

# The effect of mobile phone use on driving style and driving skills

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**Abstract:** The aim of this study is to give a picture of drivers' use of mobile phones while driving and its effect on self-reported driving style and skills, reflecting tactical (e.g., using the mobile phone appropriately by adjusting driving style) and strategic (e.g., decision to use mobile phone or not while driving) level processes. A representative sample of 1139 Qatari drivers owning or using of a mobile phone and involved with road traffic accidents were asked to participate in the study, and 822 drivers expressed their consent to participate in this study and met the inclusion criteria with a response rate of 72%. The study included Qatari male ( $N = 590$ ) and female ( $N = 232$ ) drivers (aged range 18–65 years) who had been involved in motor vehicle collisions. A multistage stratified cluster sampling was applied. Participants completed a standardized questionnaire including socio-demographic information, detailed crash history, Driver Behaviour Questionnaire (DBQ) and Driver Skill Inventory (DSI). Of 822 drivers included for the study, only 602 (73.2%) drivers used mobile phone while driving. Of 602 drivers, 497 (82.6%) used hand-held mobile phones without any extra add-on equipment. On the other hand, a third of the respondents favoured a law against use of mobile phones while driving regardless of the type of mobile phone equipment used. The average number of drivers' incoming or outgoing calls while driving was relatively high (4.28 per day). Young drivers used mobile phone while driving more often than drivers of other age groups. The driving skills did not influence the decision to use (or not use) mobile phone while driving at the strategic level. Mobile phone usage was rather associated with driving style by tactical level decisions.

**Key words:** Mobile phone, driver attention, Driver Behaviour Questionnaire, Driver Skill Inventory, injury crash risk.

## INTRODUCTION

There is increasing evidence that the use of a handheld mobile telephone while driving a motor vehicle increases the risk of fatality [1] and the risk of road crashes [1–10]. In a case-control study, Violanti [1] showed that, for example, the risk of a fatality is increased ninefold when using a

mobile phone. The risk of collision when using mobile phone while driving increased fourfold when compared to driving without using a phone (e.g., [5]). Many believe that cellular mobile phone may contribute to collisions by distracting drivers (e.g., [11]).

Analyses of traffic accidents indicate that human factors are a sole or a contributory factor in road traffic accidents [12]. Human factors in driving can be seen as being composed of two separate components, driving style and driving skills [13].

Driver Behaviour Questionnaire (DBQ) is one of the most widely used instruments for measuring driving style. DBQ is based on a theoretical taxonomy of aberrant behaviours divided into errors and violations (see Reason [14]). Errors were defined as 'the failure of planned actions

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to achieve their intended consequences' and differentiated into slips and lapses (resulting from action) and mistakes (errors of intention). They largely involve failures of memory and attention deficits. Violations referred to 'deliberate deviations from those practices believed necessary to maintain the safe operation of a potentially hazardous system'. Contextual and motivational demands influence violations rather than slips and lapses and mistakes.

DBQ has been used in several international studies, and data were collected in a number of countries including Australia [15], Sweden [16], Finland and The Netherlands [17], in Britain, Finland and the Netherlands [18] and in United Arab Emirates and in State of Qatar [19].

The findings of the previous studies showed that self-reported driving violations are associated with both active and passive accidents. Besides, violations predicted accident involvement, both retrospectively and prospectively [20, 21]. In particular, violations have been reported to be associated with active loss-of-control and passive right-of-way accidents [21], as well as with speeding and parking offences [22]. Although errors rarely predicted accident involvement [22], lapses seemed to be a main predictor of involvement in active accidents among elderly drivers [23].

Driver Skill Inventory (DSI) was developed for measuring self-reported driving skills [24]. DSI is based on Spolander's [25] distinction between technical and defensive driving skills. Lajunen and Summala [24] extended the contents of the instrument by using Hatakka and his colleagues' [26] internal reference evaluation method. Then, Lajunen and Summala [24] verified the two-factor structure of DSI as perceptual-motor and safety skills. A consistent factor structure and high reliability of the DSI was obtained in very different populations (e.g., among male traffic criminals, male policemen and male traffic instructor candidates by Summala and Hyvén [27]). Later, the English version of the DSI was used in Australia [28] and in the United Kingdom [29]. Earlier studies have indicated that driving skills were positively associated with the number of accidents, penalties and the level of speed, while safety skills were negatively associated with these variables [28].

Recently, Pöysti *et al.* [30] addressed how self-evaluated driving skills influence the mobile phone use at three levels as proposed by Michon [31]: strategic (using or not using mobile phone while driving), tactical (using the mobile phone appropriately by adjusting driving style, for example, speed level) and operational level (moment-to-moment control of traffic situations) (see Pöysti *et al.* [30] for detailed information about these levels). Pöysti *et al.* [30] found that a driver's self-image was influential both at the strategic and tactical levels. Thus, low perceptual motor skills level and high safety skills level promoted not using a mobile phone at all while driving. Pöysti and her colleagues suggested that phone-using drivers are in general riskier drivers [8, 32]. However, they did not compare mobile phone users and non-users on self-evaluated driv-

ing skills and did not use behavioural measure for risky driving style (e.g., DBQ) at the tactical level.

In the present study, self-reported driving skills and driving style measures was used to investigate how mobile phone use interfered with driving at strategic and tactical levels. It was hypothesized that those drivers who use mobile phone while driving would have higher scores on perceptual-motor skills but lower scores on safety skills than drivers not using a mobile phone while driving. Besides, it was supposed that mobile phone users would score higher on violations, errors and lapses than non-mobile phone users. The aim of this study is, therefore, give a picture of drivers' use of mobile phones while driving and its effect on self-reported driving style and skills at the strategic and tactical levels among Qatari drivers.

## SUBJECTS AND METHODS

### Participants

This is a cross-sectional survey performed in the State of Qatar. The data reported in the present study were collected from Qatari drivers between December 2004 and June 2005. A multistage stratified cluster sampling was applied by using the administrative division of the Qatar into 21 primary health care (PHC) clinics of the State of Qatar. PHCs are approximately equal sized in terms of number of inhabitants. The participants were selected among patients registered and attending twelve PHC centres (nine urban and three semi-urban), which represent over 75% of total visits per year by Qatari nationals. Qualified nurses and health educators were instructed to structurally interview and complete a questionnaire for randomly selected Qatari men and women drivers. It is worth noting that in 2004, the population of the State of Qatar was 755,163 and the total number of registered mobile phone users was 532,141 (70.5% of the total proportion had access to mobile phones in Qatar). A representative sample of 1139 Qatari drivers involved with road traffic accidents were asked to participate in the study, and 820 drivers expressed their consent to participate in this study and met the inclusion criteria with a response rate of 72%. Three hundred and seventeen participants were excluded from the study either because of being under 18 years old and not holding a valid driving license or because of refusing to participate in this study or they did not confirm of traffic accident records or they did not complete the questionnaire and had currently unstable medical or social problems. The study and analysis was based on the 822 Qatari drivers (232 female and 590 male) aged 18 years and above who had driving license. All participants had driving licenses and were assured of anonymity and confidentiality. The participants filled out the DBQ and DSI items related to drivers' driving records and demographic variables. The age distribution ranged from 18 to 60 years (mean 26.5 years, SD 8.4 years) and annual mileage ranged from 11,750 to 43,500 km (mean 21,963 km, SD 6776 km).

Table 1 Socio-demographic experience and seatbelt use of surveyed drivers by mobile phone use

Variables	Mobile phone users (N = 602)	Non-mobile phone users (N = 220)	P value significance
Age group			
<20	107 (17.8)	61 (27.7)	
20–29	319 (53.0)	106 (48.2)	
30–39	109 (18.1)	33 (15.0)	0.022
40–49	58 (9.6)	15 (6.8)	
≥50	9 (1.5)	5 (2.3)	
Sex			
Male	443 (73.6)	147 (66.8)	0.056
Female	159 (26.4)	73 (33.2)	
Marital status			
Single	64 (10.6)	29 (13.2)	
Married	503 (83.6)	175 (79.5)	0.408
Divorced/widowed	35 (5.8)	16 (7.3)	
Education			
Illiterate	123 (20.4)	24 (10.9)	
Primary	184 (30.6)	67 (30.5)	
Intermediate	81 (13.5)	31 (14.1)	0.001
Secondary	183 (30.4)	67 (30.5)	
University	31 (5.1)	31 (14.1)	
Occupation			
Not working	20 (3.3)	4 (1.8)	
Sedentary/professional	77 (12.8)	44 (20.0)	
Businessman	172 (28.6)	26 (11.8)	
Manual	105 (17.4)	58 (26.4)	0.001
Housewife	75 (12.5)	38 (17.3)	
Army/Police	108 (17.9)	16 (7.3)	
Student	45 (7.5)	34 (15.5)	
Driving experience			
<1 year	86 (14.3)	50 (22.7)	
2–5 years	160 (26.6)	67 (30.5)	0.001
5–9 years	150 (24.9)	32 (14.5)	
≥10 years	206 (34.2)	71 (32.3)	
Use of seat belt			
Never	222 (36.9)	79 (35.9)	
Less than half of the trips	80 (13.3)	14 (6.4)	0.033
More than half of the trips	275 (45.7)	117 (53.2)	
Always	25 (4.2)	10 (4.5)	
Penalties due to traffic violation* (*Multiple choice question, percentage may not add to 100%)			
Crossing red traffic light	273 (45.3)	54 (24.5)	0.001
Parking in forbidden places	86 (14.3)	105 (47.7)	0.001
Exceeding speed limit	290 (48.2)	81 (36.8)	0.004
Speed (usual in km/h) Mean ± SD			
On 60 km/h road	68.8 ± 13.3	68.3 ± 13.9	0.644
On 80 km/h road	85.9 ± 12.7	85.6 ± 12.3	0.728
On 100 km/h road	101.8 ± 14.6	100.2 ± 14.3	0.158
On 120 km/h road	122.4 ± 19.9	120.4 ± 22.4	0.232

165 **Measures**

166 **Driver Behaviour Questionnaire**

167 Q2 DBQ with extended violations was used to measure aberrant driver behaviours [18, 33]. A translated Arabic version of the DBQ was revised by the bilingual co-investigator and back translated by another bilingual expert. Both translators met and made necessary corrections, modifications and

rewording after considering the minor differences and discrepancies. The Arabic translation and the factor structure of the DBQ have been validated in studies conducted in Qatar and United Arab Emirates [19]. The extended version of DBQ includes aggressive and ordinary violations (10 items, e.g. ‘pull out of junction so far that the driver with right of way has to stop and let you pass’), lapses (eight items, e.g., ‘forget where you left your car in the car

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*Table 2 Driving Skills compared by mobile phone use while driving*

Variables	Mobile phone users (N = 602)	Non-mobile phone (N = 220)	P value
	Mean ± SD	Mean ± SD	
<b>Driving skills</b>			
<b>Safety skills</b>			
Driving behind a slow car without getting impatient	1.8 ± 1.5	1.7 ± 1.4	0.596
Driving carefully	1.6 ± 1.5	1.8 ± 1.6	0.120
Showing consideration for other road users	1.4 ± 1.4	1.5 ± 1.4	0.405
Stay calm in irritating situations	1.9 ± 1.4	1.8 ± 1.4	0.288
Avoid competing in traffic	1.8 ± 1.5	1.5 ± 1.6	0.020
Keeping a sufficient following distance	1.6 ± 1.3	1.8 ± 1.3	0.060
Relinquishing legitimate right when necessary	2.0 ± 1.5	2.0 ± 1.5	0.813
Controlling to the speed limits	1.9 ± 1.5	2.0 ± 1.5	0.637
Avoid unnecessary risks	2.1 ± 1.4	2.1 ± 1.3	0.628
Tolerating other drivers errors calmly	2.0 ± 1.5	1.8 ± 1.5	0.093
<b>Perceptual-motor skills</b>			
Fluence lane-changing in heavy traffic	1.6 ± 1.4	1.6 ± 1.4	0.941
Fast reactions	1.8 ± 1.5	1.8 ± 1.5	0.759
Controlling the vehicle	1.8 ± 1.4	1.8 ± 1.4	0.766
Make a hill start on a steep incline	1.9 ± 1.5	1.8 ± 1.4	0.373
Overtaking	2.1 ± 1.4	2.1 ± 1.4	0.653
Reverse parking in a narrow gap	1.9 ± 1.5	1.7 ± 1.4	0.147
Performance in critical situation	2.1 ± 1.5	2.2 ± 1.5	0.399
Managing the car through a skid	1.9 ± 1.5	1.9 ± 1.6	0.763
Predicting traffic situations ahead	1.6 ± 1.7	1.5 ± 1.6	0.652
Knowing how to act in particular traffic situation	1.9 ± 1.6	1.9 ± 1.7	0.627

180 park') and errors (eight items, e.g., 'misjudging the speed  
181 of another vehicle when overtaking'). Two violation items  
182 were dropped because of cultural factors (e.g., drinking  
183 and driving). Participants were asked to indicate how often  
184 they committed each of the 26 behaviours in the previ-  
185 ous year on a six-point scale (0 = never, 1 = hardly ever,  
186 2 = occasionally, 3 = quite often, 4 = frequently and 5 =  
187 nearly all the time).

188 **Driver Skill Inventory**

189 The DSI is a 20-item self-reported measure of perceptual-  
190 motor (10 items, e.g., controlling the vehicle) and safety  
191 skills (10 items, e.g., stay calm in irritating situations) de-  
192 veloped by Lajunen and Summala [24]. DSI was pre-  
193 viously translated into English and had been shown to  
194 have good reliability and predictive validity in different  
195 Western countries [28]. Similar to DBQ translation, a  
196 translated Arabic version of the DSI was revised by the  
197 bilingual co-investigator and back translated by another  
198 bilingual expert. Both translators met and made necessary  
199 corrections, modifications and rewording after considering  
200 the minor differences and discrepancies. This instrument  
201 asked drivers to rate how weak or strong they were on the  
202 given skills by using 5-point scales (0 = very weak and  
203 4 = very strong).

204 **Demographic variables**

205 Participants were asked to indicate their age, gender, mar-  
206 ital status, educational level, occupation, place of living,

housing conditions, driving experience, type of car, fre- 207  
quency of seat belt usage, reasons for not wearing seat belt, 208  
speed choice on different roads, annual mileage, traffic of- 209  
fences, history of accident and injury involvement. 210

211 **Statistical analyses**

212 The analyses were performed using the Statistical Package  
213 for Social Sciences [34] for the statistical analysis. Fisher  
214 exact and chi-square tests, Student-*t* test, ANOVA and  
215 nonparametric Mann-Whitney 'U' mean test were used to  
216 test the difference between mobile phone users and non-  
217 mobile phone users on demographic variables, DBQ and  
218 DSI items.

219 **RESULTS**

220 **Mobile phone users versus non-mobile phone users**  
221 **on socio-demographic characteristics**

222 As presented in Table 1, the results showed that out of 822  
223 drivers, 602 (73.2%) of Qatari drivers used mobile phone  
224 while driving. Of 602 drivers, 497 (82.6%) used hand-  
225 held mobile phones without any extra add-on equipment.  
226 The majority of victims (71.8%) were males. The sex ratio  
227 (female/male) was 1:2.6. Most of the drivers (39.8%) were  
228 victims of crossing red traffic signal; 45.1% stated excessive  
229 speeding; 35.9% smoking while driving; 32.7% keeping  
230 their child in the front seat. The average number of drivers'  
231 incoming or outgoing calls while driving was 4.28 per day.

Table 3 The mean values of violations, errors and lapses related to the DBQ scale by mobile phone user while driving

Variables	Mobile phone user (N = 602)	Non-mobile users (N = 220)	P Value significance
	Mean ± SD	Mean ± SD	
<b>Violations</b>			
Drive especially close to the car in front as a signal to its driver to go faster or get out of the way	1.63 ± 1.7	1.17 ± 1.6	0.001
Cross a junction knowing that the traffic lights have already turned red	1.37 ± 1.7	1.07 ± 1.7	0.001
Disregard the speed limits late at night or early in the morning	1.94 ± 1.8	1.45 ± 1.8	0.001
Disregard the speed limits on a motorway	1.25 ± 1.7	0.98 ± 1.6	0.010
Have an aversion to a particular class of road user and indicate your hostility by whatever means you can	1.33 ± 1.6	1.25 ± 1.6	0.270
Become impatient with a slow driver in the outer lane and overtake on the inside(right) lane	1.89 ± 2.0	1.79 ± 1.9	0.423
Get involved with unofficial ‘races’ with other drivers	1.63 ± 1.7	1.65 ± 1.8	0.741
Angered by another driver’s behavior, you give chase with the intention of giving him/her a piece of your mind	1.53 ± 1.6	1.34 ± 1.5	0.103
Sound your horn to indicate your annoyance to another driver	1.69 ± 1.8	1.75 ± 1.9	0.859
Stay in a motorway that you know will be closed ahead until the last minute before forcing you way into the other lane	1.37 ± 1.6	1.2 ± 1.6	0.132
<b>Errors</b>			
Attempt to overtake someone that you hadn’t noticed to be signalling a left turn	1.64 ± 1.9	1.53 ± 1.9	0.407
Miss ‘Give Way’ signs and narrowly avoid colliding with traffic having right of way	1.75 ± 1.8	1.33 ± 1.7	0.001
Fail to notice that pedestrians are crossing when turning into a side street from a main road	1.75 ± 1.6	1.50 ± 1.7	0.008
Queuing to turn right onto a main road, you pay such close attention to the mainstream of traffic that you nearly hit the car in front	2.15 ± 1.8	1.54 ± 1.8	0.001
On turning right nearly hit a two wheeler who has come up on your inside	2.04 ± 1.8	1.48 ± 1.7	0.001
Fail to check your rear-view mirror before pulling out or changing lanes, etc	1.57 ± 1.5	1.30 ± 1.5	0.008
Underestimate the speed of an oncoming vehicle when overtaking	1.83 ± 1.7	1.52 ± 1.7	0.005
Apply sudden brakes on a slippery road, or steer wrong way in a skid	1.49 ± 1.4	1.35 ± 1.4	0.099
<b>Lapses</b>			
Get into the wrong lane when approaching a roundabout or a junction	1.28 ± 1.6	1.30 ± 1.6	0.999
Misread the signs and exit from the roundabout on the wrong road	2.11 ± 1.9	1.98 ± 2.0	0.219
Forget where you left your car in the car park	1.30 ± 1.4	1.08 ± 1.5	0.003
Hit something when reversing that you had not previously seen	1.65 ± 1.5	1.22 ± 1.5	0.001
Attempt to drive away from the traffic lights	1.54 ± 1.5	1.27 ± 1.5	0.008
Switch on one thing, such as headlights, when you meant to switch on something else, such as wipers	2.39 ± 1.8	1.92 ± 1.9	0.002
Intending to drive to destination A and, you ‘wake up’ to find yourself in destination B, because the latter is your more usual destination	1.67 ± 1.6	1.37 ± 1.5	0.008
Realise you have no clear recollection of the road along which you have been travelling	1.57 ± 1.7	1.51 ± 1.8	0.428

232 In contrast, mobile phone users had higher number of  
233 tickets for not obeying traffic light (45.3%) and exceeding  
234 speed limit (48.2%).

235 **Mobile phone users versus non-mobile phone users on**  
236 **driving skills**

237 Table 2 shows that mobile phone users scored higher on  
the number of DSI items than non-mobile phone users

such as driving behind a slow car without getting im- 238  
patient, predicting traffic situations ahead, stay calm in 239  
irritating situations, avoid competing in traffic, make a 240  
hill start on a steep incline and tolerating other drivers 241  
errors calmly. However, there were no significant differ- 242  
ences between mobile phone users and non-mobile users 243  
on all DSI items, except avoid competing in traffic ( $p =$  244  
0.020). 245

## 246 Mobile phone users versus non-mobile phone users on 247 driving style

248 Table 3 shows that mobile phone users scored significantly  
249 higher on the four items of violations (e.g., crossing a junc-  
250 tion knowing that the traffic lights have already turned red),  
251 six items of errors (e.g., miss 'give way' signs and narrowly  
252 avoid colliding with traffic) and five items of lapses (e.g.,  
253 intending to drive to destination A and you wake up to find  
254 yourself in different destination and realise you have no  
255 clear recollection of the road) than non-mobile phone user  
256 drivers.

## 257 DISCUSSION

258 The results of the present study indicated that 73.2% of  
259 drivers, who were involved in an accident, were mobile  
260 phone users. Young drivers have already been identified  
261 as a particularly high-risk group in Arabian Gulf countries  
262 [19, 35]. The results of the present study also indicated that  
263 20–29 years old driver group had the highest proportion  
264 of accident involvement. This is inconsistent with previ-  
265 ous studies reporting that young male drivers and drivers  
266 who drive at night have a higher risk of being involved  
267 in traffic crashes [36, 37]. Mobile phones are becoming  
268 increasingly popular communication devices, and adoles-  
269 cents were identified as a particularly high-risk cellular  
270 phone user group in the State of Qatar and other Western  
271 countries [11]. In the present study, males with phones had  
272 a significantly higher rate than females for many of acci-  
273 dent characteristics. This is consistent with earlier reported  
274 studies [4, 5, 11]. More recently, case-crossover study by  
275 McEvoy *et al.* [10] on the user of mobile phones and their  
276 role in motor vehicle crashes showed that mobile phone  
277 use was associated with an increased likelihood of crashing  
278 in regardless of hand-held versus hands-free mobile phone  
279 use.

280 It is very likely that risky driving behaviours are one  
281 of the main reasons behind high accident involvement  
282 among young male drivers and mobile phone users. The  
283 general findings in DBQ literature show that males and  
284 young drivers report more violations than females and older  
285 drivers [16]. In addition, speeding violations are generally  
286 identified as the major factor behind accident involvement  
287 [22]. As hypothesized, the results of the present study  
288 showed that mobile phone users scored higher on viola-  
289 tions, in particular speeding items than non-mobile phone  
290 users. In addition, the previous studies showed that vio-  
291 lations were associated with higher number of accidents  
292 and penalties [20–22]. Bener *et al.* [19] found that lapses  
293 and errors were related to accident involvement in United  
294 Arab Emirates and Qatar as much as violations. As hy-  
295 pothesized, the results of the present study also revealed  
296 that mobile phone users committed more errors and lapses  
297 than non-mobile phone users. It seems that cellular mo-  
298 bile phone may bring extra workload to memory and share  
299 attention sources, which might contribute collisions by dis-

tracting drivers (e.g., [11]). Hence, it can be concluded that  
mobile phone usage seems to influence driving at the tacti-  
cal or operational levels than strategic one. Consequently,  
phone-related accidents might not increase in the same  
proportion as the use of mobile phones [30]. It should be  
noted that, however, other techniques (e.g., experimental  
studies, simulator measures) could be used for investigat-  
ing the role of mobile phone use at the operational level.  
In contrast to Pöysti *et al.* [30] and our hypothesis, it was  
found that self-evaluated driving skills did not appear at  
the strategic level.

There is a considerable impact of mobile phone use on  
the road traffic injuries and crashes in Western countries  
[1–6, 9, 30, 38–40]. The present study also revealed that  
the mobile phone use had a negative effect on driving style,  
which, in turn, might lead to accident involvement. Espe-  
cially young drivers and drivers at their early 30s should  
be targeted in road safety campaigns. It is also obvious that  
these campaigns would succeed in improving safe driving  
style when promoted to support proper enforcement and  
traffic regulations. Since the lack of enforcement and traffic  
education lead to risky driving (e.g., speeding) even in the  
high quality roads, the basic requirements (enforcement  
and education) of safe traffic should be fulfilled in order to  
solve this public health problem.

## REFERENCES

1. J M Violanti, 'Cellular phones and fatal traffic collisions', *Accident Anal Prevention*, 1998 30 519–524.
2. F Sagberg, 'Accident risk of car drivers during mobile telephone use', *Int J Vehicle Des*, 2001 26 57–69.
3. D Lamble, T Kauranen, M Laakso and H Summala, 'Cognitive load and detection thresholds in car following situations: safety implications for using mobile cellular telephones while driving', *Accident Anal Prevention*, 1999 31 617–623.
4. J M Violanti, 'Cellular phones and traffic accidents', *Public Health*, 1997 111 423–428.
5. D A Redelmeier and R J Tibshirani 'Association between cellular-telephone calls and motor vehicle collisions', *New England J Med*, 1997 336 453–458.
6. A J McKnight and A S McKnight 'The effect of cellular phone use upon driver attention', *Accident Anal Prevention*, 1993 25 259–265.
7. L T Lam, 'Distractions and the risk of car crash injury: the effect of drivers' age', *J Safety Res*, 2002 33 411–419.
8. J Wilson, M Fang, S Wiggins and P Cooper, 'Collision and violation involvement of drivers who use cellular telephones', *Traffic Injury Prevention*, 2003 4 45–52.
9. P A Hancock, M Lesch and L Simmons, 'The distraction effects of phone use during a crucial driving maneuver', *Accident Anal Prevention*, 2003 35 501–514.
10. S McEvoy, M R Stevenson, A T McCartt, M Woodward, C Haworth and P Palamara, 'Role of mobile phones in motor vehicle crashes resulting in hospital attendance: a case-crossover study', *BMJ*, 2005 331 (7514) 428.
11. J M Violanti and J R Marshal, 'Cellular phones and traffic accidents: an epidemiological approach', *Accident Anal Prevention*, 1996 28 265–270.

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358	12. I Lewin, 'Driver training: a perceptual-motor skill approach',	of their perceptual-motor and safety skills: Australians	405
359	<i>Ergonomics</i> , 1982 25 917-924.	and Finns', <i>Personality Individual Differences</i> , 1998 24	406
360	13. J Elander, R West and D French, 'Behavioral correlates of	539-550.	407
361	individual differences in road traffic crash risk: an examination	29. T Lajunen, D Parker and S Stradling, 'Dimensions of driver	408
362	of methods and findings', <i>Psychol Bull</i> , 1993 113 279-294.	anger, aggressive and highway code violations and their	409
363	14. J T Reason, <i>Human Error</i> , New York, Cambridge University	mediation by safety orientation in UK drivers', <i>Transp Res F</i> ,	410
364	Press, 1990.	1998 1 107-121.	411
365	15. P N Blockey and L R Hartley, 'Aberrant driving behaviour:	30. L Pöysti, S Rajalin and H Summala, 'Factors influencing the	412
366	errors and violations', <i>Ergonomics</i> , 1995 38 1759-1771.	use of cellular (mobile) phone during driving and hazards	413
367	16. L Aberg and P A Rimmo, 'Dimensions of aberrant driver	while using it', <i>Accident Anal Prevention</i> , 2005 37 47-51.	414
368	behaviour', <i>Ergonomics</i> , 1998 41 39-56.	31. J A Michon, 'A critical review of driver behaviour models:	415
369	17. T Lajunen, D Parker and H Summala, 'Does traffic congestion	what do we know, what should we do', <i>Human Behaviour and</i>	416
370	increase driver aggression?', <i>Transp Res F</i> , 1999 2 225-236.	<i>Traffic Safety</i> , L Evans and R C Schwing (Eds.), New York,	417
371	18. T Lajunen, D Parker and H Summala, 'The Manchester	Plenum Press, 1985, pp. 485-524.	418
372	Driver Behaviour Questionnaire: a cross-cultural study',	32. D W Eby and J M Vivoda, 'Driver hand-held mobile phone	419
373	<i>Accident Anal Prevention</i> , 2004 36 231-238.	use and safety belt use', <i>Accident Anal Prevention</i> , 2003 35	420
374	19. A Bener, D Haigney D Crundall, AK Bensiali, AS Al-Falasi. TP 3488	893-895.	421
375	"Driving behaviour, Stress Error and Violation on the Road: A cross-cultural	33. R Lawton, D Parker, AS Manstead, S Stradling. The role effect in predicting	
376	comparison study": 3rd International Conference on Traffic and Transport	social behaviors: the case of road traffic violations, <i>J Appl Soc. Psychol</i> ,	
377	Psychology. ICTTP, 5-9 September 2004, Nottingham UK.	1997 70 552-566.	
378	20. D Parker, J T Reason, A S R Manstead and S G Stradling,	34. MJ Norusis, SPSS/PC+ for Windows: base system and advanced statistics	
379	'Driving errors, driving violations and accident involvement',	user guide. Chicago, Illinois SPSS 1992.	
380	<i>Ergonomics</i> , 1995 38 1036-1048.	35. A Bener, FM Abu Zidan, AK Bensiali, AAK AL-Mulla, KS Jaddan.	
381	21. D Parker, R West, A S R Manstead and S G Stradling,	Strategy to imporveroad safety in developing countries. <i>Saudi</i>	
382	'Behavioural characteristics and involvement in different types	<i>Med J</i> , 2003 24 603-608.	
383	of traffic accident', <i>Accident Anal Prevention</i> , 1995 27 571-581.	36. T E Boyce and E S Geller, 'An instrumented vehicle	425
384	22. J Mesken, T Lajunen and H Summala, 'Interpersonal	assessment of problem behaviour and driving style: do younger	426
385	violations, speeding violations and their relation to accident	males really take more risks?', <i>Accident Anal Prevention</i> , 2002	427
386	involvement in Finland', <i>Ergonomics</i> , 2002 45 469-483.	34 51-64.	428
387	23. D Parker, L McDonald, P Rabbitt and P Sutcliffe, 'Elderly	37. A Bener and D Crundall, 'Road traffic accidents in the United	429
388	drivers and their accidents: the Aging Driver Questionnaire',	Arab Emirates compared to Western countries', <i>Adv Transp</i>	430
389	<i>Accident Anal Prevention</i> , 2000 32 751-759.	<i>Studies Int J A</i> 2005 6 5-12	431
390	24. T Lajunen and H Summala, 'Driver experience, personality,	38. D Crundall, M Bains, P Chapman and G Underwood,	432
391	and skill and safety motive dimensions in drivers'	'Regulating conversation during driving: a problem for mobile	433
392	self-assessments', <i>Personality Individual Differences</i> , 1995 19	telephones?', <i>Transp Res F</i> , 2005 8 (3) 197-211.	434
393	307-318.	39. D L Strayer and F A Drews, 'Profiles in driver distraction:	435
394	25. K Spolander, 'Bilförarens uppfattning om egen körförmåga	effect of cell phone conversations on younger and older	436
395	(Drivers' assessment of their own driving ability)', Report no:	drivers', <i>Human Factors</i> , 2004 46 640-649.	437
396	252, Linköping, Swedish Road and Traffic Research Institute,	40. D C Seo and M R Torabi, 'The impact of in-vehicle	438
397	1983.	cell-phone use on accidents or near accidents among college	439
398	26. M Hatakka, E Keskinen, S Laapotti, A Katila and H Kiiski,	students', <i>J Am Coll Health</i> , 2004 53 101-107.	440
399	'Driver's self-confidence - the cause of the effect of mileage',	41. H Alm and L Nilsson, 'The effects a mobile telephone task on	441
400	<i>J Traffic Med</i> , 1992 21 313-315.	driver behaviour in a car following situation', <i>Accident Anal</i>	442
401	27. H Summala and A Hyvén, 'Measuring (safety-related) driver	<i>Prevention</i> , 1995 27 707-715.	443
402	skills in the laboratory: towards a new test for the driver	42. A Bener 'The neglected epidemic: road traffic accidents in a	444
403	examination', Report no. 21, Helsinki, Traffic Research Unit,	developing country, State of Qatar', <i>Injury Control Safety</i>	445
404	University of Helsinki, 1990.	<i>Promotion</i> , 2005 12 (1) 45-47.	446
	28. T Lajunen, A Corry, H Summala and L Hartley,	43. A Bener and R Alwash, 'A perspective on motor vehicle crash	447
	'Cross-cultural differences in drivers' self-assessments	injuries and speeding in the United Arab Emirates', <i>Traffic</i>	448
		<i>Injury Prevention</i> ; 2002 3 61-64.	449
		44. D Lamble, H Summala and L Hyvaerinen, 'Driving	450
		performance of drivers with impaired central visual field	451
		acuity', <i>Accident Anal Prevention</i> , 2002 34 711-716.	452