DRIVER DISTRACTION

INSURANCE BUREAU OF CANADA / BUREAU D'ASSURANCE DU CANADA

EXECUTIVE SUMMARY

THE EFFECTS OF CELLPHONE AND CD USE ON NOVICE AND EXPERIENCED DRIVER PERFORMANCE

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In recent years, concerns about the impact of cellphone use on accident risk have been widely publicized. The current research examined the effect of cellphone use on the driving behaviour of novice as compared to experienced drivers, to determine whether a cellphone prohibition might be an appropriate graduated licensing (GDL) restriction.

The two-part study was conducted in a driving simulator in a university laboratory and on the streets of Calgary; previously in Canada, research of this type had focused only on simulated or closed-circuit on-road courses. In both phases of the recent study, participants were asked to interact with cellphones while dealing with traffic situations. In the simulator, participants were also asked to interact with a CD player while driving. The reaction times, eye movements and vehicle control of the participants were measured to assess driver performance.

Not surprisingly, the study results confirm that the overall driving behaviour of novices is poorer than that of experienced drivers. What is surprising is that the results also indicate that the driving behaviour of novices is *not* more affected by cellphone/CD-player interaction than is the driving behaviour of experienced drivers. In the study, the driving behaviour of both groups was affected by the use of cellphones and CD players, though not always in the same ways. In fact, in some instances, the distractors (i.e., cellphones and CD players) had more of an impact on experienced drivers than novice drivers. That is, novice drivers demonstrated poor driving behaviour both with and without the distractors, while experienced drivers drove better than novice drivers when they weren't distracted and just as poorly as novice drivers when they were distracted.

The overall conclusion coming out of this research is that cellphones and CD players are detrimental to the driving behaviour of *all*, not just novice, drivers.

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SUMMARY OF EFFECTS

NOVICE vs. EXPERIENCED	
SIMULATOR	• Novice drivers were slower to perceive pedestrian and vehicle pullout hazards and, therefore, had longer perception-reaction times.
ON-ROAD	• The driving instructor had to apply the second brake more often for novices than for experienced drivers. • Novices drove slightly faster than experienced drivers.

DISTRACTOR (cellphone, CD) vs. NO DISTRACTOR	
SIMULATOR	While using cellphones: • Novices and experienced drivers were slower to respond to pedestrian hazards. • Novices and experienced drivers had restricted visual scanning. • Experienced drivers slowed down, but novices did not. • Novices wandered more in the lane. While changing CDs: • Experienced drivers were slower to react to lead vehicle braking. • Novices were not affected.
ON-ROAD	While using cellphones*: • Novices and experienced drivers slowed down. • Novices and experienced drivers got closer to hazards before detecting them. • Novices were more likely to use speed dial instead of manual. • When only speed dialers were compared, novices and experienced drivers spent similar amounts of time looking at the phone when interacting with it. **There was no CD-changing activity in the on-road study.*

PART I: DRIVING SIMULATION STUDY

Objectives:

1. To determine whether novice drivers were more adversely impacted by using cellphones or interacting with CD players than were experienced drivers.
2. To describe performance differences between novice and experienced drivers.
3. To determine whether novice or experienced drivers engage in driving strategies that may mitigate the decreases in safety margins that result from the use of a cellphone or CD player.
4. To relate the results of the study to policy implications for graduated licensing restrictions.

Participants:

Twenty novice drivers (i.e., with less than 6 months' experience) and 20 experienced drivers (i.e., with more than 10 years' experience) participated in the study. To be eligible to participate, novice drivers were required to have had no accidents, while experienced drivers were required to have had no accidents in the previous three years. Both groups were required to be regular (i.e., daily) users of cellphones, to own their own cellphones, and to have used them while driving. All participants passed a visual screening test.

Method:

Participants were exposed to simulated driving environments and scenarios in The University of Calgary Driving Simulator. Over the course of a 7-minute pre-test drive, four 10-minute experimental drives, and a 7-minute post-test drive, each participant "drove" through a mixture of urban, industrial, suburban and residential roadways with speed limits of either 60 km/h or 80 km/h. At various points throughout the simulation, three types of events took place: the vehicle in front of the participant would brake suddenly ("lead vehicle braking event"); a pedestrian would step out from behind parked cars into the path of the participant's vehicle ("pedestrian incursion event"); and a car would pull out from the right side of the road into the path of the participant's vehicle ("vehicle pullout event"). Each of these types of events required participants to react quickly by applying pressure to the brakes and/or steering to avoid colliding with the hazard.

While driving, participants were prompted, at various times, to manipulate the CD player in the simulator or to dial, answer or carry on a conversation on their cellphones.

Measures:

Participants' driving behaviour was assessed throughout the simulation, with the following measures:

1. **Perception Response Time (PRT)**: the time, in seconds, that elapses between a pedestrian or vehicle becoming visible and the participant beginning to depress the brake pedal.
    a. *Perception time:* the time, in seconds, that elapses between a pedestrian or vehicle becoming visible and the participant removing his/her foot from the accelerator pedal.
    b. *Response time:* the time, in seconds, that elapses between the participant removing his/her foot from the accelerator pedal and the foot's contact with the brake pedal.
2. **Minimum Headway Distance**: the minimum distance, in metres, between the front bumper of the participant's vehicle and the pedestrian or other vehicle involved in the emergency event.
3. **Collisions**: instances of overlapping of the participant's vehicle and another object.
4. **Velocity**: the participant's vehicle's speed, collected in metres per second and then converted to kilometres per second.
    a. *SD Velocity:* the standard deviation of velocity, in kilometres per hour.
5. **SD Lane Position**: the standard deviation of the participant's lane position, in metres.
6. **Gaze Variability**: the sum of the standard deviation of gaze coordinates for each fixation, in centimetres; measured for a period of one minute from the beginning of a participant's interaction with the cellphone.
    a. *Horizontal Gaze Variability*
    b. *Vertical Gaze Variability*

Conclusions:

Novice versus Experienced Drivers

Driving experience plays a significant role in drivers' perception of hazardous events on the roadway. The novice drivers were consistently slower to recognize hazards than were experienced drivers, regardless of cellphone or CD-player use. Both on and off the phone, novices were slower than experienced drivers to respond to the sudden braking of the vehicle ahead of them, to a pedestrian walking into their vehicle's path, and to another vehicle pulling out from the side of the road into their vehicle's path.

As a result, novice drivers consistently came closer to hazards and had more collisions with hazards than did experienced drivers. These results are consistent with the growing recognition that novice drivers lack the experience to detect and recognize specific hazards or threats.

Effects of Cellphone Use

The overall driving behaviour of novice drivers was not more affected by the use of a cellphone than was the driving behaviour of experienced drivers.

Both novice and experienced drivers restricted their visual scanning when they were on the phone. While on the phone, experienced drivers slowed down, increasing their margin of safety, but this adaptive response did not always compensate for the distraction; experienced drivers' perception/response times to pedestrian hazards deteriorated to novice levels, when experienced drivers were talking on the phone. Novice drivers drove at similar speeds while on the phone as they did off the phone. While dialing or talking on the phone, novice drivers wandered more in their lane than they did while not on the phone. Experienced drivers did not demonstrate this difference.

Effects of CD-player Use

Compared to baseline, while manipulating the CD player, experienced drivers were slower to perceive and respond to the sudden braking of the vehicle ahead of them. Novice drivers did not demonstrate this difference.

General Conclusion

Because the responses of the drivers differed according to the type of hazard they encountered, generalizations about driver performance while on cellphones must be made with caution. However, it can be concluded that the driving of novices is poorer than that of experienced drivers. Failing to recognize hazards quickly and, as a result, coming too close to hazards place novice drivers at greater risk, even if they aren't using a cellphone or CD player.

Overall, the driving behaviour of both novice drivers and experienced drivers was negatively affected by the drivers' use of a cellphone.

PART II: ON-ROAD STUDY

The goal of this study was to understand whether distraction due to conversations and interactions with cellphones more severely impacts novice drivers than experienced drivers. Measures of vehicle control and responses to traffic events were used to determine if driver performance was adversely affected. The hazards were naturalistic ones, and occurred frequently in the downtown area of a large city. This is the first time to the authors' knowledge that detection times to naturally occurring hazards have been presented.

Objectives:

1. To determine whether novice drivers are more adversely impacted by using cellphones than are experienced drivers.
2. To describe performance differences between novice and experienced drivers.
3. To relate the results of the study to policy implications for graduated licensing restrictions.

Participants:

Nineteen novice drivers (i.e., with less than 6 months' experience) and 20 experienced drivers (i.e., with more than 10 years or 250,000 kms of experience) participated in the study. To be eligible to participate, novice drivers were required to have had no accidents, while experienced drivers were required to have had no accidents in the previous three years. Both groups were required to be regular (i.e., daily) users of cellphones. All participants passed a visual screening test, and a breathalyser test to ensure 0.0 blood alcohol concentration.

Method:

Participants drove a specially equipped car (i.e., with a computer, cameras, a GPS, a microphone, and a second brake) through a test route, located in Calgary, which consisted of a practice section (behind a mall on a university campus) and three laps around a 20-minute circuit on residential and urban roadways with speeds of 50 km/h or lower.

Participants were accompanied in the car by a researcher (in the back seat) and a driving instructor (in the front passenger seat). Participants were asked to call out hazards as they became aware of them. Each driver did an initial drive through the 20-minute circuit to practise calling out hazards, without the cellphone coming into play. A hazard was defined as "*the presence of a vehicle, or pedestrian located less than five seconds away that requires the driver's immediate attention and observation, but not necessarily a response.*"

At various points in the drive, participants were instructed to make two outgoing calls. They were advised to dial each call in the manner with which they were most comfortable (i.e., manual dial or speed dial). The researcher in the car prompted phone calls (two) to the participant and monitored the computer equipment. The primary role of the driving instructor was to ensure the safe operation of the vehicle and intervene when necessary.

Drivers' performance was measured while talking on a cellphone and while not talking on a cellphone.

Measures:

Drivers were observed in order to measure:

1. **Hazard Detection Time**: measured from when the driver identified a hazard to when the vehicle's path intersected the likely path of the hazard. Longer hazard detection times indicate better performance.
2. **Proportion of Hazards Missed**: the number of hazards identified by the driver divided by the total number of hazards identified by the driver and the driving instructor (no duplication).
3. **Reaction Time to Traffic Signal Changes**: the time from the onset of the green signal to when the driver applied his/her foot to the accelerator (measured only when the driver was stopped in the lead position at a traffic light).
4. **Total Duration and Average Duration of Glances at the Cellphone**: the total (across glances) and average (per glance) amount of time a driver spent looking at his/her cellphone.
5. **Lane Threshold Exceedances**: the amount of time the vehicle was encroaching on the other lane or within .3 metres of the centreline.
6. **Velocity Mean and Standard Deviation**: measured using a hand-held GPS; only velocities over 30 km/h were included in the analysis.
7. **Instructor's Brake Applications**: the number of times the driving instructor engaged the passenger-side brake.

Conclusions:

Novice versus Experienced Drivers

For drivers who used speed dial, there was no difference between novice drivers and experienced drivers in the total time spent glancing at the phone while dialing, answering and hanging up the phone. Novice drivers used speed dial more often than did experienced drivers. For manual dialers (mostly experienced drivers) and speed dialers (mostly novice drivers) combined, experienced drivers spent more time glancing at the phone while dialing, answering and hanging up than did novice drivers. Average glance duration did not differ between the two groups, suggesting that the difference between manual and speed dialers was the number of glances rather than their length.

The driving instructor had to use the emergency brake more often for the novice drivers as compared to the experienced drivers.

There was no difference between novice drivers and experienced drivers in the time it took them to detect hazards or the proportion of hazards they missed detecting.

Effects of Cellphone Use

Both novice and experienced drivers drove more slowly, by an average of 1.27 km/h, while on the phone as compared to while not on the phone. Despite this adaptive behaviour, which would have reduced the demands on the drivers' attention, both groups of drivers detected hazards more slowly while on the phone.

General Conclusion

This quasi-naturalistic on-road study provides evidence that both novice and experienced drivers detect actual roadway hazards less quickly when on the phone, despite an adaptive response involving a slight slowing of speed. Over the hundreds of thousands of hours that drivers drive while using cellphones, negative changes in behaviour, such as delayed detection of hazards, are likely to occur eventually in unforgiving circumstances and contribute to crashes.

Simulator and On-road Comparison

Seven novices and 11 experienced drivers participated in both the simulator and on-road studies. Replacement participants were recruited for the on-road portion for those participants who decided not to continue after the simulator portion.

Overall, the simulator study found more significant effects, for more performance measures than did the on-road study.

Simulator studies allow researchers to present driver tasks in a highly controlled manner, so that each participant is exposed to precisely the same conditions. In on-road studies, traffic conditions and consequent task demands are not fully under the control of researchers. Simulator studies also allow for precise measurement of factors such as lane position and perception response time. For these reasons, driver behaviour in an on-road study is likely to be more variable than driver behaviour in a simulator study, and greater variability means more difficulty finding significant effects between conditions.

Therefore, the on-road findings that hazard detection times increased while drivers were on the phone can be taken as strong evidence that cellphones affect a driver's crash risk.