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Mobile phone conversations, listening to music and quiet (electric) cars: Are traffic sounds important for safe cycling?

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ABSTRACT

Listening to music or talking on the phone while cycling as well as the growing number of quiet (electric) cars on the road can make the use of auditory cues challenging for cyclists. The present study examined to what extent and in which traffic situations traffic sounds are important for safe cycling. Furthermore, the study investigated the potential safety implications of limited auditory information caused by quiet (electric) cars and by cyclists listening to music or talking on the phone. An Internet survey among 2249 cyclists in three age groups (16–18, 30–40 and 65–70 year old) was carried out to collect information on the following aspects: 1) the auditory perception of traffic sounds, including the sounds of quiet (electric) cars; 2) the possible compensatory behaviours of cyclists who listen to music or talk on their mobile phones; 3) the possible contribution of listening to music and talking on the phone to cycling crashes and incidents. Age differences with respect to those three aspects were analysed. Results show that listening to music and talking on the phone negatively affects perception of sounds crucial for safe cycling. However, taking into account the influence of confounding variables, no relationship was found between the frequency of listening to music or talking on the phone and the frequency of incidents among teenage cyclists. This may be due to cyclists' compensating for the use of portable devices. Listening to music or talking on the phone whilst cycling may still pose a risk in the absence of compensatory behaviour or in a traffic environment with less extensive and less safe cycling infrastructure than the Dutch setting. With the increasing number of quiet (electric) cars on the road, cyclists in the future may also need to compensate for the limited auditory input of these cars.

1. Introduction

For a cyclist auditory perception can be of great importance, especially for gathering information from areas outside his/her field of view, or when visibility is obstructed. Auditory cues, such as tyre and engine noises, may help to detect and localise approaching road users and orient cyclists' visual attention towards oncoming traffic. Recently, the use of auditory information by vulnerable road users, such as cyclists and pedestrians, may have become more challenging due to the growing number of electric (and hybrid) cars on the road. Electric cars are still relatively rare on our roadways. However, their number is expected to increase sharply as many European countries set ambitious sales or stock targets for electric cars in the near future (OECD/IEA, 2016). When driven at low speeds, cars in electric mode are generally quieter than conventional cars, especially in the built-up area where engine noise dominates. Slow moving (hybrid) electric cars are also detected later and localised less accurately by vulnerable road users than conventional cars, especially in environments with low ambient noise (Stelling-Konczak et al., 2015). Furthermore, electric cars driven at low speeds are localised less accurately than conventional cars, as found in a recent laboratory study including vehicle motion paths relevant for cycling activity (Stelling-Kończak et al., 2016). Also studies with drivers of electric cars suggest that cyclists have problems hearing these vehicles (Cocron and Krems, 2013; Hoogeveen, 2010). None of the drivers participating in these studies reported a noise-related crash. However, a substantial percentage of drivers (45% in the study of Hoogeveen and 67% in the study of Cocron & Krems) reported noise-related incidents, especially at low speeds, e.g. pedestrians and cyclists missing the electric car or getting startled or surprised by its approach.

Besides electric cars, the increasing use of mobile technology while

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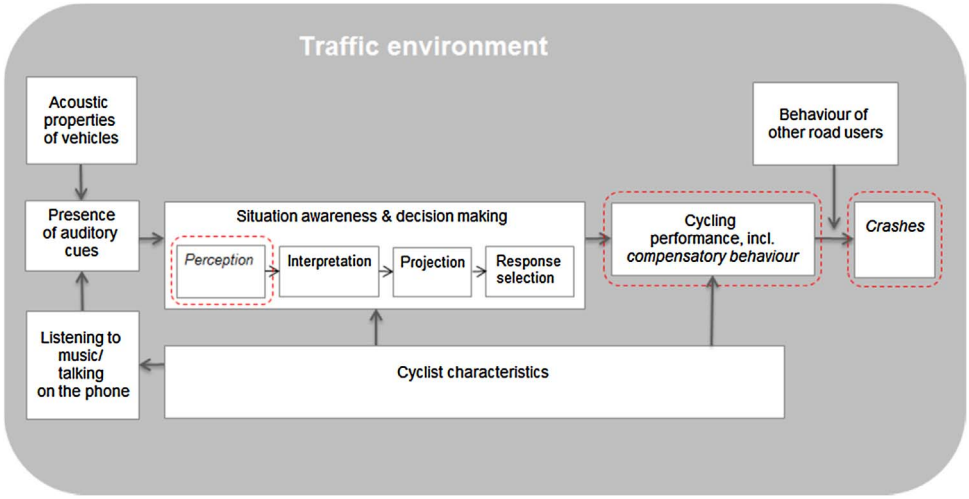

Fig. 1. Conceptual model of the role of auditory information in cycling safety (adapted from Stelling-Konczak et al., 2015). Knowledge gaps are marked by dashed red boxes. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

cycling can also make it more difficult for cyclists to utilize auditory cues. A field study by de Waard et al., (2011) has shown that listening to music and talking on the phone impairs cyclists' perception of relevant traffic sounds such as the sound of a bicycle bell (de Waard et al., 2011). In this study high tempo music, loud music and in particular music listened through in-earphones has been found to impair even hearing of loud sounds, that is, horn honking. Talking on the phone and listening to music are quite popular among cyclists, especially youngsters. In a Dutch survey, 76% of the teenage cyclists but only 14% of the cyclists older than 50 years old reported listening to music. In the same study, 77% of the teenage cyclists and 34% of the older cyclists reported using a mobile phone while cycling (Goldenbeld et al., 2012).

The role of auditory information in cycling has only recently become the topic of scientific research. According to the conceptual model of Stelling-Konczak et al. (2015), restricted auditory perception can have consequences for cycling safety (see Fig. 1). Being unable to hear traffic sounds can negatively affect cyclists' situation awareness[1] and cycling performance. In the presence of traffic-related hazards, a degraded cycling performance can in turn lead to crashes if it is not sufficiently compensated by the cyclist himself or other road users involved. The conceptual model in Fig. 1 also acknowledges the importance of cyclist characteristics (biological, sociocultural, traffic-related and temporary factors) and of the traffic environment (e.g. road infrastructure, weather, traffic-related conditions) when studying the relationship between restricted auditory perception and cycling safety.

To date, little research has been done into the impact of device use while cycling or of the quietness of electric cars on cycling safety. In their review article Stelling-Konczak et al. (2015) identify a number of important knowledge gaps which need to be addressed for a better understanding of the relationship between limited auditory information and cycling safety.

To begin with, little is known about the auditory perception of cyclists who listen to music or talk on the phone. Phone conversation and music was found to deteriorate the detection of traffic sounds, i.e. the sound of a bicycle bell and a horn honking (de Waard et al., 2011). There are two potential explanations for these negative effects. Music and telephone conversation may cause distraction by diverting attention away from the traffic task toward inward experiences (thoughts, memories, emotions, moods) (see for example Herbert, 2013; Strayer et al., 2013). The other explanation concerns auditory masking: the phenomenon that occurs when one sound (e.g. music or speech) prevents or blocks the perception of another sound (e.g. a sound of an approaching car). Auditory masking is a complex phenomenon and the potential of a sound to be masked depends on the frequency and intensity of that sound (see e.g. Baldwin, 2012). Given the complexity of the masking phenomenon, the results of prior research into cyclists' auditory perception do not allow conclusions about the influence of listening to music or talking on the phone on the perception of other traffic sounds such as the sounds of cars, whether they be conventional or electric cars.

Next, not much is known about the potential compensatory behaviour of cyclists who listen to music or talk on the phone. In the only study that we could find, an Internet survey by Goldenbeld et al. (2012), two-third of the cyclists reported adjusting their behaviour when using portable devices. The most popular type of compensatory behaviour among older cyclists was wearing a bicycle helmet and refraining from using portable devices in demanding traffic situations. Younger cyclists reported compensating for the use of devices mainly by paying more attention to traffic. Compensatory behaviour in that study was examined for device use in the aggregate (consisting of listening to music, having a phone conversation, texting and searching for information). We therefore do not know to what extent cyclists specifically listening to music or talking on the phone engage in compensatory behaviour.

Furthermore, very little research has been done into the impact of device use or the quietness of electric cars on cyclists' crash involvement. The only study into the effect of mobile devices on cyclists' crash risk we have been able to find (Goldenbeld et al., 2012) showed that using a mobile device was associated with an increased risk of self-reported bicycle crash involvement. The study controlled for the influence of a number of cyclist characteristics and factors in the traffic environment (i.e. age, urbanization, cycling time, and cycling in demanding situations). The overall risk of a self-reported crash for cyclists who used electronic devices on every trip was found to be a factor 1.6 higher for teenagers and a factor 1.8 higher for young adults compared with their respective age counterparts who never used devices while cycling. Apparently the compensatory behaviour of young cyclists is not sufficient to counterbalance all the risks associated with the use of electronic devices. The crash risk of individual tasks was not examined in that study and thus remains unknown. Some individual tasks may pose a higher safety risk than others. Texting and searching for information are activities that do not require auditory but mainly visual perception and attention, and are considered riskier than listening to music or talking on the phone.

As concerns electric cars, their safety performance cannot be easily compared to that of conventional cars, primarily due to the lack of

[1] Situation awareness refers to the awareness of the meaning of dynamic changes in the environment (Endsley, 1995), e.g. the awareness of approaching vehicles.