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Examining the Effects of Passenger Conversation on Older Adult Driving

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Abstract

Background: *Older adults have impaired driving performance compared to other age groups, and auditory stimuli has adverse effects on driving performance (Karthaus & Falkenstein, 2016). Therefore, the purpose of this study was to expand knowledge of driving and passenger conversation within the older adult population.*

Methods: *Participants (n = 17) completed a drive of 7.8 miles on a driving simulator twice; once without conversation and again with conversation. Both drives used the same simulated driving tasks to examine driving performance with and without conversation.*

Results: *Participants exhibited poorer driving performance from the first drive without conversation to the second drive with conversation, specifically in time over the speed limit and average speed. Descriptive statistics also indicated that participants demonstrated poorer driving performance between the first drive and the second drive*

Discussion: *Taken together, these findings indicated that passenger conversation negatively impacted driving performance in older adults. Therefore, older adults should be cautious about engaging in conversation while driving, as it can impair their safety.*

Keywords: *Older adults, Aging, Driving, Passenger Conversation*

Introduction

Driving is an essential part of maintaining independence in daily life. In the field of occupational therapy, driving and community mobility falls under the occupational domain of instrumental activities of daily living (IADLs) within the Occupational Therapy Practice Framework (American Occupational Therapy Association [AOTA], 2020). Today, individuals between the ages of 55–75 (the "baby boomer" generation) represent a large proportion of the population in the United States and many continue to drive. For older adults, continuing to drive allows them to connect to goods, services, and activities in and around their community. The ability to continue to drive while aging also facilitates successful aging as it allows older adults the ability to spend more time outside their home and in their community.

An important component of successful driving is the ability to shift attention and scan the environment while avoiding hazards. Distracted driving, such as passenger conversation, can negatively impact on driving performance. Research suggests that older adults have decreased reaction time and impaired driving performance, which is evident when compared to other age groups (Karthaus & Falkenstein, 2016). Certain conditions prevalent in the older adult population, such as cognitive and neurological deficits, can impact driving performance (Vardaki et al., 2016). Distracted driving occurs among all age populations, and additional distractions such as auditory stimuli can adversely affect driving performance (Karthaus & Falkenstein, 2016). The aging population continues to grow, and currently, there is a lack of insight regarding older adult drivers and distractions that could negatively impact their safe driving. Therefore, future research could help researchers better understand the potentially negative effects of older adult drivers engaging in passenger conversations. The purpose of the current study is to gain insight on the effects of passenger conversation on driving within the older adult population.

Older Adult Drivers

Occupational therapists commonly treat the aging population (AOTA, 2020). Because many older adults use driving as a means of community mobility and a source to maintain independence, it is important to consider the factors that can affect safe driving performance among older adults (AOTA, 2020; Barney & Perkinson, 2016). One such factor is cognitive impairment, with changes in the brain affecting driving performance (Calhoun & Pearlson, 2012).

Anstey and Wood (2011) found that driving errors increased with chronological age and this could be due to various decreases in cognition. One study examining the functional skills of older adults (i.e., cognitive, motor, and visual skills) found that these skills required for driving decrease as individuals age, which can affect driving abilities (Karthaus & Falkenstein, 2016). Similarly, another study attributed the impaired driving performance in older adults to increased visual and information processing (Kim et al., 2019). Cognitive, sensory function, and physical function/medical conditions, in addition to appropriate monitoring of these factors, are all required for safe driving (Lacherez et al., 2013). Therefore, aging and its impact on cognition is an important element of driving that needs to be evaluated due to the functional impact on driving performance.

Impact of Passenger Conversation on Distracted Driving

Many contributing factors can influence safe driving behaviors and performance. Specifically, passenger conversation can affect driving behavior. Dromey and Simmons (2019) found that individuals aged 60 and older who engaged in passenger conversation demonstrated greater variability in driving speed and reported an increased number of steering adjustments. Another form of passenger conversation increasing in popularity is driving while on a cellphone.

Talking on a digital device can be just as dangerous as talking to a passenger in the car. Strayer and

Drew (2004) found that reaction time decreased when drivers engaged in a hands-free phone conversation. However, they also found that there was a two-fold increase in rear-end collisions due to talking on a cell phone while driving (Strayer & Drew, 2004). Age is a contributing factor in ability to divide attention and maintain safe driving skills. Older adults had significantly decreased driving performance while completing divided attention tasks compared to younger drivers (Lacherez et al., 2013). Therefore, the results of these studies indicated that both age and passenger conversation negatively impact safe driving performance.

Additional research is needed to better understand the implications of passenger conversation on driving performance among older adults. Driving simulators are a useful tool in evaluating driving performance in older adult drivers (Lee & Lee, 2005; Vardaki et al., 2016). Driving simulation is a computer-aided technology that mimics real-life driving scenarios a variety of real-life scenarios intended for educational or rehabilitative purposes. The simulation technology allows professionals to assess ability to drive, including physical and cognitive factors, as well as identify appropriate treatment strategies. The driving simulation produces real- world and evidence-based results that professionals can review with clients via reports or video replay to provide education and training on their changing needs related to aging and driving. Although previous research shows the negative impact of passenger conversation and age on driving performance, research does not specifically focus on exploring this relationship within the older adult population. The purpose of this study was to examine the effect of passenger conversation on older adult driving performance.

Methods

This study employed a descriptive, quantitative research design. A university institutional review board approved the study in which participants signed consent to participate in the study. We created an informational handout to distribute around the university where the study was conducted to hang on various bulletin boards and to hand out to individuals. We also obtained participants through informal recruitment meetings and the snowball recruitment method. If interested, potential participants contacted the research team to schedule a date and time to participate in the driving study.

Participants

We set the following inclusion criteria for participants: (1) possess a valid United States driver's license, (2) between the ages of 50–90 years old, (3) wear corrective vision lenses, if necessary, (4) have no prior diagnosis of vertigo within the previous year, and (5) provide informed consent. Exclusion criteria were: (1) did not possess a valid driver's license, (2) not between the ages of 50–90, and (3) did not provide informed consent.

Procedure

Participants were taken to a room with two chairs, the driving simulator, and adequate lighting. During the study, only the researchers and participant were allowed in the room to maintain confidentiality and minimize distractions. After participants provided informed consent, we guided participants through the study procedures. While seated in the STISIM driving simulator, we instructed participants about how to adjust the seat and basic driving controls for the steering wheel, turn signal, gas, and brake. Next, participants completed the first drive without simulated passenger conversation. Upon completion of the first drive, participants received a 10-minute break. During the second drive, we used a script to ask participants ten questions to engage in conversations that reflected on past experiences and memories to elicit responses similar to those of someone talking to a passenger. Questions from the script included: "Explain some of the happiest moments in your life," "what world events had the most impact on you," and "what were your favorite things to do when you were growing up?" Throughout the questions, we used probing questions and prompts for clarification and to continue the conversation. Each drive was 7.8 miles and lasted approximately 13 minutes.

Throughout both drives, we monitored the participants for signs and symptoms of simulator sickness. We observed for signs of sweating, facial pallor, and motion sickness. If these signs were present, we stopped the simulation driving task and concluded the study for that participant. During the break period between drives, we also asked participants about feelings of nausea and dizziness. If participants reported feeling nauseous, dizzy, or lightheadedness, we concluded the study, and the participant did not complete the second drive. Our sample included 17 participants who completed both drives, with 12 participants between ages 50–69 and 5 participants between ages 70–90.

Participant Attrition

Throughout the drives, participants were monitored for simulation sickness. Simulation sickness occurs when the eyes and inner ear receive conflicting information. The onset of simulation sickness can result in fatigue, profuse sweating, nausea, vomiting, blurry vision, and other autonomic responses. During the first drive, nine participants experienced simulator sickness. Once a participant complained of or demonstrated simulation sickness, the drive immediately ceased to prevent further discomfort.

Driving Simulator Properties

The STISIM Driving Software, a simulated driving system, assessed and collected data over a challenged driving task performance with medium difficulty while the participants completed the drive. During the drive, participants traversed through a variety of scenarios including residential, rural, urban, and construction zones (see Appendix for images). Each scenario exposed participants to driving hazards including slower traffic, pedestrians, and hazards in the road. All driving scenarios had medium level traffic. There were several events ranging in difficulty including: Vehicles passing from behind on the left, pedestrian traffic, construction zones (one with a truck backing into the driver's lane), passing a slow moving vehicle (which requires waiting for a dashed yellow line and for oncoming traffic), maneuvering away from a passing vehicle that enters the driver's lane, cross traffic running a red light (which requires looking left and right at intersections), and turning left at an intersection with oncoming traffic. Other driving hazards included avoiding an oncoming vehicle entering the driver's lane, looking left and right at intersections as other drivers ran red lights, and turning left with oncoming traffic.

The driving simulation software measured the number of total off-road crashes, total collisions with vehicles and roadway, total traffic light tickets, and total times over the posted speed limit, percentage of time over the posted speed limit, total times participant crossed the centerline, total times the driver went off the road, percentage of time out of lanes, number of correctly negotiated intersections, number of incorrectly negotiated intersections, overall turn signal usage, construction zone performance, turn performance, maneuver, head-on collision avoidance, slow vehicle passing maneuver, vehicle control performance, and collision avoidance maneuver.

Results

We initially analyzed the performance of the two drives based on participant age and found no differences. Frequencies and averages are listed in Table 1. Next, we conducted analyses to determine if there were differences in driving performance between drive one without passenger conversation and drive two with passenger conversation.

Descriptive Results

We first examined the descriptive statistics and noted several trends among our sample. First, fewer participants collided with cross traffic vehicles, with eight participants colliding with cross traffic vehicles in drive one to only two participants in the second drive. Between the two drives, there were several improvements in driving performance: Minimum time to collision with backing vehicle in a construction zone (0.75 to 0.85 seconds), minimum distance to backing vehicle (8.60 to 10.84 feet), total pedal reaction time in head on collision avoidance (5.50 to 6.44 seconds), minimum time to head on collision in head on collision avoidance (0.64 to 1.33 seconds), minimum distance to head on collision (93.64 to 206.17 feet), the minimum time to collision with cross traffic vehicles while executing collision avoidance maneuver (336.90 to 356.31 seconds), and minimum distance to cross traffic vehicles while executing collision avoidance maneuvers (893.74 to 947.74 feet).

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Passenger Conversation Differences

After examining the descriptive data, we employed paired-sample *t*-tests to explore differences between the ratio-level outcomes of the two drives. Paired-sample *t*-tests are used to examine differences between repeated measures (Adams & Lawrence, 2019). There were significant differences between the first drive and the second drive in time over the speed limit and average speed. Participants spent more time over the speed limit in the second drive with passenger conversation ($M = 6.88$, $SD = 4.06$) than in the first drive ($M = 5.35$, $SD = 2.89$), $t(16) = 1.84$, $p < .05$. Additionally, participants' average speed was higher in the second drive with passenger conversation ($M = 37.69$, $SD = 5.90$) than in the first drive ($M = 34.78$, $SD = 3.62$), $t(16) = 2.90$, $p < .001$.

Discussion

The aim of the study was to determine the impact of conversation on driving performance. Our results show that conversation can decrease multiple indicators of driving performance in older adults. Between the first and second drives, the time over the speed limit and average speed significantly increased. Upon examining the descriptive statistics, the participants showed an increase in the time over the speed limit, number of times to pass slowly moving vehicles, the minimum time to collision with cross traffic vehicles, and the minimum distance to cross traffic vehicles. Collisions with cross-traffic vehicles and overall reaction time improved in the second drive and was likely due to participants becoming more familiar with the drive and the mechanics of the simulator. Also, improvements could be due to the participants' recall abilities by remembering various hazards from the initial drive.

Currently, there is limited literature within occupational therapy regarding driving and community mobility related to co turn signal usage. The use of the same driving simulator scenario may not be the proper assessment tool for more than one drive but would be beneficial as a cognitive memory tool to measure recall. Other studies found that driving simulator performance translates to real-life driving performance; however, these studies did not repeat the same scenario within the same day per the procedures of the current driving study (Doshi & Trivedi, 2010; Lee & Lee, 2005). The summative findings of the study could be more precise in measuring driving capabilities and reaction time amongst older drivers if the confounding variable of recall is not present. Recall from the first drive directly impacted the results and performance of older drivers during drive two.

However, the improvement in driving performance due to recall indicates that older drivers may be safer and have improved performance when driving on familiar roads.

Strengths

The study has many strengths. The study incorporated the use of a driving simulator with realistic vehicle features, including a car seat, steering wheel, turn signal, and seatbelt. According to Karthaus and Falkenstein (2016), driving simulators are a safe alternative to on-road driving assessments and provide an accurate measure of real-life driving performance. Thus, using a driving simulator improved the safety of the participants and researchers during the study. Another strength of the study involved the willingness of older adults to participate from the surrounding community, which allowed for recruiting a sufficiently large sample size to use parametric statistics to analyze our data.

Through the study, we advocated for the role of occupational therapy in driving assessment and rehabilitation, as well as educated the community on the role and scope of occupational therapy regarding driving and community mobility (AOTA, 2020). Another strength of the study is that the findings contribute to furthering knowledge to a specialty area, the impact of passenger conversation on driving tasks in older adult drivers, which contains sparse literature. Other studies examined driving performance of older adult drivers, but only assessed fitness to drive (Dickerson, 2013), the impact of cognitive impairments (Calhoun & Pearlson, 2012; Vardaki et al., 2016), and impact of specific diagnoses and disabilities (Blane et al., 2018). The current study expanded on the literature by assessing the impact of passenger conversation on multiple driving tasks in the older adult driver population, and not just reaction time as other

Table 1. *Overall Driving Performance Scores (n = 17)*

Driving Performance Variables	First Drive (No Passenger Conversation) Average Score	Second Drive (With Passenger Conversation) Average Score
Summary of Driving Simulation Results		
Driver Mistakes		
Total off-road crashes	0	0
Total collisions with vehicles and roadway	0.71	0.29
Total collisions with pedestrians	0	0.05
Total traffic light tickets	0	0
Total stop sign tickets	0.94	0.94
Total times over the posted speed limit	5.35	6.70
Percentage of time over the posted speed limit	7.58%	11.61%
Total times participant crossed the centerline	5.88	4.88
Total times the driver went off the road	4.65	4.65
Percentage of time out of lanes	3.83%	3.96%
Intersection Turns		
Number of correctly negotiated intersections	8.65	8.53
Number of incorrectly negotiated intersections	0.35	0.47
Construction Zone Performance		
Collision with vehicles or workers	3	3
Average speed through the construction zone (miles/hour)	25.54	26.07
Construction zone entry speed (miles/hour)	32.86	31.01
Total pedal reaction time (seconds)	3.40	0.84
Gas pedal reaction time (seconds)	0.60	0.35
Minimum time to collision with backing vehicle (seconds)	0.75	0.85
Minimum distance to backing vehicle (feet)	8.60	10.84
Left Turn Performance		
Did the driver turn in the correct direction	14	16
Collision with oncoming vehicles	0	0
Was the turn signal used correctly	16	11
Crossed the center line	1	3
Went off the road	5	3
Did the driver wait for all vehicles to pass	3	5
Right Turn Performance		
Did the driver turn in the correct direction	16	14
Did the driver crash while turning	0	0
Collision with pedestrians	1	0
Was the turn signal used correctly	15	15
Crossed the center line	6	6
Went off the road	1	3

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Lane Change Maneuver		
Collision with vehicles	1	0
Was the turn signal used correctly	16	14
Was excessive steering used	0	1
Did the driver wait for vehicle to pass	0	0
Left Turn Performance		
Did the driver turn in the correct direction	16	15
Collision with oncoming vehicles	0	0
Was the turn signal used correctly	14	13
Crossed the center line	0	0
Went off the road	17	17
Head On Collision Avoidance		
Collision with vehicles	1	0
Off road crash	0	0
Total pedal reaction time (seconds)	5.85	6.44
Gas pedal reaction time (seconds)	3.56	3.88
Was excessive steering used	0	0
Minimum time to head on collision (seconds)	0.64	1.33
Minimum distance to head on collision (feet)	93.64	206.17
Slow Vehicle Passing Maneuver		
Collision with vehicles	0	0
Time to pass (seconds)	49.61	50.33
Did the driver pass illegally	0	0
Did the driver tailgate	0	0
Right Turn Performance		
Did the driver turn in the correct direction	15	17
Did the driver crash while turning	0	0
Was the turn signal used correctly	16	17
Crossed the center line	17	17
Went off the road	2	0
Vehicle Control Performance		
Average speed (Speed limit = 35 miles/hour)	34.78	37.69
Speed deviation (miles/hour)	2.71	3.05
Average lane position (feet)	5.68	5.65
Lane position deviation (feet)	1.57	1.53
Collision Avoidance Maneuver		
Collision with cross traffic vehicles	8	2
Total pedal reaction time (seconds)	7.25	6.05
Gas pedal reaction time (seconds)	5.57	2.80
Minimum time to collision with cross traffic vehicles (seconds)	336.90	356.31
Minimum distance to cross traffic vehicles (feet)	893.74	947.74

researchers evaluated. The study also provided a means for increased social participation for the participants. The participants had a chance to engage socially with university staff, faculty, and students while on campus to participate in the study.

Limitations

There are several limitations that impacted the driving study. Simulator sickness impacted 9 participants out of the 26 participants. The impacted participants withdrew from the study due to the symptoms experienced from simulator sickness, such as nausea, anxiety, dizziness, fatigue, vertigo, excessive sweating, and lightheadedness, which significantly decreased the sample size. The time of onset of simulator sickness varied across all participants; some fully completed the first drive, whereas were unable to complete five minutes of driving. Participants primarily experienced simulator sickness when completing turns, stating that the simulation moving across multiple screens made them feel nauseated. Also, both drives were the same, making the participants more prepared during the second drive. Participants knew what to expect during the second drive because they remembered the driving tasks from the first drive, such as specific obstacles and collisions from prior mistakes or near-collisions. Therefore, the participants' recall abilities interfere with the validity of the test.

Implications for Occupational Therapy Practice

The study highlights various findings that indicate the impact of passenger conversation on driving performance and overall differences in performance among older adults. Driving and community mobility is an occupation that falls underneath the instrumental activities of daily living (IADLs) (AOTA, 2020). Occupational therapists are qualified to serve various populations for successful driving and community. Unfortunately, there currently is not vast research regarding driving amongst the older adult population in order for occupational therapists to provide optimal evidence-based practice when addressing driving during interventions. The profession of occupational therapy seeks to improve clients' independence; therefore, occupational therapists should educate themselves on what can impact clients' driving behaviors to improve their driving performance.

Recommendations for Future Research

Based on observations and the driving simulator outcomes, the participants seemed to be more comfortable with the driving simulator system and operation during the second drive. In future practice, it will be beneficial to assess for simulator sickness with the use of a brief practice drive that incorporates turns, steering, stoppage, and lane maneuvers to allow participants to become adjusted to the driving simulator. Occupational therapists should be cautious using the same drive more than once within a driving simulator to assess and track clients' progress; this may produce inaccurate outcomes, as the study results indicated that recall interfered with simulator outcomes. If future studies have larger sample sizes, researchers should consider the use of counterbalancing to avoid practice effects as a possible confounding variable. Future studies should also consider incorporating multiple conditions in the study and assigning participants to varying simulator difficulty conditions to consider how passenger conversation interacts with drive difficulty level. Prior research indicates driving simulation translates well to real-life conditions and is safer than on-road conditions (Karthaus & Falkenstein, 2016); therefore, we recommend that future studies continue to incorporate the use of driving simulators in future studies with the appropriate modifications, such as using different drives of the same difficulty.

Conclusion

The purpose of the current study was to increase knowledge pertaining to driving performance and passenger conversation within the older adult population, as passenger conversation affects basic driving tasks in older adult drivers. The findings indicated that passenger conversation negatively impacted driving performance in older adults. Therefore, older adult drivers should be cautious to engage in passenger conversation while driving. Occupational therapists should discuss the implications of passenger conversation on driving performance found by the current study with older adult clients, especially when addressing driving and community mobility during interventions. Both conversation and recall impacted driving performance on a simulator. Future research needs to expand upon the results of the current study to further examine the impact of passenger conversation and the use of driving simulators as an intervention method amongst the older adult population.

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