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Case Study: Reaction Time of Children According to Age

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Abstract

Study presents findings of a simulator study that examined the differences of reaction time for children aged from 3 to 18 years, compared to adults aged from 20 to 30 years. Choice reaction time has been analysed and three sets of measurement have been realized. In the first set, psychical children's reaction time has been measured. Second experiment has contained the measurement of reaction time psychical with visual reaction time. All three components have been examined in the last experiment in sum. Obtained results have been statistically analysed using analysis of variance (ANOVA). Post hoc tests showed differences or similarities between selected age groups. Obtained results revealed a need to use other values of reaction time for children than for adults. Values of reaction time of adults can be possibly exchanged for a teenage, no significant differences between 15–18 and 20–30 age group have been found.

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1. Introduction and study background

The main human characteristic in traffic accident analysis is reaction time (RT). Children are one of the most vulnerable participants of public traffic because they are not able to notify danger. Police accident data confirmed that children and youngsters made a not insignificant percentage of road – accident participants (about 7% of all crashes in the Czech Republic are children involved). The mentioned arguments demonstrate a need to focus on

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children and their RT. The goal of the research is to make analysis of all children's individual components of RT. The research also helped to define RT of young road-users objectively.

RT could be affected by various elements. The influences of selected distracting factors especially for drivers have been intensively studied by many authors. These studies range from an interaction with in-vehicle devices (using route guidance system [1], conversing to a hand-held or a hands-free mobile phone [2], [3], [4], interaction with radio [5]) to distraction of the driver's attention by various elements surrounding a road such as advertisements.

Not only high density of information which may be caused by a distraction of external influences or road geometry characteristics affects RT. Also low density of information or the under demanding road environment may decrease the alertness and the vigilance. For the monitoring of the driver fatigue the facial expression for example an eye blinking [6], a degree of eye openness [7] or yawning [8], [9], [10] have been used. EEG analysis of drowsy driver [11] was performed using a driving simulator. Early onset of fatigue could have been detected using heart rate variability [12]. Also the aging effects at the RT have been observed across a wide range of experimental studies (for example [13], [14], [15], [16]). Despite that fact unfortunately only a few information is known in detail about RT of children across the whole age range. Several studies have been focused on response time of children, typically psychological, medical or pedagogical, but most of papers compared the group of elderly people with group of younger ones. In [17] a development of processing speed among preschool children (4-years old, 5-years old and 6-years old) compared to adults was analysed. The test consisted of three types of RT tasks: simple, discrimination and choice. In [18] was proved inverse relationship between elementary aged children's RT and intelligence. Some of the researchers have examined RT changes in connection with certain diseases. In [19] RT of 112 children aged 4.5 to 13 years with epilepsy was studied. Not only simple RT measurement was conducted, but also choice RT with and without distraction was measured. Compared to children without epilepsy RT is significantly longer. RT is also higher in case of patients with ADHD, ages 9 to 12 [20]. Because of ontogenesis we assume the children's RT is different than adults. Results published by [21] in 1963 indicates that RT increases up during early adulthood and then decreases.

2. Methods of solution

Children aged from 3 to 18 years (n = 150) participated in this study. Participants have been divided into six age groups: 3–5 years, 6–7 years, 8–9 years, 10–14 years, 15–18 years. The comparison of measurement with adults aged 20–30 years has been also performed. All participants in this study were free of medical and cognitive impairment. Research including children requires simple and safe design, testing on public roads is not possible. Series of experiments were performed on the simulator, which has been implemented by a personal computer. The recognition RT was measured. There was more than only one stimulus. The easiest stimulus is changing of colours, so there were different colours changing on the computer screen. But only one of this (red colour) should have been responded by participant. There was only one correct response – pressing the mouse button. To eliminate predictability, colour order and also the time of colour changes were absolutely random. Participants were seated at the same position and required to press the mouse button with the dominant hand as soon as red colour appeared on the screen. If they made a mistake, the reaction was excluded. Participants completed at least 5 reactions. Participants were tested individually in a quiet room. Measurement of all three individual components of RT (visual, psychical, physical) as a study goal has been stated, so the testing consisted of three types of measurement.

In the ***first*** part, only psychical children's RT has been measured. The other components of RT had to be eliminated. If the angle of target was 0 degrees, visual RT was null [22]. The PC screen was in front of the participant; so visual RT was eliminated. Participants put their dominant hands on a mouse of PC, so also minimization of physical RT was provided.

In the ***second*** experiment psychical RT with visual RT has been analysed. The same simulator as in previous experiment was used, it was only adjusted. Colours were changed independently on two screens. The angle of screens was established experimentally. The range of this angle could vary from 0° to the upper limitation – 90°. Measurement where the angle between two screens was 90° was too difficult for younger children. The angle was established to only a half (45°) because of simplicity. This resolution was also validated by field of view measured