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The relationship between mind wandering and dangerous driving behavior among Chinese drivers

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ABSTRACT

Although mind wandering as a cognitive distraction is universal in our daily driving, very few studies have focused on the impact of mind wandering on driving behavior. In this study, the relationship between mind wandering during everyday life and dangerous driving behavior was investigated. 295 drivers completed the Mind Wandering scale (MW), the Dula Dangerous Driving Index (DDDI), and Demographic questionnaire. The results showed that the frequency of mind wandering was positively correlated with risky driving, aggressive driving, negative cognitive/emotional driving and drunk driving as measured by the DDDI. In addition, drivers' mind wandering was also positively correlated with self-reported traffic accidents, penalty points and fines. Moreover, the interaction effects of mind wandering and gender on dangerous driving behavior were also explored. In the high mind wandering group, male drivers reported more risky and negative emotional driving behaviors than did female drivers, but there were no significant differences in the middle and low mind wandering groups. Also, male drivers reported more penalty points and fines, but were involved in fewer accidents than were female drivers. These results present considerable implications for road safety and strategies for self-regulation of mind wandering.

1. Introduction

Mind wandering is a common mental activity, which is experienced by everyone, to some extent. It usually occurs when attention is distracted away from an external task toward internally focused mentation (Singer, 1966; Smallwood and Schooler, 2006). For example, during a meeting or lecture someone may suddenly realized that he had been thinking of something completely unrelated to what the speaker had been saying. Mind wandering, also known as daydreaming, refers to a kind of spontaneous and task unrelated thought, which may involve a failure of cognitive control (Antrobus et al., 1966; Carriere et al., 2008; Gold and Reilly, 1985; Klos and Singer, 1981; McVay and Kane, 2010). It is a frequent experience for most people, with evidence suggesting that it occupies 30–50% of our waking hours (Killingsworth and Gilbert, 2010; Song and Wang, 2012). But mind wandering occurs at some cost, being associated with disrupted performance on sustained attention, working memory and reading tasks (McVay et al., 2009; Smallwood et al., 2008a). Driving as a complicated task needs drivers to concentrate on it, but all drivers experience occasional drifting of their mind to internal thoughts, a temporary "zoning out" that might dangerously distract them from the road (Galéra et al., 2012). However, there are only a few studies which have focused on the relationship between mind wandering and driving behaviors. One study explored the effect of mind wandering on driving outcomes by interviewing drivers who had been injured in a traffic crash (Galéra et al., 2012). It found that mind wandering while driving can jeopardize the ability of the driver to incorporate information from the environment, thereby threatening safety on the roads due to decoupling attention from visual perceptions. This study was conducted in a hospital, where interviews were done with patients who had been injured in a road traffic crash in the previous 72 h. During the interview, patients were asked to describe their thought content just before the crash. The results showed that over half of the drivers reported some mind wandering just before the crash. The authors also mentioned that retrospective self-reports might have underestimated the prevalence of mind wandering during driving because of incomplete recall or desirability bias toward the interviewer. But the conclusion is limited because there was no control condition. For example, there was no data about the mind wandering of drivers who had not been involved in a crash.

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One important perspective of related research is viewing mind wandering as a kind of driver distraction. Driver distraction can be defined as the diversion of attention away from activities critical for safe driving toward a competing activity (Stutts et al., 2001). According to the sources of distraction, the National Highway Traffic Safety Administration (NHTSA) classified driver distraction into four categories: visual distraction (e.g., looking away from the roadway), auditory distraction (e.g., responding to a ringing cell phone), biomechanical distraction (e.g., manually adjusting the radio volume), and cognitive distraction (e.g., mind wandering) (Ranney et al., 2000). Previous studies have demonstrated that driver distraction impairs driver performance (Farmer et al., 2010; Horberry et al., 2006; Matthews et al., 2003; Violanti and Marshall, 1997) and is a significant risk factor for crash involvement (Castro, 2008; Klauer et al., 2006; Dingus et al., 2006; Stutts et al., 2001; Redelmeier and Tibshirani, 1997). Neyens and Boyle (2007) analyzed the relationships between four types of distractions (cognitive, cell phone, in-vehicle, and passenger-related) and three types of accidents (angular collision, rear-end, and fixed object) among teenage drivers. The results showed that different kinds of driver distraction have varying effects on different kinds of collision. Cognitive distraction more likely resulted in a rear-end crash and angular collisions compared to fixed-object collisions. These results were obtained by analyzing a crash database in the USA, but need to be evaluated with caution as there were a limited number of related cases in the database.

Two studies inspected directly the effect of mind wandering on driving behavior in simulated driving. He et al. (2011) asked drivers to report any time they caught themselves mind wandering while they were completing a car-following task in a high-fidelity driving simulator. The result found that drivers who were mind wandering tended to fail to monitor the environment, tended to focus visual attention narrowly on the road ahead, spent less time gazing at the side mirrors, decreased speed and increased headway distance. Another study developed an internal cognitive process task to compare the effect of mind wandering on driving behavior to the effects of a sound and speech task. A control group was also included in the experimental design. The results showed that mind wandering has the same negative effect on driving behavior as visual and auditory distraction. It resulted in a slightly slower mean speed, and fewer glances in the mirror, because the drivers paid less attention to the driving task due to their own thoughts (Martens and Brouwer, 2013).

However, there are some limitations in existing studies. The first limitation concerns the measurement of mind wandering during simulated driving. Some studies ask drivers to report their mind wandering while they are completing a driving task (e.g., He et al., 2011; Martens and Brouwer, 2013), so they need to monitor their own thoughts and report episodes of mind wandering. However, they cannot separate the effect of mind wandering on driving behavior, from the influence of monitoring and reporting the mind wandering episodes. On the other hand, mind wandering might occur without a driver's conscious awareness and performance changes may have occurred before a report of self-caught mind wandering. Previous research has found that participants were not aware or failed to report they were mind wandering (Schooler et al., 2005). So it is very difficult to measure mind wandering during a driving task. Second, most previous studies measured the frequency of mind wandering in a specific scenario, and evaluated the influence of mind wandering on immediate task performance (Galéra et al., 2012; He et al., 2011; Martens and Brouwer, 2013). Recent studies have shown that when the driving situation is too complex (Becic et al., 2010) or when the processing of their thoughts is too demanding in processing resources (Lemercier et al., 2014), then people make fewer reports of mind wandering. However, spontaneous mind wandering occurs more often in real-life settings than in an experimental situation, and it may be considered as a stable characteristic. So instead of studying mind wandering in specific laboratory scenarios, an alternative method is to measure the frequency of mind wandering in everyday life to explore the relationship between mind wandering and self-reported driving behavior and accident involvement. To our knowledge, no similar research has been reported till now. In addition to mind wandering involving "task-unrelated thought" (Smallwood et al., 2004), its influence on a driver may be similar to negative emotional thoughts. Research on the impact of negative emotional thoughts on attentional behavior has shown that attentional orientation is altered by ruminations (Pêcher et al., 2011). Also, Lagarde et al. (2004) found that people who have lived through a traumatic event (such as divorce or the death of a close relative) during the last year, have more risk of having a car accident, and Pêcher et al. (2009) showed that emotions influence driving behavior.

Moreover, individual differences play an important role in mind wandering. Previous studies have found demographic variables, such as age and gender, are associated with mind wandering. Many studies have investigated the relationship between mind wandering and aging, with most finding a negative correlation between mind wandering and age. This has been found with self-report questionnaires (Carciofo et al., 2014; Giambra, 1993), and also when using thought probes in a laboratory setting to record mind wandering: older people report a lower mind wandering rate compared with younger people (Giambra, 1989; Krawietz et al., 2012; McVay et al., 2013; but for an exception, see Einstein and McDaniel, 1997), although the reason/s for this are not yet fully understood (for discussions see Giambra, 1989, 1993; McVay et al., 2013). Few studies have reported on the relationship between mind wandering and gender. A study explored gender differences for the content of mind wandering. They found that females were more likely than men to report mind wandering about the future, but females report less mind wandering about the past and fantastical things compared to men (Mar et al., 2012). To our knowledge, no study has explored the interaction between mind wandering and demographic variables for driving behavior.

In order to measure the overall frequency of mind wandering, researchers have developed some scales to explore the general state of mind wandering, such as the Mind Wandering scale (Carciofo et al., 2014; Singer and Antrobus, 1972). This scale assesses thoughts that involve two components: First, they are spontaneous thoughts, that is, they are unbidden; and secondly, they are relatively unrelated to what you were doing or thinking about at the time. Participants can choose an appropriate frequency for daily events (e.g. 'during a speech, meeting, or lecture, I often "come to" realizing that I have not heard a word the speaker was saying'). Some studies have shown that mind wandering is associated with impaired performance on sustained attention, memory and reading tasks (Mooneyham and Schooler, 2013), but none has explored the driver's mind wandering in everyday life. So this study used the Mind Wandering scale to assess the overall frequency of mind wandering in daily life.

In sum, mind wandering is likely to hinder the ability to notice and respond to external events (Smallwood et al., 2008b, 2007). Considering the prevalence of off-task thinking, and that mind wandering can occur without awareness, mind wandering may impair driving safety. Therefore, this study investigated:

(1) The relationships between the overall frequency of mind wandering in daily life and dangerous driving behavior. Both aspects were measured by self-report scales.