

# THE EFFECTS OF ATTENDING TO AUDITORY STIMULI ON DRIVER SPEED AND LANE WEAVING BEHAVIORS IN A DRIVING SIMULATOR

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## 1. INTRODUCTION

Research concerning the effects of various stimuli on driving behaviors has become more important as the number of drivers on the road has increased 64% since 1970 ("Aggressive Driving," 2002). Studies have ranged from the effects of alcohol on signal detection, divided attention and reaction speed (Gengo, Gabos, Straley & Manning, 1990) to the effects of fatigue (e.g. Lal & Craig, 2002) and recently, driving behavior while using a cellular phone (McKnight & McKnight, 1993). Music has also been studied in regards to its effects on driving, and has been found to reduce driver stress in highly frustrating traffic congestion (Wiesenthal, Hennessy & Totten, 2000).

Intuitively, all of these factors involve an attentional component, as does driving. Attention can be divided between many tasks, however with a limited capacity (Wiesenthal et al.). The amount of cognitive resources available for attention to each of these tasks decreases as the number of tasks increases (Wiesenthal et al.). Therefore, performing such tasks as conversing on a cellular phone or listening to an engaging auditory stimulus while driving increases the number of cognitive tasks the driver must perform, and decreases the amount of attention that can be paid to cognitively demanding tasks such as visual tracking and motor reactions.

The present study attempts to determine whether or not attending to an auditory stimulus while driving in a simulator will have an effect on drivers' speed and lane-weaving behaviors. A comedy sketch is used in the effect condition, as it is assumed that because of the pleasant nature of the stimulus, participants will be more likely to attend to the stimulus than they would be to a neutral, non-engaging stimulus (control condition). It is hypothesized that drivers attending to an engaging auditory stimulus will drive a significantly different speed than drivers listening to a nonsense recording of scrambled words. It is also hypothesized that drivers listening to the engaging stimulus will engage in significantly different lane-weaving behaviors than drivers listening to the scrambled words.

## 2. METHOD

Participants were 47 undergraduate students enrolled in at least one psychology class at the University of Calgary. Participation was voluntary through a bonus credit system.

Participants were randomly assigned to the control condition (listening to scrambled words while driving) or the effect condition (listening to a comedy sketch while driving). There were 29 female participants enrolled in the study and 18 male participants. Participants' driving experience ranged from one to 20 years ( $M=5.6$ ) and participants' age ranged from 18 to 39 ( $M=21.6$ ). All participants were administered a hearing test before commencing the study, and all participants displayed average or above average hearing. Eight participants reported being prone to motion sickness while reading in a moving vehicle. Due to technical problems, data from two participants was unable to be collected, and four participants terminated participation in the study due to motion sickness after commencing the driving portion of the study. Final analysis was based on data from 41 participants: 20 in the effect condition and 21 in the control condition.

This experiment was carried out using the University of Calgary Driving Simulator (UCDS). The UCDS is comprised of a Saturn SL1 positioned in front of a wraparound screen. An elaborate connection of computers collected data from the driving scenario and sent data to the screens in front of the car<sup>3</sup>. Participants listened to the auditory stimuli through speakers in the car while they were driving a predetermined course in the simulator, and were asked to pay attention to the stimulus as they drove.

Participants in the effect condition listened to a Jerry Seinfeld comedy sketch, which was recorded using a male voice, and did not contain a laugh track. Upon completion of the drive, these participants were asked to complete a questionnaire regarding the content of the comedy sketch, to ensure they were attending while driving. Participants in the control condition listened to the same male speaker, with the exact same content in the stimuli, however the words were scrambled, though still spoken with prosody.

## 3. RESULTS

The simulator data consisted of measures taken every 0.33 seconds. Speed data, measured in meters per second, was averaged to compute the overall speed for the entire drive for each participant. An alpha level of 0.05 was used for all statistical tests. A one-way analysis of variance found that participants in the control (scrambled word) condition ( $M = 20.134$ ,  $SD = 2.377$ ) drove significantly faster than participants in the effect (comedy) condition ( $M = 18.337$ ,  $SD = 1.780$ ),  $F(1,39) = 7.46$ ,  $p = 0.009$ .

**Table 1. Speed behavior results (meters per second).**

	M	SD
Control	20.134	2.377
Effect	18.337	1.780

Data on lane position was also collected every 0.33 seconds. In order to obtain an average lane-weaving statistic, the absolute difference between each measure was calculated, and these difference scores were then averaged for each participant. A one-way analysis of variance determined that there was no significant difference in lane-weaving behaviors between the control group ( $M = 0.07670$ ,  $SD = 0.02291$ ) and the effect group ( $M = 0.06769$ ,  $SD = 0.01589$ ),  $F(1, 39) = 2.12$ ,  $p = 0.154$ .

**Table 2. Lane-weaving behavior results (average lane position).**

	M	SD
Control	0.07670	0.02291
Effect	0.06769	0.01589

## 4. DISCUSSION

It is assumed that participants in the control condition did not attend to the stimulus, as it consisted of nonsense, scrambled prose. Participants most likely would have started the drive by attending to the prose (because they were asked to), however when they realized that it consisted of nonsense, would have stopped attending. Participants in the effect condition had to complete a questionnaire about the content of the comedy sketch following the drive, and if participants answered fewer than 80% of the questions correctly, their data would not have been included (however this did not occur).

As hypothesized, the average speed of drivers listening to the comedy sketch was significantly different than the speed of the drivers listening to the scrambled words, as drivers listening to the comedy drove slower. This could be attributed to the fact that since the drivers attended to the comedy stimulus and not the scrambled words, the amount of attentional resources available for the driving task becomes decreased. Since the drivers have an increased attention load, their ability to concentrate on the speed of the vehicle becomes decreased, perhaps leading to the decreased speed.

The hypothesis that lane-weaving behavior would also

be affected by attending to an auditory stimulus was not supported. This could be due to the fact that while driving simulators replicate speed control accurately, they are deficient at replicating "lane keeping" behavior in comparison with actual on-road driving (Reed & Green, 1999).

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## AUTHOR NOTES

This work was conducted while Kirsten Dugdale was a student at the University of Calgary. For more information about the driving scenario and UCDS setup, please send requests to [kldugdal@ucalgary.ca](mailto:kldugdal@ucalgary.ca).