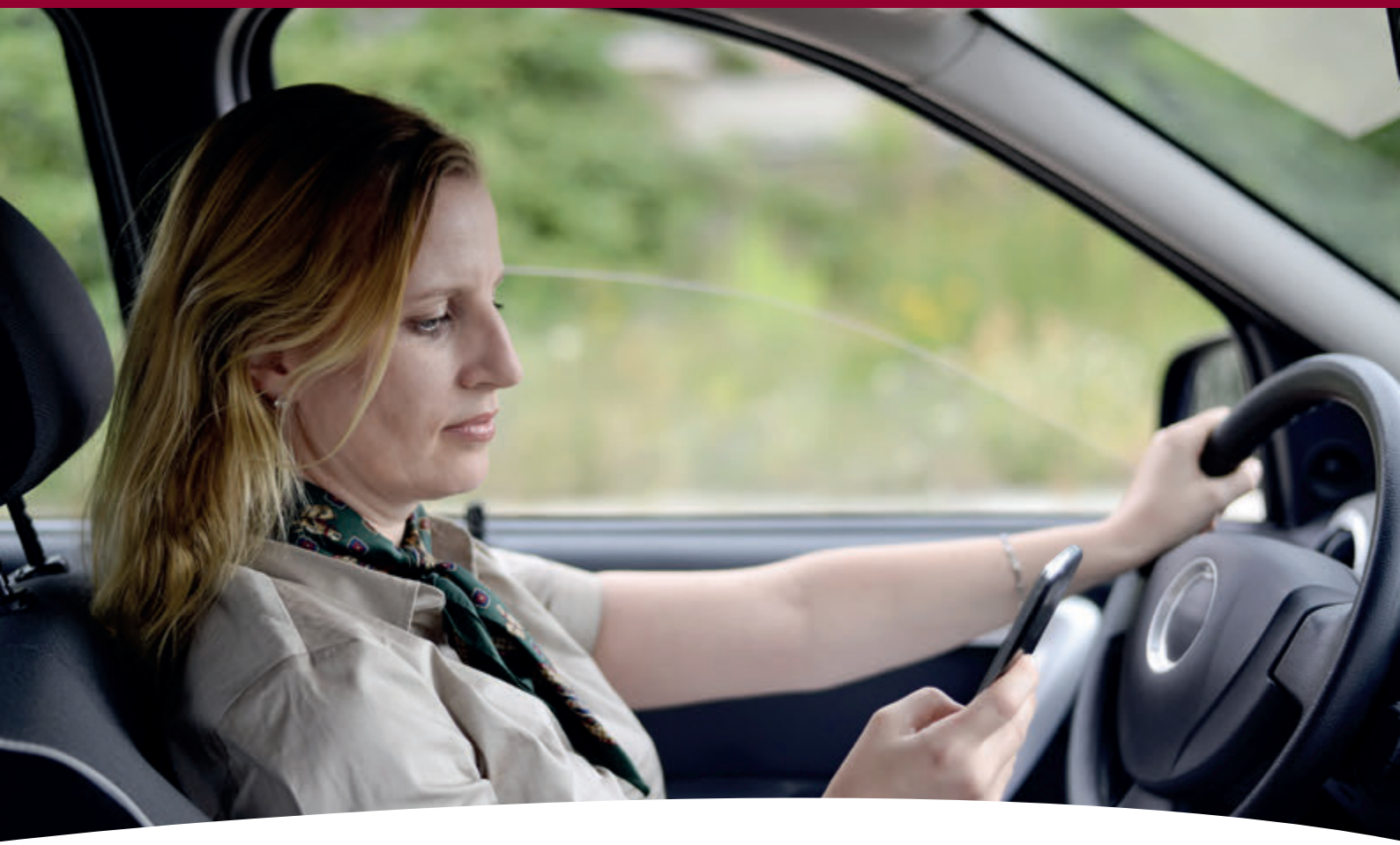

Driver distraction while texting

Compact accident research

Unfallforschung der Versicherer

GDV

Contents

Preliminary remarks

Smartphones are part of people's everyday lives. They use them all the time, wherever they are, even in the car. More and more drivers are text messaging or writing emails while driving, yet it is known that reading and writing text messages can have a negative impact on drivers' performance and increase the risk of accidents (e.g. greater deviation from the lane and slower reactions to sudden occurrences [1], [2]).

In previous research, participants have largely not been free to choose the situations in which they engage in text messaging while driving. Instead, they have been encouraged to write a text message at specific points on a route (generally in a driving simulator), regardless of whether they would normally have done this in real traffic.

At the same time, research studies also show that drivers invariably make an assessment of the traffic situation before deciding to read or write text messages, and they proceed according to the requirements of the driving situation. This suggests that previous findings on the consequences of reading and writing text messages while driving do not adequately reflect what actually happens on the roads. However, the fact that drivers adjust their text messaging behavior depending on the traffic situation does not rule out the possibility of negative consequences of drivers being distracted. It is not clear whether their subjective assessment of the driving situation is actually correct and meets the requirements of the driving situation. It is also not clear to what extent new technical developments such as speech recognition have an impact on driving performance and drivers' reactions. There are at least indications that speech recognition can have a positive impact on driving performance and reactions compared to manual input [3], [4].

Research questions

The UDV (German Insurers Accident Research) commissioned Chemnitz University of Technology to carry out a study that investigates the effect of texting while driving on driving performance as realistically as possible [5]. Again a driving simulation was used, among others. However, in this study participants were able to decide for themselves when to read or write text messages during the driving simulation.

The following research questions were investigated:

(1) When are drivers willing to engage in text messaging while driving?
(2) How does text messaging affect driving performance in general (e.g. speed selection, staying in lane)?
(3) How does text messaging affect reactions in critical driving situations (e.g. reaction times, distances)?

Methodology

A number of different methods were used to answer these three research questions (Table 1).

Study design

First, traffic situations in which drivers are willing to read or write text messages were identified. For this, a literature review was carried out, the data of a large American naturalistic driving study (SHRP2) was reanalyzed, and a video-assisted interview study was conducted with drivers known to engage in text messaging while driving in principle.

Tabel 1: Study design

	Research question	Method
1	When are drivers willing to engage in text messaging while driving?	• Literature review • Reanalysis of the data of the SHRP2 naturalistic driving study • Video-assisted interview study
2	How does text messaging affect driving performance in general?	Driving simulator study
3	How does text messaging affect reactions in critical driving situations?	Driving simulator study

In the subsequent driving simulator study, a route was created with driving situations that encouraged drivers to text while driving. The aim was to investigate driving performance and reactions to critical traffic situations while texting in situations that they believed to be suitable for texting.

Driving simulator study

Route

The route was designed to encourage drivers to engage in text messaging while driving. Driving situations were selected that were known to be situations in which most drivers would engage in text messaging. The following potentially critical situations were also included in the simulation:

- a roadworks site that was difficult to see
- a child running onto the road

Figure 1: Critical situations on the route in the driving simulation with/ without information in advance

These two potentially critical situations were implemented both with and without information in advance (Fig. 1).

In addition, relevant but non-critical information was presented in two different scenarios (Fig. 2):

- 30 km/h speed limit signs where the previous speed limit had been 50 km/h

Figure 2: Relevant but non-critical information on the route in the driving simulation (a 30 km/h speed limit sign)

Secondary tasks

In addition to text messaging by manual smartphone use, text messaging by speech recognition was investigated. That reflects the recent revision of the German Road Traffic Regulations (StVO, §23, Para 1), which excludes speech-based systems from the ban on using smartphones while driving.

Thus, there were four different forms of text messaging (referred to below as a secondary task):

- writing
- reading
- voice input
- voice output

Table 2: Sample size for each experimental condition (N=82)

	Women		Men		Total	
Condition	***N***	***M age(SD)***	***N***	***M age(SD)***	***N***	***M age(SD)***
no ST/no ST	9	35.0 (10.9)	8	32.0 (13.1)	17	33.6 (11.7)
reading/writing	9	24.7 (5.5)	8	29.9 (8.2)	17	27.1 (7.2)
writing/reading	7	26.1 (3.7)	9	28.8 (6.5)	16	27.6 (5.4)
voice output/input	8	26.5 (3.6)	8	27.5 (4.0)	16	27.0 (3.7)
voice input/output	8	39.5 (13.3)	8	32.4 (10.0)	16	35.9 (11.9)
ST = secondary task						

The participants read and wrote text messages using their own smartphones. Speech recognition was implemented by an integrated touchscreen in the center console. The speech recognition system was designed as a flawless, error-free system (e.g. the system did not ask the driver to confirm or correct what he/she had said).

The control group consisted of drivers who did not perform any secondary tasks.

Procedure

The participants were instructed to drive as "naturally" as possible and not to violate traffic rules. They should not be in a hurry, but they also should not drive too slowly either. The participants drove two times in the driving simulator with a different secondary task each time (e.g. reading during the first drive and writing during the second). In addition, they completed questionnaires and rated selected driving situations on how demanding they are. An experiment lasted a total of 90 to 120 minutes.

Sample

82 participants (41 men and 41 women) completed the whole experiment. The average age of the participants was 30 years (Table 2). The participants were experienced drivers and proficient smartphone users. They also reported regularly reading and writing text messages while driving.

Results

When are drivers willing to engage in text messaging while driving?

The results indicate that the complexity and predictability of the driving situation determine whether drivers engage in text messaging. The participants stated that they were less likely to use their smartphone in complex situations or situations that required them to be particularly attentive. That applies for example to stretches of road with a number of bends, driving under difficult lighting conditions or limited visibility, driving in heavy traffic, at high speeds or when other road users are present. If these circumstances are not present, the drivers were quite willing to write or read a text message.

How does text messaging affect driving performance in general?

The driving simulator study revealed only minor impairment of general driving performance by text messaging. The participants drove more slowly in some parts of the route where they were carrying out a secondary task compared to sections with no secondary task. Occasionally there was slight variation in the driver's lane position when they were carrying out a secondary task. There was not difference between manual smartphone use or using the speech recognition system.

In situations in which drivers were required to reduce their speed to 30 km/h (30 km/h speed limit sign), no systematic differences were found between drivers with or without a secondary task. In the park-like scenario, the speed limit sign could only be seen very late. Therefore, drivers were forced to reduce speed abruptly. In this case, drivers writing a text message reacted later than those without a secondary task.

How does text messaging affect reactions in critical situations?

The results for the potentially safety-critical situations (a roadworks site that was difficult to see and a child running onto the road) were inconsistent. No collisions or near collisions occurred in the roadworks site scenario. In the scenario where the child ran onto the road, in almost 40 percent of the situations there was an accident or near accident. Most accidents or near accidents occurred when drivers were writing text messages. There were hardly any differences between driving while engaged in the other secondary tasks (reading, voice input and voice output) or between driving without a secondary task.

There were no systematic differences between the different secondary tasks and driving without a secondary task with regard to reducing the pressure on the gas pedal or pushing the brake pedal. However, there was a tendency for participants who were writing a text message to perform worse compared to those engaged in the other secondary tasks.

As expected information in advance indicating potentially critical situations (a warning sign about the roadworks or a ball rolling onto the road before the child) positively affected driver's reactions, regardless of the type of secondary task. There were no systematic differences between drivers with or without a secondary task if they were supposed to reduce speed (speed limit 30 km/h, point in time when they reduced speed). Occasionally, drivers writing a text message reacted more slowly.

In general for the secondary tasks except writing text messages driving performance did not differ significantly from driving performance without a secondary task. Especially for speech recognition this result was unexpected. We assumed that speech recognition would permit drivers to react more quickly compared to using their smartphones manually. We also assumed that drivers using speech recognition would react more slowly compared to drivers without a secondary task. However, the findings do not support these hypotheses. Driving per-

formance with speech recognition did not differ systematically from driving performance when reading text messages. At the same time, there were also no systematic differences between speech recognition and the control group driving without a secondary task.

The demands imposed on drivers during driving

The demands imposed on drivers by driving in the driving simulator were examined using six selected traffic situations from the driving simulation. The participants were asked to rate how demanding they experienced each situation on a scale from 0 (not demanding at all) to 150 (more than extremely demanding). The situations were rated from "not very demanding" to "somewhat demanding" (the highest rating being 55 out of a maximum of 150). That includes the situations that proved to be critical in the course of the drive.

Conclusions

Drivers find less complex and predictable situations to be more suitable for texting than complex traffic situations. This was revealed by the first three studies and confirmed by the driving simulator study. In the driving simulator, drivers often refused texting in bends even on a route that was designed to encourage them to engage in texting. Apparently drivers indeed assess the traffic situation before they decide for or against texting while driving. They adapt their behavior to the perceived requirements of the traffic situation.

For critical situations, there were hardly any differences between manual or speech-based text messaging while driving and driving without a secondary task. This is in contrast to previous studies on the impact of driver distraction on driving performance. A possible explanation is that the driving simulator route implemented was too simple. The driving simulator route was designed to encourage the participants to engage in text messaging. In other words, it was as simple as possible and largely predictable (except for the two critical situations). This was confirmed by the participants. Most traffic situations in the simulation were rated as being "not very demanding" or "somewhat demanding". As a consequence the driver of the control group who did not perform a secondary task might have become unchallenged and inattentive during their drive.

The Yerkes-Dodson law [6] states that people perform best at a moderate level of physiological and mental arousal. Levels of arousal that are too low or too high are associated with poorer performance. The very low level of the demands imposed on the drivers by the route may therefore have had a negative impact on the drivers who did not carry out a secondary task. Given this background, it is reasonable to suspect that the drivers in the control group (those without a secondary task) were operating below their optimum level of performance. That may also explain why drivers are able to complete secondary tasks in undemanding driving situations without impairment of driving performance as found in previous studies.

Summary

Most drivers believe that texting while driving is not dangerous. Indeed mostly there are no negative consequences for texting while driving. Because of the lack of negative consequences drivers learn that texting is probably not as dangerous as often claimed or at least that they are able to control the level of risk they take. Consequently, they become accustomed to text messaging while driving, also in more demanding traffic situations. Road safety communication needs to challenge this control illusion or even better to prevent it developing in the first place.

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