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Development and Evaluation Of a PC-Based Attention Maintenance Training Program

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16. Abstract

This study included the development and evaluation of a PC-based attention maintenance assessment program and the development and evaluation of PC-based training aimed at improving attention maintenance skills. The results of Study 1 showed that the assessment program was able to differentiate between the attention maintenance skills of novice and experienced drivers with results similar to those found in prior field and simulator studies. The Focused Concentration and Attention Learning (FOCAL) program was created to teach novice drivers how to reduce their glance durations to under two seconds while still performing an in-vehicle task accurately. For the post-training test in Study 2, the participants trained with FOCAL showed statistically significant reductions in the percentage of glances greater than all specified time intervals compared to participants trained with a control program. Moreover, the distribution of glances did not change for the control group before and after training. In a separate analysis, the total time that the FOCAL group spent on the map task after training did not differ from the total time that the control group spent on the map task after training, although the total time for all participants was reduced from pretest to posttest. The results of Study 1 suggest that a PC-based assessment program is a potentially valid means to measure attention maintenance problems. The results of Study 2 suggest that a PC-based training program can change young driver behaviors, at least as measured by the PC-based assessment program. Together these studies provide a strong basis for further research into the effectiveness of computerized training and assessment for improving driver safety.

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EXECUTIVE SUMMARY

Introduction

Evidence in the field (Wikman, Nieminen, & Summala, 1998) and on a driving simulator (Chan, Pradhan, Knodler, Pollatsek, & Fisher, 2008) suggests that when conducting secondary in-vehicle tasks, teen drivers are much more likely to glance inside the vehicle for long periods of time than are more experienced drivers. In a naturalistic field study, such periods of distraction were shown to be highly related to crashes and near-crashes for drivers of all ages, but especially for the younger drivers (age 18 to 20) in the study (Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006). Simply training drivers never to glance inside the vehicle, however, could be unsafe since glances at gauges and mirrors might actually serve to decrease crash risk. Also, given the large number of distractions in modern vehicles (e.g., radio/entertainment systems, cellular phones), it would be naive to think that drivers would voluntarily ignore the temptation to look away from the forward roadway while they are driving. This suggests the need for a training program that can help novice drivers learn how to distribute the time that they spend on in-vehicle tasks into more frequent and short glances instead of several long glances, even potentially for in-vehicle tasks that are not specific to the driving task. Two studies are described herein that describe the development and evaluation of such a training program.

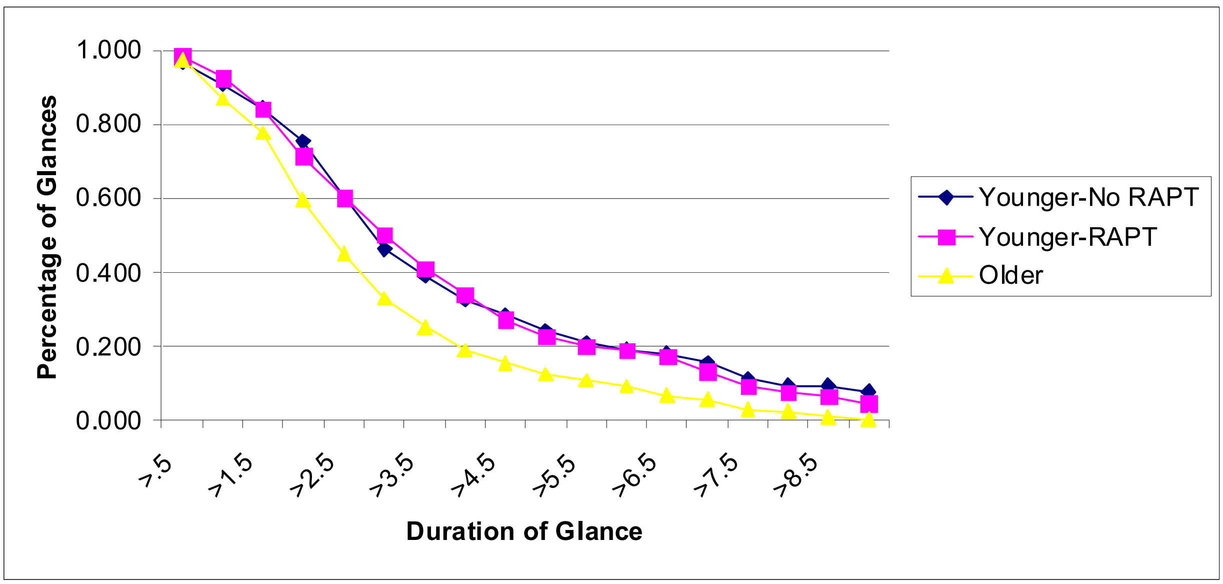
Study 1

In Study 1, a personal computer-based (PC-based) attention maintenance assessment program was developed. An evaluation was conducted to determine if the PC-based program was capable of detecting differences in glance durations among younger and older drivers similar to those observed in the field and simulator studies described above. This assessment program used an innovative approach (not an eye tracker) to determine if drivers were glancing away from the simulated roadway on the computer screen.

As part of the study, novice and experienced drivers were asked to perform two tasks displayed on a computer screen. The computer screen was split in half horizontally to display the tasks. Only one task, however, could be viewed at a time. This required the participants to toggle back and forth between the tasks to successfully complete each. The task displayed at the top of the screen involved identifying vehicles, pedestrians and bicyclists that posed a threat in a video recording of a drive down a local roadway. The other task displayed on the bottom half of the computer screen required drivers to determine if a particular street was on a map. Participants were told that they needed to identify as many potential threats in the video as possible while also determining if the streets of interest were actually on the map. Once the scenario began, the video played continuously, but when the map task was initiated by the participant, the map view replaced the video view and the video played in real time in the background. Therefore, anytime the participant toggled to the map view, the video was out of sight, but potential hazards might still be materializing. The frequency and duration of the viewing of each task was recorded.

In addition to simply looking at differences among younger and older drivers, a third group of young drivers received training before completing the PC-based assessment program. The trained drivers were taught to anticipate hazards using the Risk Awareness and Perception Training (RAPT) program. RAPT uses a computer-based guided-error training procedure and has been found to significantly improve the frequency with which drivers detect specific roadway hazards. Thus, it was hypothesized that drivers who were more aware of risks would reduce the durations of their glances inside the vehicle. The results of Study 1 (see Figure ES-1) showed that the assessment program was able to differentiate between the attention maintenance skills of novice and experienced drivers with results similar to those found in field and simulator studies. The hazard anticipation training, however, did not improve the attention maintenance skills of young drivers, which suggests the need for training that specifically addresses attention maintenance issues.

Figure 1. Percentage of Glances Greater Than Time Durations for Older, Younger RAPT and Younger No-RAPT Participants

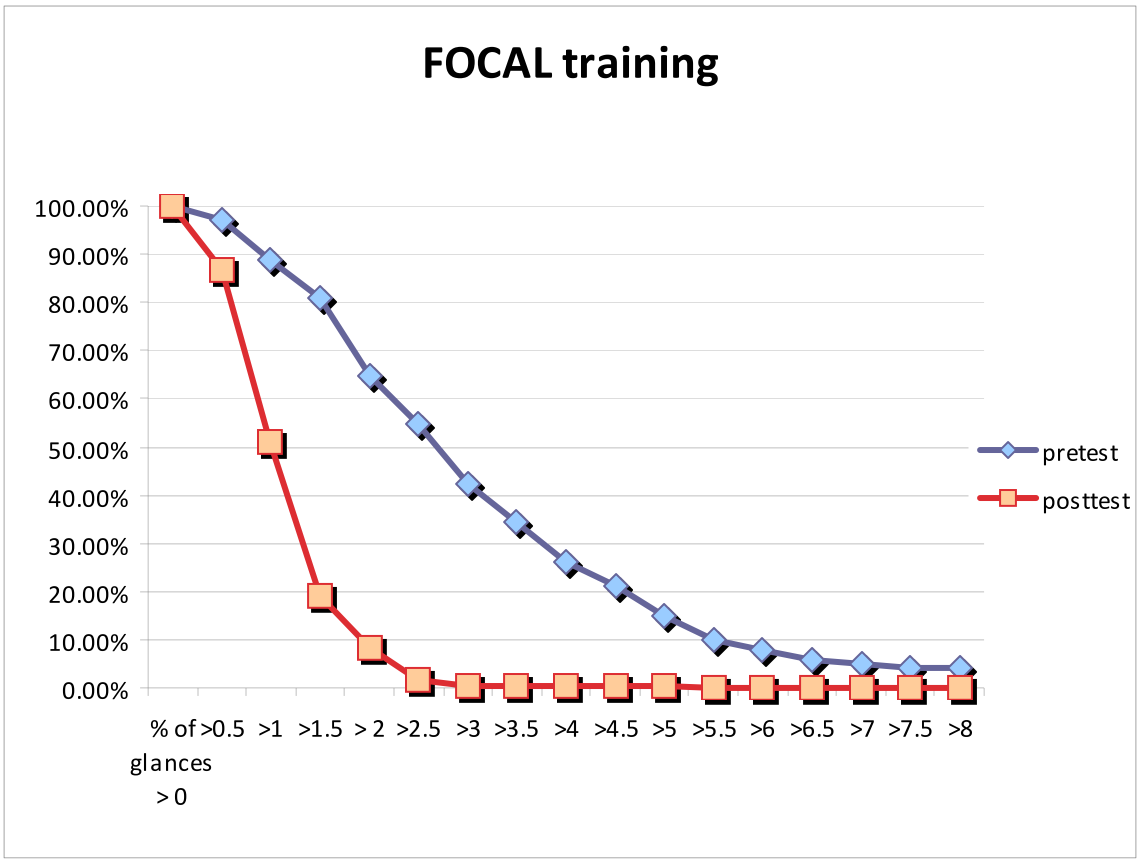


Study 2

In Study 2, a new training program that focused solely on attention maintenance skills was developed and evaluated. The Focused Concentration and Attention Learning (FOCAL) program was created to teach novice drivers how to reduce their glance durations to under two seconds while still performing an in-vehicle task accurately. The training was tied, in part, to the results of the attention maintenance assessment program. Fifteen participants were randomly assigned to FOCAL training and 15 to control training. The control training program took about the same amount of time to complete as FOCAL. Participants in the control training group were instructed on the meaning of road signs, signals and pavement markings.

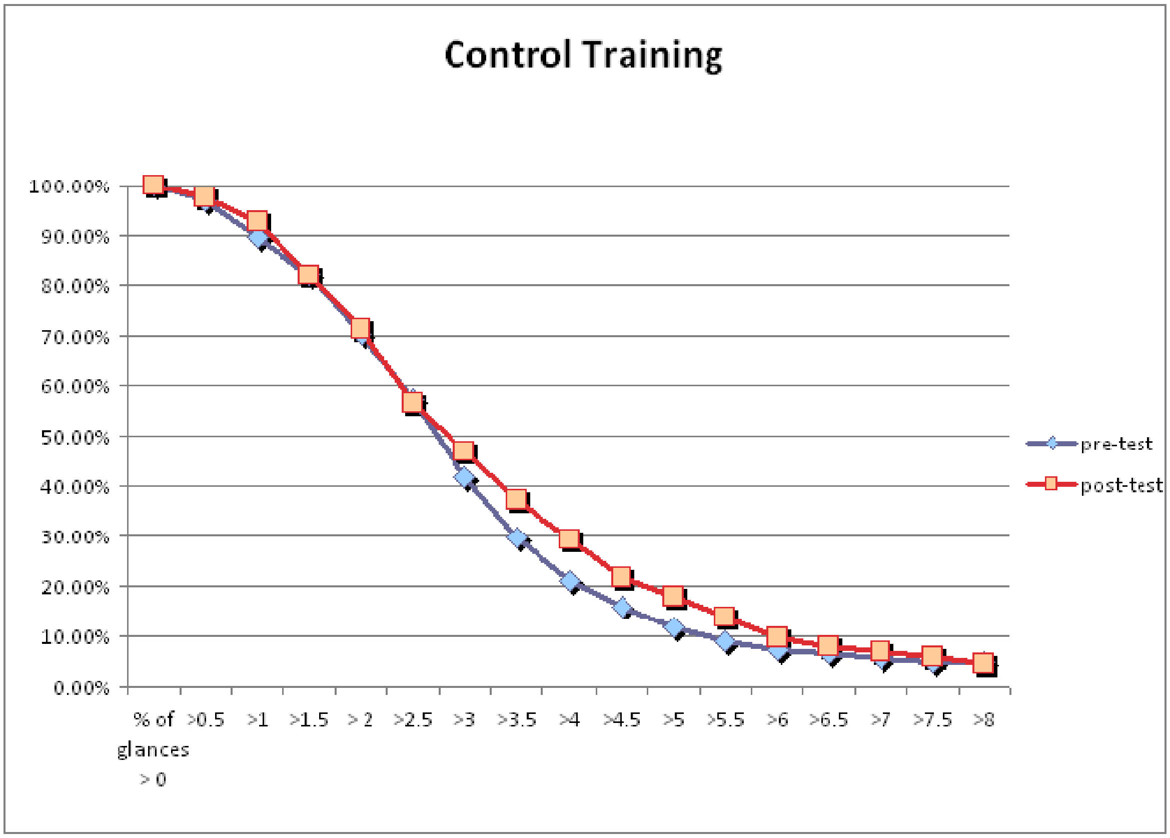
As a pretest, each participant first completed the assessment program developed in Study 1 to get a baseline measure of willingness to look away from the roadway and to also provide feedback during the training. After completing the attention maintenance assessment program, participants taking FOCAL training saw the following sequence of events: (1) a video that went blank whenever the participant looked away from the roadway in the assessment test he or she just completed; (2) a video that went blank whenever the participant looked away from the roadway during the baseline test along with a time indicating how long the participant looked away from the roadway; (3) a sequence of videos that displayed the map for three seconds whenever the participant wanted to see the map, after which the display automatically returned to the video view; (4) a sequence of videos that displayed the map for three seconds, followed by a loud tone if the map remained on for more than three seconds; (5) similar sequences displayed for two seconds. After training, the attention maintenance assessment program was again administered to all of the participants to see if the FOCAL training had any effects on time spent away from the forward roadway view.

Figure 2. Distribution of Glance Durations Before and After Focal Training



An analysis of the percentage of glances to the map task greater than x seconds ($x = 0, 0.5, 1.0, 1.5, \ldots, 8.0$ s) during the pre-training assessment program indicated that the FOCAL and control groups' glance durations did not differ significantly at baseline. For the post-training test, the participants trained with FOCAL (Figure ES-2) showed statistically significant reductions in the percentage of glances greater than x seconds compared to participants trained with the control program. Moreover, the distribution of glances did not change for the control group before and after training (Figure ES-3). In a separate analysis, the total time that the FOCAL group spent on the map task after training did not differ from the total time that the control group spent on the map task after training. This result indicates that the FOCAL training group was taking more frequent, but shorter glances and suggests that those who received FOCAL training were not ignoring the map task to complete the roadway task.

Figure 3. Distribution of Glance Durations Before and After Control Training



Discussion

The results of Study 1 suggest that the assessment program may be a valid means to measure attention maintenance because differences among older and younger drivers were found, and the differences were similar to those observed in field and simulator studies. The results of Study 2 indicate that the computer-based training program led to a significant reduction in long glance durations to the surrogate in-vehicle task used for the computer-based attention maintenance assessment program. Two qualifications of these findings relate directly to the novelty of the attention assessment and attention maintenance training programs. Whether or not the training effect transfers to more realistic environments such as a driving simulator or a test track remains to be seen and is the focus of the next task in the overall project. The persistence of the training effect is also unknown. However, finding transference of an immediate effect to a realistic environment would warrant further research into persistence as well as other factors related to the effectiveness of computerized training and assessment for improving driver safety.

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1. INTRODUCTION

Distraction has long been recognized as a major contributor to automobile crashes among all drivers (Wang, Knipling, & Goodman, 1996). The magnitude of the problem is likely to increase because of the growing popularity of in-vehicle tasks that require the driver to glance away from the forward roadway frequently and for long periods of time – most notably music retrieval operations (Chisholm, Caird, & Lockhart, 2008; Salvucci, Markley, Zuber, & Brumby, 2007) and text messaging with cell phones (Lerner & Boyd, 2005).

A recent naturalistic study of drivers in the field suggests just how risky even brief glances away from the forward roadway can be (Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006). In this study, the total time that drivers' eyes were off the forward roadway was computed for critical epochs of six seconds: from five seconds preceding an event that defined a crash or near crash until one second after the defining event. The total time the eyes were off the forward roadway was also computed for baseline six second epochs where there was no crash or near crash. Finally, the odds ratio was computed: the numerator was the odds defined by the ratio of the number of six second crash/near crash epochs with glances away from the forward roadway for more than two seconds to the number of six second crash/near crash epochs with glances away from the forward roadway for less than two seconds; the denominator was the same odds for baseline epochs. The odds ratio in this case was 2.19 (significantly greater than 1.0) and the population attributable risk was 23%, which indicates an increased risk of a crash when a driver looks away from the forward roadway.

Research on a driving simulator and in the field suggests that teens are especially likely to glance away from the forward roadway for periods of time longer than two seconds. In a study undertaken on a simulator (Chan, Pradhan, Knodler, Pollatsek, & Fisher, 2008), newly licensed (16 to 18 years old) and experienced (21 and older) drivers were asked to navigate through a virtual world while undertaking one of five secondary tasks inside the vehicle. These tasks included looking for a CD that was present in one task, absent in the other; searching a map for a street name that was present in one task and absent in the other; and dialing a cell phone number. Perhaps the simplest measure of sustained inattention is the mean length of the maximum glance (the maximum period of time a driver spent with the eyes continually off the road during the performance of a single in-vehicle task) averaged over the five in-vehicle scenarios for each driver. Chan et al. (2008) showed that there were large differences between the older and younger drivers on this measure: 1.63 seconds for the older drivers and 2.76 seconds for the younger drivers. However, because an average measure may overweight one or two extremely long glances, the percentage of scenarios for each participant in which the maximum episode was over various thresholds was also computed. The differences between the two groups were large; the percentage of scenarios in which there was an episode looking away for 2 or more seconds was 20% for the older drivers and 56.7% for the younger drivers. There were also large differences for cutoffs at 2.5 seconds (10.0% versus 45.0%) and 3 seconds (6.7% versus 33.3%). Finally, although the total time that the younger drivers spent with their eyes off the road for the in-vehicle tasks (7.36 s) was somewhat longer than for older drivers (5.80 s), this difference was not statistically significant. Thus, the major difference between the groups was not so much the total time that their eyes were off the road, but how they distributed it.

A field study conducted in Finland (Wikman, Nieminen, & Summala, 1998) showed much the same results. Twenty-three experienced and 24 inexperienced drivers drove a 126-km course through city streets and rural roads. Although the average duration of a glance did not differ significantly as a function of experience, the distribution of the glance durations did differ quite a bit. Only 13% of the experienced drivers had glance durations of at least 2.5 s whereas 46% of inexperienced drivers had glance durations at least this long. Similarly, 0% of the experienced drivers had glance durations of at least three seconds, whereas 29% of the inexperienced drivers exhibited these long glances away from the roadway.

Given the above research findings, there is a clear need for a method to assess novice drivers' attention maintenance skills that can easily be used without having access to expensive eye tracking or simulator equipment. Additionally, there is a clear need for a program to improve the attention maintenance skills of novice drivers since current driver education does not appear to be addressing the issue well. The development and evaluation of a new attention maintenance assessment method and the use of this method to evaluate the effectiveness of an existing training program are described in Study 1. Study 2 describes the development and evaluation of a training program to reduce the duration of young drivers' eye glances away from the forward roadway.

2. STUDY 1

In Study 1, a PC-based program was developed and assessed to determine if such a program can be used to capture differences in the times that novice and experienced drivers spend glancing away from the forward roadway. Additionally, the attention maintenance assessment program was used to determine if a hazard anticipation training program could decrease the likelihood that novice drivers will take long glances away from the forward roadway.

2.1 Method

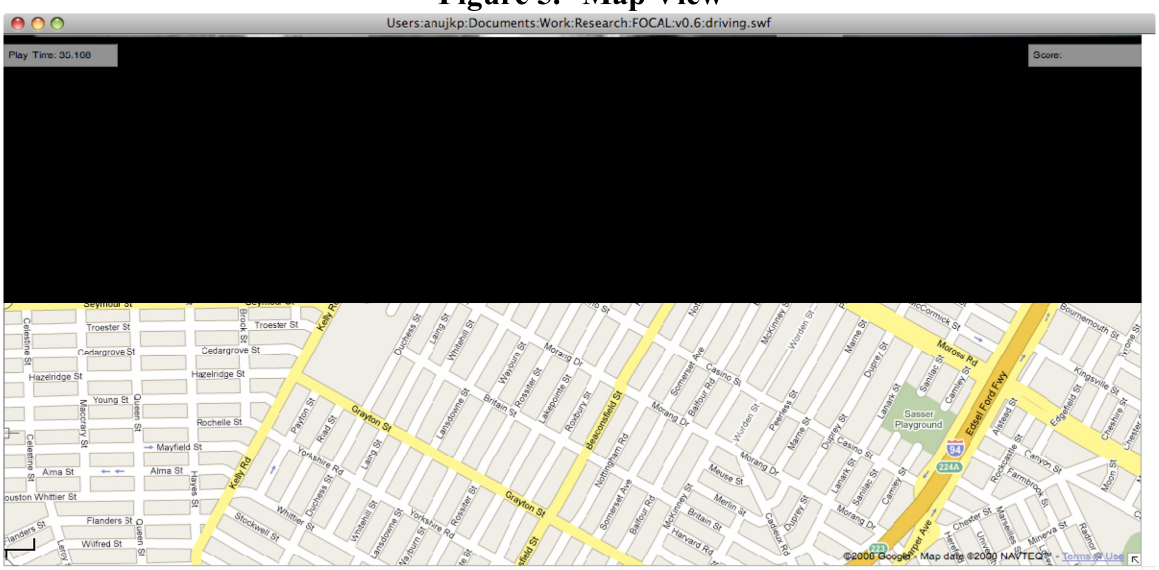
An evaluation was conducted to determine if the PC-based attention maintenance program was capable of detecting differences in glance durations among younger and older drivers similar to those observed in prior field and simulator studies. This assessment program used an innovative approach to determine if drivers were glancing away from the simulated roadway on the computer screen. As part of the study, novice and experienced drivers were asked to perform two tasks displayed on a computer screen. The computer screen was split in half horizontally to display the tasks. Only one task, however, could be viewed at a time. This required the participants to toggle back and forth between the tasks to successfully complete each.

The task displayed at the top of the screen involved identifying vehicles, pedestrians and bicyclists that posed a threat in a video recording of a drive down a local roadway (Figure 4). Participants had to indicate via a key press when a threat passed through certain areas of the screen as the video progressed. The other task displayed on the bottom half of the computer screen required drivers to determine if a particular street was on a map (0). Participants were told that they needed to correctly identify as many potential threats in the video as possible while also correctly determining if the streets of interest were actually on the map. Once the scenario was started, the video played continuously. When the map task was initiated by the participant, the top half of the screen showing the video went black; the map view replaced the video view, and the video played in real time in the background. Therefore, anytime the participant toggled to the map view, the video was out of sight, but potential hazards might still be materializing. The frequency and duration of the viewing of each task was recorded for young and older drivers. At the end of each video, participants indicated by checkboxes whether or not they saw the streets on the map.

In addition to simply looking at differences among younger and older drivers, a third group of young drivers received training before completing the PC-based assessment program. The trained drivers were taught to anticipate hazards using the Risk Awareness and Perception Training (RAPT-3) program. This program had already been shown to greatly increase novice drivers' ability to anticipate hazards both on a driving simulator and on the road (Pollatsek, Narayanaan, Pradhan, & Fisher, 2006). As such, it was thought that the program might also decrease these drivers' willingness to take their eyes away from the forward roadway since not looking at the roadway greatly decreases the ability to effectively scan for hazards.

Figure 4. Forward View

Figure 5. Map View



2.1.1 Participants

A total of 30 individuals participated in the study, 23 younger drivers (11 received training, 12 no training) 16 to 18 years old who were taking a driver education class and 11 experienced drivers 35 to 55 years old. Parental consent was obtained for the drivers under 18. Each participant also provided assent or consent as necessary.

2.1.2 Attention Maintenance Assessment Program

The attention maintenance assessment program included four videos, each approximately one minute long, that were filmed throughout downtown Amherst, Massachusetts. Street signs, traffic signs, pedestrians, and traffic appeared throughout the videos. Each trial (video) began with the forward roadway view. Participants pressed the spacebar on the computer keyboard to see the map view. The "Enter" key was used both to bring back the forward view and to indicate that a traffic sign, pedestrian, or opposing vehicle was passing through one of the vertical "target bars" that were superimposed on the forward view (see Figure 4).

At the beginning of each trial, the participant was presented with three street names. At the end of the trial, the participant was asked if he or she had seen each of the three street names on the map. All three street names were present in the first three trials. Two of the three street names were present in the fourth trial.

2.1.3 Hazard Anticipation Training Program (RAPT)

The hazard anticipation training program, called RAPT-3, has been described at length elsewhere (e.g., Pollatsek et al., 2006). Briefly, participants are shown a sequence of still photographs with each displayed for three seconds. Each sequence was filmed in downtown Amherst in areas that contained situations in which a hidden threat might emerge from behind some obscuring object, such as a pedestrian emerging from behind a truck stopped in the parking lane before a marked midblock crosswalk, or a stationary vehicle might become a potential threat when a vehicle in a left-turn lane might suddenly pull into the adjacent lane in front of the driver. Participants must use the computer mouse to click on all areas of each photograph where they would look if they were actually driving through the scene depicted. There were 5 to 10 still photographs in each scenario. If a driver did not click in the area that was of most concern, a plan view was presented describing the potential threat and the participant repeated the sequence. The participant repeated this sequence until he or she clicked in the correct area or until five repetitions had elapsed.

2.1.4 Design

Younger drivers were assigned randomly either to the RAPT training or the no-RAPT group. Older drivers received no training. RAPT training always preceded the test of attention maintenance. The assessment trials were presented in the same order to all participants.

2.1.5 Procedure

Participants assigned to receive training first completed the training before proceeding to the attention maintenance assessment program. Training generally took 20 to 45 minutes depending on the participant, since some participants would have to complete a training trial multiple times before the program would let them continue. All untrained participants simply completed the assessment program. The assessment program took less than 10 minutes to complete.

2.2 Results

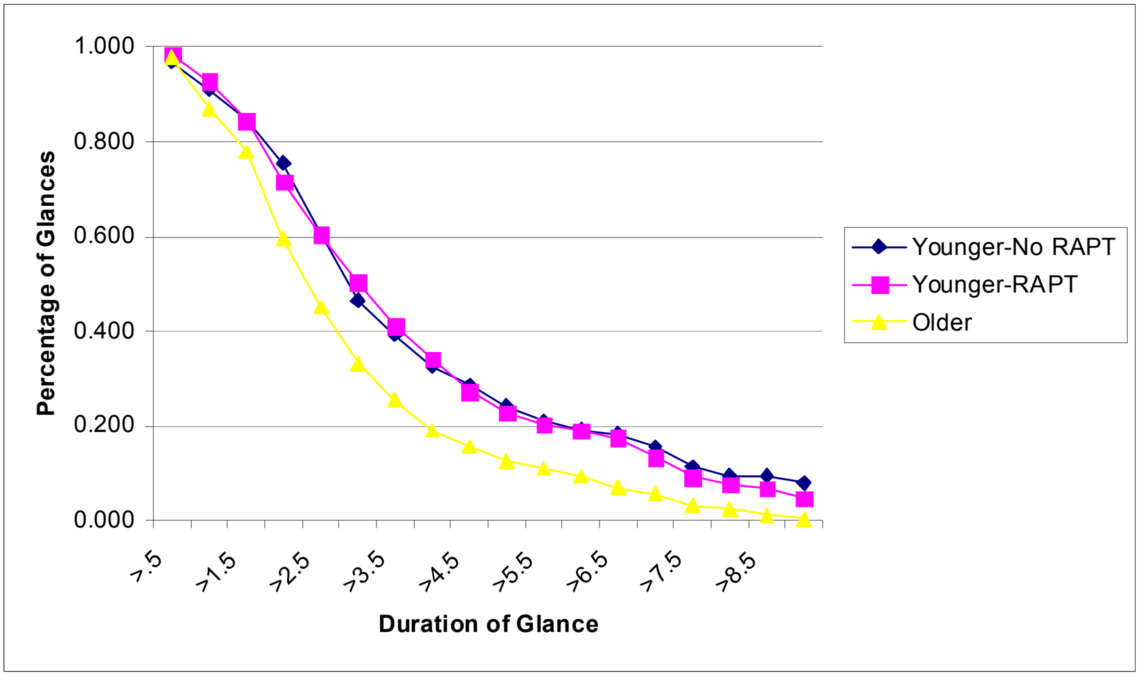
The primary data element collected was the duration of individual glances away from the forward roadway task. For the PC-based assessment program, this was accomplished by measuring the amount of time between when the participant pressed the spacebar to view the map and when they pressed the Enter key to return to the roadway video. The simplest single global measure of extended inattention to the forward roadway was the average of these glance durations. The averages for the younger no-RAPT group and the younger RAPT group were 4.12 s and 4.06 s, respectively, and 2.84 s for the older group. Despite these mean differences, neither of the differences between the younger groups and the older group was statistically significant ($t(21) = 1.58$, $p < .20$; $t(21) = 1.73$, $p < .10$).

A problem with a measure of such average duration is that it includes extremely long durations (one participant had a glance that was almost 20 s) and there is not a clear rationale for excluding outliers. The key measures that appear to be ecologically valid are the percentages of glance durations over 2 seconds and 2.5 seconds. As 0 indicates, there were clear differences between the older drivers and each younger group in the percentages of glances that exceeded certain durations. It is also clear from 0 that there was virtually no difference between the younger drivers who had RAPT training and the untrained younger drivers.

For the older drivers, the percentage of glances that were over 2.0, 2.5, and 3.0 seconds were 59.6%, 45.1%, and 33.2%, whereas they were 75.5%, 60.5%, and 46.4% for the younger untrained drivers and 71.5%, 60.5%, and 50.4%, for the younger drivers trained with RAPT. These 12 to 17 percentage-point differences between the older and younger drivers were clearly smaller than in the Wikman et al. (1998) study results; however, tests of whether the proportions were different between the older group and the each of the two younger groups were statistically significant, *t*s > 4, *p*s < .001. Also, in the present study the absolute values of the percentages were also quite a bit higher for all three groups than those observed by Wikman.

Despite having a higher magnitude in the present study, the percentage of glances greater than a specified duration appears to be linearly related to the percentage of glances inside the vehicle observed in the field test conducted by Wikman. The percentage of glances inside the vehicle longer than some specified time on the simulator test (Chan et al., 2008) also appears to be linearly related to the PC-based assessment results. Thus, the results from the PC-based test appear to be a valid measure of attention maintenance, at least relative to prior field and simulator test results.

Figure 6. Percentage of Glances Greater Than Some Fixed Duration for Older, Younger RAPT and Younger No-RAPT Participants



2.3 Discussion

The desire was to construct a valid test of attention maintenance that would produce results similar to those observed in prior field and simulator studies. It was important to develop a task that drivers would take seriously and would react in a manner similar to a distraction in a real vehicle. The primary task of looking away from the roadway to view a map appeared to achieve this goal, as participants did not indicate that the task was unrealistic. Also, based on two key indicators, the test appeared to have construct validity. First, the results indicated that, similar to prior studies, teen drivers were more likely to glance away from the forward roadway for durations longer than 2.0, 2.5, and 3.0 seconds than were older, more experienced drivers. Second, there appeared to be trend toward longer average glances for the two younger driver groups, although the statistical tests were not significant.

It must be noted, however, that relative to previous studies, there were smaller differences between groups and a higher overall frequency of long glances for both older and younger drivers. These findings indicate that the test environment (in particular, not actually being responsible for the control of a vehicle) may entice people to look away from the roadway for longer episodes than when they are controlling an actual or simulated vehicle.

Given that the PC-based assessment appears to be measuring a behavior similar to that observed on the road and in the simulator, it is reasonable to believe that it could be used in place of much more extensive testing on a driving simulator that requires using an eye tracker to monitor gaze duration. Moreover, because performance is not at a ceiling for glance durations longer than 2.0 seconds and not at floor for glance durations shorter than 7.0 seconds, there is a reasonable expectation that the PC-based assessment could be used to evaluate the effects of attention maintenance training.

It was somewhat disappointing that the hazard anticipation program, RAPT, did not produce any improvements in the attention maintenance skills of the novice drivers. There was some expectation for such improvement, if only because novice drivers exposed to RAPT had shown clear improvement in hazard anticipation skills both on near and far transfer tests (Pollatsek et al., 2006). It would seem to follow that drivers trained with RAPT would be less willing to take their eyes away from the forward roadway, however, this was not the case. This suggests the need for a separate training program that specifically addresses attention maintenance issues. It also suggests that shifting attention between the forward roadway and inside the vehicle is a skill that is separate from scanning and perceiving specific roadway threats.

3. STUDY 2

Study 1 demonstrated that differences in attention maintenance skills among younger and older drivers could be detected using a PC-based attention maintenance assessment program. Given that the RAPT program did not appear to affect attention maintenance behaviors of young drivers, the next step in the process was the development and evaluation of a program specifically designed to improve the attention maintenance skills of novice drivers. Study 2 evaluated the Focused Concentration and Attention Learning (FOCAL) program. The development and evaluation are discussed below.

3.1 Method

All participants were administered the attention maintenance assessment program, both before and after training in an attempt to measure the effects of the training. Participants completed either the newly developed FOCAL training or a control training course. The control training took about the same time as training with FOCAL, but was not related to attention maintenance. In particular, participants were asked to remember the implication of various traffic signs, signals and pavement markings for safe movement of their vehicle.

3.1.1 Participants

A total of 30 participants were enrolled in the study, 28 males and 2 females. The age range was 19 to 31 with a mean age of 21.8 years. All participants were students at the University of Massachusetts Amherst.

3.1.2 Attention Maintenance Assessment Program

The attention maintenance assessment program used in this study was the same one developed and tested in Study 1 with some minor modifications. The program was used both as a pretest and as a posttest. The same videos were used in the pretest and posttest, but the street names that the participants were to look for on the maps were changed from pretest to posttest. Data from the pretest were actually used as part of the FOCAL training, so participants could see how they actually behaved and the potential consequences of those behaviors.

3.1.3 FOCAL Training

A detailed description of FOCAL is provided in Appendix A, along with estimates of the time it takes to complete each section and subsection. FOCAL training starts with practice on the PC-based pseudo-driving and map task. This practice is followed by the attention maintenance assessment program pretest described above. The program then provides the user with feedback about performance on the pretest by actually showing what it looked like when long glance durations were taken during the pretest. FOCAL then demonstrates what a three-second glance looks and feels like. For this demonstration, the user completes a roadway search task (top half of screen) and map search task (bottom half of screen), similar to that in the pretest, that requires toggling back and forth to successfully complete both tasks. The training, however, does not allow the user to glance at the map for more than three seconds. At three seconds, the screen automatically returns to the road view. The next training section allows the user to toggle between the two views, and does not automatically change screens. Although the program does not switch views automatically, the system beeps when a glance exceeds three seconds. The same type of training is then performed for two-second glances. Again, the system demonstrates what a two-second glance looks like by automatically changing back to the road task when a glance exceeds two seconds, and the next training section allows the user control of the toggling but the system beeps when glances are too long. This concludes the actual training. The participant then completes the attention maintenance assessment program posttest. A final ending message is provided upon completion of the posttest.

3.1.4 Control Training

This training material was retrieved from the Massachusetts Registry of Motor Vehicle's Driver's Manual (2009). Participants read about the implications of various signs, signals and pavement markings for the behavior of a driver. They were then given ten questions. For example, the participants might be asked: "What should you do if a signal light is blacked out and not functioning?" They then had space to write an answer. The answer in this case is: "If signals are blacked out and not functioning, you should be cautious and treat the intersection as having stop signs in all directions. Proceed when it is safe to do so." If they got one or more questions incorrect, they were asked to reread the materials and answer a new set of questions (see Appendix B).

3.1.5 Design

The experimental design was a 2 by 2 mixed design. Training group was a between subjects variable, and participants were randomly assigned to either the control or attention maintenance (FOCAL) training programs. Training period was a repeated measures variable; all participants completed both the attention maintenance pretest and posttest. Glance durations before and after exposure to training were the primary dependent variables. Other measures of interest included total time with eyes off the roadway and accuracy on the map task.

3.1.6 Procedure

All participants began with the attention maintenance assessment program pretest. They then participated in either the control or FOCAL training. Finally, they were given the attention maintenance assessment program posttest. Comments were solicited from participants at the conclusion of the study.

3.2 Results

Three sets of results are presented below: the percentage of drivers in the control and FOCAL training groups on the pretest and posttest who glanced longer than some period away from the forward roadway; the total time that each group spent on the map task in both the pretest and posttest; and the accuracy of each group in the map task on both the pretest and posttest.

3.2.1 Effect of Training on Glance Durations

The distribution of glance durations before and after control training is presented in 0. If anything, after training the participants in the control group appear to become slightly more willing to take a long glance inside the vehicle. For example, the percentage of glances longer than 4.0 seconds on the pretest is roughly 20%. It increased to almost 30% on the posttest.

The pretest and posttest scores for the FOCAL trained group are displayed in 0. The training led to dramatic decreases in glance durations from pretest to posttest.

The primary comparisons of interest were between the posttest mean percentage of glances above a certain duration for the FOCAL training and control training groups. As an example of the magnitude of the differences between the training groups on the posttest, the mean percentage of glances greater than 0.5, 2.0 and 4.0 seconds for the control group were 97.7%, 71.5% and 29.3%, respectively, compared to the FOCAL times of 86.7%, 8.3% and 0.6%. T-tests were used to separately test the statistical significance of the differences in the average proportion of glances greater than x seconds (x = 0.5, 1.0, 1.5, …8.0) on the posttest for the control and FOCAL groups. These differences were statistically significant for all glance durations greater than 0.5 s (Table 1).

Figure 7. Distribution of Glance Durations Before and After Control Training

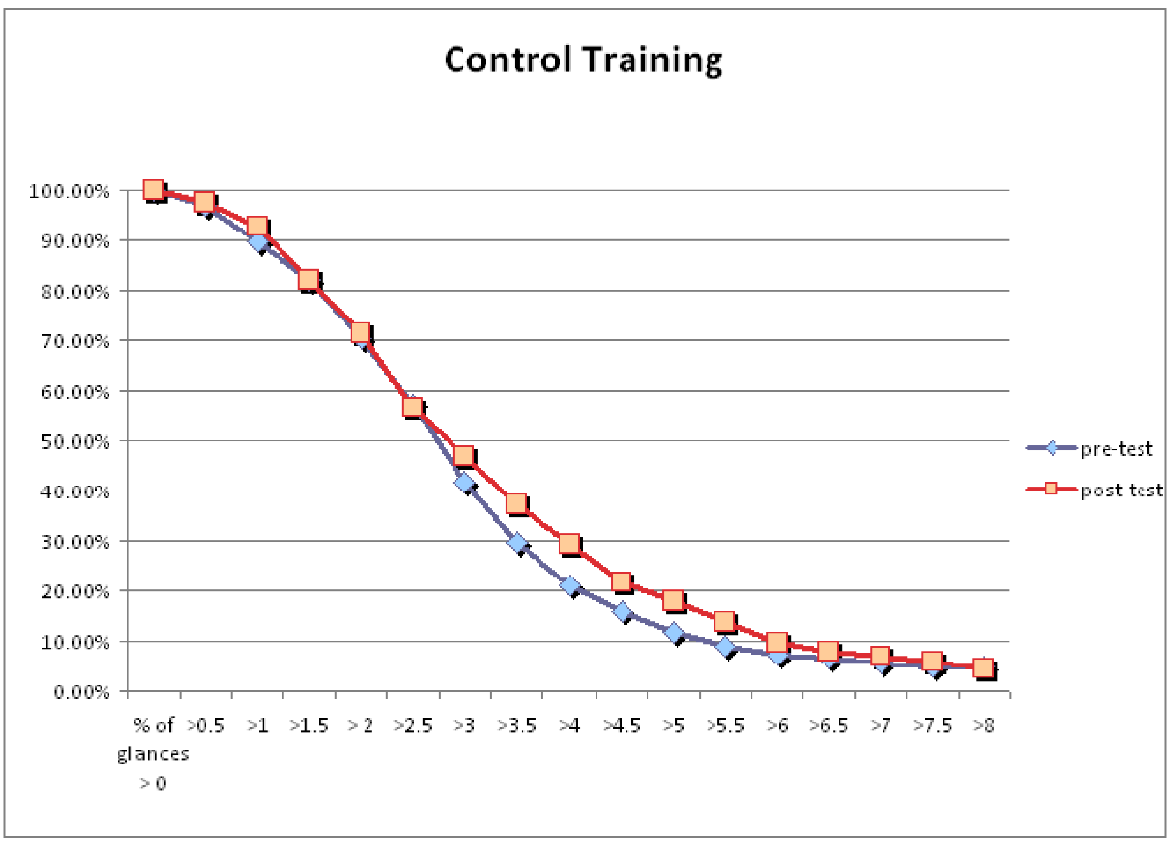


Figure 8. Distribution of Glance Durations Before and After Focal Training

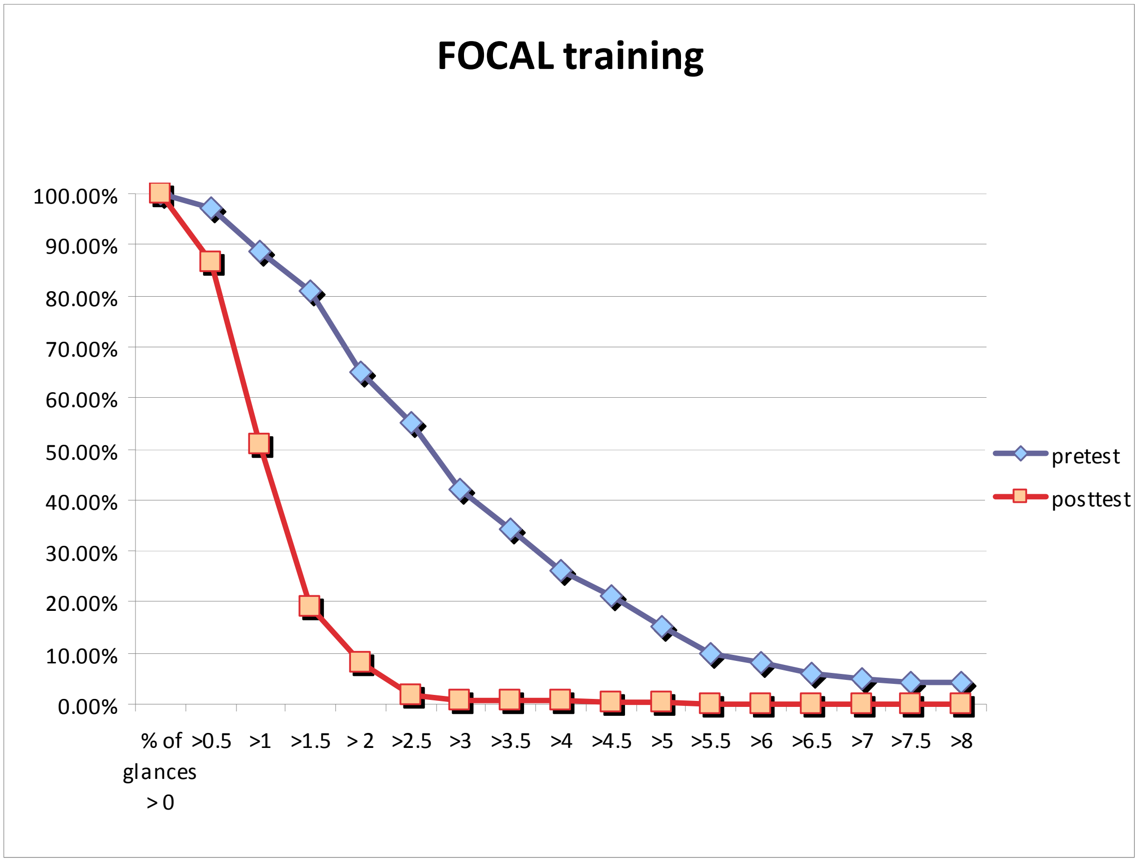


Table 1. Comparison of Posttest Control and Posttest FOCAL Scores

Glance Duration	Difference[a]	Standard Error	t statistic	p value
>0.5	0.1099	0.0508	2.1641	0.0391
>1.0	0.4185	0.0890	4.7009	0.0001
>1.5	0.6285	0.0717	8.7609	0.0000
> 2.0	0.6323	0.0681	9.2864	0.0000
>2.5	0.5477	0.0743	7.3706	0.0000
>3.0	0.4627	0.0774	5.9758	0.0000
>3.5	0.3672	0.0795	4.6168	0.0001
>4.0	0.2875	0.0786	3.6587	0.0010
>4.5	0.2151	0.0672	3.1997	0.0034
>5.0	0.1763	0.0619	2.8484	0.0081
>5.5	0.1386	0.0532	2.6078	0.0145
>6.0	0.0971	0.0406	2.3893	0.0239
>6.5	0.0786	0.0339	2.3209	0.0278
>7.0	0.0704	0.0318	2.2166	0.0349
>7.5	0.0580	0.0268	2.1650	0.0391
>8.0	0.0440	0.0224	1.9645	0.0595

[a] Difference is equal to FOCAL posttest proportion minus control posttest proportion.

3.2.2 Total Time and Accuracy

The results above demonstrate that the participants trained with FOCAL were indeed taking shorter glances away from the forward roadway during the posttest. It was also important, however, to determine if the FOCAL training group showed any changes in the total time they were spending with eyes off the roadway compared to the control training group. As seen in Table 2, the FOCAL group did reduce the total time they spent on the map task from pretest to posttest, but so did the control training group. When taking into consideration the differences between the groups in total time with eyes off the roadway during the pretest, the difference between the two groups for the posttest was not statistically significant. This suggests that there was an overall practice effect for the assessment program, but that FOCAL training did not differentially affect the amount of time participants spent with eyes off the forward roadway task.

Table 2. Total Time Spent on the Map Task

	PRETEST	POSTTEST	Difference
FOCAL	19.04	14.39	4.65
Control	22.60	18.91	3.69
Difference	-3.56	-4.52	0.96

Difference	0.96
SE2	6.23
SE	2.50
t statistic	0.39
p value	> .05

Also of concern was how accurately participants performed the map task and how FOCAL training affected the accuracy of trainees. The intent of FOCAL was not necessarily to increase performance on the map task, nor was it the goal to change behavior such that the participants could not perform the map task as well as they did before training because they thought it best to never look down. Therefore, a measure of accuracy on the map task was calculated. This measure was simply the percentage of streets correctly identified as present or absent on the map task. Averaging over all participants in a group, the map accuracy for the FOCAL trained group increased from 61% to 72% from pretest to posttest. For the control group, accuracy increased from 65% to 72% from pretest to posttest. It therefore appears that FOCAL neither greatly improved nor harmed overall accuracy on the map task compared to the control training group. Finally, the performance on the map search task indicates that the FOCAL participants were not ignoring the map task to focus on the roadway video.

3.2.3 Participant Comments

The participants were asked to comment on the training they received (Appendix C). Most of the comments about the FOCAL training were positive and there were several common threads that will need to be addressed as program development continues. First, it needs to be made clear to participants that the map task is one which includes roads that are not necessarily found in Amherst. Also, the participants were initially confused by the map task in training because it asked them to name a connecting street between the main route and an alternative route. They assumed, reasonably, that they were on the main route when in fact they may not have been.

3.3 Discussion

The FOCAL training appears to have achieved its goal of reducing the glance durations of participants who completed the PC-based attention maintenance assessment program. This was most evident with the precipitous drop in the percentage of glances over two seconds after FOCAL training (from 64.9% on the pretest to 8.3% on the posttest). In addition, this change in the distribution of glance durations did not come at the expense of accuracy on the map task.

Despite these positive results, there are clear limitations as to the generalizations that can be made. First, the assessment and training were conducted on a PC with participants that were on average 2 to 4 years older than typical novice drivers. The next step is to see if the training effects will generalize to a simulator or, more importantly, to the field. Second, the assessment and training were conducted with a map task as the primary in-vehicle task. It is not clear if the effects observed when using the map task will generalize to other in-vehicle tasks that may be more or less distracting. Also, participants were "forced" to perform the map task and were told they needed to complete the task accurately, something that may not be completely realistic on the road. Finally, the posttest was completed immediately after training and the training effects could diminish with time.

Even with these limitations, the results suggest that young drivers can be trained to control their glances inside the vehicle. Alterations to the program will be made based on the comments of the participants and observations of the researchers. The plan is to test the effects of the FOCAL training program using a simulator and on-road evaluation. Should these tests demonstrate similar results, it might be concluded that such a PC-based training program and the accompanying assessment program are viable means to train young drivers and improve their safety on the road.

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Appendix A

Contents of FOCAL Training and Selected Screenshots

A description of the training and data collected in each section is provided below. Text in italics explains particulars of the training. Text not in italics indicates screen shots shown to participants. The actual instructions below are shortened versions of what was given to participants. The complete set of screen shots with the detailed instructions is provided in Appendix B.

5.1 Practice

1. Practice. Practice toggling between video and map views using spacebar (brings up the map view) and enter key (brings up the video), respectively. (1 min)
2. Practice. Practice using enter key to mark 'targets' on video (signs, pedestrians, incoming vehicles). (1 min)
3. Practice. Practice searching for targets on Map. (1 min)
4. Practice. Practice doing both tasks (video + map) together (X 2). (2 min)

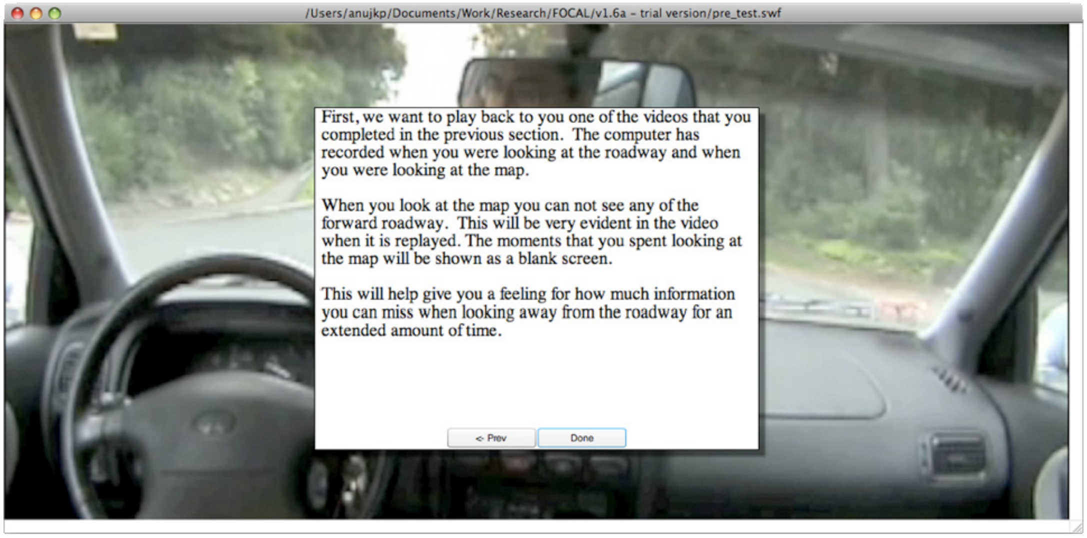
5.2 Attention Maintenance Assessment Program – Pretest

1. Assessment. Complete Video 1 + Map Task 1. (1 min)
2. Assessment. Complete Video 2 + Map Task 2. (1 min)
3. Assessment. Complete Video 3 + Map Task 3. (1 min)
4. Assessment. Complete Video 4 + Map Task 4. (1 min)
5. *Data recorded: Video score/accuracy, Up/Down durations, map target score/accuracy.*
6. *Time: 4 videos, 4 min.*

5.3 Attention Maintenance Assessment Feedback

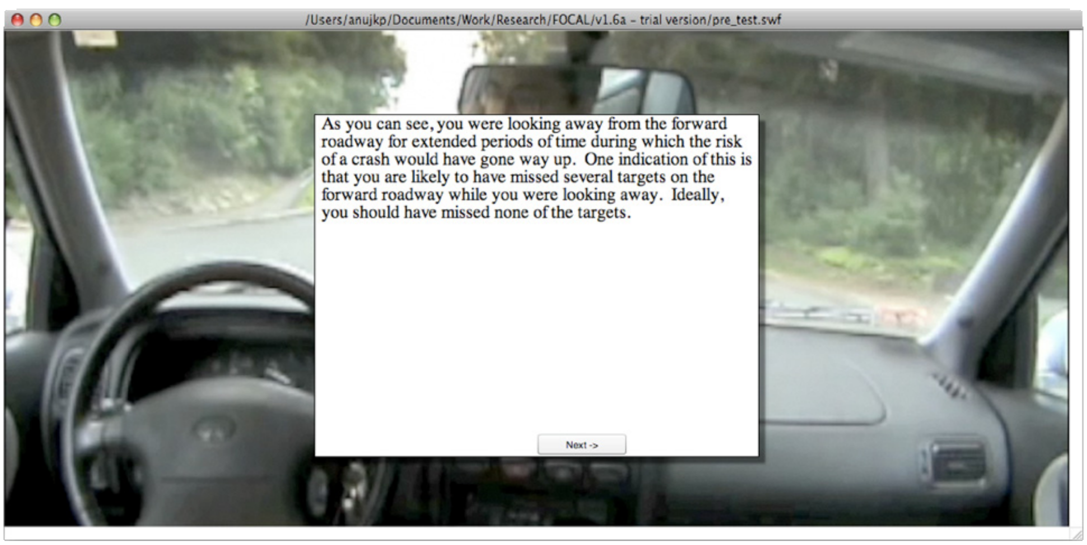
1. *Computations. Calculate the worst performance from section II (4.2) as determined by the video with the longest glance at the map.*
2. Instructions: Blank Video. During the next section, you will have an opportunity to see how well you performed on the first section when you were switching your attention between glances outside the vehicle and those inside the vehicle (i.e., those directed at the map). First, we want to play back to you one of the drives you did in Part II of the study. The computer has recorded when you were looking at the roadway and when you were looking at the map. When you were looking at the map you cannot see any of the forward roadway. This will be very evident in the video when it is replayed. This will help give you a feeling for how much information you can miss when looking away from the roadway for an extended amount of time.
2. Training: Video Replay (1-4). Play back "worst performance video" while "blacking out" the glance-down durations (obtained from user's data). (1 min)

Training: Video Replay (1-4)



3. Feedback. As you can see, you were looking away from the forward roadway for extended periods of time during which the risk of a crash would have gone way up.

Feedback



4. Instructions: Blank Video with Timer (1-4). We will now play this drive back again. In this second replay of your drive, the time you looked away will be presented on the replay so that you can start to get a feeling for how long "too long" is. Ultimately, you should learn never to look away from the road for a period more than 2 seconds to perform critical tasks such as checking the speedometer, activating the windshield wipers, and so on.

5. Training. Play back "worst performance video" while blacking out glance down durations. Also, display a countdown timer (seconds and tenths of seconds) during the black-out periods. In addition to the countdown timer, display a LARGE numeral for

every second that elapses, i.e., the small countdown timer will be running normally and once the timer reaches “1 sec” there will be a large “1” that fades in and fades out on the screen, and when the timer reaches “2 sec” there will be a large “2” and so on. (1 min)

6. Feedback. How long did you look away from the forward roadway? Most teen drivers find that they looked away for longer than 2 seconds. The longer you looked away the more risk you assume. Glances longer than two seconds are associated with a crash risk three times higher than those under two seconds.

5.4 Attention Maintenance Training – 3 seconds

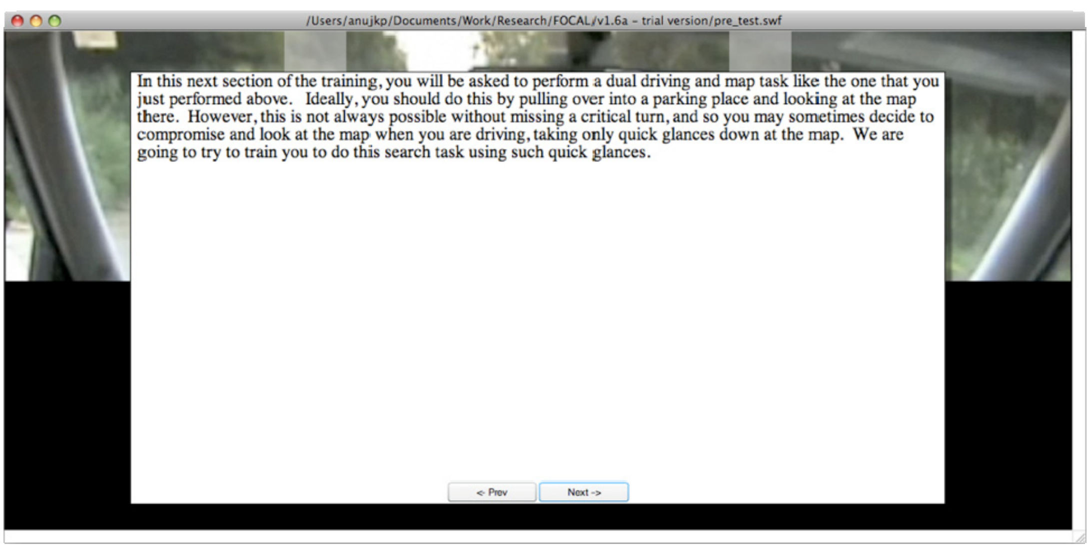
5.4.1 3 Second Map Task – Time Controlled by System

1. Instructions: General. We will have two sections here where we will practice performing the tasks for 3 sec and 2.0 sec.

2. Instructions: 3 Second Map Task. In this section of the training, you will be asked to perform a dual driving and map task like the one that you just performed above. Ideally, you should do this by pulling over into a parking place and looking at the map there. However, this is not always possible without missing a critical turn, and so you may sometimes decide to compromise and look at the map when you are driving, taking only quick glances down at the map. We are going to try to train you to do this search task using such quick glances.

What is crucial to understand is that you can’t look away from the roadway for very long without taking unacceptable risks. However, when you are involved in a task such as looking at a map, it is easy to get involved in the task and lose track of time. Thus, in training, we are going to try to give you something like an internal “clock” that will give you a protection against looking away from the roadway for too long.

Instructions: 3 Second Map Task



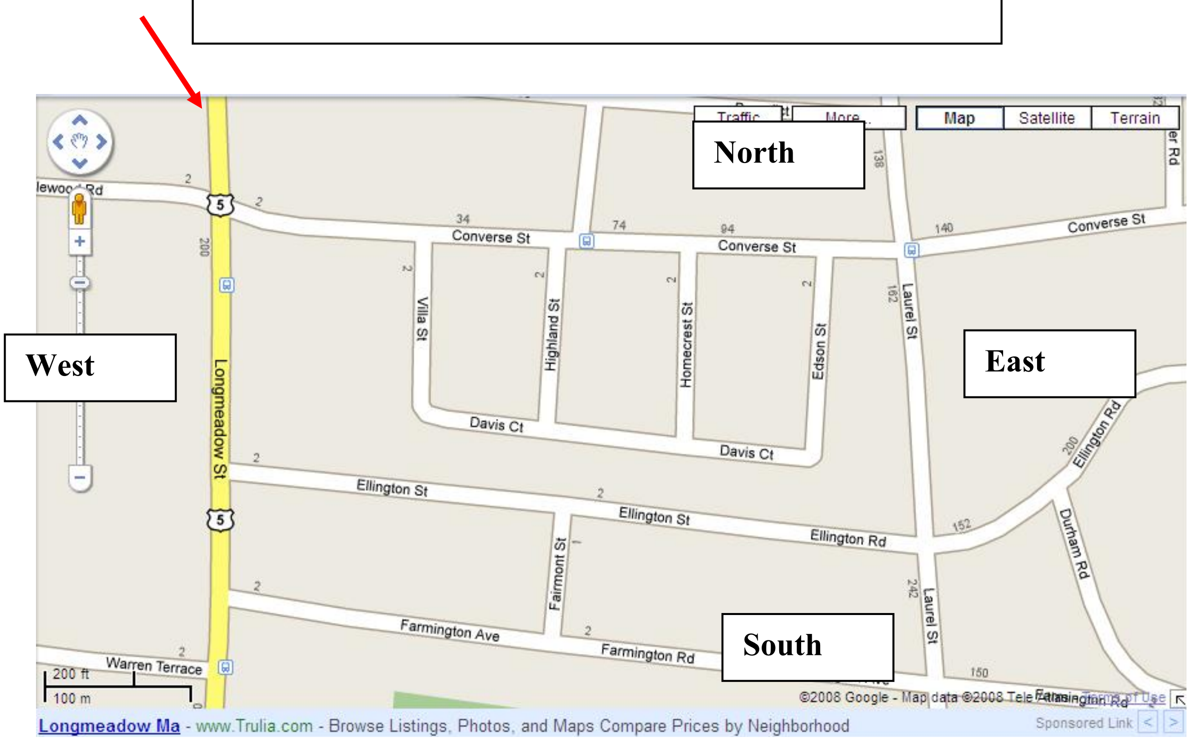
3. Instructions: Connector Street Map Task. The map task you will be doing in this section is one that you might find yourself caught having to do when you are driving.

You can think of your situation as follows. You are in a city or town that you do not know well. You know the name of the street you are trying to find (the destination street) and you know it is a small side street that is not connected to the main street (origin street) on which you are driving. You are fairly sure that there is one street that intersects the street you are driving on that will connect up with the street you are looking for. Thus, your task is to look at the map to find the connector street that links the street you are driving on (the origin street) with the destination street towards which you are heading.

4. Practice: Example of Connector Street Map Task. An example is given in the map below. Imagine you are traveling south on Longmeadow St. heading towards Fairmont St. What street would connect you with Fairmont? You will always be shown an arrow indicating your current location and direction of travel and the four points of the compass. Your instructions on the display will appear as abbreviated directions:

Connector Map Task Used in FOCAL Training

Origin and Direction: South on Longmeadow St.
Destination: Fairmont St.

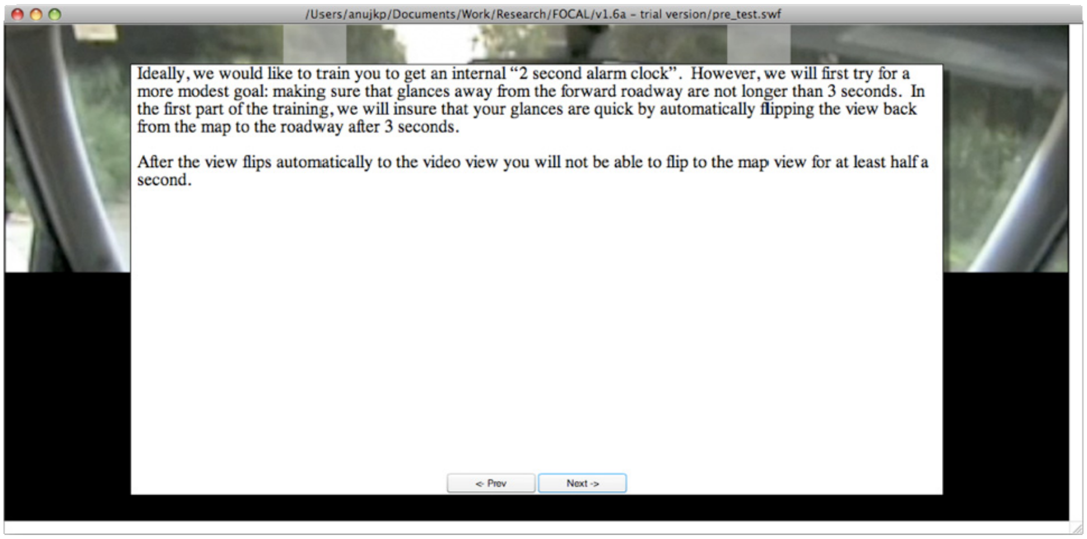


In this case, you should take Ellington St. After you see the entire video you will be given five names of streets. You must decide which street is the connector street.

5. Instructions: Procedure. Ideally, we would like to train you to get an internal "2 second alarm clock". However, we will first try for a more modest goal: making sure that glances away from the forward roadway are not longer than 3 seconds. In the first part of the training, we will insure that your glances are quick by automatically flipping the view back from the map to the roadway after 3 seconds.

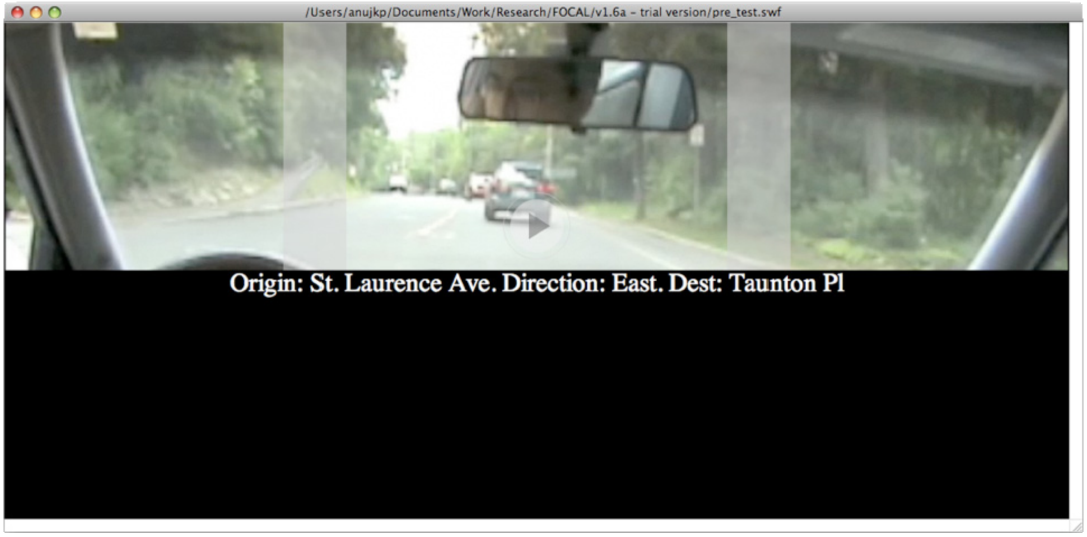
If you do not get the connector street name correct, you will need to repeat the video. Again, as before, you should also respond to each time you see a significant event on the road such as a relevant sign, a pedestrian, or a vehicle in the opposing lane. If you miss any of the significant events you will also need to repeat the video. Remember there is no safe number of significant events that you can miss.

Instruction: Procedure



6. Training: Video 5 + Connector Map Task. (*Spacebar flips to map task, but flips back automatically to video view in 3 sec. At the end of each of three videos check if user finds target. If target is not found then repeat task -- and same video -- just once. We want to provide some incentive for finding the target.*)
7. Training: Video 6 + Connector Map Task.
8. Training: Video 7 + Connector Map Task.
9. *Time*. *(3 videos) Min time 3 mins, Max time 6 mins*.

Training: Video 5 + Connector Map Task

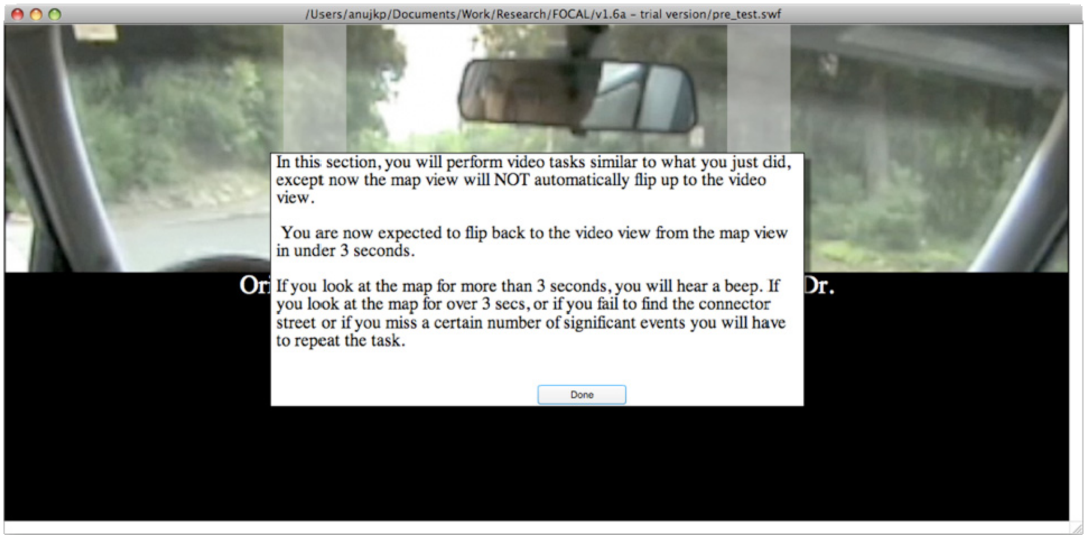


10. Feedback. Almost all students needed to repeat the task, often multiple times. Do not get discouraged.

5.4.2 3 Second Map Task – Time Controlled by User, Beep Added

1. Instructions: 3 Second Map Task – Time Controlled by User. Now you will have to time the glances yourself. You should be sure not to look at the map for more than 3 seconds in any one glance. If you do look at the map for more than 3 seconds, you will hear a beep. If you hear a beep, you'll have to practice it again. And again, if you do not get the name of the connector street correct at the end of the video or if you miss any significant events, you will also need to repeat the task.

Instructions: 3 Second Map Task - Time Controlled by User



2. Training: Video 8 + Connector Map Task. (*Spacebar flips to map task; beep occurs after 3 seconds if map task not exited.*)
3. Training: Video 9 + Connector Map Task.
4. Training: Video 10 + Connector Map Task. (*Not all participants will complete this video; see comments on computations below.*)
5. Training: Video 11 + Connector Map Task. (*Not all participants will complete this video.*)
6. *Computations. At the end of each of first two videos check to see if any of the "down" glances were over 3 seconds. If no glances were over 3 s in first two videos, end. If the glances were over 3 seconds in one or both of the first two videos, then repeat the task, with new video/map combination until participant gets two videos in a row with all glances less than 3 sec or has seen four videos. In this section we are trying to get them to develop an internal clock so that they can estimate when they are looking away from the forward roadway for more than 3 sec.*
6. *Time. (2-4 videos) Min time 2 min, Max time 4 mins.*

5.5 Attention Maintenance Training – 2 seconds

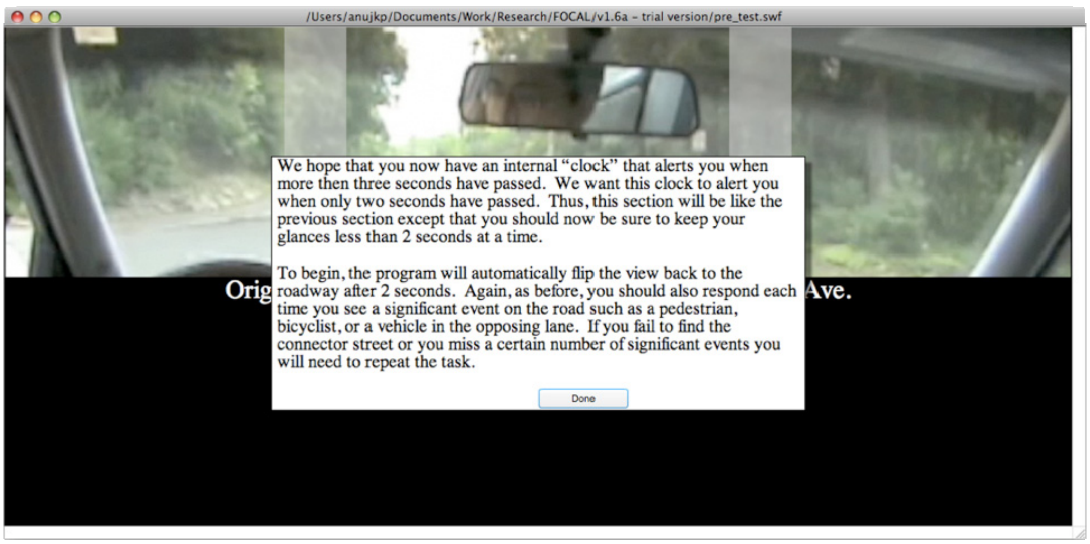
5.5.1 2 Second Map Task – Time Controlled by System

1. *General. Same as III.A and III.B except for the timing. The window here would be between 0.0 and 2.0 seconds.*
2. Instructions: Training: 2 Second Map Task. We hope that you now have an internal "clock" that alerts you when more then three seconds have passed. We want this clock to alert you when only two seconds have passed. Thus, this part will be like the last part except that you should now be sure to keep your glances less than 2 seconds at a time. To begin, the program will automatically flip the view back to the roadway after 2 seconds. Again, as before, you should also respond to each time you see a significant event on the road such as a relevant sign, a pedestrian, or other vehicle. If you fail to find

the connector street or you miss one or more significant events you will need to repeat the task.

2. Training: Video 12 + Connector Map Task. (*Spacebar flips to map task; beep occurs after 2 seconds if map task not exited. At the end of each of three videos check if user finds target. If target is not found then repeat task -- and same video -- just once.*)
3. Training: Video 13 + Connector Map Task.
4. Training: Video 14 + Connector Map Task
5. *Time. (3 videos) Min time 3 mins, Max time 6 mins.*

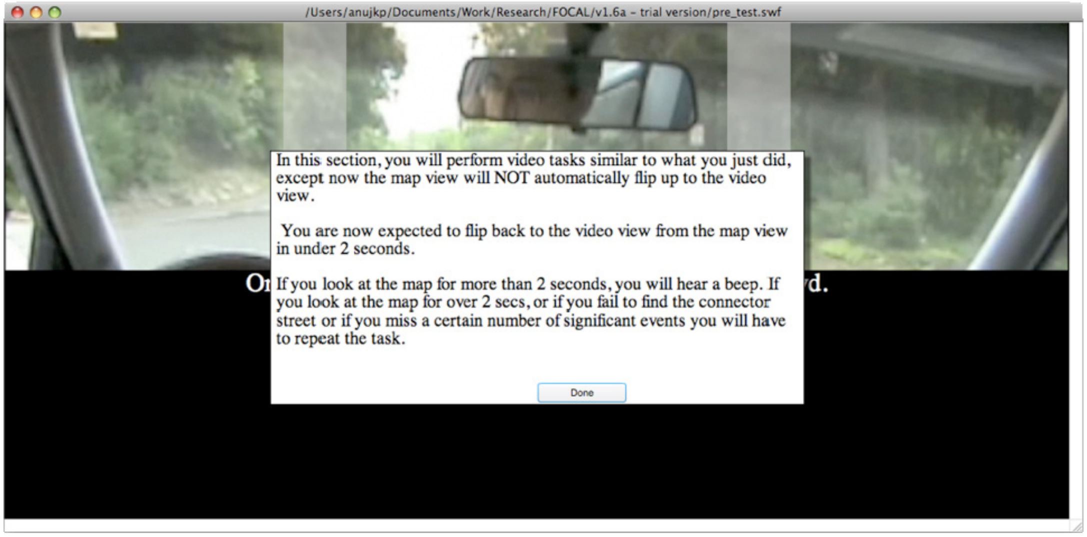
Instructions: Training: 2 Second Map Task



5.5.2 2 Second Map Task – Time Controlled by User, Beep Added

1. Instructions: Training: 2 Second Map Task – Time Controlled by User. Now you will have to time the glances yourself, except that you now have to make them less than 2 seconds at a time. As before, if you look at the map for more than 2 seconds, you will hear a beep, and if you hear a beep, you'll have to practice it again. Additionally, if you fail to find the connector street or miss any significant events you will have to repeat the task.

Instructions: Training: 2 Second Map Task – Time Controlled by User



2. Training: Video 15 + Connector Map Task. (*Spacebar flips to map task; beep occurs after2 seconds if map task not exited.*)
3. Training: Video 16 + Connector Map Task.
4. Training: Video 17 + Connector Map Task. (*Not all participants will complete this video; see comments on computations below.*)
5. Training: Video 18 + Connector Map Task. (*Not all participants will complete this video.*)
6. Computations. *At the end of each of first two videos check to see if any of the "down" glances were over 3 seconds. If no glances were over 3 s in first two videos, end. If the glances were over 3 seconds in one or both of the first two videos, then repeat the task, with new video/map combination until participant gets two videos in a row with all glances less than 3 sec or has seen four videos. In this section we are trying to get them to develop an internal clock so that they can estimate when they are looking away from the forward roadway for more than 3 sec.*
6. Time. *(2-4 videos) Min time 2 min, Max time 4 mins.*

5.6 Attention Maintenance Assessment Program – Posttest

1. Instructions. You will now get a test similar to the pre-test you took initially. As with the pre-test, your task is to report whether the street names are on the map or not. You should also respond to the significant events on the roadway as well, just as before. You should be able to schedule your glances better than before. Good luck!
2. Assessment. Complete Video 1 + Map Task 1. (1 min)
3. Assessment. Complete Video 2 + Map Task 2. (1 min)
4. Assessment. Complete Video 3 + Map Task 3. (1 min)
5. Assessment. Complete Video 4 + Map Task 4. (1 min)
6. Data recorded: *Video score/accuracy, Up/Down durations, map target score/accuracy.*
7. Time: *4 videos, 4 min.*

5.7 Ending Message

1. Exit Instructions. It is never, ever safe to take your eyes off the forward roadway. However, there may be occasions it is necessary to do such. Situations in which this could occur include ones where you need to stop suddenly and alert the vehicles behind you, perhaps by putting on your emergency flashers. Here you would need to look inside the vehicle for the button which activated the flashers. Other situations in which you might need to look away from the forward roadway include ones where an emergency vehicle is approaching, you need to get out of the way, but you cannot determine from the sound from which directing it is coming. In this case you would need to glance away from the forward roadway at the rear and side view mirrors. Also, you might be in an area which required a sudden change in speed limits. Even something as simple as monitoring your speed requires you to take your eyes away from the forward roadway. Finally, in a really rare situation you might find yourself on a highway which has no breakdown lane. You are rushing to your spouse or family member who has been taken to a hospital and is critically ill. You are not familiar with the exits, but know that the hospital is an exit off the highway on Berkeley St. You can easily locate the highway and the streets which intersect the highway on a map you have in the front seat beside you. You might in this case glance for one second every five seconds at the map in order to find the appropriate exit.

Research indicates that if you are in a situation where you need to take your eyes away from the forward roadway, you should glance less than a total of one second during any five second interval. One way easily to remember this rule is to imagine the five fingers on your hand as each indicating one second. Only one of those fingers (i.e., your eyes) can be down during any five second interval in order to be most safe. The remaining four fingers (your eyes) must be up.

Appendix B

Control Training

Training[1]

All travel on public roadways is controlled by a system of signs, signals, pavement markings, and driving laws. No matter what type of vehicle you are driving or what kind of road you are driving on, you *must* obey these "rules of the road."

Please read the following five pages for a review of traffic signal and traffic sign rules.

Afterwards, please answer the open ended questions that were handed out to you. An example of a question you might be asked is the following:

Question:

If you encounter a flashing red signal, where must you stop?

Answer:

If a white stop line or crosswalk line is painted on the pavement, you must stop before the line. When there are no pavement markings you must stop as close to the intersection as needed to view traffic in both directions without entering the intersection.

Note! If you do not answer all open ended questions correctly, you will be asked to repeat the training with a <u>new</u> set of questions. Please be thorough reading through the material below. It should take you between 20 and 25 minutes to do such and be able to recall everything you read since you will already be familiar with much of the material.

[1] This training material was retrieved from the MASS RMV Driver's Manual

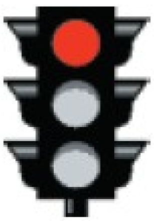
Traffic Signals

Traffic signals are lights that control the movement of vehicles and pedestrians, usually at intersections. You must know what each light means and obey its signals at all times.

Motor Vehicle Signals

Traffic signals typically consist of three round lights: red, yellow, and green, from top to bottom. There are other types of signals, however, such as single flashing lights or colored arrows.

Steady Red



A steady red light means "stop." Do not go until the light turns green. You may make a right turn on a red light *only* after coming to a complete stop, then yielding to pedestrians or other vehicles in your path. You may *not* turn on red if a **NO TURN ON RED** sign is posted.
If you are travelling on a one-way street and turning left onto another one-way street, you are allowed to turn left on a red light. Come to a complete stop and yield to pedestrians and other vehicles before turning.

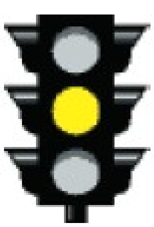
Steady Red Arrow

A steady red arrow means the same as a steady red, circular signal *(see the preceding* Steady Red *section)*, but a steady red arrow applies only to vehicles intending to proceed in the direction of the arrow. The same rules for "turning on red" apply.

Flashing Red

A flashing red light means the same as a **STOP** sign. Come to a complete stop. Obey the right of-way laws and proceed when it is safe to do so. If a white stop line or crosswalk line is painted on the pavement, you must stop **before** the line. When there are no pavement markings you must stop as close to the intersection as needed to view traffic in both directions without entering the intersection.

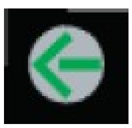
Steady Yellow



A steady yellow light means the traffic signal is changing from green to red. You *must* stop if it is safe to do so. If you are already stopped at an intersection or a stop line, you may *not* proceed.

Flashing Yellow
A flashing yellow light is a warning. Proceed with caution, and stay alert. Look both ways when crossing an intersection.

Steady Green
A steady green light means "go," but only after you have yielded to other vehicles, bicycles, or pedestrians in the road. If you are crossing an intersection, make sure you have enough room to make it completely through. Never block an intersection. You may make a turn as long as you have enough space to complete the turn and avoid creating a hazard. Look out for drivers who are not obeying traffic signals or are racing through intersections.



Green Arrow
A green arrow means you may make a "protected" turn in the direction of the arrow. As long as a green arrow displays for your turning lane, pedestrians and oncoming vehicles should be stopped for red lights. Look closely for signs saying you may turn *only* on a green arrow.

Traffic Lights Not Working
If traffic signals are not working as they normally do, they will simply flash red or yellow lights. In these cases, follow the rules for flashing lights. If signals are blacked out and not functioning, you should be cautious and treat the intersection as having stop signs in all directions. Proceed when it is safe to do so.

Traffic Signs

Traffic signs control the flow of traffic, warn you of hazards ahead, guide you to your destination, and inform you of roadway services. The shapes and colors of traffic signs are meaningful. Sign colors mean the following:

RED—stop or prohibition
GREEN—direction, shows where you can go
YELLOW—general warning
BLACK/WHITE—regulation
BLUE—motorist service (e.g., gas, food, hotels)
BROWN—recreational, historic, or scenic site
ORANGE—construction or maintenance

warning
Know signs by their appearances so you can recognize them at a distance.

Stop and Yield Signs

The **STOP** sign always means **"come to a complete halt"** and applies to each vehicle that comes to the sign. You must stop before any crosswalk or stop line painted on the pavement. Come to a complete stop, yield to pedestrians or other vehicles, and proceed carefully. Simply slowing down is not enough. If a **4-WAY** or **ALL WAY** sign is added to a **STOP** sign at an intersection, all traffic approaching the intersection must stop. The first vehicle in the intersection or four-way stop has the right of way.

Yield

When you see a **YIELD** sign, slow down and be prepared to stop. Let vehicles, bicyclists, and pedestrians, pass before you enter the intersection
or join another roadway. You must come to a complete stop if traffic conditions require it.

Regulatory Signs

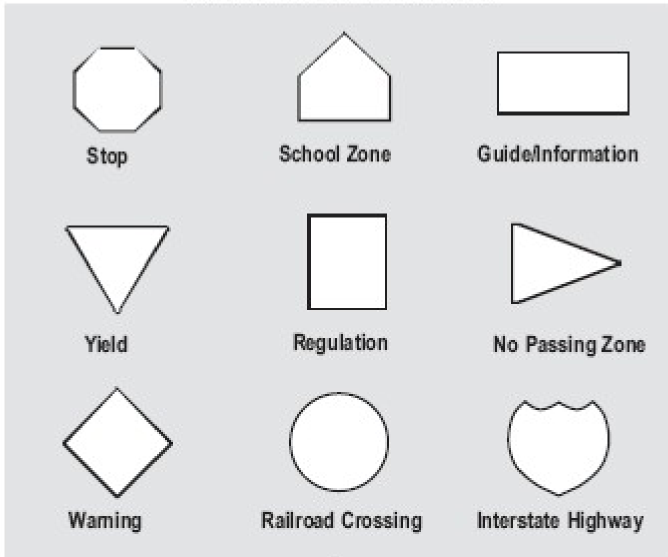

No right turn

The United States is now using an international system of traffic control signs that feature pictures and symbols rather than words. The red-and-white **YIELD** and **DO NOT ENTER** signs are examples, and you have probably seen signs that use a red circle with a diagonal slash. These signs prohibit access or movement. When you see one, think of the word *no.*

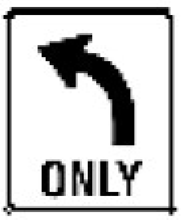
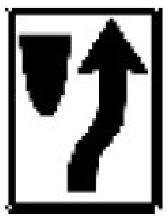
Warning Signs
Yellow warning signs alert you to hazards or changes in conditions ahead. The road layout may be changing, you may be approaching a school zone, or you may need to be aware of some special situation ahead. Slow down and obey the sign.

Please review the meanings of the following traffic sign shapes.

Know traffic signs by their shapes



Now, have a look at the following traffic signs (Regulatory and Warning Signs).

Regulatory Traffic Signs				
 No right turn	 No left turn	 No U-turn	 No trucks	 No bicycles
 All traffic must go left	 Keep to the right of the upcoming median or lane divider	 No pedestrians	 No parking allowed between posted hours	

Warning Signs				
 Traffic signal ahead	 Roundabout ahead	 Stop ahead	 School crossing	 School zone

 Lane merging from right, watch for other traffic	 Maximum height allowed	 Road narrows or right lane ends	 Road slippery when wet	  Road curves right
 Divided highway begins	 Winding road, do not pass	 Divided highway ends	 Pedestrian crossing	 Crossroad ahead
 Road entering from the right	 Road ends at junction	 Traffic may flow on both sides of sign	 Two-way traffic	 Playground

Short-Quiz:

Participant-Number:____________________

Questions:

Please answer every question as completely as possible.

1) WHAT DOES A FLASHING RED TRAFFIC LIGHT MEAN?

*A flashing red light means the same as a **STOP** sign: a) come to a complete stop; b) obey the right-of-way laws, and c) proceed when it is safe to do so*

2) WHAT IS THE PRIMARY COLOR OF HISTORIC SIGNS?

Brown

3) WHAT SHOULD YOU DO IF A SIGNAL LIGHT IS BLACKED OUT AND NOT FUNCTIONING?

If signals are blacked out and not functioning, you should be cautious and treat the intersection as having stop signs in all directions. Proceed when it is safe to do so.

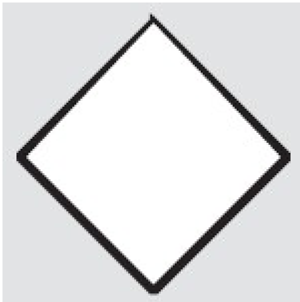
4) WHAT DOES AN ORANGE TRAFFIC SIGN MEAN?

Such a sign warns drivers of construction or maintenance.

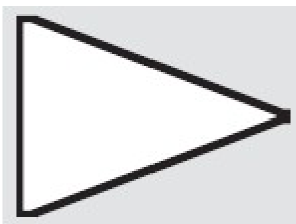
5) WHAT DOES THE FOLLOWING TRAFFIC SIGN MEAN?

All traffic must go to the left.

6) WHAT IS THE COMMON SHAPE FOR A WARNING SIGN?



7) WHAT IS THE SHAPE OF A SIGN THAT INDICATES NO PASSING IS ALLOWED?



8) WHEN CAN YOU NOT TAKE A LEFT ON A STEADY GREEN EVEN THOUGH NO OTHER TRAFFIC OR PEDESTRIANS ARE IN SIGHT?

One cannot take a left on a steady green when there a sign is present indicating a left turn on a green arrow only.

9) WHAT DOES THE FOLLOWING SIGN INDICATE?

Divided highway ends

10) WHEN CAN YOU GO LEFT ON A RED LIGHT AFTER STOPPING?

When you are on a one way street.

Questions:

Please answer every question as completely as possible.

11) WHAT DOES A FLASHING YELLOW TRAFFIC LIGHT MEAN?

A flashing yellow light is a warning. Proceed with caution, and stay alert. Look both ways when crossing an intersection.

12) WHAT KIND OF SIGN IS PRIMARILY BLUE?

Motorist service signs (e.g., gas, food, hotels).

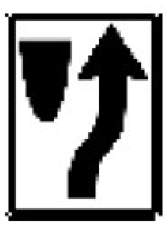
13) WHAT RULES APPLY FOR A STEADY RED ARROW?

A steady red arrow means the same as a steady red, circular signal, but a steady red arrow applies only to vehicles intending to proceed in the direction of the arrow. The same rules for "turning on red" apply.

14) WHAT DOES A GREEN TRAFFIC SIGN MEAN?

Such a sign gives drivers direction, shows where they can go.

15) WHAT DOES THE FOLLOWING TRAFFIC SIGN MEAN?

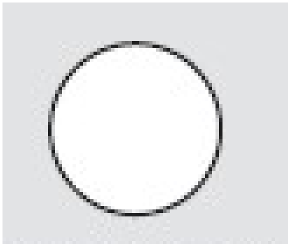


Keep to the right of the upcoming lane or median divider.

16) WHAT IS THE CORRECT PROCEDURE FOR A YIELD SIGN?

Slow down and be prepared to stop. Let vehicles, bicyclists, and pedestrians, pass before entering the intersection or joining another roadway. Come to a complete stop if traffic conditions require it.

17) WHAT IS THE SHAPE OF A SIGN THAT INDICATES A RAILROAD CROSSING?



18) WHO HAS THE RIGHT OF WAY AT A FOUR WAY INTERSECTION?

The first vehicle in the intersection or four-way stop has the right of way.

19) WHAT DOES THE FOLLOWING SIGN INDICATE?

Winding road, do not pass.

20) IF THERE ARE NO STOP LINES PAINTED ON THE STREET, WHERE SHOULD YOU STOP?

When there are no pavement markings, you must stop as close to the intersection as needed to view traffic in both directions without entering the intersection.

Appendix C

Participant Comments

-

A little confusing, poor map choice. Usually, people who will be looking at a map identify key streets before driving to make looking down easier, this was a bit too random.

-

I thought the program was fine. It's certainly hard to find the streets while still trying to catch all the people and cars but it gets the point across.

-

No general feedback. The test was pretty cool actually. I remembered where the original streets were from the beginning of the test, so I recalled where they were on the map, which made the very last part of the test easier to do.

-

I thought that this test was very frustrating. It was hard to look at a map that I had never seen before with many roads and search for roads that I had just been told the name of with no other indication of where they could be. Other than that I thought that the simulation was fun, except for the street signals quiz.

-

Here are my results. I think this was a memory test where we get practice rounds looking at a map and seeing hazards and then we are made to do something completely different, i.e., the written test, and then look at the same maps to check our results on how well we remember where streets were and also where hazards were. It was also to show us how looking off of the road is dangerous but it didn't tell us how many hazards we missed on each given road.

-

Here’s some good stuff...one test with Park and Glenberry connectors was frustrating and took my mind off the next test.

-

This study was interesting but the thing that i disliked most is that you never are going to lose complete site around you and just focus on the map. Also the font was so small that it was almost impossible to find the street names. The quality of the video was not good enough to see the street signs and pedestrians well enough.

-

Terrible assignment. There was no way that I would be able to look down and find where I was without looking down for more than two seconds. I think that this was beaten into our brains after the 50th time. Two or three examples would have been enough. Waste of a class time.

-

This study was very interesting to see the difference in time that I took my eyes off the roadway from the beginning of the study to the end. At the beginning I glanced away for almost 6 seconds at one point, and by the end I was really trying to keep my glances to 2 seconds or less. The only thing that didn't seem necessary were the headphones.

-

This is was a very difficult assignment, because you are being asked to located things on the road and on the map. I am guessing you are measuring how long we take our eyes off the road. It was very tricky and I could only locate some of the roads. It may turn out some skewed results because of initial confusion.

-

Here is my data from the test. I feel that resolution of the video is a very large problem. I feel like this better tests how I would drive if I really needed glasses and did not have them. I also find that it doesn't work as well to test this if I do not have control of the driving. Coming up to stop signs for example, I would stop longer to look at the map, and I would know when I was about to leave the stop position, I would not have to guess as I did in this simulation.

-

I thought this was interesting, and a nice change of pace, plus a good way to concrete many of the safety concerns that have been discussed in class. My only request is higher quality videos. In real life, it would be much easier to ascertain whether those pixels are a car, person, tree, or sky from further away.

-

The only comment I have is that the video quality is low so its hard to distinguish people sometimes.

-

It was hard to switch between the map and view. You should have them on the same page that would be more realistic because when you drive you can go back and forward between the road and map.

-

I found the program very informational. It took a little more time than the practice to get used to the controls as well as the concept behind the test. I couldn't get the sound to work, which would have made this significantly easier. I had to depend entirely on my eyesight. This caused me to realize how blind I am to the road when I am looking at the map. The test was informational and certainly not boring (however, if it were twice as long I think it would be starting to cross that line).

-

The written test was not hard, however I did not pass it the first time. I think that knowing the color and shape of historical signs might not be as important as the other types of signs. Perhaps the questions were picked very specifically; if that is not the case I would probably recommend placing questions about the information that is more important. For instance, knowing the color and shape of a yield sign is more important than knowing that of a historical one.

-

Assuming the sound effects do work I would consider this a good program.

-

Here is my score from the experiment. I thought that the program was not bad for a simulation. However, it was unrealistic. In a real life situation, a person can glance back and forth between the maps and the roadway without anything going black. For example, when viewing the map in this simulation the roadway is completely gone. In real life you would have your peripheral vision to still see the roadway.

-

Thought the program was ok. Only problem was that I wish that the instructions were explained verbally.

-

This is a wonderful program. I like this program. It showed me clearly how dangerous when you driving and looking away the drive way for 2 seconds or more.
-
My info was saved on the mac laptop. I thought it was OK, the visual clarity could be better. During the training it would be helpful to draw graphic arrows towards the vertical lines. There are some sections that say horizontal lines when you mean to say vertical lines and if the test was going to have us note when we saw oncoming traffic then the training should have only included that. It was fun and interesting and I agree that we should not look at maps while driving.
-
I thought the test was interesting, I didn't know what to do at first I thought that the maps correlated with the video. Some more explanation in the beginning would be nice. I think that this was a good way to test how long people look at maps while driving. It might be easier if we had an actual map in front of us while trying to watch the computer screen, that might have the same "look away" effect. I think part of the time I spent looking at the map was due to my reaction time hitting the correct key board button to toggle back and forth.
-
This was difficult for me, as I do not drive; however, it was interesting to see how a test like this could be conducted on the computer.
-
I thought the program was really good, the only think I didn't like was the resolution of the screen, it was hard to tell the difference between a fire hydrant and a person
-
I thought the lab to be pretty straight forward for the most part. It was a little difficult in the beginning to really grasp what was going on, but by video #3/4 I really started getting the hang of things. The instructions should be cleared up a little in the part where you switch from marking the street signs to marking the moving obstacles. I was unsure at first if I should still be doing street signs or marking parked cars. Something like, "Please only mark..." would greatly help (me, anyway :)) I glanced at the final results for a second...I am unsure of how the save file is set up, but if the end of the report correlates to the end of the test, I think something may be amiss. I was making sure to glace fairly quickly (~half a second) at most, yet sometimes I hit 3+ seconds? It could very well just be me frantically trying to get everything done, or maybe I was flipping too quick =p I'll be safe and say the timers were right, though.
-
Good job! Much better than falling asleep in class.
-
At first, I think the directions should be more specific about what "street" signs I should be looking for. I wasn't sure if I should include all the "parking" signs or not for example, or if it should be the type of sign with the street name on it. Also, sometimes when I was trying to toggle between the map and the video, I would accidently press "enter" when I meant to press "spacebar". Maybe pressing a third button as the toggle function would fix this. When the two bars came up, and I was supposed to say when I saw a pedestrian for example, I wasn't sure if you meant when it was ON those bars, or when the pedestrian was between those bars, or both. The directions should be a little

more specific towards that. I also think that when looking at a map in real life, you are looking for streets that are connected, instead of spread out on the map. If this test is just supposed to evaluate looking at maps, its not very accurate. However, just evaluating distractions, the test does a very good job. The test was good overall, wasn't very boring or anything, and it really shows you how when you look at something in advance, you are much less distracted

-

The program was useful, but because I was behind a computer screen, I would look at the map longer than I would usually have if I was in the actual vehicle. I would also frequently press the spacebar instead of enter when cars or pedestrians went through the bars. I am not sure if that mistake is unique to me but perhaps switching how the user inputs could eliminate false data. The simulation did show how dangerous it was and I definitely noticed even behind the screen that I shouldn't be taking my eye off the road. Thank you,

-

This simulation was an enlightening experience. I never knew how long my eyes are off the road every time I glance at something (radio, iPod, etc). I saw a huge improvement toward the end of the simulation and I find myself taking only quick glances, probably under a second, to get or look at something.

-

I thought the test was interesting, although posting the same maps in the final segment that had been posted before will not give accurate results of improvement in that I had remembered where some streets were and could find them the second time fairly easily, so it is not a accurate measure.

-

This experiment was very interesting. It was a little long and repetitive, but I definitely see why it is so dangerous to multi-task while driving. I did much worse in some sections than I thought I would. Especially when I was not given a location where I was and had to search the whole map for the streets. I almost never found the streets and could not pay attention to the roads. It was definitely much harder than I thought it would be.

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