Effects of driving experience depending on simulated driving task's difficulty

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Abstract –

Young drivers are overrepresented in road accident linked to driver distraction. We experimentally tested the hypothesis of an interaction between driving experience and distraction with a dual-task paradigm. The interference between simple task and dual task was assessed for three groups of drivers with different driving experience. Results showed that response time (braking) and standard deviation of lateral position decreased with driving experience, conversely the percentage of correct responses increased. Results are interpreted in terms of psycho-socio-cognitive differences.

Key words: *Driving experience; Novice driver; Distraction; Dual-task.*

1. Introduction

Driving is a dynamic complex task which implies to simultaneously perform several sub-tasks, like looking for the information in the visual scene and keeping lane. So, drivers are often in situation of divided-attention, notably when a secondary task (for example using mobile phone) distracts them. Thus attentional processes play an essential role in driving activity which is confirmed by the fact that driver distraction is an important factor of road-crashes. Distraction is present "whenever a driver is delayed in the recognition of information needed to safely accomplish the driving task, because some event, activity, object, or person within [or outside] his vehicle, compelled or tended to induce the driver's shifting of attention away from the driving task" (Treat, 1980, pp. 21, in Reg[1]). More recently, Hoël (2010) define the distraction as the interference between the driving task and a secondary motor or visuo-spatial task. Many researches were interested in the effects of various distractive tasks on driving behaviour but only few investigated the influence of moderating factors like attentional requirement of the task and the amount of free and available resources to carry out the task.

Firstly, we assumed that the higher the task's attentional requirement, the higher the effects of distraction would be. Secondly, as the processes necessary to safely drive become automatic with the practice, the more the drivers is experienced, the more they have free resources to process the information necessary to succeed the driving task. We thus postulated that experienced drivers had more available attentionnal resources than novice drivers to perform a secondary task. These resources must progressively increase depending on driving experience.

2. Method

2. 1. Subjects

Three groups of drivers: young novice (18 years, 4 months of driving license), young experienced (21 years, 36 months of driving license which corresponds, in France, to the end of the period of probationary license), more experienced (30 years, at least 8 years of practice).

2.2. Experimental design

Participants were submitted to a dual-task paradigm in a driving simulator. It consisted in performing a car-following task combined with a numbers identification task. In the main task, drivers had to maintain a fixed distance (30 meters) with a lead vehicle which speed varied. The secondary task consisted in the identification of odd or even numbers in the central or in the peripheral visual field. Performance in the car following task was assessed by objective measures (inter-vehicular distance, standard deviation of lateral position on the lane (SDLP), response time that is press on the brake pedal when the lead vehicle decelerated, time to reach the same speed that the lead vehicle). Performance in the numbers identification task was measured by response accuracy and response times.

2.3. Statistical analyses

Dependent variables were submitted to ANOVA with repeated measure as a function of driving experience (3 groups) and task (simple vs dual).

3. Results

ANOVA revealed a significant main effect of the task attentionnal requirement. The analyzes highlighted an impairment of performance in dual task compared to car-following single task on the time necessary to reach the same speed that the lead vehicle ($F(1,31) = 8.85$, $p < 0.005$, respectively m = 11.04 s and 10.34 s) and on the mean inter-vehicular distance ($F(1,31) = 4.61$, $p < 0.05$, respectively 54.92 m and 50.08 m). The percentage of correct responses ($F(1,31) = 24.87$, $p < 0.001$) also decreased (respectively m = 87% , m = 91.2%) and the percentage of omission increased ($F(1,31) = 24.87$, $p < 0.001$, respectively m = 6.1% and m = 2.9%) on dual task. An interaction between task and numbers location (central vs peripheral) (correct responses $F(1,31) = 12.77$, $p <0.005$ and omissions $F(1,31) = 11.33$, $p < 0.005$) showed that these impairments in dual task occurred only when the numbers appears in peripheral vision.

ANOVA also revealed a significant decrease of time to brake and of standard deviation of lateral position (SDLP) ($F(2,31) = 8.22$, $p < 0.005$) with driving experience (Figure 1). Conversely, the percentage of correct responses ($F(2,31) = 4.91$, $p < 0.05$) increased with driving experience (86.2% after 4 months of practice, 90% after 36 months, and 91.4% after 8 years).

4. Conclusion

Just licenced drivers seem to distribute their attentionnal resources in an inappropriate way. This outcome is consistent with previous research on distraction among young novice drivers (Stu[3], 2001; Met[4], 2011). Attentional abilities after 36 months of practice don't seem differ significantly from those after 8 years of licensing. In an applied viewpoint, the training to divide the attention of novice drivers in driving simulator could have benefits on the driving behaviour.

Figure

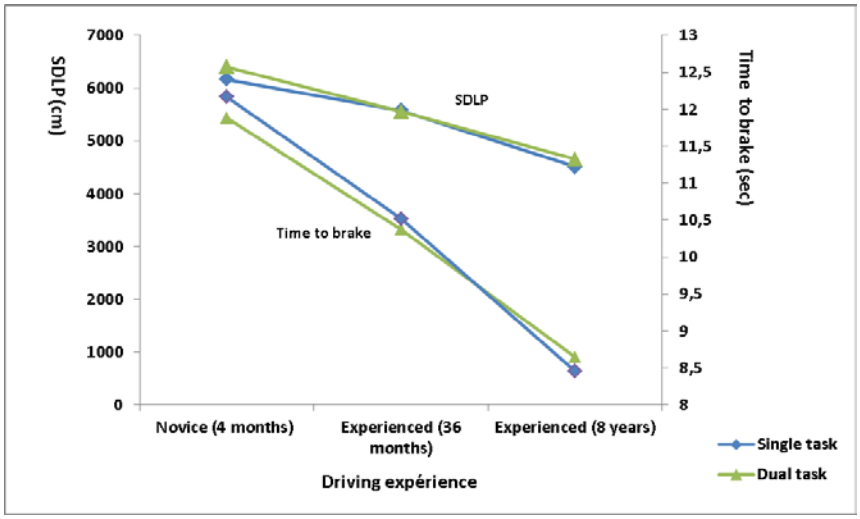

Fig.1. SDLP and time to brake as a function of task and driving experience.

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