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INTERNAL DISCTRACTION AND DRIVING: DOES IT SHOW?

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Summary: The effect of daydreaming ('internal distraction') on driving behavior little is known. Since it happens to some extent to most drivers, an explorative study was performed to see whether in an experimental setting something like daydreaming could occur, and if so whether this would show up in driving behavior. Three groups of participants made two drives in the TNO driving simulator. Group 1 did not perform any secondary task, Group 2 performed a 'thinking and reasoning' task (daydreaming condition) during specific parts of the drive, and Group 3 performed a 'listening and remembering' task during the same sections of the drives as Group 2. Mostly an effect was found for the 'listening and remembering' task. If an effect was found for the internal distraction condition, it indicated a same (negative) effect as the 'listening and remembering' task, although less severe.

It is not that difficult to get distracted while driving. Both outside and inside a vehicle there are enough opportunities to get involved in other non-driving related tasks. Drivers who are distracted may fail to notice changes that are of importance for the driving task, or see them too late to react on time. Distraction can have an external source (telephone conversation, tuning the radio) or an internal source (daydreaming). External distraction has already received quite some attention (see, e.g., Ady, 1967; Alm & Nilsson, 1995). And also internal distraction is a relevant research topic (see, e.g., Recarte & Nunes, 2003). However, internal distraction in the sense of daydreaming is not often the topic under investigation, probably because it is difficult to achieve. (see Karrer et al, 2005; Vlakveld, Aarts, & Mesken, 2005). In this study we tried to get participants in a state of daydreaming and compared that condition to a normal driving condition and a condition in which participants had to perform a secondary 'external distraction' task. This paper describes some results on an overall level and some on an individual level (for all results see Martens & Brouwer, 2006)

METHOD

A between-subjects design was used to compare three different conditions (20 participants in each condition). In the first condition, participants did not receive any task. In the second condition, before the drive participants received a description of a police investigation. They were instructed that at a certain point in time during their drive they would be asked to form hypotheses about what had happened. They had five minutes to form hypotheses. After the drive they had to formulate their hypotheses. In the third condition, participants had to perform a listening and remembering task in which they had to count certain sounds among other sounds (Östlund et al, 2004). This task also lasted five minutes. Participants drove two drives on a motorway, and each drive lasted 20 minutes. In both drives participants in Condition 2 and 3 performed their secondary task. Between the two drives there was a short break. During this break participants in the second condition got additional information about the police

investigation. Each drive was divided into three sections of five minutes. In Section 1, no task had to be performed in any of the conditions, while in Section 2, participants in Conditions 2 and 3 had to perform their task. In Section 3 no one had to perform a task.

While driving, the maximum speed on the highway varied, which was indicated by traffic signs. Each drive started with a maximum speed of 120 km/h and this changed six times (the other speed limit was 100 km/h). Participants were instructed to follow the speed limit as closely as possible and to stay as much as possible in the right lane.

In all conditions, in the second drive, a leading vehicle suddenly braked. For the participants in Condition 2 and 3 this happened when they were involved in the secondary task

The following dependent variables were analyzed with respect to driving behavior:

- longitudinal: deviation from maximum speed, average speed, standard deviation speed, maximum and average deceleration, time headway, distance headway, time-to-collision (TTC)
- lateral: lane changes, lateral position, standard deviation lateral position, time-to-line crossing (TLC)
- steering effort: steering reversal rate three degrees
- visual: looking into mirrors
- subjective estimation of attentional involvement (1 indicating not attentive and 10 completely attentive).

Some physical measures were also taken (EOG, heart rate), but these will not be discussed here.

An ANOVA with three factors was used to analyze the data, Condition (no distraction, internal distraction, external distraction), Section (the three sections) and Drive (two drives). Only the significant interactions between Condition and Section will be presented.

RESULTS

Rating attentional involvement

In order to have an indication of whether participants were distracted while performing the secondary task, they were asked to rate their attentional involvement in the driving task after the different sections. So for each condition and each drive, two ratings were for driving without a secondary task (Sections 1 and 3). One rating was related to performing the secondary task for Condition 2 and 3. Thus, for Condition 1, all ratings applied to driving without a secondary task.

Figure 1 shows the average subjective scores for each combination section of a drive (Section 1, 2 [with task] or 3) and condition (Condition 1, 2 or 3). No main effect of Condition was found, which shows that there was no group that scored higher than the other groups. An interaction between Condition and Section was found [$F(4,114) = 16.61, p < 0.0001$]. This interaction is presented in Figure 1 and shows that subjectively, participants indicated they were less attentively involved in the driving task when performing a secondary task.

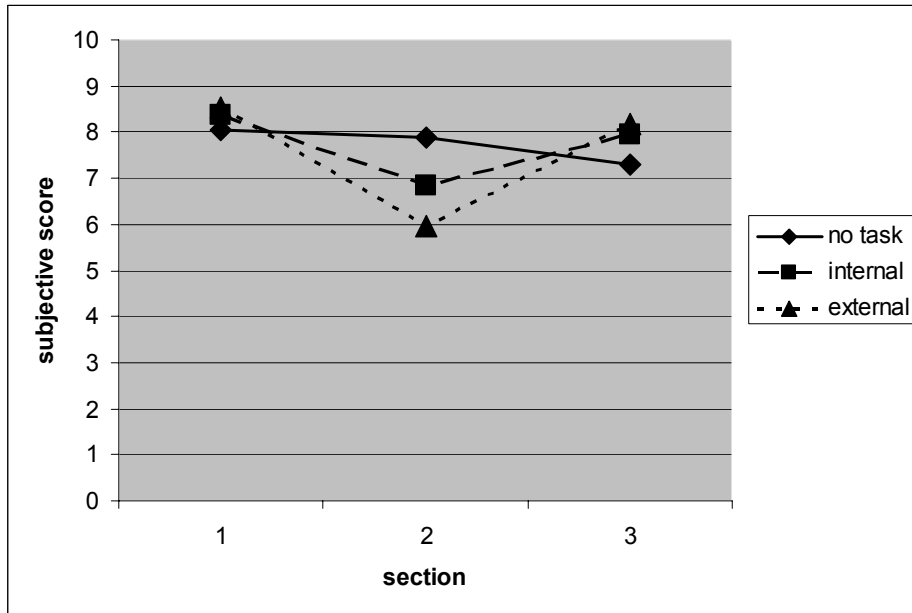


Figure 1. Average subjective scores of attentional involvement in the driving task

Overall driving behavior

An interaction effect between Condition and Section was found for the standard deviation of speed [$F(4,114) = 2.72, p < 0.03$]. This interaction is shown in Figure 2. The standard deviation increases in Condition 3 when participants performed the listening and remembering task (in Section 2).

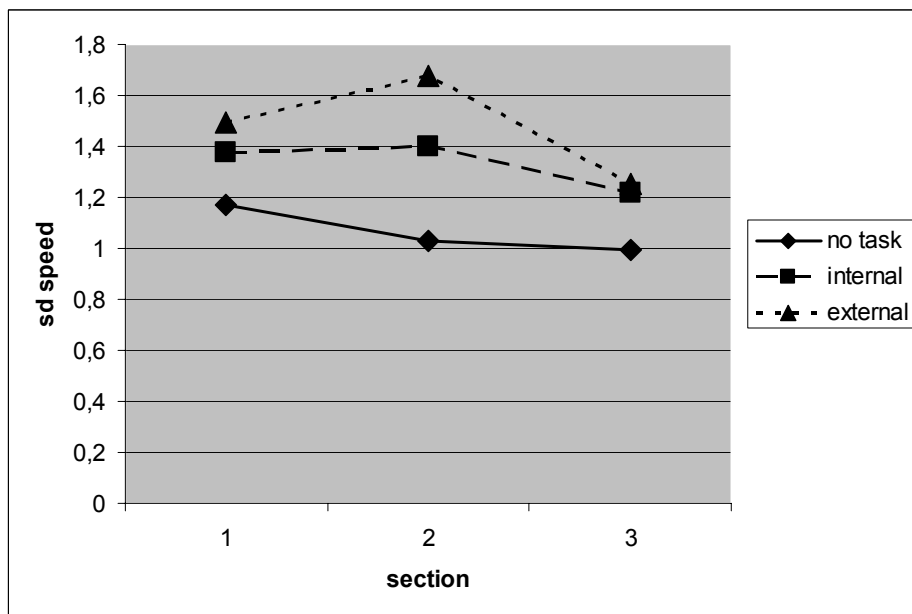


Figure 2. The average standard deviation of speed for the different drives, sections and conditions

An interaction effect was also found for the steering reversal rate which indicates steering effort [$F(4,114) = 2.56, p < 0.05$]. The interaction is presented in Figure 3 and shows that the steering effort for participants in Condition 3 while performing the secondary task increases; this is not the case for participants in Condition 1 and 2.

The number of times participants checked their mirrors (inside and outside) was counted. An interaction was found between Condition and Section [$F(4,112) = 4.81, p < 0.001$]. The interaction shown in Figure 4 shows that number of times that the mirrors were checked decreased when a secondary task was performed (in Condition 2 and 3).

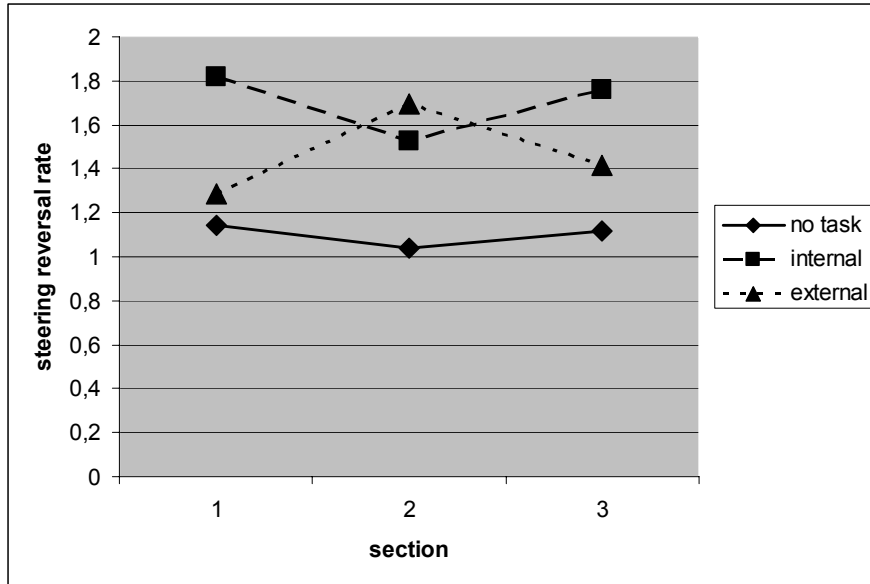


Figure 3. The average steering reversal rate for the different drives, sections and conditions

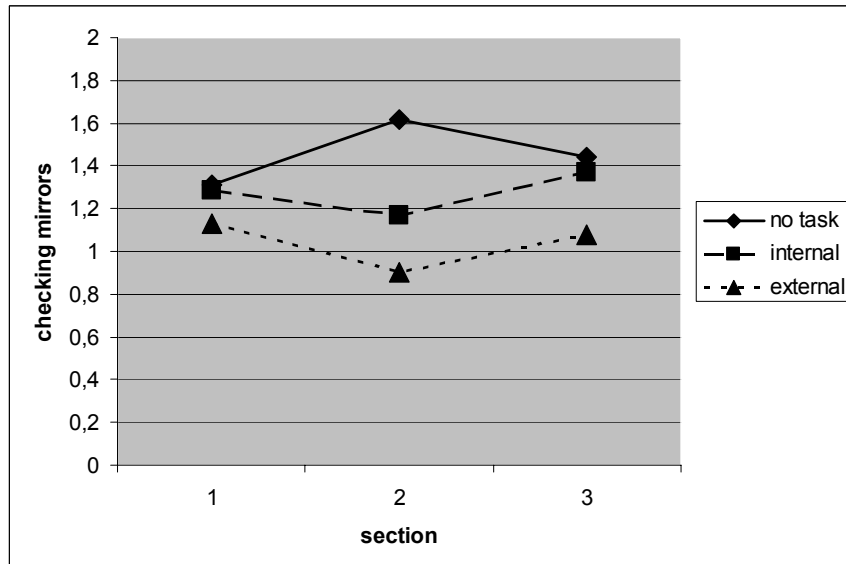


Figure 4. The average number of times the mirrors were checked for the different drives, sections and conditions

Individual differences

The analyses over all participants showed very few effects. However, individual differences may be quite high and therefore a few extreme scores were analyzed. For example, one participant in Condition 2 (Participant 22) gave high ratings on attentional involvement (a nine and a seven) when driving without the internal distraction task while the rating for driving with this task was quite low (a three). The data of this participant were analyzed. The deviations from the maximum speed are presented in Figure 5 (each point indicates 10 sec of driving). This figure also shows the deviations from maximum speed for a participant in Condition 1 (no task; Participant 2) who scored all sections the same (a seven).

While not performing the internal distraction task, Participant 22 first drives above the maximum speed then below. Participant 2 in general drives the same speed, which is approximately 10 km/h above the speed limit. When performing the internal distraction task, the speed of Participant 22 is always lower than the maximum speed. So the lower attentional involvement of Participant 22 when performing the task results in decreased performance in keeping the speed limit.

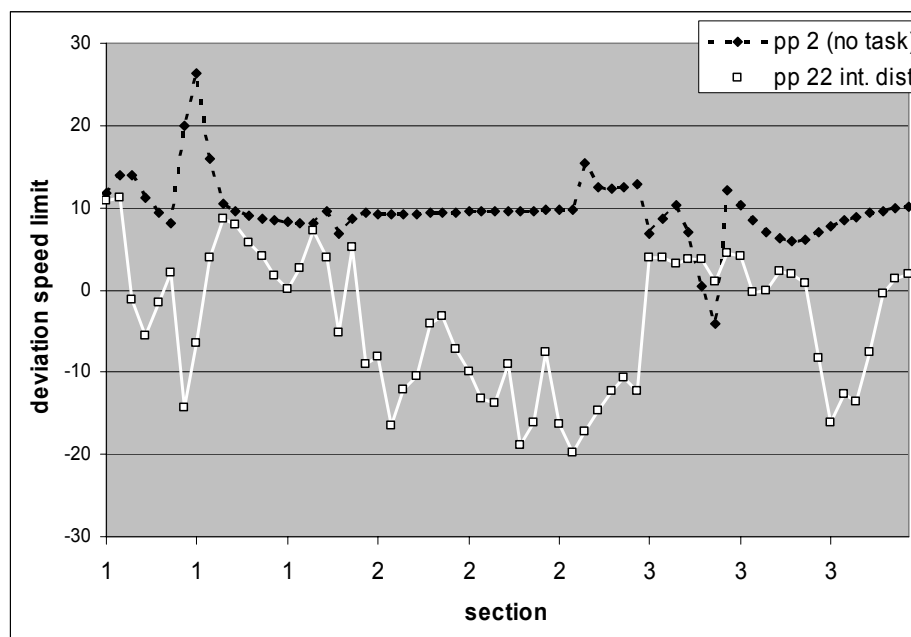
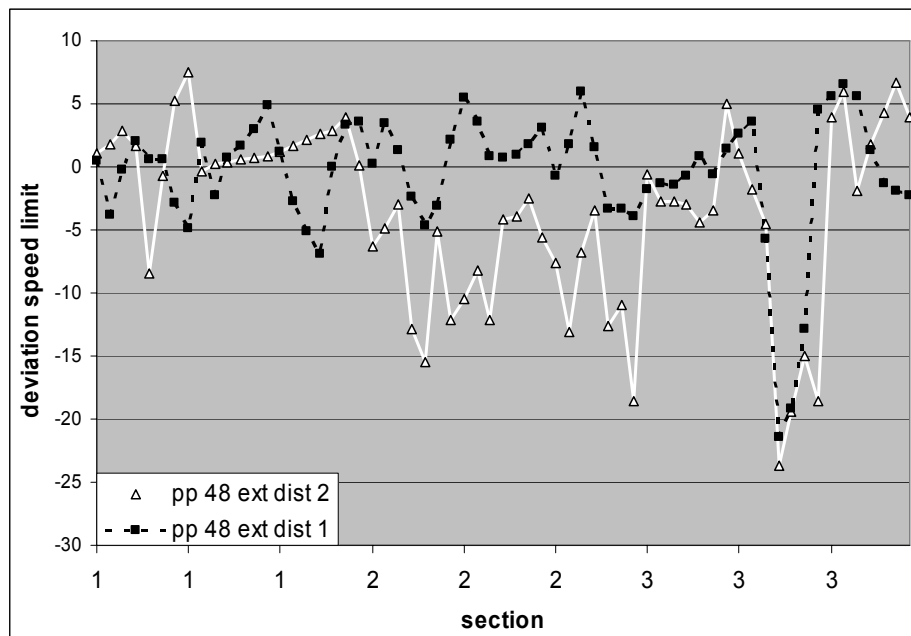


Figure 5. Deviations from maximum speed for Participant 2 (no task) and Participant 22 (internal distraction)

However, also on the individual level there were participants who reported a low level of attentional involvement, which did not always show in the driving behavior, not even within a participant. Participant 48 (external distraction), for example, rated driving without the task in the first drive a nine and an eight, while driving with the task a three. In the second task, ratings were almost the same—a nine and an eight for driving without the task and a two with the task. However the influence of the secondary task only seems to show in the second drive (see Figure 6). In the second drive while performing the task, the speed remains below the speed limit. However this is clearly not case in the first drive.



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