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Does driving experience in video games count? Hazard anticipation and visual exploration of male gamers as function of driving experience

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ABSTRACT

Risk perception and distribution of visual attention while driving are crucial elements for accident prevention and new-driver improvement. This study investigates how racing videogames could shape the visual exploration of virtual and real road in male pre-drivers. The visual performance of players of racing video games with and without driver's license was tested in virtual vs. real scenarios. Attention to specific elements of different types of road interactions was monitored using an eye-tracking system. Results showed that habitual use of racing video games was not found to foster a positive effect on users' distribution of visual attention, supporting visual patterns typical of novice drivers. Gamers without driving experience replicated the same patterns in a real road scenario, ignoring road signs and potential areas of interactions with other drivers, while experienced drivers gamers explored video games roads like real roads. The fact that the gamers' driving performance was not comparable to drivers in the virtual scenario suggests that there are other variables in the gameplay that create a less complex traffic scene, still the visual complexity of different real road interactions is kept in video game interactions, opening new perspectives towards gamers' visual exploration of the road.

1. Introduction

The role of risk perception and perceptual learning in pre-drivers are important topics in transportation research and are considered crucial issue to prevent road accidents (Barg, Keddem, Ginsburg, & Winston, 2009; Ciceri & Confalonieri, 2012; Deighton & Luther, 2007; Elliot & Baughan, 2003; Husband, 2010; Mann & Lansdown, 2009; Poulter & McKenna, 2010). Worldwide studies, reviews and police reports show that young male drivers experience more accidents in their first years of driving than any other category of drivers (Clarke, Ward, & Truman, 2005; OECD., 2006; Williams, 2003). The average collision rate for young male drivers does not begin to decline for at least six months after they begin driving (Mayhew, Simpson, & Pak, 2003) and as far as the Italian context the total accident rate for male start decreaseing only after five years since the achievement of the driving license (ACI-ISTAT, 2009, 2010, 2011, 2012) a period of time where drivers may learn from gradual and non-systematic driving experiences, while still being highly exposed to road accident (Bjornskau & Sagberg, 2005; Groeger, 2001; Kass, Cole, & Stanny, 2007; Underwood, 2005). For these reasons Italian legislator has recently ap-

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proved a revision of the Traffic Code (Decreto Ministero Infrastrutture e trasporti 11.11.2011 no. 213, GU 23.12.2011) allowing controlled backed up guide session for 17 years old, in order to increase the amount of driving experience before getting the driving license.

However, non-drivers can have a direct experience of the road and the traffic regulation system (Twisk, Vlakveld, Mesken, Shope, & Kok, 2013; Walke, Butland, & Connell, 2000; Waylen & McKenna, 2002; Waylen & McKenna, 2008; Zakrajsek et al., 2013). Pre-drivers are particularly active users of the street as pedestrians and cyclists, (Gatersleben & Haddad, 2010) and it is possible for them to actively explore the road and interact with complex traffic environment when driving in interactive playful simulations of video games (Beullens, Roe, & Van den Bulck, 2011). Modern racing video games can simulate whole cities as well as complex road interactions in which the virtual driver must explore cities, drive in different traffic situations and interact with other cars in a highly realistic urban environment (Fischer et al., 2009; Metzger & Flanagin, 2008; Vorderer & Bryant, 2006). Beginning in early childhood, adolescents play video games for hours every week (Durkin, 1995, 2006), and racing video games represent the 5.8% of the top sellers video games in the US market (ESA., 2013). Italian video games market represents €0.6bn in revenue, and racing video games represent the 10.3% of the market. Italian gamers are for 71% male aged 15–30 and 88% of Italian adolescent aged 14–19 years spend a mean of half an hour playing video games every day (AESVI, 2011; ISFE, 2012; Rivoltella, 2006).

Gaming and virtual experiences interact both directly and indirectly with cognitive and emotional processes that regulate visual attention and risk perception (Ciceri, 2004; Ciceri, 2005; Feldman, 2011; Underwood, Crundall, & Chapman, 2011). Perception and action in video games and virtual words are embodied and merged in coordinating actions and cognitions (Carberry & De Rosis, 2008; Knoblich & Flach, 2003; Lakoff & Nunez, 2000), allowing the gamer to act and immerse in flow experiences (Klasen, Weber, Kircher, Mathiak, & Mathiak, 2012) and experimenting directly with their body scheme the possible actions and interaction the video game require to be performed, like they are actually inside these virtual scenarios (Zlatev, Racine, Sinha, & Itkonen, 2008). The effects of this virtual interaction are real (Gorini, Gaggioli, & Riva, 2007; Juul, 2011) and lead to empowerment of perception, visuo-motorial skills and eye-hand coordination (Imamizu, Higuchi, Toda, & Kawato, 2007; Whiteley, Spence, & Haggard, 2008). In particular video games increase selective visual attention (Green & Bavelier, 2003), speed of visual processing (Anderson, 2013; Dye, Green, & Bavelier, 2009), improve target localization (Achtman, Green, & Bavelier, 2008; Green & Bavelier, 2007) and quicken decision making and cognitive control (Bailey, West, & Anderson, 2010; Barlett, Anderson, & Swing, 2009). All skills and abilities that are crucial and essential for driving (Groeger, 2001). On the other hand video games can have negative effects, and lead to risky behaviors, especially for adolescents (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011; Dumas, Ellis, & Wolfe, 2012). Many experimental studies have been made about the influence of video games on specific behavior and on social abilities like attitude toward violence (Anderson, 2002b; Anderson, 2003; Anderson & Bushman, 2001; DeWall, Anderson, & Bushman, 2011; Dill & Dill, 1998; Fleming & Rick wood, 2001; Gentile & Trad. Media violence, 2003; Villani, 2001), empowerment of complex cognitive functions (Adachi & Willoughby, 2013; Basak, Boot, Voss, & Kramer, 2008; Bavelier & Davidson, 2013; Jenkins 2002; Pillay, 2003), and transfer of skills and effective learning in serious games (Breuer & Bente, 2010; Cerri, Clancey, Papadourakis, & Panourgia, 2012; Coleman 2001; Durkin & Barber 2002; Mitgutsch, Rosenstingl, & Wimmer, 2012; Ritterfeld, Cody, & Vorderer, 2009). As video games are able to impact gamer's risky driving attitudes and complex social behaviors (Vingilis et al., 2013), we want to know if also specific visual behaviors that affect driving abilities can be influenced by habitual use of racing video games. Does virtual driving experience in games support functional strategies of road exploration? Do gamers possess visual strategies that are useful for real driving?

Visual attention and risk perception, are among the main causes of road accidents (Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006; Lee, 2008; Reyes & Lee, 2008; Ruscio, 2012; Summala, 1996; Vorderer & Klimmt, 2006) and can be studied by analyzing eye movement and gaze fixations (Endsley, 1995; Konstantopoulos, Chapman, & Crundall, 2012; Martens, 2004). Previous research has shown that non-drivers and novice drivers approach the road with visual strategies that differ from those used by experienced drivers in terms of time efficacy and efficiency of gaze performance (Chapman, Underwood, & Roberts, 2002; Jackson, Chapman, & Crundall, 2009; Martens & Fox, 2007b; Underwood, Chapman, Brocklehurst, Underwood, & Crundall, 2003). Through driving experience, novice drivers adapt to a more functional attentional resource allocation (Konstantopoulos, Chapman, & Crundall, 2010; Martens & Fox, 2007a; Shahar, Alberti, Clarke, & Crundall, 2010; Underwood, Crundal, & Chapman, 2002). Evidence shows that an exploration of the visual field can be organized to alter drivers' gaze orientation and configuration of saccades and fixations around salient points to enable safe driving (Crundall, Underwood, & Chapman, 1999).

The aim of the present study is to test visual attention of a particular category of pre-drivers that are male gamers of racing video games, and understand how visual skills acquired playing regularly video games are used for exploring the road. The main objectives are: (1) test gamer's selective visual attention and target localization for potential dangers, road signs and specific areas of interactions while driving; (2) test if gamer visual attention to target elements in the game scenario is adopted also in real scenarios. More specifically we hypothesize that: (a) gamer's real driving experience may influence visual exploration of the road, as reported in literature; (b) gamer's visual strategies for anticipate potential dangers in a video game scenario could be adopted also in real life scenario; (c) attentional resource allocation would be dependent on the road complexity, both in video game and in real roads, hypothesizing that similar road injunctions would require similar levels of visual attention.