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Driving skills of young adults with developmental coordination disorder: Maintaining control and avoiding hazards

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ABSTRACT

In this study we assess for the first time the driving skills of young adults with developmental coordination disorder (DCD). We use a virtual city and a driving simulator to examine steering control, speed regulation and the responses to pedestrians on the road. Participants were adolescents and young adults who had been diagnosed with the disorder as children. For most participants the symptoms were maintained (DCD group) but for others they had largely dissipated (AD group). We also invited typically developing (control) participants matched in age, gender, and driving experience to the DCD and AD participants. Compared to their matched controls, the DCD group showed difficulties in steering when turning bends but not when driving along straight roads. Although the average speed of the DCD group was similar to their controls this may have been too fast for them to steer effectively around the bends. The DCD group also took 50% more time to react to pedestrians who walked towards their path. We found no such differences between the AD and their matched controls. We discuss the results in terms of visual information processing and suggest further applied and fundamental research on this topic.

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1. Introduction

Many adolescents look forward to reaching the age when they will be able to undertake driving lessons but for people with developmental coordination disorder (DCD) learning to drive a car is a challenge. Individuals with DCD show impaired control of voluntary motor activity in the absence of known medical condition or pervasive developmental disorder (APA, 1994; WHO, 1993). Past research on DCD has focused primarily on the identification of symptoms and on the evaluation of therapeutic work (e.g., Gibbs, Appleton, & Appleton, 2007; Schoemaker, Hijlkema, & Kalverboer, 1994). The few longitudinal studies that followed children with DCD into adolescence and adulthood indicate that about half of the children will continue to present coordination difficulties as they grow into adulthood (Cantell, Smyth, & Ahonen, 1994, 2003; Losse et al., 1991), at which stage learning to drive becomes a major source of concern to them (Losse et al., 1991). Compared to their peers, individuals with DCD report more difficulties in learning to drive (Cousins & Smyth, 2003), are less likely to hold a driving licence and, if they do, drive less frequently and fewer miles than their peers (Kirby, Sugden, & Edwards, 2011; Missiuna, Moll, King, Stewart, & Macdonald, 2008). Apart from these self-reports and qualitative data, the driving skills of individuals with DCD have not been investigated. It is important, however, to do so for two very practical reasons. First, it is unclear whether individuals with DCD have difficulties with fundamental abilities that would place them at risk of being involved in serious accidents. Second, it is unclear whether individuals with DCD struggle with particular task-components and road conditions. Examples of relevant task-components and conditions are the ability to maintain the course on a straight road and the ability to regulate the speed before entering a bend.

Learning to drive can be rather complex because it involves several new skills which must be learned and executed simultaneously. Specifically, driving along a straight path requires the ability to maintain heading direction. Heading is the direction of travel and can be detected from the pattern of apparent motion of objects in a visual scene as one moves (i.e., optic flow pattern). On approaching a bend drivers need to adjust their speed to allow themselves enough time to execute the upcoming changes in direction, and on the bends they need to change heading at a smooth rate and re-align heading direction with the center of the upcoming lane. Although accurate steering consists of matching heading direction with the center of the lane, drivers do not need to judge heading (e.g., Wann & Swapp, 2000). Research has shown that effective steering can be guided solely on basis of the optic flow pattern, during motion across a ground plane, without the need to recover current heading or integrate information from eye or head movements (e.g., Wilkie & Wann, 2002). Irrespective of whether control is effected through the recovery of heading or on the basis of optic flow (Wilkie, Wann, & Allison, 2008), it is crucial for smooth steering that a link or mapping is acquired between the optic flow pattern and the steering actions. An optimal mapping enables the driver to bring about the desired optic flow pattern by steering, for example when turning a bend, as well as to continuously act on the steering wheel in order to maintain a desired optic flow pattern, for example when driving along a straight path (de Oliveira & Wann, 2011).

In the present study we used a driving simulator to investigate the skills of adolescents and young adults who were diagnosed with DCD in their childhood. We examined steering behavior by looking at the ability to maintain a small heading variance especially when driving along a straight path, and a small number of steering adjustments especially when turning bends. We examined the ability to adjust speed by looking at the average speeds when participants drive along straight paths and when turning bends. Finally, we examined their reaction times to pedestrians who crossed the road in front of their car. Based on previous reports of individuals with DCD showing less accurate, more variable and slower performance than their peers, we hypothesized that the DCD group would show poorer performance than their matched-controls on the variables pertaining to steering control, speed, and reactions to pedestrians.

2. Methods

2.1. Participants

Participants were 26 male young adults aged between 15.3 and 21.3 years. (M = 17.4, SD = 1.7) who fell into three groups. In the DCD group participants had been diagnosed with DCD when they were