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Risk compensation theory and bicycle helmets – Results from an experiment of cycling speed and short-term effects of habituation

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ABSTRACT

It has been suggested that the safety benefits of bicycle helmets are limited by risk compensation. The current study contributes to explaining whether the potential safety effects of bicycle helmets are reduced by cyclists' tendency to cycle faster when wearing them (as a result of risk compensation), and if this potential reduction can be associated with a change in perceived risk. A previous study (Fyhri & Phillips, 2013) showed that non-routine helmet users did not increase their speed immediately after being given a helmet to wear, while routine helmet users cycled more slowly. The current study tests whether the previously found reduction in speed in response to helmet removal – as an indirect indicator of risk compensation – could be established in non-routine helmet users, after a period of habituation while cycling with a helmet.

We did this by conducting a randomized crossover trial, in which we used GPS-derived speed calculations and self-reported risk perception. To test the effect of habituation, we used a design where each participant took part in two rounds with a break between and each round having two trips. We collected the data in June 2015. Non-routine helmet users (N = 31) were recruited in the field (along cycle routes in Oslo), and through a sample drawn from the Falck National register of bicycle owners. In the first phase of the study, all participants were asked to complete a test route (2.4 km downhill) with and without a helmet. In the second phase of the experiment, conducted after 1.5–2 h, the same participants again completed the test route with and without a helmet. In the time between the first and second phases of the experiment, all participants were given helmets, and told to use them on a predefined bicycle route.

Habituation to the helmet between the first and second phases of the experiment did not produce any decrease (with helmet removal) in speed, on top of the habituation that occurred while cycling down the hill (the order effect). Mean speed difference for cycling with/without a helmet before the break was −0.76 km/h, after the break this difference was 0.32 km/h; 95% CIs [−0.5, 2.9] and [−0.9, 1.5]. We argue that risk compensation is an unlikely effect of using a bicycle helmet, and probably cannot explain any adverse effects related to helmet legislation.

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1. Introduction

Case-control studies have shown injury-reducing effects of bicycle helmets (Attewell, Glase, & McFadden, 2001; Olivier & Creighton, 2016). However, evidence from countries that have introduced helmet laws indicate no reductions in head injuries over and above those observed for other injuries (Robinson, 2006, 2007). Recent studies (Bonander, Nilson, & Andersson, 2014; Olivier, Walter, & Grzebieta, 2013; Walter, Olivier, Churches, & Grzebieta, 2011), and especially a Cochrane review from 2007 (Macpherson & Spinks, 2007) have disputed this finding. Nevertheless, it has been suggested that *risk compensation* reduces the effect of bicycle helmets, i.e., helmets make people take more risks (Robinson, 2006). Further, it has been suggested that this risk compensation is related to a change in perceptions about the consequences of a potential collision (Adams & Hillman, 2001), in other words to a change in *risk perception*, as defined in the psychometric model (Fischoff, Slovic, Lichtenstein, Read, & Combs, 2000).

Risk compensation has been used to describe how perceived risk influences driving behaviour among motorists, and is related to Wilde's (1994) *target risk theory* (risk homeostasis theory). Such models predict that driver behaviour is motivated by the goal of achieving a certain outcome related to risk level. According to the risk compensation theory people will become more careful when they sense increased risk and less careful when they feel more protected (OECD, 1990).

As part of the debate surrounding effectiveness of helmet laws, it has been claimed that a safety measure needs to be noticed if it is to be compensated for (Hedlund, 2000). This is in line with Adams and Hillman's (2001) claim that risk compensation is a result of changed assessments of consequences of behaviour. If one accepts this notion, it can been argued that studies should try to explain the components of risk perception *and* link those components to associated safety behaviours to provide convincing evidence for or against risk compensation (Phillips, Fyhri, & Sagberg, 2011). The studies should also account for findings that *discomfort* is a major barrier against bicycle helmet use (Bogerd, Walker, Bruhwiler, & Rossi, 2014; Finnoff, Laskowski, Altman, & Diehl, 2001). Since studies of risk perception have indicated that risk perception and comfort are conceptually close (Backer-Grondahl and Fyhri 2008; Lewis-Evans, De Waard, & Brookhuis, 2010), it is important to study perceived comfort in conjunction to perceived risk when looking at bicycle helmets.

Fyhri and Phillips (2013) found that after having removed the participants' helmets, routine helmet users cycled more slowly and demonstrated increased psychophysiological load. For cyclists who were not accustomed to helmets there was no significant change in either cycling behaviour or psychophysiological load. However, merely testing the *immediate* effect of a helmet is insufficient evidence against risk compensation. This is because the user might need to spend some time wearing the helmet while cycling to get used to the helmet and to sense the extra protection afforded. If this is true, risk compensation might take some time to emerge. Hence, there is a need for studies that look for changes in speed in response to wearing bicycle helmets after a certain time for habituation.

Our previously observed effect of a reduction in cycling speed in response to removing the helmet from routine helmet users (Fyhri & Phillips, 2013) could be seen as indicative of a risk compensation effect – after all, accustomed helmet-users cycled faster when wearing helmets than when not wearing them. But risk compensation is meant to predict what happens when a safety device is introduced, not when it is removed. It is important to note, therefore, that when wearing a helmet in our previous study, the routine helmet-users cycled no faster than non-routine users (whether the latter wore a helmet or not). Rather than an increase in speed in response to routine helmet use (direct risk compensation) our previous observations indicated some change in psychology and/or behaviour among cyclists as they become accustomed to using a helmet, which manifested itself, initially at least, as more careful cycling in response to helmet removal (reduced speed). This reduction in speed can be seen as indirect evidence of risk compensation.

In the current article, we wanted to test whether this reduction in speed in response to helmet removal – as an indirect indicator of risk compensation – could be established in non-routine helmet users, after a period of habituation while cycling with a helmet. More precisely, we hypothesised that the difference in cycling speed with/without helmet would increase after participants had time to get accustomed to the helmet.

Further, we wanted to explore if getting used to a helmet could influence participants' perceptions of risk and safety in the different conditions.

A natural implication of the theory of risk compensation is that a safety device leads to behavioural change via changes in experienced risk. In the case of cyclists and helmet use, it can be assumed that change in cycling speed is an important behavioural indicator, or a proxy, of risk compensation. Other behaviours that are likely to be outcomes of risk compensation are traffic violations, risky route choices, close overtakes, etc. Such behaviours typically occur in natural cycling environments. The current study aims to observe the direct relationship between helmet use and risk compensation. Observing other types of behaviour calls for a very complex research design, to control for a range of potential confounds, and is not the subject of this study.

2. Method

2.1. Sample

An a priori power analysis using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) was used to calculate the number of participants needed for identifying a significant change of 1.5 km per hour (S.D 1 km/h) (found in Fyhri and Phillips (2013)). To reach this (power = 80 and alpha = 0.05) 32 participants were needed.