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A study in real traffic examining glance behaviour of teenage cyclists when listening to music: Results and ethical considerations

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ABSTRACT

Listening to music while cycling impairs cyclists' auditory perception and may decrease their awareness of approaching vehicles. If the impaired auditory perception is not compensated by the cyclist himself or other road users involved, crashes may occur. The first aim of this study was to investigate in real traffic whether teenage cyclists (aged 16–18) compensate for listening to music by increasing their visual performance. Research in real traffic may pose a risk for participants. Although no standard ethical codes exist for road safety research, we took a number of ethical considerations into account to protect participants. Our second aim was to present this study as a case study demonstrating ethical dilemmas related to performing research in real traffic. The third aim was to examine to what extent the applied experimental set-up is suitable to examine bicyclists' visual behaviour in situations crucial for their safety. Semi-naturalistic data was gathered. Participants' eye movements were recorded by a head-mounted eye-tracker during two of their regular trips in urban environments. During one of the trips, cyclists were listening to music (music condition); during the other trip they were 'just' cycling (the baseline condition). As for cyclists' visual behaviour, overall results show that it was not affected by listening to music. Descriptive statistics showed that 21–36% of participants increased their visual performance in the music condition, while 43–64% decreased their visual performance while listening to music. Due to ethical considerations, the study was therefore terminated after fourteen cyclists had participated. Potential implications of these results for cycling safety and cycling safety research are discussed. The methodology used in this study did not allow us to investigate cyclists' behaviour in demanding traffic environment. However, for now, no other research method seems suitable to address this research gap.

1. Introduction

Listening to music is popular among cyclists in, for example, the Netherlands and Sweden, especially among youngsters. In Dutch surveys listening to music was reported by about three quarters of adolescent cyclists (Goldenbeld, Houtenbos,

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Ehlers, & de Waard, 2012; Schroer, 2014; Stelling-Konczak, Hagenzieker, & Van Wee, 2014), 42% of young adults and only 6% of the elderly (65 years or older) (Stelling-Konczak & Hagenzieker, 2014). Both in Sweden and in the Netherlands, listening to music was found to be the most common technology-related activity among cyclists (Adell, Nilsson, & Kircher, 2014; Stelling-Konczak & Hagenzieker, 2014). Research shows that listening to music negatively affects cycling behaviour. Observational studies found that cyclists listening to music disobeyed traffic rules more often (de Waard, Schepers, Ormel, & Brookhuis, 2010) and engaged in unsafe behaviours more frequently than those not performing a secondary task (Terzano, 2013). Furthermore, the results of a field experiment show that cyclists' auditory perception deteriorated when they were listening to music. Even moderate volume or moderate tempo music compromised cyclists' perception of bicycle bells: more than 60% of cyclists listening to music did not hear the bells. Loud music, high tempo music, and particularly music listened through in-earphones impaired even hearing of loud sounds (i.e. horn honking). Cyclists' auditory perception was not affected only when music was listened to through one earphone. Finally, cyclists rated listening to music while cycling as more risky than "just" cycling. The higher the risk perception, the lower the frequency of listening to music. (de Waard, Edlinger, & Brookhuis, 2011; de Waard et al., 2010).

Two potential explanations can be found for these negative effects. Music, especially loud music, can mask traffic sounds. Quieter sounds are generally masked by louder sounds. The higher the sound intensity of the masking sound (e.g. music), the higher the intensity level of the masked sound (e.g. traffic sounds) must be before it can be detected (see e.g. White & White, 2014). Masking is, furthermore, more likely to occur when music contains similar frequency ranges as traffic sounds (White & White, 2014). Music can also distract attention from the environment toward inward experiences (thoughts, memories, emotions, moods) (see for example Herbert, 2013). Fundamental research found a reduction in eye movement activity (longer fixations, fewer saccades and more blinks) while listening to music, suggesting a decrease in vigilance under the influence of music (Schäfer & Fachner, 2015).

There are, however, some indications that cyclists compensate for listening to music by adapting their behaviour. In a Dutch survey two-thirds of teenage cyclists reported using adaptive strategies to compensate for listening to music (Stelling-Konczak & Hagenzieker, 2014). Increasing visual attention was found the most often reported type of compensatory strategy among Swedish and Dutch adolescents (Adell & Nilsson, 2014; Stelling-Konczak & Hagenzieker, 2014). However, a Swedish field experiment where an eye-tracker was used, found no change in visual behaviour among cyclists who were listening to music (Ahlstrom, Kircher, Thorslund, & Adell, 2016). Similarly, Dutch field experiments showed that a number of objects (printed traffic signs and a clock) noticed by cyclists was not influenced by listening to music (de Waard et al., 2011, 2014). However, in these two latter studies visual behaviour was not directly measured. Instead, after each trip, cyclists were to report noticing the objects. Since the reporting took place after the trip, failure to mention the objects may have reflected cyclists' memory deficits instead of deficits in visual perception. Furthermore, the objects used in the studies were irrelevant for the traffic task.

The discrepancies between the findings from surveys and research performed in real traffic may be a result of the different methodologies employed and reflect the difference between what cyclists think they do and their actual visual behaviour. In the Dutch survey cyclists were asked to provide information about what they typically do while cycling with music. Furthermore, surveys rely on accuracy of memory and honesty of reporting and may reflect what people think they do, rather than their actual visual behaviour. In the field experiment of Ahlstrom, the actual visual behaviour in one specific traffic environment was monitored with an eye-tracker. The traffic environment studied consisted of a combined sidewalk/-cycle track alongside an urban street and physically separated from the street. The cycle track intersected four side roads to the right, where the track had priority over the side roads. The route was situated in a semi-industrial area where traffic densities were low to moderate. It can therefore be concluded that the traffic environment in the Swedish field experiment was relatively undemanding for cyclists. The results of the study leave open the possibility that cyclists who listen to music adapt their visual behaviour only in some situations, e.g. more demanding traffic situations. Therefore, the authors recommended performing a similar study in other traffic environments. Compared to self-reported data, monitoring cyclists' behaviour in real traffic by means of an eye-tracker is better able to provide quantitative evidence on the location and duration of one's visual effort. However, studies in real traffic can be problematic from an ethical point of view.

1.1. Ethical considerations

Research in real traffic generates important ethical issues as it can lead to increased risks for cyclists. Cyclists are vulnerable road users: contrary to car occupants, cyclists are unprotected by an outside shield. Cyclists have also a higher risk of injury or death[1] than car occupants (ITF, 2013). Furthermore, as research has shown that listening to music is potentially risky for cyclists, those who engage in this activity may be at a higher risk than cyclists who 'just' cycle. Even if cyclists themselves accept risks in real traffic and decide to listen to music while on the road, it does not directly justify the researchers to inflict the same level risks on participating cyclists (see Svensson & Hannson, 2007).

Therefore, it is of primary importance that researchers protect cyclists participating in an on-road study. This requires researchers to minimize the risks and to continually monitor the ongoing research for safety threats. If harmful results manifest, researchers should be prepared to terminate the study (see Svensson & Hannson, 2007). The need to interrupt a study,

[1] risk of injury or death = number of injured cyclists respectively cyclist deaths per distance travelled.