, Lee, Brown, and McGhee (2002) compared participant's braking responses on both a high-fidelity simulator and test track. They found that participants performed similarly on the simulator and test track. However, there were differences in the onset of braking, through the braking process, and in the outcome of the braking event. Both Bittner, Simsek, Leison, and Campell (2002) and Reymond, Kemeny, Droulez, and Berthoz (2001) found that people driving in a driving simulator tended to have higher curve-entry speeds than in an on-road environment. While people drive similarly on both a driving simulator and on-road environments, it appears they don't drive exactly the same.

This does not appear to be a critical flaw in research conducted in a simulated driving environment. There are two aspects of predictive validity, absolute and relative validity. Absolute validity refers to the numerical correspondence between driving behavior in the simulator and on-road environments, while relative validity refers to the correspondence between effects of different variation in the driving situation (Blaauw, 1982; Harms, 1994). Prior research has shown that most driving simulator vs. on-road comparisons do not support absolute validity, but they do support relative validity. For example, participants in Törnnros' (1998) study drove faster and were positioned closer to the wall in a simulated tunnel compared to a real tunnel. However, each participant's speed and lateral position were very similar in both situations.

If the driving simulator is going to be a useful research tool it is necessary that the effects are obtained in both real and simulated situations (i.e., relative validity). Relative validity is necessary, but absolute validity is not essential because most research deals with assessing the effect of the independent variable (i.e., treatment vs. control) rather than determining numerical measurements (Godely, Triggs, & Fildes, 2002; Törnnros, 1998). In fact, Cox and Taylor (1999) showed that older drivers (>60 years old) identified as high-risk on a driving simulator had significantly more crashes per 1,000,000 miles driven than a group of similarly aged drivers identified as low-risk on a driving simulator. Thus, it's not necessary to assume that people who disobey the rules of the road in an on-road environment are likely to disobey the rules of the road in a simulated driving task, however, they are likely to disobey the rules of the road more often in the driving simulator.

Preliminary Study 1

This pilot study assessed driving performance on the Systems Technology Incorporated Simulation (STISIM) driving simulator under conditions identical to the Control group in the current research. Preliminary Study 1 had three primary aims: 1) assess the baseline frequency/percentage of various driving behaviors, 2) assess the similarities of the four different driving scenarios, and 3) select a target behavior (for use in both Preliminary Study 2 and the current research).

Participants

The sample consisted of 29 undergraduate students from a large southwestern Virginia university. The average age was 19.8 years, ranging from 18 to 28. Females accounted for 62.1% of the sample and males made up the remaining 37.9%. Caucasian American participants made up 86.2% of the sample, 10.3% were Asian Americans, and 3.4% identified themselves as "Other". All participants' received their driver's license when they were 16 years old. On average, each participant drove their own vehicle 5.7 days/week for 6.4 hours/week (M = 156.3 miles/week).

Over the last three years, participants averaged .62 crashes and .69 moving violations. There were no significant gender differences on any of these demographic or driving variables (all *p's* > .05)

Apparatus and Setting

The STISIM driving simulator (built by Systems Technology, Inc) is located in a 10' X 8' room. The room has one 4' X 4' one-way mirror that allows researchers to unobtrusively observe participants. The STISIM driving simulator uses three-dimensional graphics, and texturing and shading to generate a realistic representation of the driving scene. See Figure 3 below for an illustration of a driving scene.

Figure 3. Picture of a Driving Scene from the STISIM Driving Simulator.

The STISIM driving simulator includes three visual monitors, a desktop console, a customized steering unit (w/turn signal and horn), and brake and throttle controls. See Figure 4 for a picture of the STISIM driving simulator used in both Preliminary Studies 1 and 2 and the current research. The center monitor displays the field-of-view and horizon directly in front of the simulated car. The top of the center monitor displays the field-of-view directly behind the simulated car (i.e., rear-view mirror). The monitor on the left displays the visual field to the left of the simulated car, including a display of the field-of-view from the left rear view mirror (located in the bottom right on the screen), and vice versa for the monitor on the right. The steering wheel, brake, and throttle controls all operate as similar devices in an on-road vehicle.

Figure 4. Picture of the STISIM Driving Simulator used in Preliminary Studies 1 & 2 and the Current Research.

The STISIM driving simulator is a computer-based interactive driving simulator designed to measure a range of driving behaviors (including, speeding, complete stopping, road-edge excursions, center-lane crossing, and crashes), divided attention, and cognitive tasks involved in driving. The STISIM driving simulator provides both visual (field-of-view) and auditory feedback. Driving tasks can be programmed to create specific driving scenarios, such as highways, residential roads, intersections, pedestrians, hills, fog, curves, traffic control devices, road signs (speed limit, stop sign, yield, etc), and varying levels of traffic.

Method

Upon arrival, the experimenter checked each participant's driver's license to assess his/her identity and make sure the license was valid (i.e., not expired). Participants were informed the purpose of the research project was to identify how a driving simulation task might eventually be useful for planning and evaluating driver education programs. Participants were instructed they would complete six driving trials. Although participants completed only five driving trials (including the practice trial), they were informed they would complete six driving trials to avoid any unusual performance on the last trial[1]. It was further explained the information being gathered would not only aid the development of an evaluation measure, but also provide normative data on driving performance across different ages and genders. The costs and benefits of training drivers on a driving simulator were described in order to lend further creditability to the research. Appendix A illustrates an example of the instructions given to each participant by trained research assistants. Then, each participant signed an informed consent form (see Appendix B for an example of the informed consent form).

After signing the informed consent form, participants completed a brief demographic questionnaire (see Appendix C for a reproduction of the demographic questionnaire). The experimenter explained how to operate the STISIM driving controls. Then, he/she instructed participants to drive as they normally drive on the road/highway while they complete a 5-min practice trial. The experimenter remained in the room during the practice trial to answer

[1] Bandura and Cervone (1983, 1986) used a similar procedure to control for any unusual performance on the last trial when assessing participants' performance on an exercise bike.

participants' questions regarding how to operate the STISIM driving simulator. After the practice trial, participants were instructed to drive as they normally drive on a short simulated driving course (approximately 5 miles or 25,000 ft)[2]. The four different driving courses were very similar in complexity and potential hazards, however, they were counter balanced to control for order effects. Upon completion of the last driving trial, participants were thanked for their participation and asked if they would leave an email address so they could be contacted at the completion of the study.

Results

Figure 5 displays the mean percentage of total driving time participants traveled below the posted speed limit, crossed the center line, and drove off the side of the road during Trials 1-4. As depicted in Figure 5, participants' traveled below the posted speed limit for a mean of 69.6% (*SD* = 16) of their total driving time in Trial 1, 69.4% (*SD* = 17.8) in Trial 2, 67.6% (*SD* = 15.6) in Trial 3, and 64.3% (*SD* = 16.8) in Trial 4. The one-way analysis of variance (ANOVA) was not significant ($F_{(3, 25)} = 1.53$, $p > .05$). Participants' traveled over the center line for a mean of 1.2% of their total driving time in Trial 1, 2.2% in Trial 2, 1.8% in Trial 3, and 1.4% in Trial 4. Again, the ANOVA was not significant ($F_{(3, 25)} = 1.95$, $p > .05$). Lastly, Figure 5 shows that participants' drove off the edge of the road for a mean of 1% of their total driving time in Trial 1, .99% in Trial 2, .65% in Trial 3, and 1.3% in Trial 4. The ANOVA did not reveal any significant differences between trials ($F_{(3, 25)} = .84$, $p > .05$).

[2] These instructions were similar to other studies using a driving simulator (cf. Godley, Triggs, & Fildes, 2001; Törnros, 1998)

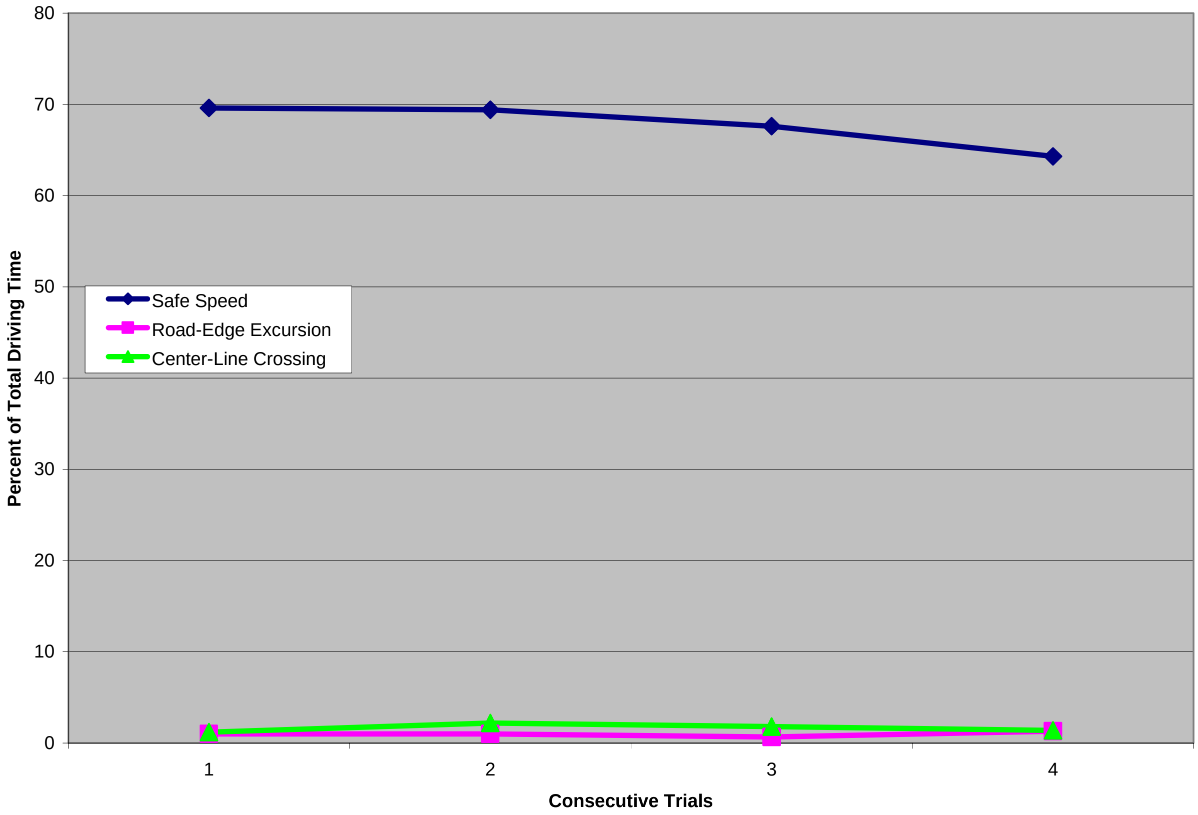

Figure 5. Mean Percentage of Total Driving Time Traveling Below the Posted Speed Limit, Crossing the Center Line, and Traveling Off the Edge of the Road During Trials 1-4 in Preliminary Study 1.

Figure 6 displays the mean frequency of participants' crashes and incomplete stops in Trials 1-4. Participants had a mean of 1.4 (*SD* = 1.01) crashes in Trial 1, .96 (*SD* = .981) in Trial 2, .72 (*SD* = .882) in Trial 3, and 1.06 (*SD* = 1.06) in Trial 4. The ANOVA did not reveal any significant differences in the frequency of crashes between Trials 1-4 ($F_{(3, 25)}$ = 1.95, p >.05). Lastly, Figure 6 indicates participants averaged .69 (*SD* = .604) incomplete stops in Trial 1, .34 (*SD* = .484) in Trial 2, .48 (*SD* = .508) in Trial 3, and .58 (*SD* = .682) in Trial 4. The ANOVA did not reveal any significant differences between the frequency of incomplete stops during Trials 1-4 ($F_{(3, 25)}$ = 1.78, p > .05).

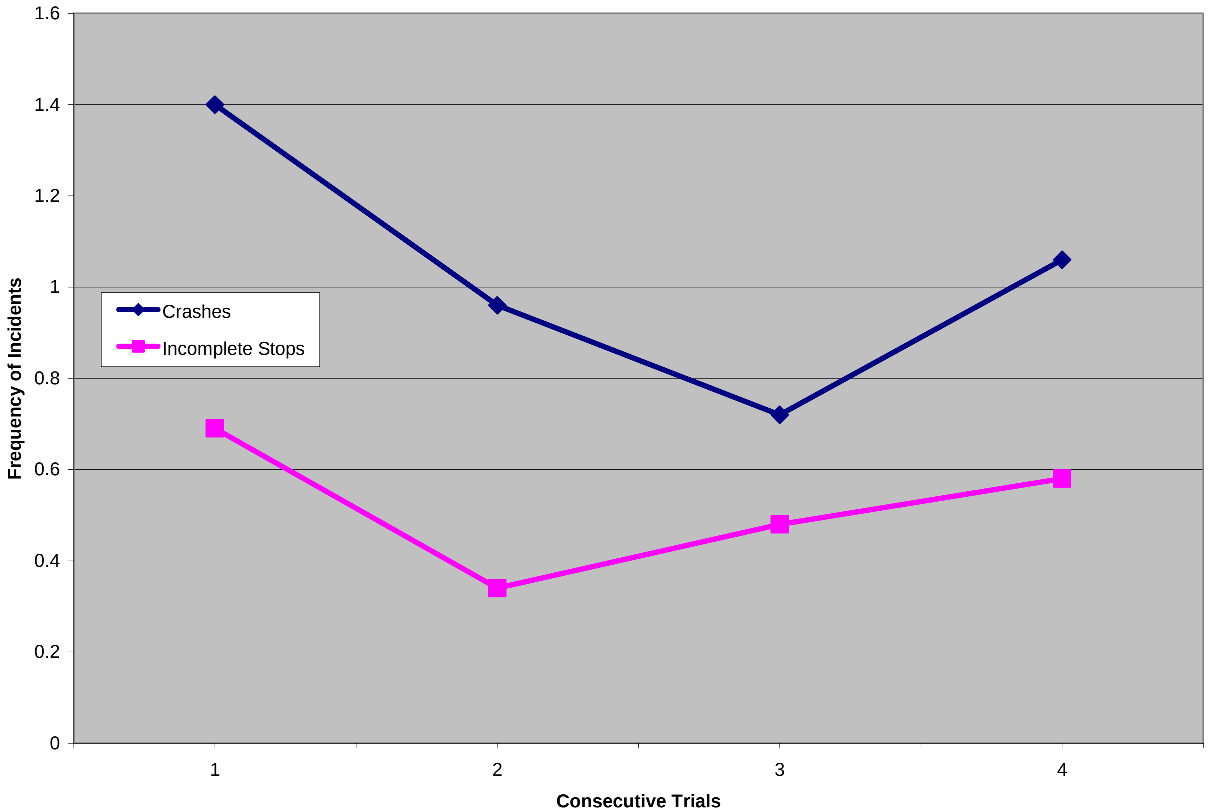

Figure 6. Mean Frequency of Crashes and Incomplete Stops During Trials 1-4 in Preliminary Study 1.

Discussion

This pilot study assessed the frequency/percentage of participant's driving behaviors while driving the STISIM driving simulator. The results indicated participants drove consistently during each trial (i.e., no significant differences were found between trials on any of the dependent variables). Further, there were no significant differences (all *p's* > .05) for any of the driving variables (i.e., crashes, traveling over the posted speed limit, etc.) when comparing the four different driving scenarios. Thus, this study indicated the four different driving scenarios were relatively identical in complexity.

Another aim of this pilot study was to assess the occurrence of each dependent variable with the intent of selecting a target behavior for the current research. It appears participants' traveled over the posted speed limit (i.e., speeding) more frequently than crossing the center line and traveling over the edge of the road. Across all trials, participant's traveled above the posted speed limit for an overall mean of 32.3% of their total driving time below, thus, they traveled below the posted speed limit for an overall mean of 67.7% (*SD* = 16.5) of their total driving time. Not only did this behavior occur frequently, but it is directly related to vehicle safety.

Speeding has been noted as one of the most prevalent contributing factors in vehicle crashes. In 2002, speeding was a contributing factor in 31% of all fatal crashes, resulting in 13,713 fatalities. The NHTSA estimated that speeding-related crashes cost an estimated $40.4 billion per year (NHTSA, 2002b). When Wasielewski (1984) unobtrusively measured the speed (by radar) of 6,638 passenger cars and matched their license plates to driving records, he found that people who were speeding were also involved in more crashes and had more prior traffic violations than people who were not speeding.

It is not surprising that increased speed is prevalently cited in collision reports and national crash and fatality statistics. As cited by NHTSA (2002b, p. 1), "Speeding reduces a driver's ability to steer safely around curves or objects in the roadway, extends the distance necessary to stop a vehicle, and increases the distance a vehicle travels while the driver reacts to a dangerous situation." The increased energy involved in crashes as a result of speed is best illustrated by the fact that 51.7% of all *fatal* crashes occurred on roads with a posted speed-limit of $\geq$55mph (NHTSA, 2002a).

Preliminary Study 2

This study assessed the efficacy of the SMS process implemented in the current research.

Participants

The sample consisted of 5 undergraduate students from a large southwestern Virginia university. The average age was 18 years. There were three female and two male participants. Caucasian American participants made up 100% of the sample. All participants received their driver's license when they were 16 years old. On average, each participant drove their own vehicle 3.6 days/week for 2.6 hours/week (M = 74 miles/week). Over the last three years, participants averaged .4 crashes and .4 moving violations.

Method

Upon arrival, the experimenter checked each participant's driver's license to assess his/her identity and make sure the license was valid (i.e., not expired). Participants were informed the purpose of the research project was to identify how a driving simulation task might eventually be useful for planning and evaluating driver education programs. Participants were instructed they would complete six driving trials (the rationale for this approach is described above). It was further explained the information being gathered would not only aid the development of an evaluation measure but also provide normative data on driving performance across different ages and genders. The costs and benefits of training drivers on a driving simulator were described in order to lend further creditability to the research. See Appendix A for a description of the instructions given to each participant by research assistants. Then, each participant signed an informed consent form (see Appendix B).

After signing the informed consent form, participants completed a brief demographic questionnaire (see Appendix C). Then, the experimenter explained how to operate the STISIM driving controls and instructed participants to drive as they normally drive on the road/highway while they completed a 5-min practice trial. The experimenter remained in the room during the practice trial to answer each participant's questions regarding how to operate the STISIM driving simulator. The four different driving courses were very similar in complexity and potential hazards, however, they were counter balanced to control for order effects. Each trial, which consisted of one different driving scenario, is described in more detail below.

Trials 1-4. Immediately after the participants completed the training trial, the experimenter entered the room and informed the participants that driver education participants typically have goals for increasing their driving performance. Thus, they were instructed to perform the stimulated driving trial with a specific goal in order to shed light on the impact of this goal on driving. Further, participants were informed that prior research has shown that a difficult, yet, attainable goal would be to travel below the posted speed limit for 85%[3] of their total driving time.

Prior to each trial, participants were instructed to write their personal goal on the goal sheet provided to them by the experimenter (See Appendix D for an example of the goal sheet used in both Preliminary Study 2 and the current research). The experimenter informed the participants to refrain from recording their name or code number on the goal sheet. The experimenter indicated this research was only concerned with how the group as a whole performs, rather than individuals, thus the whole group placed their anonymous goal sheets and self-monitoring forms into the same lock-box. After the participants completed the goal sheet, the experimenter instructed participants to place the goal sheet into the lock-box (the lock-box had a large sticker on the face that read

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[3] Traveling below the posted speed limit was chosen as the target behavior based on the results obtained in Preliminary Study 1. To determine a difficult, yet attainable goal, Huber (1985) used the mean performance of the participants who were in the top 25th percentile during pilot testing. The difficult, yet attainable goal described to participants in this study was based on the performance of participants in Preliminary Study 1 using Huber's (1985) criteria.

“Group 1”). The lock-box was filled with several blank pieces of paper. These procedures reduced the influence of social evaluation[4].

After selecting and recording a personal goal on the goal sheet, participants were informed they would be required to complete a self-monitoring form at the completion of the trial, estimating how often they traveled below the posted speed limit. Then, participants were instructed to drive as they normally drive and the experimenter left the room.

After completing Trial 1, the experimenter entered the room and gave participants a self-monitoring form, instructing them to estimate the percentage of total driving time they traveled below the posted speed limit during the previous trial (See Appendix E for an example of the self-monitoring form used in Preliminary Study 2 and the current research). Again, participants were instructed to refrain from recording their name or individual code number on the self-monitoring form. Then, participants were instructed to place the self-monitoring form into the same lock-box as before. After participants completed the self-monitoring form, they were given a piece of paper that indicated the percentage of their total driving time they traveled below the posted speed limit as recorded by the STISIM computer (see Appendix F for an example of the feedback sheet). These procedures were repeated in Trials 2-4.

Results

Figure 7 displays the mean percentage of participants’ total driving time traveling below the posted speed limit. Participants traveled below the posted speed limit for 88.1% (*SD* = 16.9) of their total driving time during Trial 1, 95.9% (*SD* = 14.9) during Trial 2, 86.3% (*SD* = 13.4) during Trial 3, and 90.3% (*SD* = 6.6) during Trial 4. See Figure 8 for a display of each individual

[4] People have a long history of social consequences for doing what they say they will do. When people set a public goal, they have established a socially available standard against which behavior should be evaluated. This may alter social contingencies, thereby altering behavior. By minimizing the effect of social evaluation, the current research can be confident any observed treatment effects were the result of the independent variables rather than social evaluation.

participant's percentage of total driving time traveling below the posted speed limit. Figure 7 also displays participants' mean personal goal and self-monitoring across trials.

As can be seen in Figure 8, participants selected a mean personal goal to travel below the posted speed limit for 71% (*SD* = 15.9) of their total driving time during Trial 1, 74% (*SD* = 31.3) during Trial 2, 71.4% (*SD* = 34.9) during Trial 3, and 90.3% (*SD* = 33.9) during Trial 4. Participants' mean estimation of the time they traveled below the posted speed limit as a percentage of their total driving time during Trial 1 was 52.6% (*SD* = 28.9), 68.6% (*SD* = 33.1) during Trial 2, 54.2% (*SD* = 37.9) during Trial 3, and 79.6% (*SD* = 33.9) during Trial 4. Appendix G illustrates each participant's percentage of their total driving time traveling below the posted speed limit, personal goals, and self-monitoring across trials.

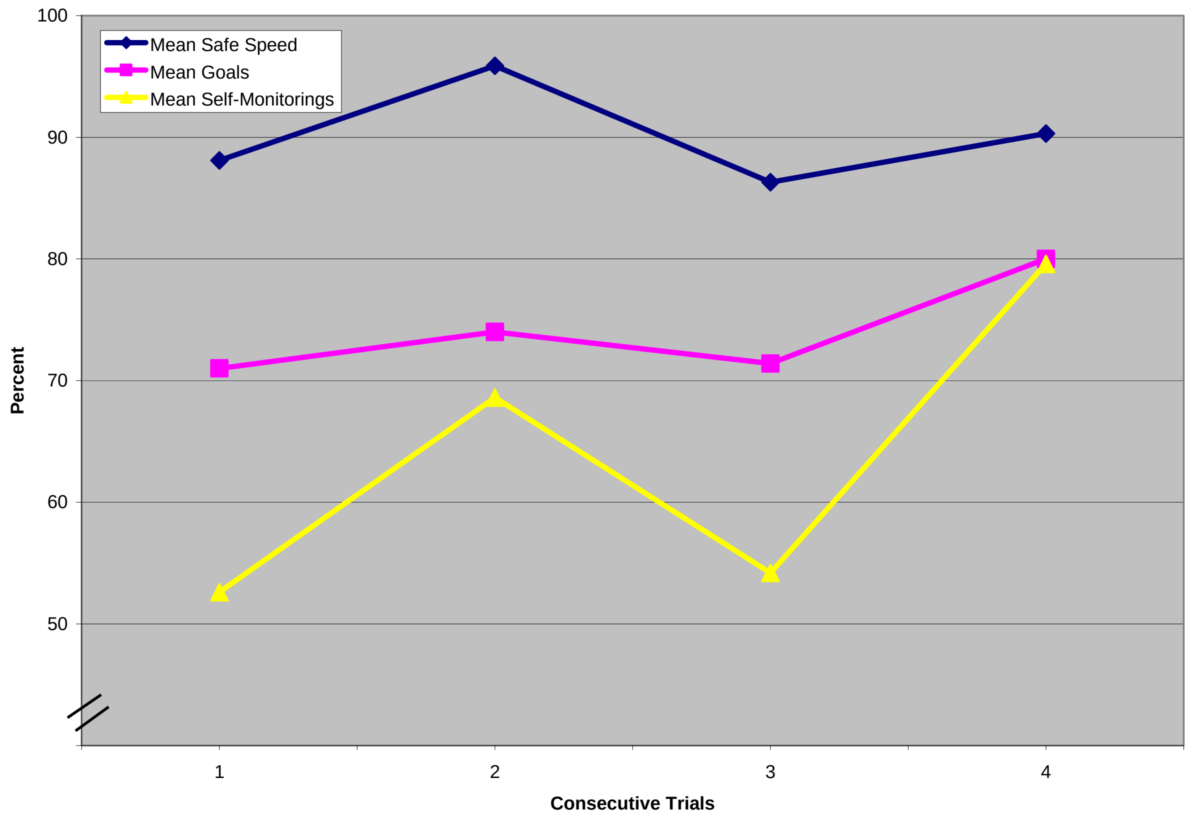

Figure 7. Mean Percentage of Total Driving Time Traveling Below the Posted Speed Limit, Personal Goals, and Self-Monitoring During Trials 1-4 in Preliminary Study 2.

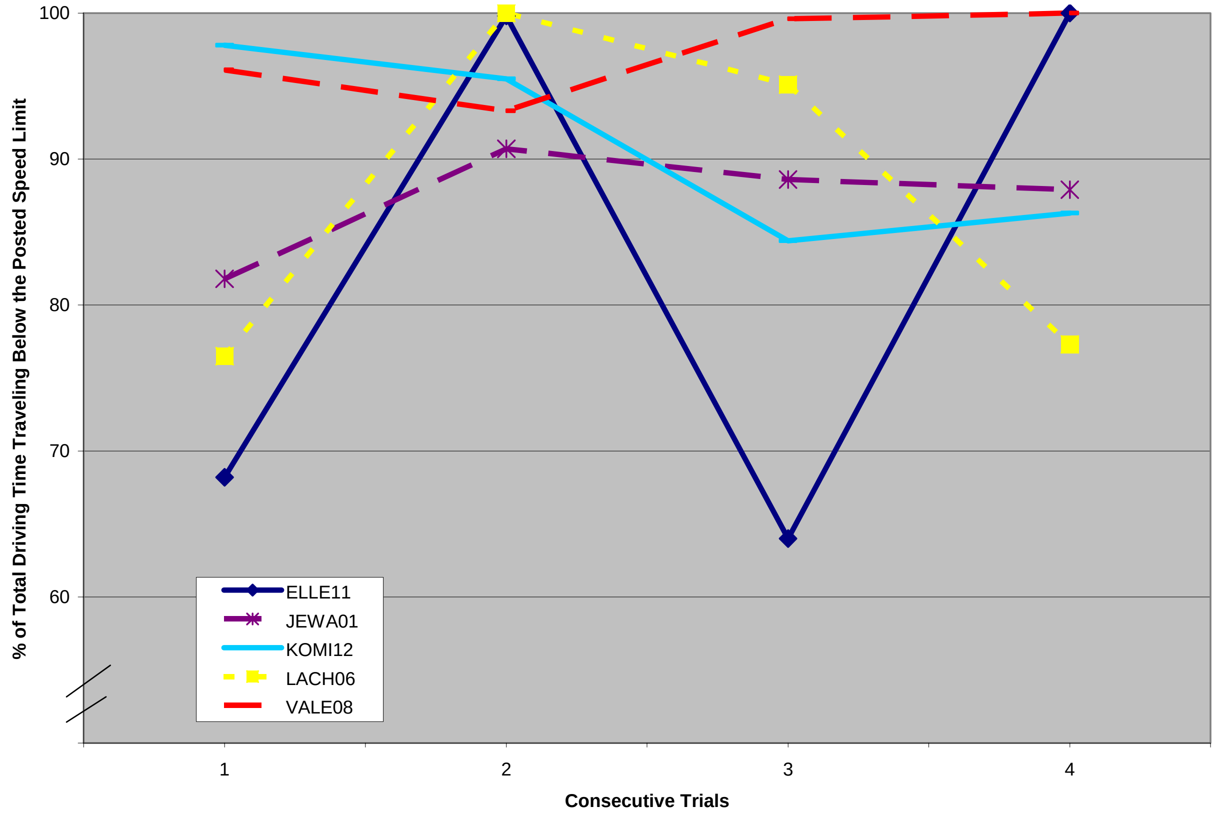

Figure 8. Percentage of Total Driving Time Traveling Below the Posted Speed Limit During Trials 1-4 for Each Participant in Preliminary Study 2.

Table 1 displays the deviation between the participant's estimation of how often they traveled below the posted speed limit as a percentage of their total driving time (i.e., self-monitoring) and how often they actually traveled below the posted speed limit as recorded by the STISIM computer across trials. Positive deviation scores indicated participants overestimated how often they were traveling below the posted speed limit, vice versa for negative deviation scores. The mean deviation score in Trial 1 was -35.5 (*SD* = 23.5), -27.3 (*SD* = 31.7) in Trial 2, -32.1 (*SD* = 37.8) in Trial 3, and -10.7 (*SD* = 32.2) in Trial 4.

Table 1. Deviation Scores for each Participant in Preliminary Study 2.

Participant	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	*Mean*
ELLE11	-45.2	-1.8	-22	0	-17.25
JEWA01	-51.8	-70.7	-68.6	-67.9	-64.75
KOMI12	-47.8	-15.5	7.6	6.7	-12.25
LACH06	-11.5	-50	-75.1	7.7	-32.22
VALE08	-1.1	1.7	-2.6	0	-0.5
Mean	-31.48	-27.26	-32.14	-10.7	

Figure 9 displays the mean percentage of total driving time traveling below the posted speed limit across trials during Preliminary Studies 1 and 2. As Figure 9 illustrates, participants in Preliminary Studies 1 and 2 traveled below the posted speed limit an average of 67.7% (*SD* = 16.5) and 89.2% (*SD* = 10.9) of their total driving time, respectively. Thus, participants in Preliminary Study 2 increased the mean percentage of their total driving time traveling below the posted speed limit by 21.5 percentage points (or a 31.8% increase) compared to Preliminary Study 1. More specifically, participants in Preliminary Study 2 increased the mean percentage of their total driving time traveling below the posted speed limit, compared to Preliminary Study 1, by 18.5, 26.5, 18.7, and 26 percentage points (or a 26.6%, 38.2%, 27.7%, and 40.4% increase) during Trials 1-4, respectively.

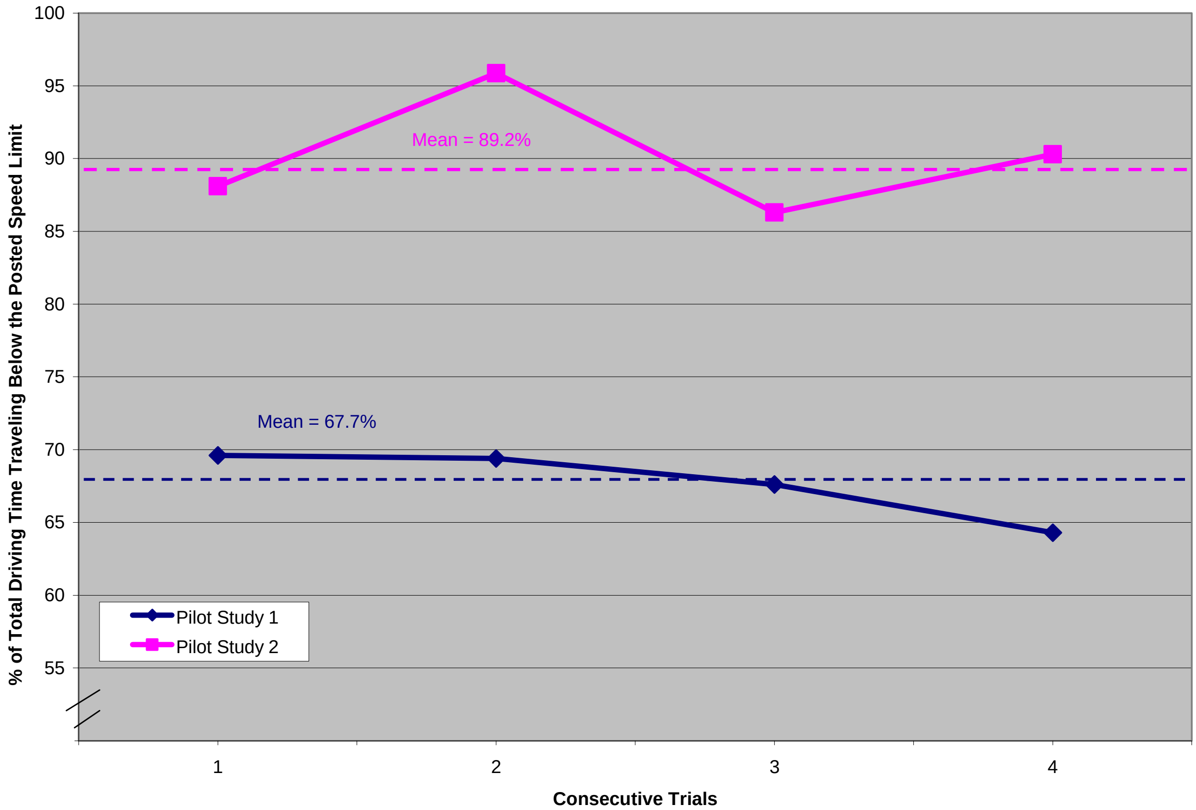

Figure 9. Mean Percentage of Total Driving Time Traveling Below the Posted Speed Limit During Trials 1-4 in Preliminary Studies 1 and 2.

Discussion

This preliminary study assessed the effect of the SMS intervention (goal setting, self-monitoring, and objective feedback) on the dependent variable (traveling below the posted speed limit) using the STISIM driving simulator. Participants traveled below the posted speed limit for 89.2% of their total driving time. As indicated in Preliminary Study 1, participants who traveled below the posted speed limit 85.5% of the total driving time were in the 75th percentile. Thus, participants exposed to the SMS intervention consistently traveled above the 75th percentile.

For the most part, the results support the linear relationship between goals and performance (Locke & Latham, 1990). As Figure 8 illustrates, participants' mean personal goal during Trial 2 was higher than Trial 1. Accordingly, the mean time traveling below the posted speed limit during Trial 2 was higher than Trial 1. The same relationship between personal goals and traveling below the posted speed limit was found when comparing Trials 2 and 3 and Trials 3 and 4.

By looking at the deviation scores, we can indirectly assess the affect of giving participants objective feedback on the targeted behavior. First, the deviation scores suggested participants consistently underestimated the time they traveled below the posted speed limit. This is similar to other studies that indicated people are likely to underestimate high frequency occurrences and overestimate low frequency occurrences (Critchfield, Tucker, & Vuchinich, 1998). Second, and more importantly, it appears participants were using the objective feedback to become more accurate in their self-monitoring. The largest deviation score occurred during Trial 1, while the smallest deviation score occurred during Trial 4. Indeed, Hickman and Geller (2003) hypothesized that participants in their study were using objective feedback to become more accurate in their self-observations.

At this point it is difficult to make assumptions about the effectiveness of the SMS intervention. Comparing the results between Preliminary Studies 1 and 2 is difficult due to the lack of random assignment and the extremely small sample size in Preliminary Study 2. However, we can assess the effect size by comparing the overall mean across trials on the target behavior obtained in Preliminary Studies 1 and 2. Using this effect size, we can estimate the sample size and associated power in the current research. Lipsey (1990) reported a method for calculating the sample size required to reach the estimated power. The Lipsey method uses the following equation for effect size: $ES = (X_E - X_C) / \sqrt{((S_E^2 + S_C^2)/2)}$.

Using this equation, ES is the hypothesized effect size, X_E is the mean dependent measure (e.g., traveling below the posted speed limit) for the Experimental condition (i.e., Preliminary Study 2), X_C is the mean dependent measure for the Control condition (i.e., Preliminary Study 1), S_E^2 is the variance for the Experimental condition, and S_C^2 is the variance for the Control condition. The following estimated values were derived from Preliminary Studies 1 and 2: X_E = 89.2; X_C = 67.7; S_E^2 = 118.5; and S_c^2 = 271.1. Because of unequal sample sizes, Howell (1992) suggested applying the correction factor "j" to the ES equation (where $j = 1 – [3 / ((4 (N^e + N^c - 2) -1)]$. Using this equation, N^e is the sample size in the Experimental condition, while N^c is the sample size in the Control condition. Using an alpha of .05 with a 4 X 3 ANOVA, and given the corrected estimated ES of 1.49, we would reach a power of .999 with *10 participants per condition*.

Project Overview

The current research evaluated the effectiveness of an SMS process on a simulated driving task. Using a simulated driving task, the specific aims of the current research study were to: a) determine if the SMS process results in significant increases in safe driving behavior, b) determine if the addition of objective feedback significantly increases the accuracy of participants' self-monitoring, c) determine if the addition of objective feedback increases safe driving behavior, and d) assess the relationship between personal goals and performance on the targeted driving behavior. The dependent measures included the participants' safe driving behavior on a simulated driving task and their accuracy scores (obtained from comparisons between self-monitoring and computer data).

To accomplish the project objectives, data were collected in the following ways: a) electronic data on the targeted driving behavior recorded on a computer hard drive, b) participants' self-recorded estimates of the targeted driving behavior, and c) self-reported personal goals for improvement on the targeted driving behavior.

Method

Participants

Participants included 93 undergraduate students (41 males, 52 females) randomly assigned[5] to one of three groups (31 participants per group). All participants had a valid driver's license and attended a large university in southwest Virginia. All students signed an informed consent form and received one point of extra credit in a psychology course. The mean age of participants was 19.37 yeas old.

Setting and Apparatus

The STISIM driving simulator was located in a 10' X 8' room with one 4' X 4' one-way mirror that allowed research assistants to unobtrusively observe participants. The same STISIM driving simulator used in Preliminary Studies 1 and 2 was used in the current research. A detailed description of the STISIM driving simulator is given above.

Materials

Materials included a demographic questionnaire, goal sheet, self-monitoring form, and feedback sheet. Each measure/questionnaire is described in greater detail below.

Demographic questionnaire. The demographic questionnaire included thirteen items that assessed each participant's driving history (traffic crashes, traffic violations, and driving experience) and demographic characteristics (age, gender, and ethnicity). See Appendix C for a version of the demographic questionnaire used in the current research.

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[5] Participants were randomly assigned to groups by the experimenter. Prior to arriving, the experimenter randomly selected a number out of a box. Each number corresponded to one of the three groups.

Goal sheet. Some participants were instructed to record their personal goal for the targeted driving behavior on a goal sheet. See Appendix D for an example of the goal sheet used in the current research.

Self-monitoring form. Some participants were instructed to record their self-observations of the targeted driving behavior on a self-monitoring form. See Appendix E for an example of the self-monitoring form completed by participants in the current research.

Feedback sheet. Some participants were given a feedback sheet that indicated their performance on the previous trial as recorded by the STISIM computer. See Appendix F for an example of the feedback sheet used in the current research.

Dependent Measures

Target driving behavior. The STISIM driving simulator can measure a variety of driving behaviors. However, Preliminary Study 1 found that participants traveled below the posted speed limit 67.7% of their total driving time. Thus, speeding occurred with some frequency and was selected as the target behavior in the current research.

Accuracy scores. The participants' self-monitoring forms were compared to data recorded by the STISIM driving simulator (i.e., objective feedback). An accuracy calculation was made for each participant per trial in the Intervention groups by comparing each participant's self-observations (obtained from self-monitoring forms) with data obtained from the STISIM driving simulator. The accuracy score was calculated by recording each participant's deviation between their self-observations and actual scores as recorded by the STISIM computer. More specifically, the percentage of total driving time traveling below the posted speed limit as recorded by participants was subtracted from their percentage of total driving time traveling below the posted speed limit as recorded by the STISIM computer). As indicated above, a negative accuracy score indicated participants underestimated their actual performance on the target behavior, and vice versa for a positive accuracy score.

Study Design

The study used a Between-Subjects, Repeated Measures 3 Group (Control, Self-Monitoring, Self-Monitoring + Objective Feedback) X 4 Trial (Trials 1-4) Factorial design. Participants drove on a different driving scenario during each of the four trials. The dependent variables included the percentage of time traveling below the posted speed limit and accuracy scores. Comparisons were made between the three groups, described in detail below.

Control group. Participants in this group did not receive any of the intervention materials (i.e., goal setting, self-monitoring, or objective feedback). They were instructed to drive as they normally drive on each trial (identical to Preliminary Study 1).

Self-Monitoring + Objective Feedback (SM + OFB) group. Participants in this group received objective feedback from the experimenter about their actual performance on the target behavior as well as personal feedback from their self-monitoring forms. These participants recorded their individual improvement goals on the targeted driving behavior (identical to Preliminary Study 2).

Self-Monitoring (SM) group. Participants in this group recorded their individual improvement goals on the targeted driving behavior, but received only personal feedback from their self-monitoring forms. Participants in this group received the identical instructions as participants in the SM + OFB group, however, they did not receive objective feedback regarding their actual performance on the target behavior.

Procedures

The procedures were almost identical to those described in Preliminary Study 2 above. Upon arrival, the experimenter checked each participant's driver's license to assess his/her identity and make sure the license was valid (i.e., not expired). Participants were informed the purpose of the research project was to identify how a driving simulation task might eventually be useful for planning and evaluating driver education programs. Participants were informed they would complete six driving trials (the rationale for this procedure is described above). The participants were also informed the information being gathered will not only aid the development of an evaluation measure, but also provide normative data on driving performance across different ages and genders. See Appendix A for a description of the instructions given to each participant, in each group, by research assistants. Next, each participant signed an informed consent form (see Appendix B).

After signing the informed consent form, participants completed a brief demographic questionnaire (see Appendix C). Then, the experimenter explained how to operate the STISIM driving controls and instructed participants to drive as they normally drive on the road/highway while they complete a 5-min practice trial. The experimenter remained in the room during the practice trial to answer each participant's questions regarding how to operate the STISIM driving simulator. The four different driving courses were found to not significantly differ from each other (as indicated in Preliminary Study 1), however, they were counter balanced to control for order effects.

Trials 1-4[6]. Immediately after the participants completed the training trial, the experimenter entered the room and informed the participants that driver education participants

[6] Participants in the Control group only received instructions to drive as they normally drive.

typically have goals for increasing their driving performance. Thus, they were instructed to perform the stimulated driving trial with a specific goal in order to shed light on the impact of this goal on driving. Further, participants were informed prior research had shown that a difficult, yet, attainable goal would be to travel below the posted speed limit for 85% of their total driving time.

Next, participants were instructed to write their personal goal on a goal sheet provided to them by the experimenter (See Appendix D for an example of the goal sheet used in both Preliminary Study 2 and the current research). The experimenter informed the participants to refrain from recording their name or code number on the goal sheet. The experimenter indicated the current research was only concerned with how the group as a whole performs, rather than individuals. Thus, the whole group will place their anonymous goal sheets and self-monitoring forms into the same lock-box. After participants completed the goal sheet, the experimenter instructed participants to place the goal sheet into the lock-box. The lock-box had a large sticker on the face that read “Group 1”. The lock-box was filled with several blank pieces of paper. These procedures were implemented to reduce the influence of social evaluation.

After selecting and recording a personal goal on the goal sheet, participants were informed they were required to complete a self-monitoring form at the completion of the trial, estimating how often they traveled under the posted speed limit. Then, participants were instructed to drive as they normally drive and the experimenter left the room.

After completing Trial 1, the experimenter entered the room and gave participants a self-monitoring form, instructing them to estimate the percentage of total driving time they traveled below the posted speed limit during the previous trial. See Appendix E for an example of the self-monitoring form used in Preliminary Study 2 and the current research. Again, participants were instructed to refrain from recording their name or individual code number on the self-monitoring form. Then, participants were instructed to place the self-monitoring form into the same lock-box as before. After participants completed the self-monitoring form they were given a piece of paper that indicated the percentage of their total driving time they traveled below the posted speed limit as recorded by the STISIM computer. However, participants in the SM group did not receive any feedback from the STISIM computer. These procedures were repeated in Trials 2-4.

Results

Demographic Variables

Participants completed a brief demographic questionnaire prior to driving the STISIM driving simulator. A 2 Gender (Male, Female) X 3 Group (Control, SM, SM + OFB) multivariate analysis of variance (MANOVA) was used to test for statistically significant differences among the demographic characteristics. Further, a 2 Gender (Male, Female) X 3 Group (Control, SM, SM + OFB) Chi-Square was performed on the two categorical variables: a) Do you own your own vehicle?, and b) ethnicity. Gender was added to the factorial analysis for two primary reasons: a) prior research has shown that males are far more likely than females to travel above the posted speed limit[7] (NHTSA, 2004) and b) there were markedly more females in the SM (n = 20) and SM + OFB (n =21) groups compared to the Control group (n = 11).

Both 2 X 3 Chi-Square tests were non significant, *p's* > .05. The 2 X 3 MANOVA indicated that none of the multivariate tests were significant (*p's* > .05). However, there were two significant univariate effects across Group: a) the number of hours participant's reported driving each week , $F_{(2, 87)} = 3.38$, $p < .05$, and b) the number of moving violations participants received during the previous 12 months, $F_{(2, 87)} = 3.46$, $p < .05$. The complete results from 2 X 3 MANOVA can be found in Appendix H. T-tests indicated participants in the SM and SM + OFB

[7] Although the gap between females and males has closed in recent years (regarding traveling above the posted speed limit), males are still far more likely than females to travel above the posted speed limit (Laapotti, Keskinen, & Rajalin, 2003).

groups reported driving significantly more hours each week (*M* = 7.8 and 6.9 hours, respectively) than did participants in the Control group (*M* = 4.2 hours). Further, t-tests also indicated that participants in the SM and Control groups (*M* = .52 and .52 moving violations, respectively) reported receiving significantly more moving violation during the previous 12 months than did participants in the SM + OFB group (*M* = .13 moving violations). Table 2 on pages 37-39 displays the means and standard deviations for each item on the demographic questionnaire as a function of gender and group.

Table 2. Means and Standard Deviations for the Demographic Questionnaire Items as a Function of Gender and Condition.

Item	Group	Gender	Mean	Std. Deviation	N
Age	Control	Female	19.3636	1.28629	11
		Male	19.2500	1.16416	20
	SM	Female	18.9000	.85224	20
		Male	19.1818	1.83402	11
	SM + OFB	Female	19.2857	1.10195	21
		Male	20.0000	1.69967	10
Ethnicity	Control	Female	72.7% Caucasian 9.1% African American 9.1% Asian American 9.1% Other		11
		Male	90% Caucasian 5% Asian American 5% Other		20
	SM	Female	70% Caucasian 25% African American 5% Asian American		20
		Male	81.8% Caucasian 18.2% Asian American		11
	All	Female	61.9% Caucasian 9.5% African American 23.8% Asian American 4.8% Latin American		21
		Male	70% Caucasian 10% African American 20% Asian American		10

Table 2 (continued). Means and Standard Deviations for the Demographic Questionnaire Items as a Function of Gender and Condition.

Item	Group	Gender	Mean	Std. Deviation	N
Months with Drivers License	Control	Female	46.45	13.71	11
		Male	42.2	18.10	20
	SM	Female	33.55	11.59	20
		Male	41.36	22.63	11
	SM + OFB	Female	44.42	15.38	21
		Male	40.6	18.91	10
Own Car	Control	Female		90.9% Yes 9.1% No	11
		Male		100% Yes	20
	SM	Female		100% Yes	20
		Male		81.8% Yes 18.2% No	11
	SM + OFB	Female		95.2% Yes 4.8% No	21
		Male		100% Yes	10
Hours Driving Each Week	Control	Female	3.59	2.9	11
		Male	4.52	2.91	20
	SM	Female	7.67	5.94	20
		Male	8.00	9.59	11
	SM + OFB	Female	6.45	5.07	21
		Male	7.90	8.23	10
Miles Driven Each Week	Control	Female	82.72	80.78	11
		Male	114.00	88.68	20
	SM	Female	214.35	245.87	20
		Male	147.45	166.45	11
	SM + OFB	Female	169.04	164.21	21
		Male	91.50	75.05	10
Days Driving Each Week	Control	Female	4.54	2.87	11
		Male	4.70	2.079	20
	SM	Female	4.90	2.29	20
		Male	4.09	2.8	11
	SM + OFB	Female	5.38	2.35	21
		Male	4.70	2.49	10
Moving Violations During the last 12 Months	Control	Female	.45	.52	11
		Male	.55	.82	20
	SM	Female	.35	.81	20
		Male	.81	.75	11
	SM + OFB	Female	.09	.30	21
		Male	.20	.42	10

Table 2 (continued). Means and Standard Deviations for the Demographic Questionnaire Items as a Function of Gender and Condition.

Item	Group	Gender	Mean	Std. Deviation	N
Crashes During the Last 12 Months	Control	Female	.09	.30	11
		Male	.45	.82	20
	SM	Female	.20	.52	20
		Male	.27	.46	11
	SM + OFB	Female	.14	.35	21
		Male	.20	.42	10
At-Fault Crashes During the Last 12 Months	Control	Female	.09	.30	11
		Male	.20	.69	20
	SM	Female	.15	.48	20
		Male	.18	.404	11
	SM + OFB	Female	.04	.21	21
		Male	.20	.42	10
Moving Violations During the Last 36 Months	Control	Female	1.27	1.10	11
		Male	.85	1.22	20
	SM	Female	.85	1.49	20
		Male	1.36	1.02	11
	SM + OFB	Female	.47	.74	21
		Male	.70	.82	10
Crashes During the Last 36 Months	Control	Female	.81	.98	11
		Male	.70	1.12	20
	SM	Female	.60	.82	20
		Male	.81	.98	11
	SM + OFB	Female	.66	.79	21
		Male	.40	.51	10
At-Fault Crashes During the Last 36 Months	Control	Female	.27	.64	11
		Male	.30	.73	20
	SM	Female	.30	.65	20
		Male	.45	.52	11
	SM + OFB	Female	.38	.58	21
		Male	.30	.48	10

Correlation Matrix

Table 3 displays a correlation matrix of the demographic variables, mean total goals across all four trials, and the mean percentage of total driving time traveling over the posted speed limit across all four trials. As shown in Table 3, there were only two significant correlations with the mean percentage of total driving time traveling below the posted speed limit across all four trials, Gender and Mean Total Goals (all other *p's* < .05). There was a significant negative correlation between gender and the mean percentage of total driving time traveling below the posted speed limit across all four trials, $r = -.254$, $p < .05$. There was a significant positive correlation between mean total goals and the percentage of total driving time traveling below the posted speed limit across all four trials, $r = .648$, $p < .001$. Thus, gender was included as a factorial (Male, Female) in the ANOVA and ANCOVA analyses, and mean total goals was the covariate in the ANCOVA.

Table 3. Correlation Matrix of the Demographic Variables, Mean Total Goals, and the Mean Percentage of Total Driving Time Traveling Below the Posted Speed Limit Across all Four Trials.

		Mean Total Speed	Gender	Age	Have Drivers License	Hours Driven Each Week	Miles Driven Each Week	Days Driven Each Week	Moving Violation s1Y	Crashes in Last 1Y	At-Fault Crashes in 1Y	Moving Violations in 3Y	Crashes in Last 3Y	At-Fault in Last 3Y	Mean Total Goal
Pearson Correlation	Mean Total Speed	1.000	-.254	-.114	-.055	-.009	-.010	.116	.109	.035	.138	.010	.017	.193	.648
	Gender	-.254	1.000	.172	.054	.064	-.180	-.151	.224	.073	.116	.166	-.009	.033	-.188
	Age	-.114	.172	1.000	.726	.341	-.008	.168	-.138	-.117	-.067	-.085	-.111	-.166	-.104
	Have Drivers License	-.055	.054	.726	1.000	.480	-.006	.264	-.171	-.192	-.193	-.091	-.168	-.195	.166
	Hours Driven Each Week	-.009	.064	.341	.480	1.000	.432	.613	-.153	-.013	-.050	-.024	-.220	-.190	-.012
	Miles Driven Each Week	-.010	-.180	-.008	-.006	.432	1.000	.443	.190	.093	.103	.276	-.057	-.028	-.138
	Days Driven	.116	-.151	.168	.264	.613	.443	1.000	-.050	.067	.034	.064	-.022	-.006	.162

	Each Week														
	Moving Violations 1Y	.109	.224	-.138	-.171	-.153	.190	-.050	1.000	.471	.556	.752	.332	.348	-.014
	Crashes in Last 1Y	.035	.073	-.117	-.192	-.013	.093	.067	.471	1.000	.826	.486	.587	.374	-.098
	At-Fault Crashes in 1Y	.138	.116	-.067	-.193	-.050	.103	.034	.556	.826	1.000	.523	.429	.532	-.054
	Moving Violations in 3Y	.010	.166	-.085	-.091	-.024	.276	.064	.752	.486	.523	1.000	.465	.525	-.068
	Crashes in Last 3Y	.017	-.009	-.111	-.168	-.220	-.057	-.022	.332	.587	.429	.465	1.000	.687	.059
	At-Fault in Crashes in 3Y	.193	.033	-.166	-.195	-.190	-.028	-.006	.348	.374	.532	.525	.687	1.000	.179
	Mean Total Goal	.648	-.188	-.104	.166	-.012	-.138	.162	-.014	-.098	-.054	-.068	.059	.179	1.000
Significance (1-tailed)	**Mean Total Speed**	.	.023	.188	.336	.472	.470	.186	.200	.393	.143	.469	.447	.067	.000
	Gender	.023	.	.091	.339	.310	.081	.121	.040	.285	.185	.099	.472	.400	.071
	Age	.188	.091	.	.000	.003	.475	.095	.143	.184	.302	.255	.196	.099	.211
	Have Drivers License	.336	.339	.000	.	.000	.481	.019	.092	.068	.067	.241	.096	.065	.099
	Hours Driven Each Week	.472	.310	.003	.000	.	.000	.000	.117	.461	.350	.427	.043	.069	.462
	Miles Driven Each Week	.470	.081	.475	.481	.000	.	.000	.070	.236	.212	.015	.330	.415	.143
	Days Driven Each Week	.186	.121	.095	.019	.000	.000	.	.351	.302	.398	.311	.432	.481	.104
	Moving Violations 1Y	.200	.040	.143	.092	.117	.070	.351	.	.000	.000	.000	.004	.003	.458
	Crashes in Last 1Y	.393	.285	.184	.068	.461	.236	.302	.000	.	.000	.000	.000	.001	.225
	At-Fault Crashes in 1Y	.143	.185	.302	.067	.350	.212	.398	.000	.000	.	.000	.000	.000	.337
	Moving Violations in 3Y	.469	.099	.255	.241	.427	.015	.311	.000	.000	.000	.	.000	.000	.299
	Crashes in Last 3Y	.447	.472	.196	.096	.043	.330	.432	.004	.000	.000	.000	.	.000	.325

	At-Fault in Crashes in 3Y	.067	.400	.099	.065	.069	.415	.481	.003	.001	.000	.000	.000	.	.083
	Mean Total Goal	.000	.071	.211	.099	.462	.143	.104	.458	.225	.337	.299	.325	.083	.
N	**Mean Total Speed**	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Gender	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Age	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Have Drivers License	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Hours Driven Each Week	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Miles Driven Each Week	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Days Driven Each Week	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Moving Violation s 1Y	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Crashes in Last 1Y	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	At-Fault Crashes in 1Y	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Moving Violations in 3Y	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Crashes in Last 3Y	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	At-Fault Crashes in 3Y	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	Mean Total Goal	62	62	62	62	62	62	62	62	62	62	62	62	62	62

Hypothesis 1: The SM and SM + OFB groups will drive below the posted speed limit significantly more often than the Control group.

A plot of the mean percentage of total driving time traveling below the posted speed limit across trials is illustrated in Figure 10. A 2 Gender (Male, Female) X 3 Group (Control, SM, SM + OFB) X 4 Trial (Trials 1-4) repeated measures ANOVA was used to test for significant differences in the mean percentage of driving time traveling below the posted speed limit. The Mauchly sphericity test was significant ($p < .01$); thus, the probabilities associated with the F-values were corrected using the Greenhouse-Geisser epsilon (.872). The 2 X 3 X 4 repeated measures ANOVA showed only a significant main effect for condition, $F_{(1, 87)} = 7.55$, $p < .01$, all other main effects and interactions were non-significant (*p's* > .05).

Tables 4 and 5 display the within- and between-subjects outputs from the 2 X 3 X 4 repeated measures ANOVA for the targeted driving behavior, respectively. To assess differences among the three levels for the main effect for Condition, the Tukey honestly significant difference (HSD) follow-up procedure was performed. The results indicated that participants in the SM and SM + OFB groups (*M* = 86.7% and 87.8%, respectively) drove below the posted speed limit as a percentage of their total driving time significantly more often ($p < .05$) than participants in the Control group (*M* = 73.3%). Thus, Hypothesis 1 was supported by the findings.

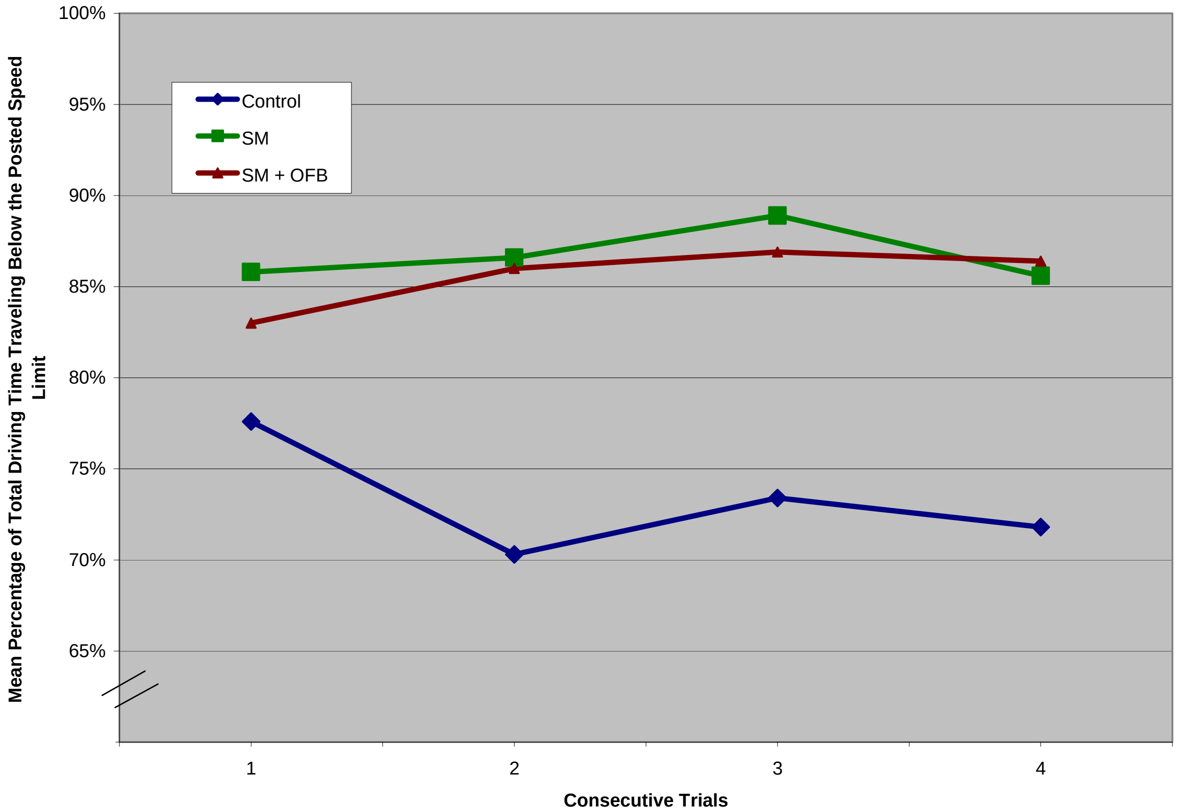

Figure 10. Mean Percentage of Total Driving Time Traveling Below the Posted Speed Limit Across Trials as a Function of Condition.

Table 4. Within-Subjects Output from the 2 X 3 X 4 Repeated Measures ANOVA for the Target Driving Behavior.

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Trial	Sphericity Assumed	172.08	3	57.36	.53	.658
	Greenhouse-Geisser	172.08	2.61	65.78	.53	.633
	Huynh-Feldt	172.08	2.85	60.18	.53	.649
	Lower-bound	172.08	1.00	172.08	.53	.466
Trial X Gender	Sphericity Assumed	611.97	3	203.99	1.90	.129
	Greenhouse-Geisser	611.97	2.61	233.93	1.90	.137
	Huynh-Feldt	611.97	2.85	214.02	1.90	.132
	Lower-bound	611.97	1.00	611.97	1.90	.171
Trial X Group	Sphericity Assumed	762.19	6	127.03	1.18	.313
	Greenhouse-Geisser	762.19	5.23	145.68	1.18	.315
	Huynh-Feldt	762.19	5.71	133.28	1.18	.314
	Lower-bound	762.19	2.00	381.09	1.18	.310

Table 4 (continued). Within-Subjects Output from the 2 X 3 X 4 Repeated Measures ANOVA for the Target Driving Behavior.

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Trial X Gender X Group	Sphericity Assumed	231.80	6	38.63	.36	.903
	Greenhouse-Geisser	231.80	5.23	44.30	.36	.882
	Huynh-Feldt	231.80	5.71	40.53	.36	.896
	Lower-bound	231.80	2.00	115.90	.36	.698
Error(Trial)	Sphericity Assumed	27893.64	261	106.87		
	Greenhouse-Geisser	27893.64	227.58	122.56		
	Huynh-Feldt	27893.64	248.76	112.12		
	Lower-bound	27893.64	87.00	320.617		

Table 5. Between-Subjects Output from the 2 X 3 X 4 Repeated Measures ANOVA for the Target Driving Behavior.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	2212233.97	1	2212233.97	3281.33	.000
Gender	2043.68	1	2043.68	3.03	.085
Group	10188.64	2	5094.32	7.55	.001
Gender X Group	648.66	2	324.33	.48	.620
Error	58654.24	87	674.18		

Control group. Across all trials, participants in the Control group traveled below the posted speed limit for a mean of 73.3% of their total driving time. These participants traveled below the posted speed limit for a mean of 77.6% of their total driving time in Trial 1, 70.3% in Trial 2, 73.4% in Trial 3, and 71.8% in Trial 4 (*SD* = 11.97, 19.94, 18.27, and 16.15, respectively).

SM group. Across all trials, participants in the SM group traveled below the posted speed limit for a mean of 86.7% of their total driving time. These participants traveled below the posted speed limit for a mean of 85.8% of their total driving time in Trial 1, 86.6% in Trial 2, 88.9% in Trial 3, and 85.6% in Trial 4 (*SD* = 14.31, 13.13, 16.69, and 17.5, respectively).

SM + OFB group. Across all trials, participants in the SM + OFB group traveled below the posted speed limit for a mean of 87.8% of their total driving time. These participants traveled below the posted speed limit for a mean of 83% of their total driving time in Trial 1, 86% in Trial 2, 86.9% in Trial 3, and 86.4% in Trial 4 (*SD* = 16.08, 11.37, 13.01, and 15.89).

Goal Setting

The analysis performed to test Hypothesis 1 assessed whether participants in the intervention groups (SM and SM + OFB) drove below the posted speed limit significantly more often than participants in the Control group. As participants in the Control group did not select individual performance goals, goal setting could not be included as a covariate in this analysis. Thus, a 2 Gender (Male, Female) X 2 Group (SM, SM + OFB) X 4 Trial (Trials 1-4) repeated measures ANOVA was used to test for significant differences in mean goal level.

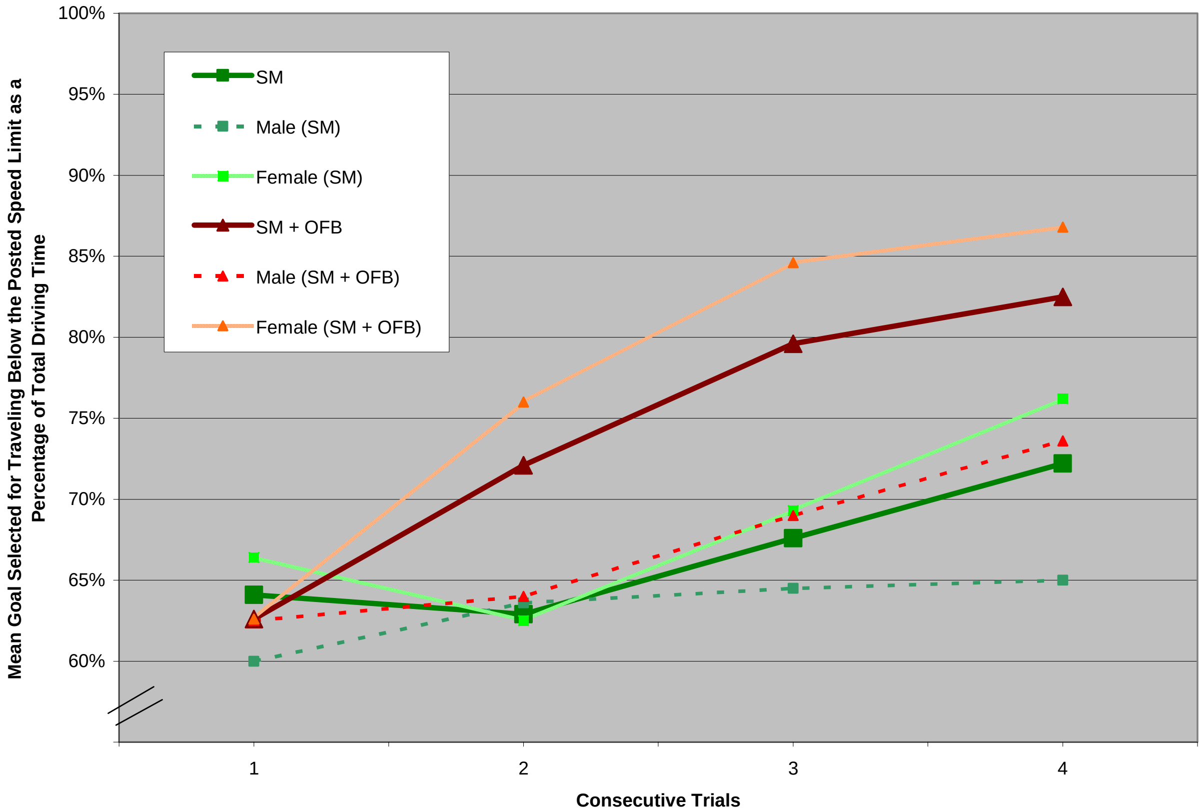

Figure 11. Mean Goal Selected for Traveling Below the Posted Speed Limit as a Percentage of Total Driving Time Across Trials as a Function of Gender and Group.

A plot of the mean goals level across trials is illustrated in Figure 11. The Mauchly sphericity test was significant ($p < .01$); thus, the probabilities associated with the F-values were corrected using the Greenhouse-Geisser epsilon (.741). The 2 X 2 X 4 repeated measures ANOVA only showed a significant main effect for Trial, $F_{(3, 174)} = 8.85$, $p < .001$, all other main effects and interactions were non-significant (*p's* > .05). Tables 6 and 7 display the within- and between-subjects output from the 2 X 2 X 4 repeated measures ANOVA for goals selected, respectively. To assess differences among the four levels for the main effect for Trial, pair-wise comparisons were performed. The results indicated that across the SM and SM + OFB groups, the mean goal on the target driving behavior in Trials 3 ($M = 73.6\%$) and 4 ($M = 77.4\%$) were significantly higher (*p* < .05) than in Trial 1 (*M* = 63.4%). The mean goals on the target driving behavior in Trials 3 and 4 were significantly higher (*p* < .05) than in Trial 2 (*M* = 67.5). The mean goal on the target driving behavior in Trial 4 was significantly higher (*p* < .05) than in Trial 3. Thus, it appears goal level increased as a function of Trial across the SM and SM + OFB groups.

Table 6. Within-Subjects Output from the 2 X 2 X 4 Repeated Measures ANOVA for Goals.

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Trial	Sphericity Assumed	5127.62	3	1709.20	8.85	.000
	Greenhouse-Geisser	5127.62	2.22	2307.61	8.85	.000
	Huynh-Feldt	5127.62	2.43	2106.61	8.85	.000
	Lower-bound	5127.62	1.00	5127.62	8.85	.004
Trial X Group	Sphericity Assumed	1006.20	3	335.40	1.73	.161
	Greenhouse-Geisser	1006.20	2.22	452.82	1.73	.176
	Huynh-Feldt	1006.20	2.43	413.38	1.73	.172
	Lower-bound	1006.20	1.00	1006.20	1.73	.193
Trial X Gender	Sphericity Assumed	708.26	3	236.08	1.22	.303
	Greenhouse-Geisser	708.26	2.22	318.74	1.22	.300
	Huynh-Feldt	708.26	2.43	290.98	1.22	.301
	Lower-bound	708.26	1.00	708.26	1.22	.273
Trial X Group X Gender	Sphericity Assumed	818.99	3	272.99	1.41	.240
	Greenhouse-Geisser	818.99	2.22	368.57	1.41	.246
	Huynh-Feldt	818.99	2.43	336.47	1.41	.245
	Lower-bound	818.99	1.00	818.99	1.41	.239
Error(Trial)	Sphericity Assumed	33588.18	174	193.03		
	Greenhouse-Geisser	33588.18	128.87	260.61		
	Huynh-Feldt	33588.18	141.17	237.91		
	Lower-bound	33588.184	58.00	579.10		

Table 7. Between-Subjects Output from the 2 X 2 X 4 Repeated Measures ANOVA for Goals.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1061008.57	1	1061008.57	668.51	.000
Group	2308.64	1	2308.64	1.45	.233
Gender	3332.65	1	3332.65	2.10	.153
Group X Gender	339.06	1	339.06	.21	.646
Error	92052.18	58	1587.10		

SM group. Across all trials, participants in the SM group selected a mean goal to travel below the posted speed limit for 66.7% of their total driving time. These participants selected a mean goal to travel below the posted speed limit for 64.1% of their total driving time in Trial 1, 62.9% in Trial 2, 67.6% in Trial 3, and 72.2% in Trial 4 (*SD* = 25.3, 26.6, 22.5, and 24.2, respectively).

SM + OFB group. Across all trials, participants in the SM + OFB group selected a mean goal to travel below the posted speed limit for 74.2% of their total driving time. These participants selected a mean goal to travel below the posted speed limit for 62.6% of their total driving time in Trial 1, 72.1% in Trial 2, 79.6% in Trial 3, and 82.5% in Trial 4 (*SD* = 26.8, 22.5, 18.6, and 18.8, respectively).

Hypothesis 2: The SM + OFB group will drive below the posted speed limit significantly more often than the SM group.

A 2 Group (SM, SM + OFB) X 4 Trial (Trials 1-4) repeated measures analysis of covariance (ANCOVA) was used to test for significant differences in the mean percentage of total driving time traveling below the posted speed limit. The covariate in this analysis was the mean goal across trials for each participant (i.e., [goal in Trial 1 + goal in Trial 2 + goal in Trial 3 + goal in Trial 4] / 4). The Mauchly sphericity test was significant ($p < .01$); thus, the probabilities associated with the F-values were corrected using the Greenhouse-Geisser epsilon (.740). The 2 X 4 repeated measures ANCOVA only showed a significant main effect for the Covariate[8], $F_{(1, 59)} = 47.65$, $p < .001$, all other main effect and interactions were non-significant (*p's* > .05).

Table 8 displays the adjusted means for traveling below the posted speed limit as a percentage of total driving time for the SM and SM + OFB groups. Tables 9 and 10 display the

[8] Please note that the main effect for the covariate should be viewed with caution. The covariate reflects the mean goal across all four trials, rather than the goal for each corresponding trial and group.

within- and between-subjects outputs from the 2 X 4 repeated measures ANCOVA for the percentage of total driving time traveling below the posted speed limit, respectively. Indeed, the covariate significantly correlated with the dependent measure in Trial 1 (β = .309, $t_{(1, 59)} = 3.41$, $p < .01$), Trial 2 (β = .376, $t_{(1, 59)} = 5.44$, $p < .001$), Trial 3 (β = .472, $t_{(1, 59)} = 6.23$, $p < .001$), and Trial 4 (β = .532, $t_{(1, 59)} = 6.32$, $p < .001$). Based on these results, Hypothesis 2 was not supported.

Table 8. Adjusted Means for Traveling Below the Posted Speed Limit as a Percentage of Total Driving Time for the SM and SM + OFB Groups.

	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
SM Group	86.95%	87.98%	90.76%	87.52%
SM + OFB Group	81.89%	84.62%	85.14%	84.41%

Table 9. Within-Subjects Output from the 2 X 4 Repeated Measures ANCOVA for the Percentage of Total Driving Time Traveling Below the Posted Speed Limit.

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Trial	Sphericity Assumed	520.34	3	173.44	2.00	.116
	Greenhouse-Geisser	520.34	2.22	234.37	2.00	.134
	Huynh-Feldt	520.34	2.38	217.80	2.00	.130
	Lower-bound	520.34	1.00	520.34	2.00	.162
Trial X Mean Goal	Sphericity Assumed	704.45	3	234.81	2.70	.047
	Greenhouse-Geisser	704.45	2.22	317.31	2.70	.065
	Huynh-Feldt	704.45	2.38	294.87	2.70	.060
	Lower-bound	704.45	1.00	704.45	2.70	.105
Trial X Group	Sphericity Assumed	65.47	3	21.82	.25	.860
	Greenhouse-Geisser	65.47	2.22	29.49	.25	.800
	Huynh-Feldt	65.47	2.38	27.40	.25	.816
	Lower-bound	65.47	1.00	65.47	.25	.618
Error(Trial)	Sphericity Assumed	15344.66	177	86.69		
	Greenhouse-Geisser	15344.66	130.98	117.14		
	Huynh-Feldt	15344.66	140.95	108.86		
	Lower-bound	15344.66	59.00	260.07		

Table 10. Between-Subjects Output from the 2 X 4 Repeated Measures ANCOVA for the Percentage of Total Driving Time Traveling Below the Posted Speed Limit.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	56880.01	1	56880.01	158.81	.000
Mean Goal	17066.33	1	17066.33	47.65	.000
Group	1090.85	1	1090.85	3.04	.086
Error	21130.68	59	358.14		

Hypothesis 3: The SM + OFB group will have significantly higher accuracy scores than the SM group.

Figure 12 displays a plot of the mean accuracy scores (i.e., deviation between participants' self-reported percentage of their total driving time traveling below the posted speed limit and their actual percentage of total driving time traveling below the posted speed limit as recorded by the STISIM driving simulator) across trials. A 2 Group (SM, SM + OFB) X 4 Trial (Trials 1-4) repeated measures ANOVA was used to test for significant differences in the participants' accuracy scores. The Mauchly sphericity test was significant ($p < .01$), thus, the probabilities associated with the F-values were corrected using the Greenhouse-Geisser epsilon (.694). The 2 X 4 repeated measures ANOVA only showed a significant main effect for Trial, $F_{(2.08,\ 124.99)} = 21.19$, $p < .001$. Tables 11 and 12 display the within- and between-subjects output from the 2 X 4 repeated measures ANOVA for the accuracy scores, respectively.

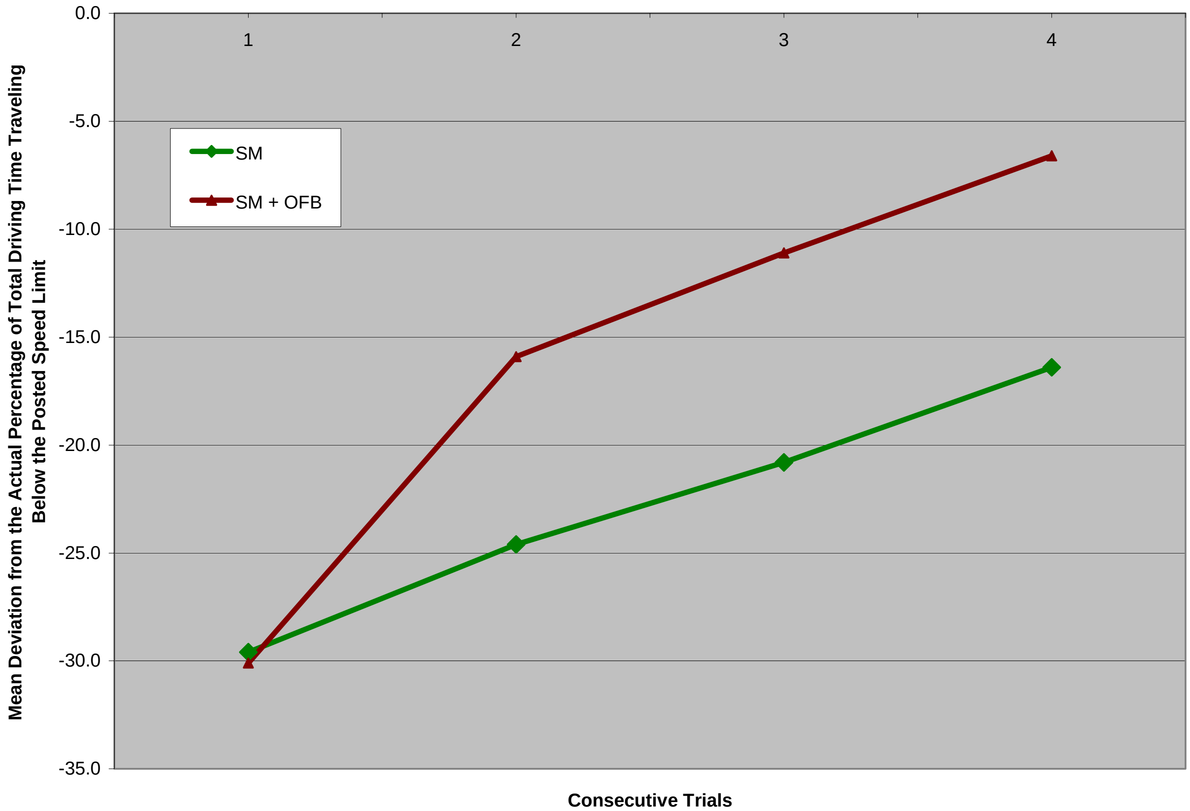

Figure 12. Mean Accuracy Scores Across Trials as a Function of Group.

Pair-wise t-tests showed that participants in Trial 1 (*M* = -29.8) underestimated their actual percentage of total driving time traveling below the posted speed limit significantly more than in Trial 2 (*M* = -20.25), $t_{(61)} = -3.91$, $p < .001$, Trial 3 (*M* = -15.98), $t_{(61)} = -4.45$, $p < .001$, and Trial 4 (*M* = -11.49), $t_{(61)} = -6.1$, $p < .001$. Participants in Trial 2 underestimated their actual percentage of total driving time traveling below the posted speed limit significantly more than in Trial 3, $t_{(61)} = -2.0$, $p < .05$, and Trial 4, $t_{(61)} = -4.79$, $p < .001$. Lastly, participants in Trial 3 underestimated their actual percentage of total driving time traveling below the posted speed limit significantly more than in Trial 4, $t_{(61)} = -2.68$, $p < .01$. Based of these results, Hypothesis 3 was not supported.

Table 11. Within-Subjects Output from the 2 X 4 Repeated Measures ANOVA for the Accuracy Scores.

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Trial	Sphericity Assumed	11407.75	3	3802.58	21.18	.000
	Greenhouse-Geisser	11407.75	2.08	5476.08	21.18	.000
	Huynh-Feldt	11407.75	2.19	5195.90	21.18	.000
	Lower-bound	11407.75	1.00	11407.75	21.18	.000
Trial X Group	Sphericity Assumed	1143.89	3	381.29	2.12	.099
	Greenhouse-Geisser	1143.89	2.08	549.10	2.12	.122
	Huynh-Feldt	1143.89	2.19	521.01	2.12	.119
	Lower-bound	1143.89	1.00	1143.89	2.12	.150
Error(Trial)	Sphericity Assumed	32308.47	180	179.49		
	Greenhouse-Geisser	32308.47	124.99	258.48		
	Huynh-Feldt	32308.47	131.73	245.26		
	Lower-bound	32308.47	60.00	538.47		

Table 12. Between-Subjects Output from the 2 X 2 X 4 Repeated Measures ANOVA for the Accuracy Scores.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	93294.60	1	93294.60	99.16	.000
Group	3018.71	1	3018.71	3.20	.078
Error	56446.81	60	940.78		

SM group. Across all trials, participants in the SM group underestimated the percentage of their total driving time traveling below the posted speed limit by a mean of -22.83. Participants in the SM group underestimated the percentage of their total driving time traveling below the posted speed limit by a mean of -29.6 in Trial 1, -24.6 in Trial 2, -20.8 in Trial 3, and -16.4 in Trial 4 (*SD* = 20.3, 19.9, 18.5, and 17.3, respectively).

SM + OFB group. Across all trials, participants in the SM + OFB group underestimated the percentage of their total driving time traveling below the posted speed limit by a mean of -15.93. Participants in the SM + OFB group underestimated the percentage of their total driving time traveling below the posted speed limit by a mean of -30.1 in Trial 1, -15.9 in Trial 2, -11.1 in Trial 3, and -6.6 in Trial 4 (*SD* = 23.9, 19.0, 18.3, and 15.6, respectively).

Hypothesis 4: Within the SM and SM + OFB groups, there will be a significant positive correlation between personal goal level and the percentage of total driving time traveling below the posted speed limit.

A Pearson Product-Moment Correlation was calculated in each Intervention group (SM and SM + OFB) between each participant's percentage of total driving time traveling below the posted speed limit (as recorded by the STISIM driving simulator) and corresponding goal for that trial. Rather than having four separate correlations per group (one for each trial), each observation was treated as a cell (31 cells per Trial X 4 Trials = 124 cells per group). As hypothesized, there was a significant correlation between the percentage of total driving time traveling below the posted speed limit and goal level for the SM, $r_{(124)} = .530$, $p < .001$, and SM + OFB groups, $r_{(124)} = .491$, $p < .001$. Figure 13 illustrates a scatter plot of goals and the percentage of total driving time traveling below the posted speed limit as a function of Group. Based on these results, Hypothesis 4 was supported.

Hypothesis 5: Personal goals and accuracy scores will predict a significant amount of variance in the percentage of total driving time traveling below the posted speed limit.

A hierarchal multiple regression was calculated for each group (SM and SM + OFB) to determine the amount of variance in the percentage of total driving time traveling below the posted speed limit predicted by the independent variables (goals, gender, and accuracy scores). Gender was dummy coded as Male = 1 and Female = 0. Since the accuracy scores were both negative and positive, they were transformed into true scores by the following equation: |accuracy score|[9]. As many prior meta-analyses indicate a strong liner relationship between goals and performance (Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Wood, Mento, Locke, 1987), goals were entered into the first block. In the second block, gender and true accuracy scores were added to assess if they predict a significant amount of the variability in the dependent variable above goals.

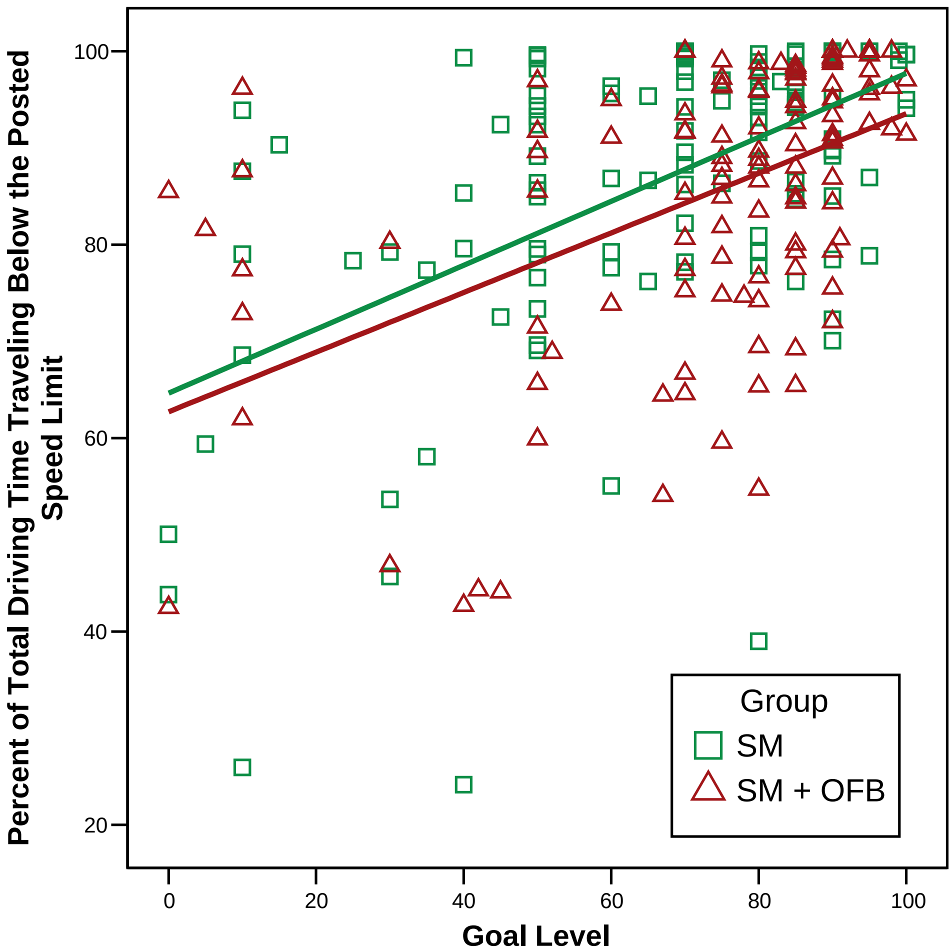

Figure 13. Scatter Plot of Goal Level and the Percent of Total Driving Time Traveling Below the Posted Speed Limit as a Function of Group.

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[9] This should not affect the regression equation because the true accuracy score reflects how many units the participants deviated from the actual score. Thus, accuracy scores of -5 and 5 reflect an underestimation and an overestimation by 5 units, respectively. However, both accuracy scores are 5 units away from the actual score.

SM group. The results of the hierarchal multiple regression for the SM group indicated that goal level significantly predicted 28.1% ($F_{(1, 122)} = 47.7$, $p < .001$) of the variance in the percentage of total driving time traveling below the posted speed limit. Table 13 displays a correlation matrix for the SM group's hierarchical multiple regression. The addition of gender and true accuracy scores to the model significantly predicted an additional 5% ($F\Delta_{(2, 120)} = 4.89$, $p < .05$) of the variance in the percentage of total driving time traveling below the posted speed limit. Thus, the full model significantly predicted 31.4% of the variability in the percentage of total driving time traveling below the posted speed limit ($F_{(3, 120)} = 19.79$, $p < .001$). Both goal level ($t = 6.39$, p < .001) and gender ($t = -2.49$, p < .01) significantly predicted the percentage of total driving time traveling below the posted speed limit. However, true accuracy scores ($t = 1.25$, p > .05) did not significantly predict the percentage of total driving time traveling below the posted speed limit. The regression equation for the model is: Y' = 62.98 + .355 (goal level) -6.07 (gender) + .092 (true accuracy score).

Table 13. Correlation Matrix for the SM group's Hierarchal Multiple Regression.

		Percent Safe Speed	Goals Level	Gender	True Accuracy Score
Pearson Correlation	Percent Safe Speed	1.000	.530	-.257	-.172
	Goal Level	.530	1.000	-.103	-.524
	Gender	-.257	-.103	1.000	-.076
	True Accuracy Score	-.172	-.524	-.076	1.000
Sig. (1-tailed)	Percent Safe Speed	.	.000	.002	.028
	Goal Level	.000	.	.128	.000
	Gender	.002	.128	.	.200
	True Accuracy Score	.028	.000	.200	.
N	Percent Safe Speed	124	124	124	124
	Goal Level	124	124	124	124
	Gender	124	124	124	124
	True Accuracy Score	124	124	124	124

SM + OFB group. The results of the hierarchal multiple regression for the SM + OFB group indicated that goal level significantly predicted 24.1% ($F_{(1, 122)}$ = 38.77, p <. 001) of the variance in the percentage of total driving time traveling below the posted speed limit. Table 14 displays a correlation matrix for the SM + OFB group's hierarchal multiple regression. The addition of gender and true accuracy scores to the model predicted an additional 2.5% ($F\Delta_{(2, 120)}$ = 2.08, p > .05) of the variance in the percentage of total driving time traveling below the posted speed limit, however, this was not a significant increase in explained variability. Only goal level (t = 5.78, p < .001) significantly predicted the percentage of total driving time traveling below the posted speed limit, neither gender (t = -.642, p > .05) nor true accuracy scores (t = 1.85, p > .05) significantly predicted the percentage of total driving time traveling below the posted speed limit. The regression equation for the model is: Y'= 55.72 + .376 (goals) -1.59 (gender) + .140 (true accuracy score). Based on the results, Hypothesis 5 was only partially supported.

Table 14. Correlation Matrix for the SM + OFB group's Hierarchal Multiple Regression.

		Percent Safe Speed	Goal Level	Gender	True Accuracy Score
Pearson Correlation	Percent Safe Speed	1.000	.491	-.167	-.193
	Goal Level	.491	1.000	-.209	-.632
	Gender	-.167	-.209	1.000	.052
	True Accuracy Score	-.193	-.632	.052	1.000
Sig. (1-tailed)	Percent Safe Speed	.	.000	.032	.016
	Goal Level	.000	.	.010	.000
	Gender	.032	.010	.	.285
	True Accuracy Score	.016	.000	.285	.
N	Percent Safe Speed	124	124	124	124
	Goal Level	124	124	124	124
	Gender	124	124	124	124
	True Accuracy Score	124	124	124	124

Post-Hoc Analysis

Variability between and within groups may explain the lack of differences between the SM and SM + OFB groups. Did some participants select easy goal levels while others consistently selected difficult goal levels? Participants who selected a goal of traveling below the posted speed limit for 80% or more of their total driving time were placed in the Difficult Goal group, while those who selected a goal of traveling below the posted speed limit for 79% or less of their total driving time were placed in the Easy Goal group. This was done for each trial. Interestingly, participants who meet the criteria for placement in the Difficult Goal group in Trial 1 also meet criteria in Trials 2-4, and vice versa for the Easy Goal Group. Thus, participants consistently selected a difficult or easy goal level across trials.

In the SM group, fourteen participants meet the criteria for inclusion into the Difficult Goal group, while nine participants in the SM + OFB meet these same criteria. A 2 Group (SM, SM + OFB) X 2 Goal Level (Difficult, Easy) X 4 Trial (Trials 1-4) repeated measures ANOVA, where the dependent variable was the percentage of total driving time traveling below the posted speed limit, only showed a significantly main effect for Goal Level, $F_{(1,58)} = 7.37$, $p < .01$ (all other *p's* < .05).

Discussion

This laboratory experiment evaluated the effectiveness of an SMS approach to increase the safe driving speed of participants in a simulated driving task. Almost all prior behavior-based safety research has targeted safety-related behaviors in settings where employees can systematically observe the safe versus at-risk behavior of their coworkers (e.g., Geller & Williams, 2001; McSween, 1995; Williams & Geller, 2000). However, employees who work in relative isolation or have little or no oversight, compared to traditional industrial workers, require a process by which they can systematically observe themselves.

The current study attempted to answer the following empirical questions concerning the impact of an SMS process in a simulated driving task: a) will the SMS process result in significant increases in safe driving behavior?, b) will the addition of objective feedback significantly increase the accuracy of participants' self-monitoring?, c) will the addition of objective feedback significantly increase safe driving behavior?, and d) what is the relationship between individual goal levels and performance on the targeted driving behavior?

Effectiveness of SMS

Similar to past self-management interventions directed at increasing safety-related driving behavior (Hickman & Geller, in press; Krause, 1997; Olson & Austin, 2001), SMS led to clear improvement in subsequent safety performance. Based on the recorded driving behaviors of 93 participants, SMS was effective in increasing the mean percentage of total driving time traveling below the posted speed limit compared to a control group that did not receive any of the SMS components. Across the four trials, participants in the SM and SM + OFB group significantly increased the percentage of total driving time traveling below the posted speed limit by 13.4 (18.3%) and 14.5 (19.8%) percentage points, respectively, compared to participants in the Control group.

The introduction of the SMS process was clearly beneficial in improving the percentage of total driving time traveling below the posted speed limit, relative to the Control group. These results support Hypothesis 1--both the SM and SM + OFB groups would significantly increase the percentage of their total driving time traveling below the posted speed limit, compared to the Control group. However, not all of the *a priori* hypotheses were supported.

Objective Feedback vs. Personal Feedback from Self-Monitoring

While it is clearly relevant that participants exposed to the SMS process significantly increased the percentage of total driving time traveling below the posted speed limit compared to participants in the Control group, one of the primary aims of the current study was to assess the effect of providing participants with objective feedback. Hypothesis 2 stated the SM + OFB group would drive below the posted speed limit significantly more often than participants in the SM group. The rationale for this hypothesis was that participants in the SM + OFB group would be more accurate in their self-monitoring, thereby resulting in greater behavior change (cf. Hickman & Geller, 2003; Kopp, 1998; McCann & Sulzer-Azaroff, 1996; Sharp et al., 1997). Unfortunately, the current study did not find support for this hypothesis. In fact, a repeated measures ANCOVA showed no significant difference in the percentage of total driving time traveling below the posted speed limit between the SM and SM + OFB groups.

There are several possible explanations for the lack of significant differences in the percentage of total driving time traveling below the posted speed limit between the SM and SM + OFB groups. The simplest explanation for the lack of significant differences in the percentage of traveling below the posted speed limit as a percentage of total driving time between the SM and SM + OFB groups is that accuracy in self-monitoring is not necessary for behavior change, a contention supported in the literature (Kazdin, 1974; Wurtle, Wilson, & Lyman, 1985). Hickman and Geller (2005) acknowledged this hypothesis in their review of SMS techniques, but argued that greater accuracy in self-monitoring was likely to lead to greater behavior change (compared to inaccurate self-monitoring). However, this hypothesis was made in reference to continuous safety-related behaviors that are frequently preformed.

Traveling below the posted speed limit is a discrete driving behavior in the sense that it is easy to report whether a person did or did/not travel below the posted speed limit on any given trip; the person only has to look as far as the speedometer. However, over the course of a trip people are less certain about how often they traveled below the posted speed limit (Corbett, 2001), and in that respect it is less discrete than using a safety-belt. Further, traveling below the posted speed limit was frequently performed (as indicated in Preliminary Study 1 and the Control group). The target driving behavior meets both these criteria, continuous and frequently performed, so why was there no difference in performance?

One of the fundamental tenets of both goal setting theory and SCT is that goal-performance discrepancies are a powerful motivational force. People create discrepancies by selecting a goal above previous levels of performance and then try to reduce the discrepancy to achieve positive self-evaluations (Bandura, 1986). When there are discrepancies between goals and performance, people are likely to be motivated to make adjustments in their behavior or goals to reduce the discrepancy. Figure 11 clearly shows that participants in the SM and SM + OFB did not reduce their goal levels. In fact they increased their goal level over successive trials.

Figure 10 clearly shows that participants in the SM and SM + OFB groups did not alter their performance over successive trials. However, Figure 10 displays participants' actual percentage of total driving time traveling below the posted speed limit as recorded by the STISIM driving simulator and not their estimations from self-monitorings on how often they traveled below the posted speed limit as a percentage of their total driving time. For example, the mean goal-performance discrepancy, where performance was defined as the participant's self-monitoring scores, was relatively the same in each group. In fact a 2 Group (SM, SM + OFB) X 4

Trial (Trials 1-4) repeated measures ANOVA did not show any significant differences between the SM and SM + OFB groups and the mean goal-performance discrepancies (all other *p's* > .05).

The premise behind selecting a challenging or difficult goal is to create a large goal-performance discrepancy. While the SM + OFB group selected higher goals than the SM group, their goal-performance discrepancy and performance on the target driving behavior was not significantly different than the SM group. Apparently the personal feedback from self-monitoring (in both the SM and SM + OFB groups) and the objective feedback (in the SM + OFB group) allowed participants to select more difficult performance goals, as evidenced by the increasing goal level over successive trials in Figure 11. This discrepancy was enough for both the SM and SM + OFB groups to significantly outperform the Control group, but not enough for a statistically significant effect between the SM and SM + OFB groups.

Another possible explanation for the non-significant difference in the percentage of total driving time traveling below the posted speed limit between the SM and SM + OFB groups was the short length of the simulated driving trials (≈ 5 miles). Typically, participants completed the driving trials in 6 to 8 minutes. This short time period may not have been long enough for participants to have difficulty estimating the percentage of total driving time they were traveling below the posted speed limit, thereby limiting the influence of objective feedback. This explanation is supported by the non-significant difference in accuracy scores between the SM and SM + OFB groups.

Hypothesis 3 indicated the SM + OFB group would have significantly higher accuracy scores than the SM group. This hypothesis was not supported. Both groups (SM and SM + OFB) used the feedback (personal, objective, or both) to alter their self-monitoring in subsequent trials. Although the repeated measures ANOVA did not show a significant difference between the SM and SM + OFB groups (*p* = .078), it appears that objective feedback should be used in the initial stages of a SMS process to increase the accuracy of self-monitoring until a level of acceptable proficiency has been achieved (as both groups were highly inaccurate during the first trial, but became more progressively more accurate in each successive trial).

There was some evidence of a relationship between accuracy scores and the percentage of total driving time traveling below the posted speed limit. The hierarchal multiple regression analysis showed a significant negative correlation between true accuracy scores and the percentage of total driving time traveling below the posted speed limit in the SM group (*r* = .-172). Recall, true accuracy scores reflect the deviation between participants' self-monitoring and the actual percentage of total driving time traveling below the posted speed limit as recorded by the STISIM driving simulator. Thus, as the deviation between the two scores decreased (i.e., more accuracy), the percentage of total driving time traveling below the posted speed limit increased. A slightly stronger negative correlation between true accuracy scores and the percentage of total driving time traveling below the posted speed limit was found in the SM + OFB group (*r* = -.193). While the addition of objective feedback did not affect the percentage of total driving time traveling below the posted speed limit in the SM + OFB group, it did allow an objective evaluation of the current research.

If the current study only used personal feedback (i.e., from self-monitoring) to measure intervention success, the effect of the intervention would have been markedly understated. This supports Critchfield, Tucker, and Vuchinich (1998), who indicated that high-frequency behaviors (such as the percentage of total driving time traveling below the posted speed limit) are likely to be under-reported, and vice versa for low frequency behaviors. Researchers and practitioners should be cautious of relying solely on self-monitoring data to evaluate intervention success.

Goal Setting

Most of the relevant findings in the current study reflect the impact of goals on behavior. Hypothesis 4 stated that within the SM and SM + OFB group there would be a significant positive correlation between personal goal level and the percentage of total driving time traveling below the posted speed limit. This hypothesis was supported. The correlation between the percentage of total driving time traveling below the posted speed limit and goal level was .530 in the SM group and .491 in the SM + OFB group. Both groups performed similarly, but participants in the SM group selected lower performance goals (although not significantly lower) than participants in the SM + OFB group. This supports the hypothesis that goals and performance have a linear relationship (Locke & Latham, 1990).

As shown in Figure 13, goal level was skewed toward the normative goal level provided to participants in the SM and SM + OFB groups. This suggests the normative information given to participants by the researchers affected their goal choice. While the goal level was skewed towards the normative goal (i.e., traveling below the posted speed limit for 85% of total driving time), participants selected mean goals that were well below this value. There are two possible explanations for this observation.

First, participants in the SM and SM + OFB groups consistently traveled below the posted speed limit close to the normative goal level. However, they consistently underestimated, via self-monitoring, how often they traveled below the posted speed limit. Thus, their prior estimation of driving performance affected the goal they selected in the following trial. Second, participants' prior on-road driving history may have influenced their goal level. The former explanation is probably the most valid, at least after the first trial. These explanations are supported by both

Bandura (1986, 1997) and Locke and Latham (1990), who suggest that people's prior performance is a strong predictor of future goal choice.

More support for the power of goals in increasing the percentage of total driving time traveling below the posted speed limit is found in the hierarchal multiple regression equation for each group. More specifically, Hypothesis 5 stated that personal goals and accuracy scores will predict a significant amount of variance on the target behavior. This hypothesis was partially supported.

In the SM group, personal goals significantly predicted 28.1% of the variability in the percentage of total driving time traveling below the posted speed limit. While the addition of gender and true accuracy scores significantly predicted an additional 5% of variance in the percentage of total driving time traveling below the posted speed limit, the t-score for true accuracy scores was not significant ($p > .05$), thus true accuracy scores should be removed from the model. However, the significantly high negative correlation between goals and true accuracy scores ($r = -.524$) likely reduced the amount of explained variability in the percentage of total driving time traveling below the posted speed limit for the true accuracy scores. For every one percent increase in goal level, the percentage of total driving time traveling below the posted speed limit is predicted to increase by .355 percentage points.

In the SM + OFB group, personal goals significantly predicted 24.1% of the variability in the percentage of total driving time traveling below the posted speed limit. The addition of gender and true accuracy scores predicted an additional 2.5% of variance on the percentage of total driving time traveling below the posted speed limit, however this was not significant. Gender should be removed for the model first as it had the lowest t-score ($t = -.642$). Again, the significantly high negative correlation between goals and true accuracy scores ($r = -.632$) likely reduced the amount of explained variability in the percentage of total driving time traveling below the posted speed limit for the true accuracy scores. For every one percent increase in goal level, the percentage of total driving time traveling below the posted speed limit is predicted to increase by .376 percentage points.

Lessons Learned

While the SM and SM + OFB groups drove below the posed speed limit as a percentage of their total driving time significantly more often than the Control group, the current research can not rule out the possible influence of the instructions given to participants. Thus, did the instructions to select a goal for traveling below the posted speed limit or the actual goal level selected by participants affect performance? While the regression analysis and the scatter plot provide evidence that it was the goal level and the act of selecting a goal, the Control group does not allow the current research to tease out these possible confounds. A more appropriate Control group would have given participants the identical instructions as the SM and SM +OFB groups without allowing them to select a goal for the next trial.

Also, the objective feedback given to participants was not very salient. They were given an overall score that reflected their percentage of total driving time traveling below the posted speed limit. It is likely this feedback was confusing and difficult to comprehend. Further, the objective feedback used in the current research did not allow participants to determine at what point during the simulated trial they were traveling below the posted speed limit. More specific feedback and immediate feedback should be used in these driving situations so that drivers are better able to adjust their behavior while driving.

Lastly, the driving simulation did not mimic real-world driving conditions. Thus, participants could have driven well below the speed limit to achieve the goal. It is unrealistic and unsafe to have people driving 10 mph in a 45 mph zone to achieve a goal. A more realistic and challenging instructional component would be to have participants stay within a specified speed band (i.e., 5 mph over/under the posted speed limit). Thus, participants could have been instructed to travel within 5 mph on the posted speed limit. Or, they could have been instructed to drive within 5 mph of the posted speed limit if they wish to reach the end of the trial by a certain criterion (i.e., time). A timer could be prominently displayed on the screen and started when the simulation began.

Limitations

There were several limitations that should be addressed when considering the current findings. First, the population (college students) and setting (a laboratory room) limit the external validity of the results. While the age group used in the current research is at the greatest risk for crashes and fatalities (NHTSA, 2004a), they are far from a representative sample of the general driving population. Second, and related to the first limitation, the apparatus used to test participants limits the generality of the results. The STISIM driving simulator was likely a novel device for participants, thereby altering their normal driving behavior. As indicated above, this does not pose a problem when comparing treatment effects, but does limit generalization of the results to actual driving. Third, although the normative information skewed the mean goal level selected by participants, it is likely this information reduced the variability in goal setting. Thus, participants who were likely to select an easy goal may have been influenced to select a more challenging goal when presented with normative information. Lastly, the driving trials were brief. The short driving trials may have negated the benefit of receiving objective feedback. Moreover, the short driving trials didn’t allow for an evaluation of the long-term impact of SMS.

Suggestions for Future Research

Obviously, future research should try to assess the impact of the SMS process over longer time periods. The SMS process worked in the short-term; however, less is known about the long-term impact of SMS. These long-term studies might also be able to assess the efficacy of providing objective feedback in conjunction with personal feedback (i.e., self-monitoring). The fact that few participants selected difficult goals suggests the need for goal-setting training. Future SMS research should include goal setting training, or assess the added benefit of giving people goal-setting training compared to a condition where people do not receive goal-setting training. While all vehicle drivers could benefit from SMS, it appears this process is best suited for individuals who have low driving proficiency or who log many hours on the road, such as teen drivers and commercial motor vehicle drivers. Future SMS research should target these populations.

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Appendix A: Instructions Given to Participants, in Each Group, by Research Assistants

Control Group Instructions

Greet Participant:

Hi name is______. Have you signed-up to participate in a driving simulation experiment? Can I please see your driver's license.

About Study:

The purpose of the current research project is to identify how a driving simulation task might eventually prove useful in planning and evaluating driver education programs. The information being gathered will not only aid the development of an evaluation measure but also provide normative data on driving performance across different ages and genders. Driving simulators have the added benefit of exposing drivers to potentially dangerous situations without risk. Also, people can be taught basic driving skills at relatively low cost. You have agreed to participate in this research project and will receive one extra-credit point.

About the task (<u>Before leading participant to simulator room</u>):

You will be asked to drive as you normally drive your vehicle on six different driving scenarios.

Instructions to Participants before Training.

Please adjust the seat and make yourself comfortable. Point to all vehicle controls. *Follow the instructions on the blue screen.*

Instructions during Training

Show participant all controls (i.e., mirrors, tachometer, speedometer) and have them use all controls (i.e., horn and turn-signal). Have them perform several hard brakes.

Instructions for Trials 1-4:

Please drive as you would normally drive your vehicle on the roadway. There is no right or wrong way to drive, nor will you be judged on how you drive. You will not make any Left or Right turns at any stop signs or stop-lights. Please proceed straight. If you crash, please continue, the simulation will resume shortly after the crash. You will know the simulation has ended when all the screens go black.

After Completing Trial 4:

Thank you for your cooperation, that is all we need from you today. If you would like to learn about the nature of the study, we can contact you upon its completion. Please record your email address on this piece of paper. We will only contact you regarding this study. It [contact info] *will remain confidential and at no time will your contact information be used for anything other than informing you about the result of this study.*

Self-Monitoring + Objective Feedback Group Instructions

Greet Participant:

Hi, my name is______. Have you signed-up to participate in a driving simulation experiment? Can I please see your driver's license.

About Study:

The purpose of the current research project is to identify how a driving simulation task might eventually prove useful in planning and evaluating driver education programs. The information being gathered will not only aid the development of an evaluation measure but also provide normative data on driving performance across different ages and genders. Driving simulators have the added benefit of exposing drivers to potentially dangerous situations without risk. Also, people can be taught basic driving skills at relatively low cost. You have agreed to participate in this research project and will receive one extra-credit point.

About the task (<u>Before leading participant to simulator room</u>):

You will be asked to drive as you normally drive your vehicle on six different driving scenarios.

Instructions to Participants before Training.

*Please adjust the seat and make yourself comfortable***.** Point to all vehicle controls**.** *Follow the instructions on the blue screen.*

Instructions during Training

Show participant all controls (i.e., mirrors, tachometer, speedometer) and have them use all controls (i.e., horn and turn-signal). Have them perform several hard brakes.

Instructions for Trials 1-4:

Driver education participants typically have goals for increasing driving performance. Thus, you will perform the stimulated driving trial with a specific goal in order to shed light on the impact of goals on driving. Prior research has shown that a difficult, yet attainable goal would be to travel <u>BELOW</u> the posted speed limit for ***85%*** *of your total driving time. Please write your personal goal on the sheet provided to you (0-100%). You are free to choose any goal you like. This research project is only concerned with how your group as a whole performs, rather than individuals, thus your group will place their anonymous forms into this lock-box. Please do not record your ID# or name on the form. Please place the form into the lock box. Further, at the completion of the trial, you will be required to complete a self-monitoring form, estimating how often you traveled under the posted speed limit as a percentage of your total driving time (0-100%).*

Please drive as you would normally drive your vehicle on the roadway. There is no right or wrong way to drive, nor will you be judged on how you drive. You will not make any Left or Right turns at any stop signs or stop-lights. Please proceed straight. If you crash, please continue, the simulation will resume shortly after the crash. You will know the simulation has ended when all the screens go black. Experimenter leaves room.

<u>After completing the trial.</u>
Enter the room. Give participants a self-monitoring form. *On this form, please record your estimate of the percentage of total driving time you traveled below the posted speed limit during the previous trial (0-100%). I want to remind you to refrain from recording your ID# of name on the form. When you have finished, please place the form into lock-box as before.*

<u>After participant places form into the lock box</u>
Give participant feedback sheet. *Listed on the piece of paper is the percentage of total driving time you traveled below the posted speed limit as recorded by the computer*.

After Completing Trial 4:

Thank you for your cooperation, that is all we need from you today. If you would like to learn about the nature of the study, we can contact you upon its completion. Please record your email address on this piece of paper. We will only contact you regarding this study. It [contact info] will remain confidential and at no time will your contact information be used for anything other than informing you about the result of this study.

Self-Monitoring Group Instructions

Greet Participant:

*Hi, my name is*______. *Have you signed-up to participate in a driving simulation experiment? Can I please see your driver's license.*

About Study:

The purpose of the current research project is to identify how a driving simulation task might eventually prove useful in planning and evaluating driver education programs. The information being gathered will not only aid the development of an evaluation measure but also provide normative data on driving performance across different ages and genders. Driving simulators have the added benefit of exposing drivers to potentially dangerous situations without risk. Also, people can be taught basic driving skills at relatively low cost. You have agreed to participate in this research project and will receive one extra-credit point.

About the task (<u>Before leading participant to simulator room</u>):

You will be asked to drive as you normally drive your vehicle on six different driving scenarios.

Instructions to Participants before Training.

Please adjust the seat and make yourself comfortable. Point to all vehicle controls. *Follow the instructions on the blue screen.*

Instructions during Training

Show participant all controls (i.e., mirrors, tachometer, speedometer) and have them use all controls (i.e., horn and turn-signal). Have them perform several hard brakes.

Instructions for Trials 1-4:

*Driver education participants typically have goals for increasing driving performance. Thus, you will perform the stimulated driving trial with a specific goal in order to shed light on the impact of goals on driving. Prior research has shown that a difficult, yet attainable goal would be to travel <u>BELOW</u> the posted speed limit for **85%** of your total driving time. Please write your personal goal on the sheet provided to you (0-100%). You are free to choose any goal you like. This research project is only concerned with how your group as a whole performs, rather than individuals, thus your group will place their anonymous forms into this lock-box. Please do not record your ID# or name on the form. Please place the form into the lock box. Further, at the completion of the trial, you will be required to complete a self-monitoring form, estimating how often you traveled under the posted speed limit as a percentage of your total driving time (0-100%).*

Please drive as you would normally drive your vehicle on the roadway. There is no right or wrong way to drive, nor will you be judged on how you drive. You will not make any Left or Right turns at any stop signs or stop-lights. Please proceed straight. If you crash, please continue, the simulation will resume shortly after the crash. You will know the simulation has ended when all the screens go black. Experimenter leaves room.

<u>After completing the trial.</u>
Enter the room. Give participants a self-monitoring form. *On this form, please record your estimate of the percentage of total driving time you traveled below the posted speed limit during the previous trial (0-100%). I want to remind you to refrain from recording your ID# of name on the form. When you have finished, please place the form into lock-box as before.*

After Completing Trial 4:

Thank you for your cooperation, that is all we need from you today. If you would like to learn about the nature of the study, we can contact you upon its completion. Please record your email address on this piece of paper. We will only contact you regarding this study. It [contact info] will remain confidential and at no time will your contact information be used for anything other than informing you about the result of this study.

Appendix B: Informed Consent Form

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent Form for
Participant of Investigative Projects

1. THE PURPOSE OF THIS RESEARCH

You are invited to participate in a project that will identify how a driving simulation task might eventually prove useful for planning and evaluating driver education programs. The information being gathered will not only aid the development of evaluation measures but also provide normative data on driving performance across different ages and genders.

2. PROCEDURES

You will be asked to drive a simulated car as you would normally drive and complete several psychological measures and background information.

3. RISKS & BENEFITS OF THIS PROJECT

We anticipate no risks associated with participation in this project other than those attributed to operating a driving simulator. Your participation in this project will help assess the extent to which a driving simulation task might eventually prove useful for planning and evaluating driver education programs. It will also allow us to assess normative data on driving performance across different ages and genders.

4. EXTENT OF THE ANONYMITY AND CONFIDENTIALITY

THE RESULTS OF THIS STUDY WILL BE KEPT STRICTLY CONFIDENTIAL. At no time will the researchers release your results in this study to anyone other than individuals working on the project without your written consent. The information you provide will only have an anonymous subject number to identify you.

5. COMPENSATION

Participants will receive one point of extra-credit in a psychology course.

6. FREEDOM TO WITHDRAW

YOU ARE FREE TO WITHDRAW FROM THIS STUDY AT ANY TIME WITHOUT PENALTY.

7. APPROVAL OF RESEARCH

This research has been approved, by the Human Subjects Committee of the Department of Psychology and by the Institutional Review Board Virginia Polytechnic Institute and State University.

Principal Investigator: Dr. Scott Geller	Phone: 231-6223
Co-Investigator: Jeff Hickman	Phone: 231-8145
Dir. of Sponsored Programs, David Moore, V.M.D.	Phone: 231-4991

8. PARTICIPANT'S RESPONSIBILITIES

I know of no reason I cannot participate in this study. I have the responsibility of letting the researcher know of any discomfort or problems I have during the course of the study.

____ Signature & Date

9. PARTICIPANT'S PERMISSION

I have read and understand the informed consent form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project.

If I participate, I may withdraw at any time without penalty. I agree to abide by the rules of this project.

If I have any questions about this research, I will contact Jeff Hickman at the Center for Applied Behavior Systems, 202 Williams Hall, Blacksburg, VA 24060-0436, (540)-231-8145.

By signing this form I also agree not to discuss this procedure with anyone until I have been formally debriefed.

Name (Print): ____

Appendix C: Demographic Questionnaire

Demographic Questionnaire

Please answer all of the questions frankly and honestly. Remember that your answers will be anonymous. There is no way anyone can connect your name with this survey.

1. Date:______________
2. First two letters of your Mothers' Maiden name:__________
3. First two letters of the town you were born in (for example, if you were born in Blacksburg, you would write "BL"):______________
4. Month you were born (for example, if you were born in April you would write "04"):________________
5. Gender (please circle): **MALE / FEMALE**
6. Age (write in # years old): ____
7. Ethnicity (please circle one)
    a. Caucasian
    b. African American
    c. Asian
    d. Pacific Islander
    e. Native American
    f. Latin American
    g. Other (please list):____________________________
8. How many years and months have you had a valid driver's license (for example, if you've had a valid driver's license for 1.5 years, write "1 year, 5 months").____________
9. Do you own a car or truck, or have your parents lent you a car or truck for your personal use (please circle)? **YES / NO**
    a. How many *hours* a *week* do you drive on average? (write in #): _____
    b. How many *miles* a *week* do you drive on average? (write in #): _____
    c. How many *days* a *week* do you drive on average? (please circle one):

       A. one B. two C. three D. four E. five F. six G. seven
10. In the last *year*, how many moving violations (speeding, reckless driving, DUI, DWI, incomplete stop, running a stop sign) have you received (write in #)?_______________

11. In the last *year*, how many traffic crashes have you been involved in (write in #)?________
    a. If you indicated one or more traffic crashes, how many of those traffic crashes were your fault?____________________
12. In the last *three* years, how many moving violations (speeding, reckless driving, DUI, DWI, incomplete stop, running a stop sign) have you received (write in #)?_______________
13. In the last *three* years, how many traffic crashes have you been involved in (write in #)?_________
    a. If you indicated one or more traffic crashes, how many of those traffic crashes were your fault?____________________

Appendix D: Goal Sheet

PERSONAL GOAL SHEET FOR TRIAL 1

Please state your personal goal for the percentage of driving time you expect to obey the posted speed limit (For example: *I intend to travel below the posted speed limit 85% of my total driving time*).

I intend to travel below the posted speed limit ______% of my total driving time.

PERSONAL GOAL SHEET FOR TRIAL 2

Please state your personal goal for the percentage of driving time you expect to obey the posted speed limit (For example: *I intend to travel below the posted speed limit 85% of my total driving time*).

I intend to travel below the posted speed limit ______% of my total driving time.

PERSONAL GOAL SHEET FOR TRIAL 3

Please state your personal goal for the percentage of driving time you expect to obey the posted speed limit (For example: *I intend to travel below the posted speed limit 85% of my total driving time*).

I intend to travel below the posted speed limit ______% of my total driving time.

PERSONAL GOAL SHEET FOR TRIAL 4

Please state your personal goal for the percentage of driving time you expect to obey the posted speed limit (For example: *I intend to travel below the posted speed limit 85% of my total driving time*).

I intend to travel below the posted speed limit ______% of my total driving time.

Appendix E: Self-Monitoring Form

Please estimate the percentage of your total driving time you traveled below the posted speed limit during Trial 1 (0-100%).______________%

Please estimate the percentage of your total driving time you traveled below the posted speed limit during Trial 2 (0-100%).______________%

Please estimate the percentage of your total driving time you traveled below the posted speed limit during Trial 3 (0-100%).______________%

Please estimate the percentage of your total driving time you traveled below the posted speed limit during Trial 4 (0-100%).______________%

Appendix F: Version of Objective Feedback

Trial 1 Safe Speed

You traveled below the posted speed limit _____% of your total driving time.

Trial 2 Safe Speed

You traveled below the posted speed limit _____% of your total driving time.

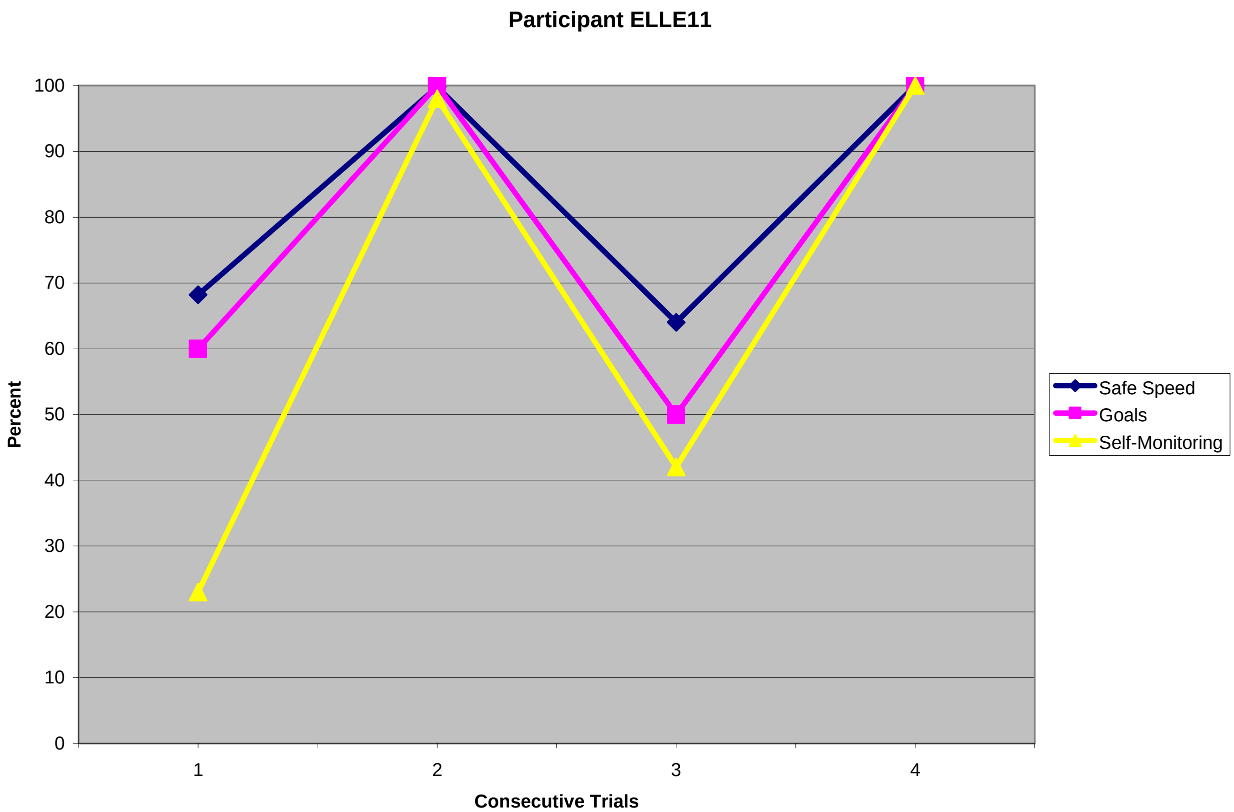
Trial 3 Safe Speed

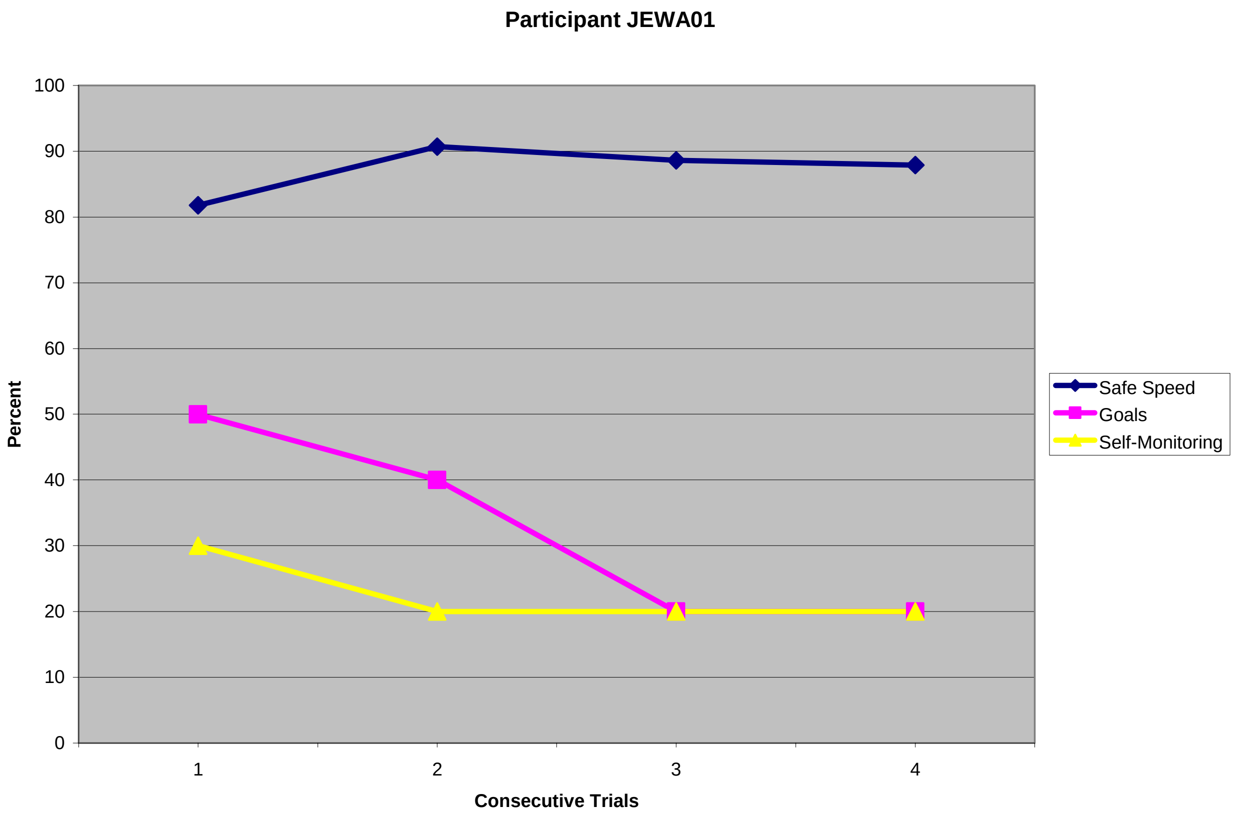
You traveled below the posted speed limit _____% of your total driving time.

Trial 4 Safe Speed

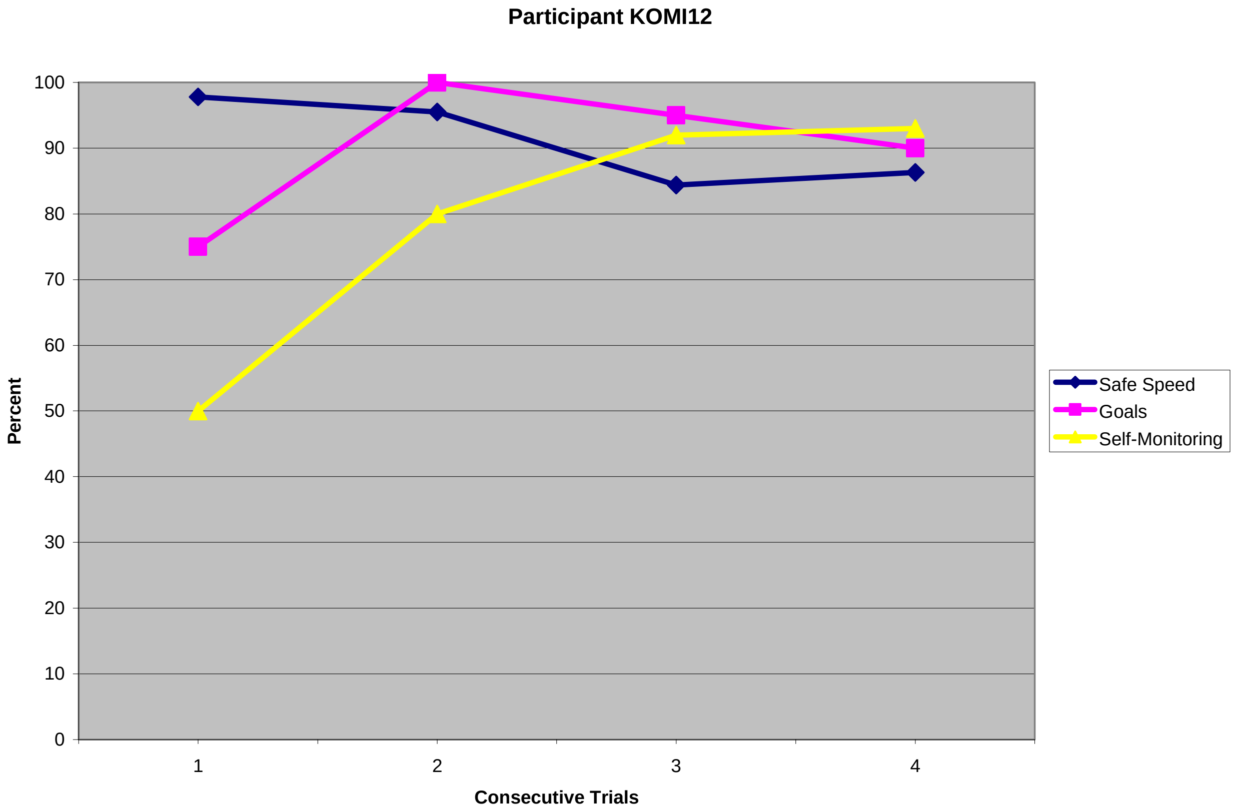
You traveled below the posted speed limit _____% of your total driving time.

Appendix G: Figures of Each Participant's Mean % of Time Traveling Below the Posted Speed Limit, Personal Goals, and Self-Monitoring

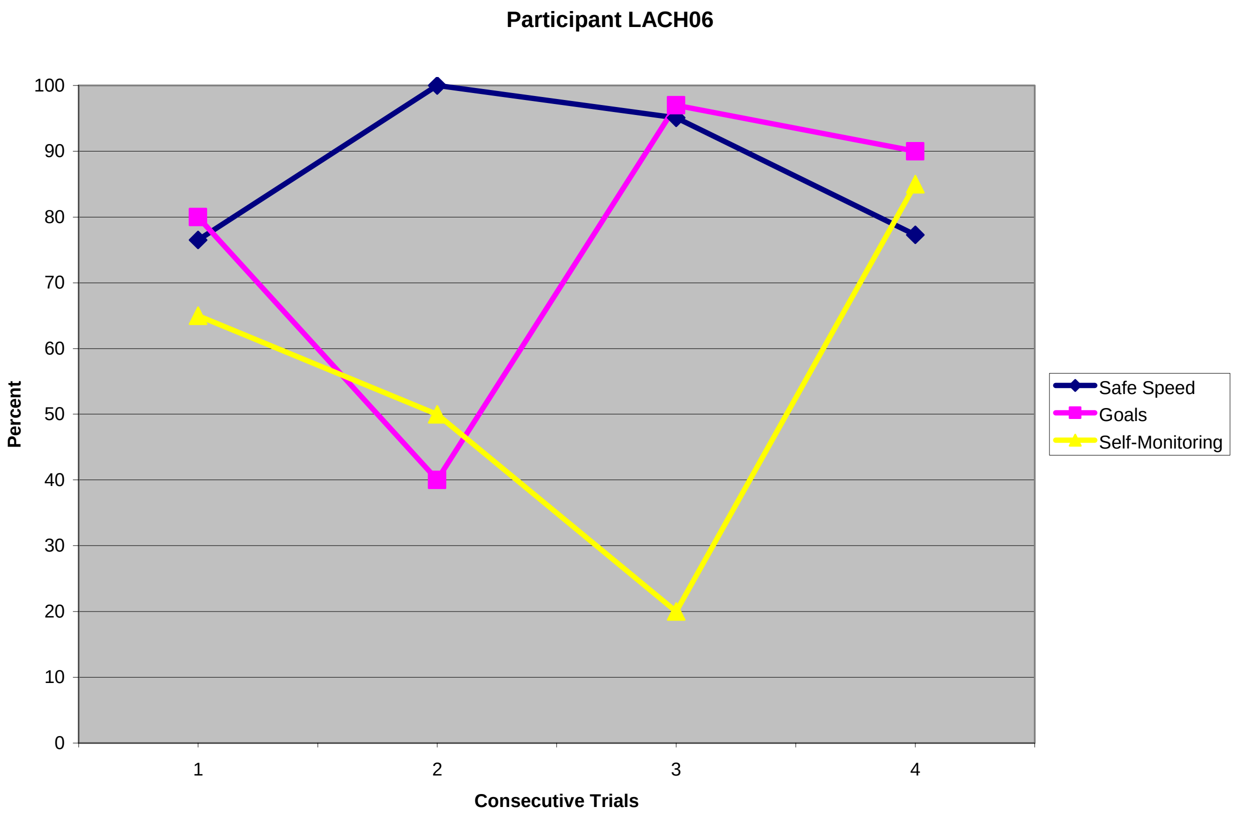

Participant ELLE11
Percent
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
Consecutive Trials
Safe Speed
Goals
Self-Monitoring

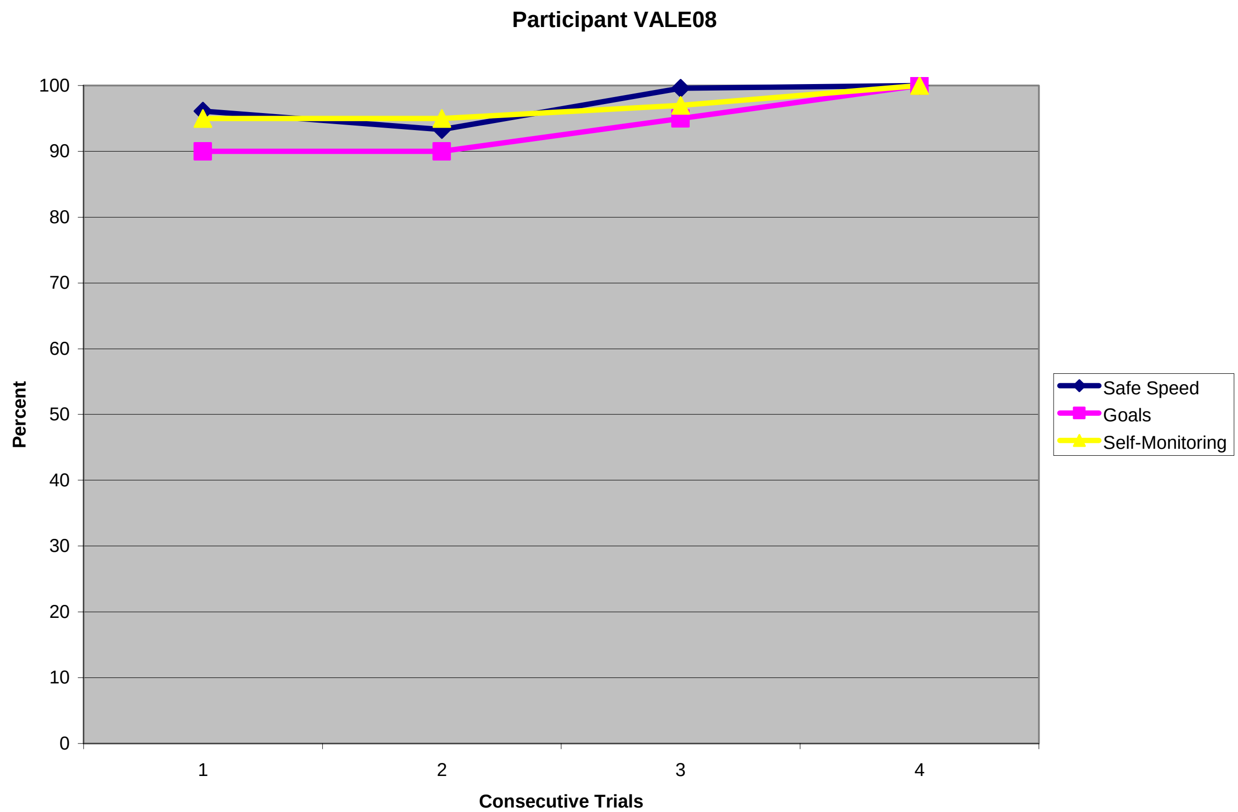


Participant JEWA01
100
90
80
70
60
50
40
30
20
10
0
Percent
1
2
3
4
Consecutive Trials
Safe Speed
Goals
Self-Monitoring



Participant KOMI12
Percent
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
Consecutive Trials
Safe Speed
Goals
Self-Monitoring


Participant LACH06
Percent
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
Consecutive Trials
Safe Speed
Goals
Self-Monitoring



Participant VALE08
100
90
80
70
60
50
40
30
20
10
0
Percent
1
2
3
4
Consecutive Trials
Safe Speed
Goals
Self-Monitoring

Appendix H: Output for 2 Gender (Male, Female) X 3 Group (Control, SM, SM + OFB) MANOVA

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.99	2611.22	13.00	75.00	.000
	Wilks' Lambda	.002	2611.22	13.00	75.00	.000
	Hotelling's Trace	452.61	2611.22	13.00	75.00	.000
	Roy's Largest Root	452.61	2611.22	13.00	75.00	.000
Group	Pillai's Trace	.36	1.30	26.00	152.00	.162
	Wilks' Lambda	.66	1.30	26.00	150.00	.165
	Hotelling's Trace	.45	1.29	26.00	148.00	.168
	Roy's Largest Root	.30	1.78	13.00	76.00	.061
Gender	Pillai's Trace	.19	1.36	13.00	75.00	.195
	Wilks' Lambda	.80	1.36	13.00	75.00	.195
	Hotelling's Trace	.23	1.36	13.00	75.00	.195
	Roy's Largest Root	.23	1.36	13.00	75.00	.195
Group X Gender	Pillai's Trace	.39	1.43	26.00	152.00	.094
	Wilks' Lambda	.64	1.41	26.00	150.00	.101
	Hotelling's Trace	.49	1.40	26.00	148.00	.108
	Roy's Largest Root	.28	1.69	13.00	76.00	.080

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	Age	8.26	5	1.65	1.02	.407
	Have Driver License	1715.50	5	343.10	1.25	.290
	How Many Hours Drive Week	239.43	5	47.88	1.40	.230
	How Many Miles Drive Week	198830.98	5	39766.19	1.55	.183
	How Many Days Drive Week	13.82	5	2.76	.47	.797
	Moving Violations 1Y	4.79	5	.95	2.23	.058
	Crashes 1Y	1.38	5	.27	.94	.455
	At-Fault Crashes 1Y	.33	5	.06	.30	.906
	Moving Violations 3Y	8.01	5	1.60	1.25	.291
	Crashes 3Y	1.32	5	.26	.32	.897
	At-Fault Crashes 3Y	.30	5	.06	.15	.978
Intercept	Age	31323.86	1	31323.86	19463.10	.000
	Have Driver License	143910.07	1	143910.07	527.45	.000
	How Many Hours Drive Week	3387.94	1	3387.94	99.47	.000
	How Many Miles Drive Week	1562256.55	1	1562256.55	60.93	.000
	How Many Days Drive Week	1867.25	1	1867.25	318.10	.000
	Moving Violations 1Y	14.18	1	14.18	33.10	.000
	Crashes 1Y	4.28	1	4.28	14.66	.000
	At-Fault Crashes 1Y	1.76	1	1.76	8.14	.005

	Moving Violations 3Y	70.76	1	70.76	55.38	.000
	Crashes 3Y	37.31	1	37.31	45.50	.000
	At-Fault Crashes 3Y	9.39	1	9.39	23.77	.000
Group	Age	5.03	2	2.51	1.56	.215
	Have Driver License	718.25	2	359.12	1.31	.273
	How Many Hours Drive Week	230.43	2	115.21	3.38	.038
	How Many Miles Drive Week	98302.02	2	49151.01	1.91	.153
	How Many Days Drive Week	4.48	2	2.24	.38	.684
	Moving Violations 1Y	2.96	2	1.48	3.46	.036
	Crashes 1Y	.14	2	.07	.23	.788
	At-Fault Crashes 1Y	.02	2	.01	.05	.945
	Moving Violations 3Y	4.54	2	2.27	1.77	.175
	Crashes 3Y	.77	2	.38	.47	.625
	At-Fault Crashes 3Y	.11	2	.05	.15	.861
Gender	Age	1.81	1	1.81	1.12	.291
	Have Driver License	.16	1	.16	.00	.980
	How Many Hours Drive Week	17.06	1	17.06	.50	.481
	How Many Miles Drive Week	29823.98	1	29823.98	1.16	.284
	How Many Days Drive Week	4.15	1	4.15	.70	.403
	Moving Violations 1Y	1.04	1	1.04	2.42	.123
	Crashes 1Y	.55	1	.55	1.90	.171
	At-Fault Crashes 1Y	.20	1	.20	.92	.339
	Moving Violations 3Y	.23	1	.23	.18	.672
	Crashes 3Y	.06	1	.06	.07	.779
	At-Fault Crashes 3Y	.02	1	.02	.06	.807
Group X Gender	Age	2.37	2	1.18	.73	.481
	Have Driver License	661.01	2	330.50	1.21	.303
	How Many Hours Drive Week	4.38	2	2.19	.06	.938
	How Many Miles Drive Week	50559.15	2	25279.57	.98	.377
	How Many Days Drive Week	3.86	2	1.93	.33	.720
	Moving Violations 1Y	.63	2	.31	.74	.479
	Crashes 1Y	.40	2	.20	.69	.501
	At-Fault Crashes 1Y	.05	2	.02	.12	.887
	Moving Violations 3Y	3.25	2	1.62	1.27	.285
	Crashes 3Y	.86	2	.43	.52	.593
	At-Fault Crashes 3Y	.19	2	.09	.24	.784
Error	Age	140.01	87	1.60		
	Have Driver License	23736.96	87	272.83		
	How Many Hours Drive Week	2963.13	87	34.05		
	How Many Miles Drive Week	2230464.91	87	25637.52		
	How Many Days Drive Week	510.68	87	5.87		

	Moving Violations 1Y	37.27	87	.42		
	Crashes 1Y	25.41	87	.29		
	At-Fault Crashes 1Y	18.84	87	.21		
	Moving Violations 3Y	111.16	87	1.27		
	Crashes 3Y	71.33	87	.82		
	At-Fault Crashes 3Y	34.36	87	.39		
Total	Age	34678.00	93			
	Have Driver License	182360.00	93			
	How Many Hours Drive Week	6895.00	93			
	How Many Miles Drive Week	4407598.00	93			
	How Many Days Drive Week	2673.00	93			
	Moving Violations 1Y	56.00	93			
	Crashes 1Y	32.00	93			
	At-Fault Crashes 1Y	21.00	93			
	Moving Violations 3Y	188.00	93			
	Crashes 3Y	114.00	93			
	At-Fault Crashes 3Y	45.00	93			
Corrected Total	Age	148.28	92			
	Have Driver License	25452.47	92			
	How Many Hours Drive Week	3202.57	92			
	How Many Miles Drive Week	2429295.89	92			
	How Many Days Drive Week	524.51	92			
	Moving Violations 1Y	42.06	92			
	Crashes 1Y	26.79	92			
	At-Fault Crashes 1Y	19.18	92			
	Moving Violations 3Y	119.18	92			
	Crashes 3Y	72.66	92			
	At-Fault Crashes 3Y	34.66	92			

Appendix I: Curriculum Vitae as of 4/01/05

Curriculum Vitae

Jeffrey Scott Hickman

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Home Address:
220 Haymaker Street
Christiansburg, VA
24073
Phone: (540) 230-1263

Business Address:
3500 Transportation Research Plaza
Blacksburg, VA
24060-0536
Phone: (540) 231-1542

Education

May 2005	Ph.D. (expected) in Clinical Psychology from Virginia Polytechnic Institute and State University in Blacksburg, VA. *Specialization Area*: Health Psychology
May 2002	M.S. in Clinical Psychology from Virginia Polytechnic Institute and State University in Blacksburg, VA. *Specialization Area*: Health Psychology
December 1997	B.S. in Psychology from University of Florida in Gainesville, FL
June 1993	High School Diploma from J. P. Taravella High School in Coral Springs, FL

Honors and Awards

- Graduate School Research Award ($500) for Dissertation research (2004)
- Accepted Internship at the Virginia Tech Transportation Institute (2004 to *present*)
- Guest Editor for the *Journal of Organizational Behavior Management* (2003-*present*)
- Graduate School Research Award ($300) for Thesis research (2001)
- Virginia Tech Graduate Student of the Month (November, 2001)
- SWABA Legibility Award (2000), Association for Behavior Analysis Washington D.C.
- Deans List (96 to 97), *University of Florida*

Professional Experience

Research Associate. (5/2004 to *present*). *Virginia Tech Transportation Institute in Blacksburg, VA.* Member of the Truck and Bus Safety group as a pre-doctoral intern. Currently working on a variety of DOT-funded research grants, including: a) evaluation of a device for assessing

drowsiness in truck drivers, b) assessing the efficacy of videos cameras in reducing truck drivers' blind spots, and c) assessing truck drivers' behavior while using aspheric mirrors.
Supervisor: *Rich Hanowski, Ph.D.*

- Management and supervision of team activities
- Data collection, data entry, data analysis, and database creation
- Design, delivery, and implementation of interventions
- Applied and theoretical statistical analysis
- Use of statistical programs to analyze data
- Writing technical reports, grant reports, quarterly reports, and peer-reviewed journal publications
- Assisted the principal investigator write several DOT-funded research grants
- Familiar with intelligent transportation systems and on-board safety monitoring devices
- Onsite technical assistance and repair of computers and other devices
- Participant recruitment and scheduling

Graduate Research Assistant. (8/99 to *present*). *Center for Applied Behavior Systems in Blacksburg, VA.* Conducted safety and health improvement interventions using behavior-based and person-based psychology. Primary areas of research include community-wide (large scale) applications of behavior-based safety, self-management, and organizational culture change techniques.
Supervisor: *E. Scott Geller, Ph.D.*

- Funded on an MSHA-funded grant assessing the efficacy of implementing a behavior-based safety process in mining operations
- Training and supervising undergraduate research assistants
- Data collection, data entry, data analysis, and database creation
- Organized and directed weekly progress meetings
- Designed, delivered, and implemented treatment interventions
- Implemented behavior-based and person-based interventions with short-haul truck drivers, above-ground miners, college students, and airline passengers
- Applied and theoretical statistical analysis
- Use of statistical programs to analyze data
- Experience writing technical reports, grant reports, press releases, and peer-reviewed journal publications
- Assisted the principal investigator write several NIH research grants for reducing occupational injuries

Assessment Specialist. (5/2002 to *present*). *Lewis-Gale Hospital, Salem, VA.* Responsible for conducting inpatient psychiatric assessments in a hospital setting.
Supervisor: *Leigh Fraizer, M.S.*

- Knowledgeable of EMTALA and HIPAA regulations
- Experience working with a clientele reporting suicidal and homicidal ideations, psychotic ideations, and alcohol and drug abuse
- Brief counseling with patients and immediate family members
- Outpatient treatment recommendations and referrals
- Worked closely with emergency room nurses, physicians, and psychiatrists
- Insurance precertification

- Secured safe transportation for patients
- Over 1,000 hours of Clinical Assessment experience

Graduate Research Assistantship. (5/2002 to 5/2004). *Virginia Tech Transportation Institute in Blacksburg, VA.* Assisted the principal investigator write three Transportation Research Board-funded synthesis reports: 1) safety management techniques for commercial motor vehicle driver, 2) high-risk drivers, and 3) commercial motor vehicle drivers and safety-belt use.
Supervisor: *Ron Knipling, Ph.D.*

- Survey design and analysis
- Conducted focus groups and phone interviews
- Literature review
- Created professional presentations
- Assisted the principal investigator write and submit the final reports

Graduate Research Assistantship. (8/2003 to 5/2004). *Psychological Services Center in Blacksburg, VA.* Member of the evaluation team for an NIH-funded research grant to increase enrollment of minority students in Ph.D. programs.
Supervisor: *Lee Cooper, Ph.D.*

- Overall program design and delivery
- Survey design, survey construction, and survey validation
- Responsible for data analysis, data collection, data entry, and database management
- Performed individual evaluation and assessment sessions using a variety of psychological measures

Research Associate. (5/2001 to 3/2002). *Health Management Consultants of Virginia, Blacksburg, VA.* Research associate on several NIH-funded research grants, including: a) *MedPal*--a medication compliance device with a decision information website for cardiac rehabilitation patients, and b) *Exerlink*--accelerometer research for objective data on cardiac patients' activity levels.
Supervisor: *Doug Southard, Ph.D.*

- Answering phones
- Preparing news flashes and website updates
- Data collection and data analysis
- Conducted focus groups
- Held weekly progress meetings with staff
- Assisted the principal investigator write a NIH-funded grant to study the efficacy of an Internet-based treatment program for depressed cardiac rehabilitation patients

Graduate Research Assistant. (5/98 to 5/99). *University of Florida in Gainesville, FL.* Principal therapist at a state facility for individuals with moderate to profound developmental disabilities.
Supervisor: *Brian Iwata, Ph.D.*

- Designed and delivered behavioral interventions to treat problem behaviors of clients
- Supervised undergraduates
- Data collection, data analysis, data entry, and database creation
- Weekly presentations on client progress and treatment options

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Undergraduate Research Assistant. (5/97 to 12/97). *University of Florida in Gainesville, FL.* Class laboratory at a state-run facility for individuals with moderate to profound developmental disabilities. **Supervisor:** *Brian Iwata, Ph.D.*

- Reading required literature
- Data collection and data analysis
- Proficient in using hand held computers
- Trained in functional analysis of self-injurious behavior

Undergraduate Research Assistant. (5/97 to 8/97). *Shands Hospital in Gainesville, FL.* Investigated the social functioning of children with cancer.
Supervisor: *Wendy Kubar, Ph.D.*

- Conducting interviews with parents and children in a hospital setting
- Data entry and data analysis
- Worked closely with case managers and nurses

Undergraduate Research Assistant. (4/97 to 8/97). *The Family Institute in Gainesville, FL.* Assisted the principal author write a text chapter on counseling Latino/a families.
Supervisor: *Andreas Nazario, Ph.D.*

- Read pertinent literature on socio-political, acculturation, dementia, therapy, and counseling theories pertaining to Hispanics
- Provided summary reports to the principal investigator

Publications

Peer-Reviewed Journal Articles

Hickman, J. S., & Geller, E. S. Goal setting: A critical component of self-management for safety. *Journal of Safety Research* (under review).

Hickman, J. S., & Geller, E. S. (in press). A self-management for safety intervention to increase safe driving among short-haul truck drivers. *Journal of Organizational Behavior Management.*

Geller, E. S., **Hickman, J. S.**, & Pettinger, C. B. (2004). The airline lifesaver: A 17 year analysis of a technique to prompt safety-belt use. *Journal of Safety Research, 35*(4), 357-366.

Hickman, J. S., & Geller, E. S. (2003). A safety self-management intervention in mining operations. *Journal of Safety Research, 34(3),* 299-308.

Geller, E. S., **Hickman, J. S.**, & Click, R. D. (2000). Addressing the human aspects of mining safety: From behaviors to attitudes to culture change. *Thirty-First Annual Institute on Mining Health, Safety, and Research,* p. 81-91.

Technical and Grant Reports

Hickman, J. S., Knipling, R. R., Olson, R. L., & Hanowski, R. J. (2005). *Phase I- preliminary analysis of data collected in the drowsy driver warning system field operational test: Task 3, preliminary analysis of partial countermeasure data*. Contract No. DTNH22-00-C-07007 (Task Order No. 21). Blacksburg, VA: Virginia Tech Transportation Institute.

Knipling, R. R., Olson, R. L., Hanowski, R. J., **Hickman, J. S.**, & Holbrook, T. G. (2004). *Phase I- preliminary analysis of data collected in the drowsy driver warning system field operational test: Task 2, Analysis Specification Report*. Contract No. DTNH22-00-C-07007 (Task Order No. 21). Blacksburg, VA: Virginia Tech Transportation Institute.

Hanowski, R. J., Knipling, R. R., **Hickman, J. S.**, Schaudt, A. W., Olson, R. L., & Dingus, T. A. (2004). *Phase I- preliminary analysis of data collected in the drowsy driver warning system field operational test: Task 1, preliminary analysis plan*. Contract No. DTNH22-00-C-07007 (Task Order No. 21). Blacksburg, VA: Virginia Tech Transportation Institute.

Hanowski, R. J., Olson, R. L., **Hickman, J. S.**, & Dingus, T. A. (2004). *The 100-Car Naturalistic Driving Study: Analysis of light vehicle/heavy vehicle interactions from the light vehicle driver's perspective.* Contract No.DTNH22-00-C-07007. Blacksburg, VA: Virginia Tech Transportation Institute.

Hanowski, R. J., Spaulding, J., Gaskins, C., Schaudt, A., Miller, S., Holbrook, T., Olson, R. L., Dingus, T. A., **Hickman, J. S**., Huey, R., & Llaneras, E. E. (2004). Field evaluation of alternative automotive systems for reducing illegal passing of school buses. National Highway Transportation and Safety Administration Project DTNH22-00-07007. Washington, D.C.: Department of Transportation.

Knipling, R. R., Boyle, L. N., **Hickman, J. S.**, York, J. S., Daecher, C., Olsen, E. C. B., & Prailey, T. D. (2004). *Synthesis report on individual differences & the "high-risk" commercial driver: Implications for carrier human resource management*. Transportation Research Board Commercial Truck & Bus Synthesis Program Project MC-04. Washington D.C.: Transportation Research Board.

Knipling, R. R., **Hickman, J. S.**, & Bergoffen, G. (2003). *Synthesis 1: Effective Commercial Truck and Bus Safety Management Techniques*. Transportation Research Board Commercial Truck & Bus Synthesis Program Project MC-02, ISSN 1544-6808, ISBN 0-309-08754-6. Washington D.C.: Transportation Research Board.

Geller, E. S., **Hickman, J. S.**, & Lea, B. N. (April, 2001). *Implementing behavior-based safety in mining operations*. Final Report for Grant #1 R01 CCR315316-01/02 from the National Institute for Occupational Safety and Health (627 pages).

Presentations

Knipling, R. J., **Hickman, J. S.**, Olson, R. L., Dingus, T. A., & Carroll, R. J. (September, 2005). *Analysis of Light Vehicle/Heavy Vehicle Interactions from the Light Vehicle Driver's Perspective*. Paper to be presented at the annual meeting of the Human Factors and Ergonomics Society in Orlando, FL.

Hickman, J. S., Clifford, J. S., Hintz, L. M., Pavlak., S. L., Caron, J., Policay, A., Kerr, J. L., Nash, T., Barnhardt, J., & Camden, M. (April, 2005*). Self-Management for Safety on a Simulated Driving Task: Objective Feedback versus Self-Monitoring*. Paper to be presented at the semi-annual meeting of the Virginia Psychological Association.

Kidd, D**.** G., Hylton, K. R., **Hickman, J. S.**, & Glindemann, K. E. (April, 2005). *Exploring the Relationship between Long-Distance Driving and Mood using a Driving Simulator*. Paper to be presented at the semi-annual meeting of the Virginia Psychological Association.

Knipling, R. R., Boyle, L. N., **Hickman, J. S**., York, J. S., Daecher, C., Olsen, E. C. B., & Prailey, T. D. (2004, July). *TRB synthesis report on Individual differences & the "high-risk" commercial driver*. Paper presented at the Federal Motor Carrier Administration: Washington D.C.

Hickman, J. S., & Geller, E. S. (2003, October). *Safety Performance, Participation, and Accuracy in Self-Management for Safety.* Paper presented at the annual Behavior Safety Now Conference: Reno, NV.

Hickman, J. S., & Geller, E. S. (2003, May). *Applying Self-Management Techniques to Improve the Safe Driving Practices of Short-Haul Truck Drivers*. Paper presented at the annual Association for Behavior Analysis Conference: San Francisco, CA.

Hickman, J. S., & Geller, E. S. (2003, May). *Behavior-Based Safety in Mining Operations: A Self-Management Approach*. Paper presented at the annual Association for Behavior Analysis Conference: San Francisco, CA.

Knipling, R. R., **Hickman, J. S.**, & Bergoffen, G. (2003, April). *TRB Synthesis Report on Effective Motor Carrier Safety Management Techniques*. Paper presented at the annual Virginia Trucking Association Meeting: Charlottesville, VA.

Hickman, J. S., & Geller, E. S. (2003, March). *Self-Management for Safety for Professional Drivers.* Paper presented at the 5th Annual Meeting of the APA Interdisciplinary Occupational Stress and Health Conference: Toronto, Canada.

Knipling, R. R., & **Hickman, J. S**. (2002, October). *Behavioral Safety Management Approaches for Professional Drivers: Behavior-Based Safety, Self-Management, and On-Board Safety Monitoring*. Paper presented at the monthly Department of Transportation Interdisciplinary Meeting: Washington, D.C.

Hickman, J. S., Geller, E. S., Cincotta, A. L., Hargrove, M. J. Rosti, S. L., & Grandin, D. (2002, May). *Safety Self-Management in Mining Operations.* Paper presented at the 80th Annual Meeting of the Virginia Academy of Sciences: Hampton, VA.

Rosti, S. L., **Hickman, J. S.**, & Geller, E. S. (2002, May). *Are we Motivated by Consequences or Reciprocity?* Paper presented at the 80th Annual Meeting of the Virginia Academy of Sciences: Hampton, VA.

Hickman, J. S. (2002, February). *Safety Self-Management in Mining Operations (Feedback).* Training and education materials presented to Virginia Tech Quarry employees at the Health and Safety Building: Blacksburg, VA.

Hickman, J. S. (2002, January). *Safety Self-Management with Short-Haul Truck Drivers (Feedforward).* Training and education materials presented to D.M. Bowman, Inc: Frederick, MD.

Hickman, J. S. (2002, January). *Safety Self-Management in Mining Operations (Feedforward).* Training and education materials presented to Virginia Tech Quarry employees at the Health and Safety Building: Blacksburg, VA.

Hickman, J. S. (2002, January). *Safety Self-Management with Short-Haul Truck Drivers (Feedback).* Training and education materials presented to D.M. Bowman, Inc: Frederick, MD.

Hickman, J. S., Glindemann, K., & Geller, E. S. (2001, May). *Measuring the Propensity to Participate in Behavioral Safety: A Culture Assessment at Six Mining Operations.* Paper presented at the annual Association for Behavior Analysis: New Orleans, LA.

Hickman, J. S., Click-Keeney, R. D., & Geller, E. S. (2001, April). *Behavior-Based Safety in the Mines: Applications, Dilemmas, and Future Directions.* Paper presented at the annual Eastern Psychological Association: Washington, D.C.

Hickman, J. S. & Click-Keeney, R. D. (2000 August*). Behavior-based safety in mining operations.* Paper presented at the annual Mine Health and Safety Conference: Roanoke, VA.

Hickman, J. S., Click-Keeney, R. D., Geller, E. S., & Pettinger, C. B. (2000, March). *The "Airline Lifesaver": A 15-year evaluation of a large-scale awareness intervention.* Paper presented at the annual program of the Southeastern Psychological Association: New Orleans, LA.

Hickman, J. S., Click-Keeney, R. D., Williams, J., & Geller, E. S. (2000, May). *Using behavior observation and feedback process in mining to improve safety.* Paper presented at the Association for Behavior Analysis: Washington, D.C.

Hickman, J. S., Click-Keeney, R. D., Geller, E. S., & Pettinger, C. B. (2000 April). *Evaluating a large-scale awareness program*. Paper presented at the annual Virginia Psychological Association: Tysons Corner, VA.

Click-Keeney, R. D., **Hickman, J. S.**, Pettinger, C. B., Ford, K., Halpin, C., & Geller, E. S. (2000, May). *Behavior-based safety: Comparing individual versus group feedback in mining operations.* Poster presented at the Association for Behavior Analysis: Washington, D.C.

Wallace, M. D., Iwata, B. A., Hanley, G. P., & **Hickman, J. S.** (2000 May). *The effects of dense and lean schedules of noncontingent reinforcement (NCR) on problem behavior*. Paper presented at the Association for Behavior Analysis: Washington, D.C.

Thompson, R. H., Iwata, B. A., Wallace, M. D., Conners, J., Roscoe, E. M., & **Hickman, J. S.** (1999, May). *Response acquisition under indirect and direct contingencies of reinforcement.* Paper presented at the Association for Behavior Analysis: Chicago, IL.

Wallace, M. D., Iwata, B. A., **Hickman, J. S.**, & Thompson, R. H. (1999, May). *Transition of satiation from extinction during non-contingent reinforcement*. Paper presented at the Association for Behavior Analysis: Chicago, IL.

Clinical Experience

Advanced Practicum. (5/2003 to 8/2003). *Psychological Services Center in Blacksburg, VA.* Advanced team discussion, observation of clinical cases, and supervised treatment of children, adults, and families with a variety of clinical problems.
Supervisor: *Lee Cooper, Ph.D.*

- Performed one-on-one clinical therapy sessions with a vast clientele
- Developed individual treatment plans
- Intake/discharge reports
- Used cognitive-behavioral, interpersonal, and behavioral interventions
- Received supervision from a licensed clinical psychologist
- Provided individual supervision with graduate clinicians
- Total Clinical Hours: 78

4th Year Practicum. (8/2002 to 5/2003). *Psychological Services Center in Blacksburg, VA.* Team discussion, observation of clinical cases, and supervised treatment of children, adults, and families with a variety of clinical problems.
Supervisor: *Russell Jones, Ph.D.*

- Performed one-on-one clinical therapy sessions with a vast clientele
- Developed individual treatment plans
- Case presentations
- Intake/discharge reports
- Used cognitive-behavioral, interpersonal, and behavioral interventions
- Received supervision from a licensed clinical psychologist
- Supervised second-year clinical graduate students with clinical interview skills, various empirically validated cognitive-behavioral therapies, assessment techniques, DSM-IV diagnoses, intake reports, and progress notes
- Total Clinical Hours: 141

Adult Assessment Team (8/2001-5/2002). *Psychological Services Center in Blacksburg, VA.* Conducted psycho-educational assessments on adult clients to assess for various attention, learning, and memory deficits.
Supervisor: *Lee Cooper, Ph.D.*
- Completed 14 psycho-educational assessments
- Wrote evaluation reports
- Scoring and interpreting evaluation measures
- Outpatient treatment recommendation to clients and educational institution
- Received supervision from a licensed clinical psychologist
- Administered evaluation measures and structured clinical interviews
- Total Assessment Hours: 326

2nd Year Practicum. (8/2000 to 3/2001). *Psychological services Center in Blacksburg, VA.* Team discussion, observation of clinical cases, and supervised treatment of children, adults, and families with a variety of clinical problems.
Supervisor: *Lee Cooper, Ph.D.*
- Performed one-on-one clinical therapy sessions with a vast clientele
- Developed individual treatment plans
- Case presentations
- Intake/discharge reports
- Used cognitive-behavioral, interpersonal, and behavioral interventions
- Received supervision from a licensed clinical psychologist
- Total Clinical Hours: 356

1st Year Practicum. (8/99 to 3/2000). *Psychological Services Center in Blacksburg, VA.* Team discussion and observation of clinical services to children, adults, and families with a variety of clinical problems.
Supervisor: *Richard Eisler, Ph.D. & Angela Scarpa-Friedman, Ph.D.*
- Performed one-on-one clinical therapy sessions with a vast clientele
- Developed individual treatment plans
- Case presentations
- Intake/discharge reports
- Used cognitive-behavioral, interpersonal, and behavioral interventions
- Co-therapist in group treatment with anti-social teens
- Received supervision from a licensed clinical psychologist
- Total Clinical Hours: 197

Teaching Experience

Graduate Teaching Assistant. (6/2003-8/2003). *Virginia Tech in Blacksburg, VA.* Head instructor for one undergraduate psychology class: *Lab in Cognitive Psychology*.
- Lecture preparation
- Class discussion on how to write an APA-style research proposal
- Individual tutoring
- Quiz and test creation

- Grading test and quizzes
- Proctoring exams
- Creating and maintaining class database

Graduate Teaching Assistant. (8/2002-5/2003). *Virginia Tech in Blacksburg, VA.* Head instructor for one undergraduate psychology class: *Introduction to Learning*.

- Lecture preparation
- Facilitated class discussions
- Individual tutoring
- Quiz and test creation
- Grading tests and quizzes
- Proctoring exams
- Creating and maintaining class database

Graduate Teaching Assistant. (1/2001-5/2001). *Virginia Tech in Blacksburg, VA.* Teaching Assistant for two undergraduate classes: *Child Psychopathology and Child Development*.
Supervisor: *Martha Bell, Ph.D. & Angela Scarpa-Friedman, Ph.D.*

- Lecture preparation
- Quiz and test creation
- Grading quizzes and tests
- Proctoring exams
- Creating and maintaining class database

Graduate Teaching Assistant. (8/99 to 5/00). *Virginia Tech in Blacksburg, VA.* Taught two recitation (lab) companion classes to the *Introductory Psychology* course.
Supervisor: *Jack Finney, Ph.D.*

- Lecture preparation
- Facilitated class discussions
- Quiz and essay creation
- Grading quizzes and essays
- Proctoring exams

References

E. Scott Geller, Ph.D.
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Blacksburg, VA
(540)-231-6225

Rich Hanowski, Ph.D.
Research Scientist
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3500 Transportation Research Drive
Blacksburg, VA

(540) 231-1513

Lee Cooper, Ph.D.
Director
Psychological Services Center
3110 Prices Fork Road
Blacksburg, VA
(540) 231-7709

Ron Knipling, Ph.D.
Senior Research Scientist
Virginia Tech Transportation Institute
7054 Haycock Road
Falls Church, VA
(703) 538-8439

Russell Jones, Ph.D.
Professor
Virginia Tech
132 Williams Hall
Blacksburg, VA
(540) 231-5934