Detection of mind-wandering in driving: contributions of cardiac measurement and eye movements

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In 2014 in France, there are still over 3,300 killed on our roads(ONISR, 2015). Many studies have highlighted inattention as a contributing factor for 25 to 50% of injury accidents(Mosedale*et al*, 2005; Galéra*et al*, 2012). Distraction can be defined as a diversion of attention away from critical activities to competitive ones while inattention can be defined as a state inducing endogenous shift of attention (LemercierandCellier, 2008).The term inattention gathers different states such as cognitive overload or **Mind-Wandering (MW), defined asa shift in the contents of thought away from an ongoing task to self-generated thoughts and feelings** (Smallwood and Schooler, 2015).

MW is a recurring phenomenon in driving, four drivers out of five declare being aware of MW on their last journey and feel being in this state for more than a third of the time (Berthié*et al*, 2015). According to Killingsworth and Gilbert (2010), this state represents nearly 50% of our daily life thoughts. It's therefore necessary to study this phenomenon to limit its impact on driving.**During mind-wandering, drivers suffer from a perceptual decoupling corresponding to the capacity for the mind to flexibly disengage attentional processes from sensory input** (Smallwood and Schooler, 2015). MW has many consequences on the driving activity. Being in MW would improve the risk to be considered responsible for a road accident (Galera*et al*, 2012). Conducted by He*et al*. (2011), **the very first study confirmed the perceptual decoupling by revealing a change in the driver's visual scanning of the road during MW episodes**. MW also leads to adecrease of speed micro-regulations and larger deviations in the vehicle's lateral position (Lemercier*et a*l, 2015). Several techniques have been used to identify MW episodes using eye gaze (Uzzaman and Joordens, 2011) and variability in lane position (Gabaude*et al*, 2012).

Thus, cardiac and gaze data have been recorded during simulated driving sessions. Participants were asked to (a) self-report their wandering thoughts when they were aware of itwhile driving and (b) thinking aboutinnovation in specific driving phases. **The results obtained after analysis shown an increase in the gaze fixity during MW episodes.** Different time-window have been set up to explore gaze behavior during inattention phase. It appears that the fixity rates is higherin the last second before the self-report (a). These results haven't been highlighted when drivers were thinking about innovation. Indeed, participants had to think about a topic on a longer time. This can explain a higher fixity rate before participants resolve the task than after on a wider time-window. **These results could foster the gaze fixity rate as a MW objective indicator.**Thus, this physiological indicator could be used to improve the detection of MW through data fusion and then warn drivers about their own state. Indeed, cardiac data collected here have not been analyzed yet butseveral indicators could be highlighted from this signal to improve our capacity to detect MW, this direction will also be explored.

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