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# Distraction in older drivers – A face-to-face interview study

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ABSTRACT

The prevalence of older drivers' engagement in distracting activities while driving is largely unexplored. Face-to-face interviews were conducted in the city of Braunschweig, Germany, comparing a sample of older drivers ($n$ = 205) to a group of middle-aged drivers ($n$ = 209). The drivers were interviewed on their engagement in distracting activities during the last half an hour of their driving trip, including the frequency and duration of these activities, their perception of the risk associated with these distracting activities and the role of these activities in at-fault crashes. Middle-aged drivers were significantly more likely to engage in certain distracting activities than older drivers. With regard to the duration of interactions with the passengers older drivers were significantly more talkative than middle-aged drivers. Middle-aged drivers rated most of the distracting activities as significantly less dangerous than older drivers. Distraction-related crashes are not a special problem of older drivers but seem to be very comparable to the middle-aged drivers. It is concluded that older drivers' reluctance to engage in distracting tasks while driving is either a process of self-regulation or their age-related prudence. The study is the first to gather knowledge about distraction in German older drivers. Although older drivers are not currently overrepresented in distraction-related crashes, it is important to note that future cohorts of older drivers might differ in the way they engage with vehicles and technologies, which in turn may influence their driving patterns and willingness to engage in potentially distracting activities.



## 1. Introduction

Older people are the fastest-growing group of drivers. According to the OECD report on Ageing and Transport (2001), by the year 2030, one out of four drivers will be aged 65 and over. This trend points out the need to better understand the driving behavior of older people, as both the driving style and the types of crashes they have, differ from those of younger and middle-aged drivers.

It has been demonstrated in many experimental studies that older people have a decreased ability to share attention between two concurrent tasks due to their diminishing visual and cognitive processes (Lindenberger et al., 2000; McDowd and Shaw, 2000; Verhaeghen et al., 2003), and, hence, may be more susceptible to the distracting effects of engaging in a secondary task while driving than younger drivers. Experimental research results demonstrate greater performance decrements for older drivers compared with younger age groups while performing a concurrent task while driving (Hancock et al., 2003; Horberry et al., 2006; McKnight and McKnight, 1993; McPhee et al., 2004; Strayer and Drews, 2004).

Several studies indicate that older drivers are able to compensate for eventual age-related problems by not driving in situations that make them uneasy (in settings in which they do not feel safe) and by simplifying the driving task, e.g., driving slower, driving less at night, on freeways or during bad weather (Baldock et al., 2006; Bauer et al., 2003; Betz and Lowenstein, 2010; Charlton et al., 2003, 2006; Owsley et al., 1999). It would be interesting to know whether this is also true for the engagement in distracting activities while driving. Lerner et al. (2008) investigated drivers' willingness and perceived risk of engaging in various secondary tasks (e.g. eating, drinking, performing different functions with a mobile phone or a navigation system). Participants drove their own vehicles over a specified route and, at specified points, rated their willingness to engage in specific tasks at that time and place, but were not required to actually engage in the tasks. In general, younger drivers expressed more willingness than middle-aged or older drivers to use in-vehicle technologies. Younger drivers also perceived this use as less risky than middle-aged and older drivers.

There is no generally accepted definition of driver distraction (Kircher, 2007; Ranney, 2008; Lee et al., 2009). Some researchers include cognitive inattention such as "being lost in thought" in the concept (Ranney et al., 2001), whereas others explicitly distinguish this kind of inattention from distraction (Stutts et al., 2005a). In their most recent paper Regan et al. (2011) provide a detailed

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taxonomy in which driver distraction is distinguished from other forms of driver inattention. The authors define "driver distraction" as one form of "driver inattention" and assert that it includes the diversion of attention to internalized mental activities (i.e., internalized thoughts and daydreams). An important source of driver distraction is secondary tasks which include eating, drinking, talking on the phone or to a passenger, and interacting with in-vehicle information (e.g., navigation system), entertainment (e.g., radio and CD player), or control systems (e.g., climate control). External distraction (e.g., animals outside the vehicle, advertising signage) is a potentially important source of distraction as well.

Numerous research studies have addressed driver distraction. Crash-based studies provide the most direct information about the safety implications of performing secondary tasks. According to data from the National Highway Traffic Safety Administration (NHTSA) 16% of fatal crashes and 20% of injury crashes on US roadways in 2009 involved reports of distracted driving (NHTSA, 2010). For the aim of this paper, we focus on the few studies that have investigated the role of distraction in older driver crashes. Using data for the years 1995–1999 from the National Accident Sampling System (NASS) Crashworthiness Data System (CDS), Stutts et al. (2003) found that 8.3% of the drivers were distracted at the time of their crash. Younger drivers (under 20) were more likely than older drivers to be identified as distracted at the time of their crash: 11.7% of younger drivers were found to be distracted, compared with 7.9% of older drivers (65+). In contrast, drivers aged 65 and older were more than three times more likely to have "looked but did not see" (16.5%) listed as a contributing factor in crashes compared with younger drivers (5.4%). However, Stutts et al. reported that these differences were not statistically significant. Drivers aged 65 and older were more likely to have been distracted by objects and events outside the vehicle (other vehicles, people, signs animals, etc.; 43%) compared with all other age groups (27–33%). The findings also showed that older drivers were less likely to have been distracted by adjusting the radio/cassette/CD (0.2%) compared with all other age groups (0.6–29%). Similarly older drivers were less likely to be distracted by other occupants (2.6%) in the vehicle compared with the other age groups (9–11%), except the 50–64 year group (1.5%). Similar analyses were performed by Stutts et al. (2005b) using the 2000–2003 CDS data. They found that 6.6% of crash-involved drivers were distracted. However, the attention status was unknown for 46% of the drivers. Younger (under 20) and older (70+) crash-involved drivers were more likely than drivers of other ages to have been distracted at the time of their crashes (12–14% vs. 6–9%).

According to 2009 US fatal crash data, younger drivers were more likely to have a fatal crash due to a distraction (NHTSA, 2010). Sixteen percent of all younger than 20-year-old; 13% of all 20- to 29-year-old; 10–11% of all 30- to 59-year-old and 9–11% of all 60- to 70+ year-old drivers in fatal crashes were reported to have been distracted while driving.

Several studies examined self-reported crash involvement due to a distraction. McEvoy et al. (2007) examined the prevalence and type of distracting activities involved in serious injury crashes. Interviews were conducted with hospitalized drivers within hours of their crash. Crashes involving a distracting activity were more likely to be reported by younger drivers (17–29 years) compared with drivers aged 50 years and older (39.1% vs. 21.9%). Driving experience was also a strong predictor of distraction-related crashes (38% for drivers with less than 10 years' experience vs. 21% for drivers with more than 30 years'). The findings of McEvoy et al. (2007) are consistent with the findings of Hakamies-Blomqvist (1994), who found that drivers 65 years and older were significantly less likely to be distracted by a non-driving activity immediately preceding a crash (42%) than younger drivers (26–40 years; 57%).

In an internet survey of 287 drivers (aged 18–83) by Young and Lenné (2010) 17.8% of the drivers reported being involved in 59 crashes during the past 2 years. Drivers attributed 10.2% of the crashes to being distracted. No age differences were found in terms of the likelihood of being involved in a crash.

To sum up, in terms of the role that distraction plays in older driver crashes, the findings from most analyses of crash data have shown that older drivers are less likely to engage in distracting activities at the time of the crash compared with younger age groups. These findings are consistent with the assertion that the behaviors that lead to older driver crashes may be more related to inattention or slowed perception and responses than to deliberate unsafe actions that are more common in younger drivers (Eberhard, 1996). Interestingly, outside distractions have been implicated in older driver crashes (Stutts et al., 2001, 2003), suggesting that visual clutter or a reduced capacity to attend to relevant driving information while filtering out irrelevant stimuli has a role in older driver crashes (Koppel et al., 2009).

Numerous observational studies have addressed driver distraction (Klauer et al., 2006; Stutts et al., 2005a) but only a limited number of studies have investigated older drivers (60+) and their propensity for distraction. Two examples are presented below.

In one of the first systematic naturalistic studies conducted, Stutts et al. (2005a) collected video data from 70 volunteer participants, driving their own vehicles over a period of a week. Study participants included 14 drivers in each of the five age groups: 18–29, 30–39, 40–49, 50–59, and 60+. Altogether, excluding any time spent talking to passengers, drivers were engaged in some form of potentially distracting activity 14.5% of the total time that their vehicle was in motion. Age differences in the likelihood of engaging in a particular distraction on at least one occasion were generally small, although numbers were too small for valid statistical testing.

Sayer et al. (2005) observed samples of 5-s video clips obtained from 36 drivers during routine driving. Their analysis was based on approximately 120 h of driving. 34% of the 5-s episodes involved a secondary task. Samples taken from younger drivers (mean age 25) were more than twice as likely to involve secondary activities as were those of older drivers (mean age 64). For this study, drivers used borrowed vehicles, which were equipped with data acquisition instrumentation. Thus, the behavior observed was not fully natural.

A number of self-report surveys have been used to quantify driver engagement in distracting activities. Although driver distraction can be caused by driver interaction with a number of sources, most of the available literature on older driver distraction has focused on mobile phone use. For example, Sullman and Baas (2004) examined the frequency of mobile phone use on New Zealand's roads by means of the questionnaires distributed at petrol stations. $N = 861$ drivers took part in the survey. The research found that more than half (57.3%) of the participants used a mobile phone at least occasionally while driving. 60+ survey participants reported using a mobile phone while driving less frequently and perceived this to be more hazardous than the younger ones. Pöysti et al. (2005) conducted telephone interviews with 834 Finnish drivers (aged 18–76) on their mobile phone use. The results indicate that 35% of older drivers (65+) sometimes use their mobile phone while driving (in comparison to 66–87% of drivers of other age groups).

Most recently, self-report surveys have also been used to explore the prevalence of a broad range of distractions while driving. Young and Lenné (2010) used an internet survey of 287 Australian drivers aged 18–83 years to quantify their engagement in distracting activities during everyday driving. 27.8% of older drivers (55–83 years) reported using a mobile phone while driving compared to 69.8% of middle-aged drivers (26–54 years) and 69.6% of young drivers (18–25 years). Specifically, the odds of older drivers reporting that

they 'never' use their mobile phone while driving were almost twice as that of the younger and middle-aged drivers. Similarly, younger drivers were more likely to report that they send SMS (76.9%), compared to middle-aged (50.6%) and older drivers (0%). Over 80% of drivers reported that they eat and drink while driving, with young drivers (42.7%) more likely to report that they eat and drink on about half of trips or more when driving, compared to middle-aged (36%) and older (11.3%) drivers.

To sum up, research indicates that driver distraction is a significant road safety concern. Older drivers may be particularly vulnerable to the effects of distraction because of eventual age-related impairments. The issue is particularly significant as older adults represent the fastest growing group of the driving population.

Crash data show that driver distraction is a significant contributing factor in vehicle crashes. However, it remains unclear whether this is due to a large exposure (driving with secondary tasks) or distraction-related crash risk. The interpretability and reliability of crash data sources on distraction is limited by the range of estimates attributable to differences in definitions, categorization and incompleteness of crash information. Crash studies are limited by the absence of matched exposure data, which are necessary to determine the relative crash risks associated with distracting secondary tasks.

Naturalistic observational studies offer the promise of providing both detailed crash and matched exposure data, but they are limited by the possibility that drivers will not behave naturally if they know they are being observed, as well as the relatively small samples of drivers due to the expense associated with instrumenting each vehicle. In addition, the degree of absorption in thought is not evident from observation alone.

A number of self-report surveys have been used to quantify driver engagement in distracting activities. The limitation of this kind of studies is that the answers may be subject to inaccurate recall if the driving trip was long before the interview. The problem of internet surveys lies in the difficulty to recruit older drivers, as they still tend to lag behind the general population in adopting new technologies. Consideration needs to be given to the fact that the older drivers who participate in an online survey may differ from those who do not (e.g., greater use of technology).

The aim of this face-to-face interview study was to investigate German older drivers' engagement in potentially distracting activities while driving, their perception of the risk associated with these distracting activities, and the role of distraction in at-fault crashes. The advantage of this efficient and cost-effective method is the ability to get information on distracting activities that cannot be recorded by outside observers (e.g., daydreaming), as well as subjective evaluation on riskiness of tasks. To minimize inaccurate recall or underestimation biases, the interviews were conducted directly after a driving trip.

## 2. Method

### 2.1. Procedure

The data were collected during a 3-month period between April and June 2010 in the city of Braunschweig (ca. 250,000 residents), Germany. Face-to-face interviews were conducted from Monday to Friday between 9.00 a.m. and 5.00 p.m. at five supermarket parking places in the city area. The supermarkets in the city area were chosen because of a large number of drivers arriving there, as shopping is the second primary route purpose in Germany after spare time activities (MiD, 2008). The drivers who have arrived at the parking place were approached and asked if they would take part in a study of driver distractions. The drivers were asked about their engagement in certain distracting activities during the last half an hour of their driving trip. This period of time was chosen to minimize inaccurate recall. If the actual trip was shorter, drivers were interviewed about their engagement in potentially distracting activities during the whole trip. Huemer and Vollrath (2011) used the method of asking participants to report on the last half an hour of their driving trip. Drivers were instructed to report only activities that were engaged in while the vehicle was in motion (i.e., not stationary). The interview took approximately 10 min.

The first part of the interview contained questions on demographics and driving profile. The drivers were then questioned about nine types of potentially distracting activities which are summarized in Table 1. These categories were derived from the literature, especially from the naturalistic driving studies (Klauer et al., 2006; Stutts et al., 2005a). For each category, the drivers were asked whether they had engaged in this distracting activity, how long this took and the extent to which they thought this type of activity presents an increased crash risk (rating on a Likert scale from '0' – not dangerous to '5' – extremely dangerous). Those drivers, who did not report engaging in certain distracting activities in the last half an hour of their driving trip, were asked if they occasionally undertake these activities.

The final section of the interview contained questions regarding crashes caused by distracting activities. The interviewed drivers were asked whether they had at-fault crashes/near-misses in the past 5 years and whether these crashes or near-misses were distraction-related.

### 2.2. Sample

Out of 526 drivers who were asked to take part in the interview, $N = 414$ drivers were willing to participate. The overall response rate was 78% (middle-aged: 68%; older: 87%). Only non-commercial drivers were interviewed. To exclude novice as well as drivers with very high mileage, only those aged $\geqslant$25 years and with yearly mileage $\leqslant$25,000 km were interviewed. This was done in order to ensure that the control sample of middle-aged drivers was more comparable to the older drivers who typically do not have very high mileages. These drivers were not defined as non-responders. Thus, the interview data of $n = 205$ older drivers (aged 65–83, mean age = 69 years, $SD = 4.3$) and of $n = 209$ middle-aged drivers (aged 26–61, mean age = 45 years, $SD = 9.7$) were compared in the study. The gender distribution in the groups was as follows: $n = 100$ female and $n = 105$ male participants in the group of older drivers and $n = 109$ female and $n = 100$ male participants in the group of middle-aged drivers. Older drivers had an average of 41 years ($SD = 7.8$) of driving experience, middle-aged drivers an average of 22 years ($SD = 9.9$). Self report estimate of annual mileage was as follows: an average of 9332 km (5798 miles) for older and 12,065 km (7496 miles) for middle-aged drivers. There was a significant difference in the annual mileage between both groups ($t_{412} = -5.331$; $p = .001$).

**Table 1**
Types of potentially distracting activities.

| |
|---|
| Interaction with passengers |
| Using the in-car device (adjusting vehicle controls, operating a radio or a CD player, fastening seat belt) |
| Self-initiated internal tasks (day-dreaming, problem-solving, singing, being lost in thought) |
| Eating or drinking |
| Smoking related |
| Outside distractions (road and traffic-related, scenery, buildings, advertising, people, animals) |
| Other behaviors (map reading, writing, animals-related, reaching/looking for objects inside vehicle) |
| Using a mobile phone hands-held or an add-on media device (e.g., an iPod) |
| Clothing and grooming (shaving, make-up) |

### 2.3. Statistical analysis

The data were analyzed using PASW Version 18.0. *Logistic regression* was used to analyze the frequency of engagement in the potentially distracting activities while driving, which produced a binary (yes/no) response. Where the data did not meet the assumptions of logistic regression procedure, they are reported descriptively. *T-Test* was performed to analyze the duration of the distracting activities undertaken in the last half an hour of the driving trip. *Mann–Whitney-U-rank test* was used to examine any age- and gender-related effects on the rankings of perceived riskiness of various distracting activities.

## 3. Results

### 3.1. Frequency of engaging in potentially distracting activities

The proportion of drivers who reported engaging in potentially distracting activities while their vehicle was in motion is presented in Fig. 1. 8.8% of older and 6.7% of middle-aged participants' trips were shorter than 30 min. The most frequently undertaken activity (in the last half an hour of the driving trip) in both age groups was *interaction with passengers*. 53.6% of the interviewed older drivers and 49.2% of middle-aged drivers had a passenger. The second most frequent activity was *using the in-car devices*. 5.8% of older drivers and 4.3% of middle-aged drivers reported that they had not engaged in distracting activities. In order to statistically evaluate the effects of age, gender and annual mileage on frequency of engaging in certain distracting activities, a logistic regression was performed including all three variables as predictors for each of the distracting activities. Age was a significant predictor of whether a driver would engage in distracting activities or not in the following categories: *using the in-car device* (OR = .34, $p = .001$); *self-initiated internal tasks* (OR = .38, $p = .012$); *eating or drinking* (OR = .24, $p = .001$); *smoking related* (OR = .20, $p = .002$); *outside distraction* (OR = .38, $p = .031$); and *other activities* (OR = .17, $p = .027$). The results show that middle-aged drivers were more likely to report engaging in these distracting activities than older drivers. None of older drivers reported engaging in *clothing/grooming* or *using a mobile phone* (*or an add-on media device*) in the last half an hour of the driving trip. Gender was a significant predictor of whether a driver would engage in distracting activities or not in the following categories: *using the in-car device* (OR = .62, $p = .029$); *eating or drinking* (OR = .28, $p = .003$); and *smoking related* (OR = .21, $p = .001$). The results show that female drivers were less likely to engage in these activities. Mileage had no effect on engagement with distracting activities in the last half an hour of the driving trip.

The mean duration of the distracting activities is shown in Fig. 2. The largest difference between the two age groups was found in the duration of the *interaction with the passengers* ($t_{160} = 8.3$, $p = .001$). Tasks related to passengers account for 48.7% of the driving time in the group of older drivers, and for 19.6% in the group of middle-aged drivers. Older male drivers differ significantly from the middle-aged male drivers ($t_{87} = 4.4$, $p = .001$), as well as older female drivers differ significantly from the middle-aged female drivers ($t_{69} = 7.8$, $p = .001$) in the duration of the interaction with the passengers. Thus, older male and female drivers seem to be more talkative while driving than their middle-aged counterparts. *Smoking related activities* account for 17.5% of the driving time in the group of middle-aged drivers, and for 11.5% in the group of older drivers ($t_{20} = -2.2$, $p = .041$). Age and gender differences in the duration of engaging in a particular distraction were generally small in other categories, although numbers were too small for valid statistical testing.

Those drivers who did not report engaging in certain distracting activities in the last half an hour of their driving trip were asked if they *occasionally* undertake these activities (see Fig. 3). The most frequent activity in both age groups was *using the in-car devices* followed by *interaction with passengers* in the group of older drivers and *outside distractions* in the group of middle-aged drivers. Age was a significant predictor of whether a driver would occasionally engage in distracting activities or not in the following categories: *self-initiated internal tasks* (OR = .29, $p = .003$); *eating or drinking* (OR = .24, $p = .001$); *other activities* (OR = .25, $p = .006$); and *using a mobile phone hands-held or an add-on media device* (OR = .19, $p = .002$). The results indicate that middle-aged drivers were more likely to report engaging in these distracting activities than older drivers. The exception was *interaction with passengers* (OR = 2.6, $p = .042$) where older drivers were more than twice as likely to report interacting with the passenger compared to middle-aged drivers. Gender was a significant predictor of whether a driver would occasionally engage in distracting activities or not in the following categories: *using a mobile phone hands-held or an add-on media device* (OR = .48, $p = .020$) where the odds of engaging in this activity among female drivers is about a half of that for male drivers; *self-initiated internal tasks* (OR = 2.9, $p = .001$), where the odds of "being lost in thought" among female drivers is almost three times as much of that for male drivers. Mileage had a significant effect only on being distracted by *objects and events outside the vehicle* (OR = 2.47, $p = .017$) where drivers with a higher mileage were more than twice as likely to report being distracted by objects and events outside the vehicle compared to drivers with a lower mileage.

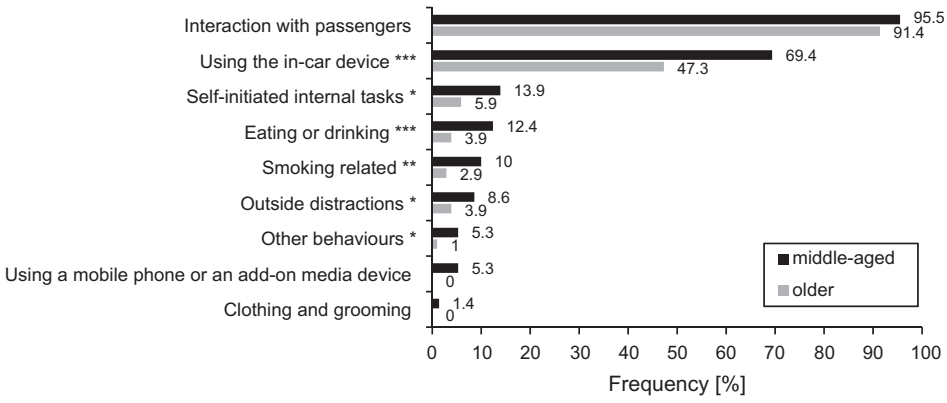


**Fig. 1.** Percentage of drivers engaging in the distracting activity in the last half an hour of the driving trip. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. *Note*: The proportion of drivers engaged in interacting with a passenger refers to the proportion of drivers with a passenger (i.e., the percentage does not refer to the entire sample).

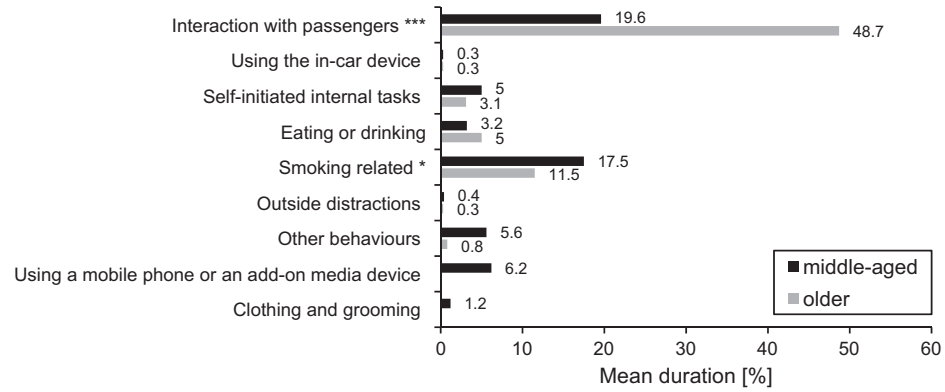


**Fig. 2.** Mean duration of the undertaken distracting activity. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. *Note*: None of older drivers reported engaging in clothing and grooming or using a mobile phone or an add-on media device.

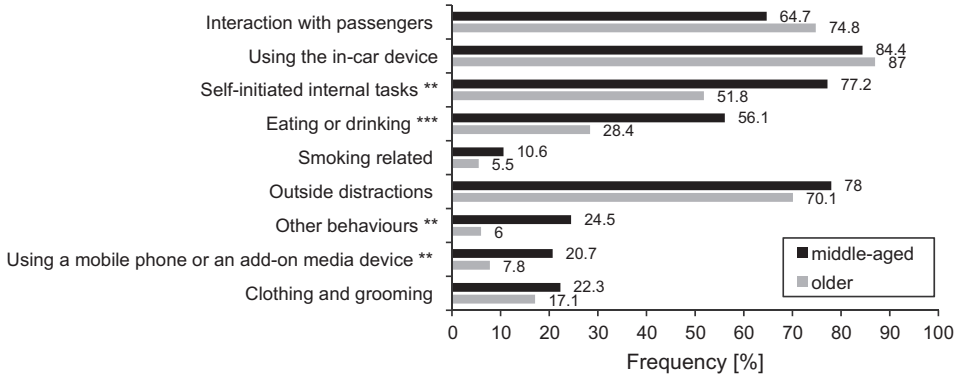


**Fig. 3.** Percentage of drivers who undertake certain distracting activities occasionally. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

### 3.2. Perception of impacts of distracted driving

For each category, the drivers were asked about the extent to which they thought this type of activity presents an increased crash risk (rating on a Likert scale from '0' – not dangerous to '5' – extremely dangerous). The proportion of drivers who rated the distracting activities as "very dangerous" and "extremely dangerous" is presented in Fig. 4. Both age groups rated *using the mobile phone hand-held* most dangerous while driving. *Other activities* (e.g., map reading, writing, animals-related, reaching/looking for objects inside vehicle) and *clothing and grooming* were rated to have the highest distraction as well. Middle-aged drivers rated most of the distracting activities as significantly less dangerous than older drivers. These activities included *interaction with passengers*, *eating and drinking*, *using the mobile phone hand-held*, *self-initiated internal tasks and outside distractions* (*Mann–Whitney-U-Test*, *all* $p \leqslant 0.001$). There were few differences between male and female drivers in their ratings. Males rated the following activities as significantly less dangerous than the females did: *interaction with passengers*, *clothing and grooming*, *using the in-car*

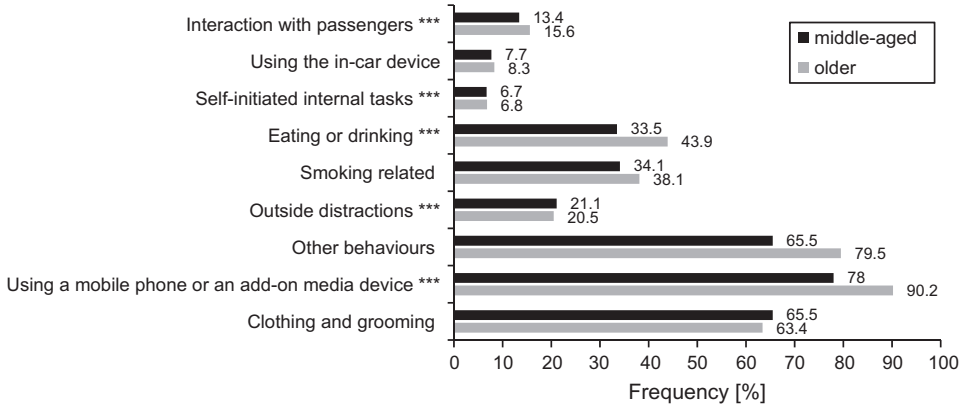


**Fig. 4.** Percentage of drivers who rated the distracting activities as "very dangerous" and "extremely dangerous". $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. *Note*: The answers "4" = "very dangerous", "5" = "extremely dangerous" are combined.

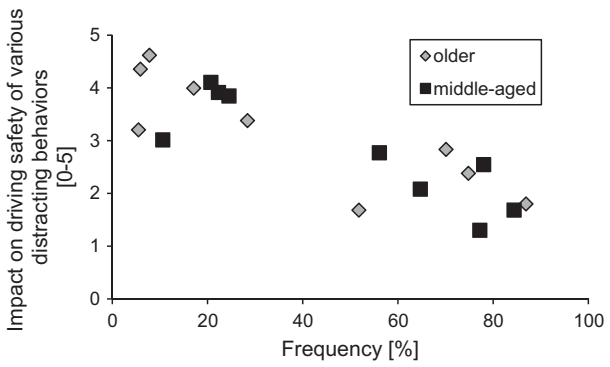


**Fig. 5.** Scatterplot between the frequency of occasional engaging in distracting activities and general impact on driving safety of these distracting activities. The points give the means of the frequency for the two groups.

*device*, *using a mobile phone hands-held or an add-on media device*, *self-initiated internal tasks and outside distractions* (*Mann–Whitney-U-Test*, *all* $p \leqslant 0.03$).

Most drivers in both age groups stated they are *using in-car devices* (e.g. adjusting music) while driving and only 7.7% of middle-aged and 8.3% of older drivers perceive this action to make driving more dangerous. Similarly, while the vast majority of drivers (middle-age: 64.7% vs. older: 74.8%) *converse with passengers* while driving, only 15.6% of older drivers and 13.4% of middle-aged drivers believe that this activity makes their driving more dangerous. Although almost half of all older drivers (51.8%) and most middle-aged drivers (77.2%) reported that they sometimes *focus on internal thoughts* (e.g. daydreaming, problem-solving) while driving, just 6.7% of middle-aged and 6.8% of older drivers feel that such activity distracts drivers enough to make driving more dangerous.

The scatterplot (Fig. 5) displays the association between the frequency of occasional engaging in distracting activities and the subjectively rated general impact on driving safety of these distracting activities for both age groups. The scatterplot clearly indicates that there is a negative correlation between the frequency of engaging in distracting activities and the impact on driving safety of these distracting activities (older: $r = -0.83$; middle-aged: $r = -0.85$). That means those drivers who engage in distracting activities feel that such activities do not distract one enough to make driving more dangerous. However, it might also be the other way round: drivers engage in those distracting activities which they think are not dangerous.

### 3.3. Self-reported at-fault crash involvement

As the numbers on self-reported at-fault crash involvement during the past 5 years were too small for valid statistical testing they are reported descriptively. 3.9% ($n = 8$) of older drivers and 5.7% ($n = 12$) of middle-aged drivers reported being involved in at-fault crashes during the past 5 years. 1.5% ($n = 3$) of older and 2.4% ($n = 5$) of middle-aged drivers reported crashes caused by distracting activities within the previous 5 years. The most frequently reported distracting activities that resulted in crashes were *self-initiated internal tasks* (e.g. daydreaming) (middle-aged: $n = 1$, older: $n = 2$) and *outside distractions* (middle-aged: $n = 2$, older: $n = 1$).

5.8% ($n = 12$) of older drivers and 9.6% ($n = 20$) of middle-aged drivers reported being involved in near-misses during the past 5 years. 1.9% ($n = 4$) of older and 5.7% ($n = 12$) of middle-aged drivers reported near-misses caused by distracting activities within the previous 5 years. The most frequently reported distracting activities that resulted in near-misses were *self-initiated internal tasks* (middle-aged: $n = 6$, older: $n = 3$). $n = 2$ middle-aged drivers were distracted by looking for something outside the vehicle, while an additional $n = 1$ was distracted by a child. One of four ($n = 1$) older drivers involved in distracted-related near-misses was dealing with a passenger (middle-aged: $n = 3$). Thus, from these reports distraction-related crashes is not a special problem of older drivers but seems to be very comparable to the middle-aged drivers.

## 4. Discussion

This is the first study conduct to specifically investigate German older drivers and: (1) their engagement in potentially distracting activities while driving, (2) their perception of the risk associated with these distracting activities, and (3) the role of distraction in at-fault crashes or near-misses.

The two most frequently undertaken activities in both age groups were *interaction with passengers* and *using the in-car devices*. These findings are generally consistent with other research, which has found that a large majority of drivers report engaging in interaction with passengers or manipulating vehicle controls (Laberge-Nadeau et al., 2003; McEvoy et al., 2006; Royal, 2003). Middle-aged drivers were more likely to report engaging in certain distracting activities than older drivers. This trend has also been found in other distraction surveys (Gras et al., 2007; McEvoy et al., 2006). Significant age differences in the likelihood of engaging in a particular distraction were found in the following categories: *using the in-car device*; *self-initiated internal tasks*; *eating or drinking*; *smoking related*; *outside distractions*; and *other activities*. None of older drivers reported engaging in *clothing/grooming* or *using a mobile phone or an add-on media device*. The results of our study suggest that older drivers' reluctance to engage in distracting tasks while driving may be their age-related prudence or a process of self-regulation, in that the older drivers may be aware of some functional decline and choose not to engage in activities that may increase the complexity of the driving task.

With regard to the mean duration of the undertaken secondary task, the largest difference between the two age groups was found in the duration of the interaction with the passengers. Older drivers seem to be more talkative while driving than their middle-aged counterparts. The question arises how older drivers are affected by the presence of passengers. Vollrath et al. (2002) reported a 28% reduction in the risk of a driver being responsible for a crash in the presence of passengers. A possible explanation for this finding is that older drivers use passengers as co-pilots to alert them to potential hazards. However, although Vollrath et al. (2002) showed that this benefit was strongest in some situations (e.g., keeping a safe distance from other cars), it was weaker in other situations (e.g., at crossroads, while overtaking). Similarly, Bédard and Myers (2004) reported that for drivers aged 65–79 years, the presence of passengers was associated with a reduced risk for some unsafe actions (e.g., driving the wrong way) but a higher risk of other actions (e.g., ignoring signs, warnings, or right of way). Hing et al. (2003) reported the results of an analysis of 4 years of crashes involving older drivers considering the effect of passengers on the crash-causing propensity of older drivers. The presence or absence of passengers was not found to affect the 65- to 74-year-old driver group. Overall, the presence of two or more passengers was found to negatively impact the probability that drivers 75 years of age or older were at fault in crashes (Hing et al., 2003). The results of these studies suggest that this topic requires further research.

Those drivers, who did not report engaging in certain distracting activities in the last half an hour of their driving trip, were asked if they undertake these activities occasionally. With the exception of two categories (*using the in-car devices* and *interaction with passengers*), middle-aged drivers were more likely to report

engaging in certain distracting activities than older drivers. Older drivers were more than twice as likely to report interacting with the passenger compared to middle-aged drivers.

Our results on perception of impacts of distracted driving are in line with the findings of Royal (2003). Both age groups rated *using the mobile phone hand-held* most dangerous while driving. *Other activities* (e.g., map reading, writing, animals-related, reaching/looking for objects inside vehicle) and *clothing and grooming* were rated to have the highest distraction as well. Middle-aged drivers rated most of the distracting activities as significantly less dangerous than the older drivers. These activities included *interaction with passengers*, *eating and drinking*, *using the mobile phone hand-held*, *self-initiated internal tasks and outside distractions*. There is a negative correlation between the frequency of engaging in distracting activities and the impact on driving safety of these distracting activities in both age groups. Not surprisingly, drivers who themselves engage in each activity are less likely to feel it makes driving more dangerous than those who do not engage in the activity. If drivers do not perceive the actions to be distracting or to make driving more dangerous, it is unlikely that they will make changes in their driving behavior either voluntarily or as a result of legislation. The real-world risk associated with a secondary task relates to the priority given by the driver to this task and the driving situations in which the driver is willing to engage in the task. Drivers' willingness to engage in secondary tasks is related to the benefits they associate with the secondary tasks. Many would claim that when driving is monotonous, secondary tasks may provide entertainment and arouse the driver to stay awake. It is also likely that over time drivers become so accustomed to driving while performing secondary tasks (e.g., listening to the radio) that the combination of primary and secondary task becomes the rule rather than the exception (Ranney, 2008).

Few differences were found between male and female drivers in terms of their exposure to distracting activities in the last half an hour of the driving trip. Female drivers were less likely than male drivers to report *using the in-car devices*, *eating or drinking*, as well as *smoking*. In terms of the occasional exposure to distracting activities, males were more likely to report *smoking* and *using a mobile phone hands-held or an add-on media device*. These findings are generally consistent with other research, which has found that males are more likely than their female counterparts to use a mobile phone while driving (McEvoy et al., 2006; Pöysti et al., 2005; Royal, 2003). The finding that females were three times as likely to report "being lost in thought" might suggest response bias. There were few differences between male and female drivers in their ratings of impacts of distracted driving. Males rated the following activities as significantly less dangerous than the females did: *interaction with passengers*, *clothing and grooming*, *using the in-car device*, *using a mobile phone hands-held or an add-on media device*, *self-initiated internal tasks and outside distractions*. These results are in line with other research, which has found that female drivers are more likely than males to believe that potentially distracting activities make driving more dangerous (McEvoy et al., 2006; Royal, 2003).

Although only a small percentage of older drivers rated *self-initiated internal tasks* (daydreaming, problem-solving, being lost in thought) as dangerous, most of the reported crashes among older drivers were due to this kind of inattention. It is important to keep in mind that these are self-reported data and are subject to potential recall errors, particularly as they cover a large time frame. Still, anonymous self-reported crash data has some advantages over archival data. For example, not all crashes are at a level of severity that would require reporting and/or recording by an insurance company or traffic enforcement agency. Arthur et al. (2001) found that more crashes were reported through self-reports than were recorded in "objective" archival data. Thus, self-reported data is not inherently inferior to archival data and could even be considered more accurate, as they can include all crashes, rather than just those above a certain severity level.

Special consideration should be given to the needs and limitations of older drivers with regard to the HMI-systems development. The introduction of high-tech displays and controls into vehicles may present more difficulties for older drivers than for others. Many older persons are unfamiliar and uncomfortable with new technologies, and may be overloaded by additional visual information on dashboards, especially in today's fast-paced, complex driving environment. Possible problems include difficulty reading small displays and manipulating small controls (Kline et al., 2002). It is important to know that improvements to human machine interface design may also have unintended effects. Lee and Strayer (2004) discussed the "usability paradox," which occurs when the improved design of an in-vehicle device makes it easier to use and thus less distracting. When drivers become aware of the increased ease of use, they may use the device more frequently, thus increasing their overall exposure to risk.

A number of limitations with the current study should be noted. First, a relatively small sample of drivers may reduce the power of the study to detect differences in distraction exposure. Second, as with any self-reported data, the current study data may be subject to self-reporting biases, such as social desirability effects (e.g., under-reporting) and limited or inaccurate recall. As Hatakka et al. (1997) point out, any self-report bias would underestimate drivers' involvement in distracting activities, not overestimate it. Subsequent follow-up research may consider the introduction of honesty and social desirability scales, to control for these potential confounds. However, another methodological issue is whether self-report bias is different for the two age groups. The supposition that the responses of older drivers could be affected more by self-report bias than those of middle-aged drivers might arise from the finding that middle-aged drivers were more likely to report engaging in certain distracting activities than older drivers. On the other hand, the following arguments might refute this assertion: The higher responder rate among older drivers in comparison to the middle-aged drivers; the fact that the number of participants who reported that they had not engaged in distracting activities during the last trip is comparable between the two age groups; and the finding that older drivers were more than twice as likely to report interacting with the passenger compared to middle-aged drivers.

The following questions would be interesting for the future research to better understand older drivers' behaviors and attitudes regarding distracted driving:

- What strategies, if any, do older drivers adopt in order to manage distraction?
- How are older drivers affected by the presence of passengers?
- How prevalent is the ownership and use of in-car advanced technology devices among older drivers?
- To which extent does the presence of in-vehicle technologies encourage unnecessary or incidental use while driving among older drivers?

Although older drivers are not currently overrepresented in distraction-related crashes, it is important to note that future cohorts of older drivers might differ in the way they engage with vehicles and technologies, which in turn may influence their driving patterns and willingness to engage in potentially distracting activities.

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