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Safety in numbers for cyclists—conclusions from a multidisciplinary study of seasonal change in interplay and conflicts

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ABSTRACT

In many European countries, it is a political goal that future growth in local travel should be absorbed by sustainable transport modes. Concerns that increased walking and cycling produce more accidents have been countered by the "safety in numbers" (SiN) argument. According to SiN, the more walkers/cyclists there are in a population, the lower their risk. SiN has been demonstrated in cross sectional and longitudinal studies, but the mechanisms behind the effect have yet to be proven.

Previous studies have mostly relied on register data. The current study, carried out in 2013 and 2014 tests the existence of this effect in a more controlled manner. This is achieved through the use of three data sets: (1) roadside survey data with cyclists, pedestrians and car drivers from Oslo carried out at three time points in the cycling season (2) a panel study covering the same time period, and (3) video observations at four different locations in Oslo. By exploiting the natural seasonal variation in cycling frequency, and by using a repeated measures design we can further control for other factors suggested to lie behind the SiN mechanism, such as differences in infrastructure and traffic culture.

The results suggest that bicyclists experience a short term Safety in Numbers effect through the season. Each individual cyclist experiences fewer occasions of being overlooked by cars and fewer safety critical situations (near-misses). Video observation data confirm this pattern. However, the SiN effect seems to be countered by another mechanism taking place at the same time: the influx of inexperienced and risk-taking cyclists through the season. Thus car drivers and pedestrians also report to find themselves being surprised by cyclists in traffic late in the season.

1. Introduction

A common argument against a shift from motorized to non-motorized travel is the concern about a potential increase in numbers of accidents resulting from such a policy. A common counter argument is *Safety in numbers*. Safety in Numbers (SiN) is used to explain the non-linear statistical relationships between the number of pedestrians (or bicyclists) and the number of injuries for the same group (Elvik, 2009; Geyer et al., 2006; Jacobsen, 2003). The mechanism has been proven in a number of cross sectional and longitudinal studies, summarised in a quite recent meta-analysis (Elvik and Bjørnskau, 2016). The concept has been subject to debate, regarding its existence (Bhatia and Wier, 2011), its mathematical characteristics (Brindle, 1994; Elvik, 2013; Knowles et al., 2009) and also related to this, regarding a clear understanding of *the mechanism* behind the effect.

The mechanism that has most frequently been proposed, is that motorists become more attentive, and change their behaviour, when exposed to higher numbers of pedestrians and cyclists (Jacobsen, 2003). Another possible mechanism is improved interplay between road users groups when road users acquire experience with each other, and develop more correct expectations (Phillips et al., 2011). Still another suggested mechanism is that the cyclists and pedestrians entering the population at a later stage may be more risk averse and cautious (Fyhri et al., 2012). It has also been suggested that the effect can be a result of safer environmental conditions, including engineering countermeasures or differences in pedestrian norms and behaviours (Bhatia and Wier, 2011). However, these hypotheses have yet to be tested. Knowledge about these mechanisms is essential (Bhatia and Wier, 2011) and is necessary to adopt a safe active transport policy aiming at a shift to increased use of sustainable urban transport.

The Scandinavian countries, and in particular Norway are interesting cases to test the SiN effect, as there is a substantial seasonal variation in bicycle use. The cycle share in winter is in the range of 1–2% of all trips, and rises to 8% in summer (Hjorthol et al., 2014).

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Pedestrians are a more steady presence in traffic. In fact, the share of pedestrians is somewhat *higher* in winter, around 22%, and drops to around 18% in summer (probably due to some bicyclists shifting to walking when conditions are not good enough for cycling). In the current study, we will test the attentiveness-mechanism by looking at interplay in traffic as a function of seasonal variation in bicycle use.

The seasonal variation is substantial, meaning that every spring there is a dramatic increase in the number of bicycles that other road users are exposed to each subsequent week. By studying conflicts and interactions at the same study sites, it is possible to keep a close control with any other potential influencing factors, and only look at the effect of changes in the share of one of the road user groups. In other words, this situation can be used as an experiment of whether motorists become more attentive, and change their behaviour, when exposed to an increasing number of cyclists.

Traffic accidents are often a result of inadequate road user interaction, but research on the importance of road user interaction for accidents is rather limited. The importance of correct expectations and the ability to predict other road users' behaviour has not been studied much, despite the fact that such abilities are vital in order to avoid accidents (Bjørnskau, 1994; Bjørnskau, 1996; Rothengatter, 1991).

When the proportions of different road user groups change, for instance through an increase in soft transport modes, interaction patterns may also change. Bjørnskau (2016) has documented how road user interaction can change over time as a result of dynamic interplay. One example is pedestrian crossings, where cars yield to cyclists contrary to the traffic rules (Bjørnskau, 2016). Another is how novice drivers change their use of the headlights and adapt to the dominant practice of dipping, contrary to what is prescribed in driver education (Bjørnskau, 1994).

Studying interaction among road users, rather than behaviour from one single road user group, creates substantial methodological challenges, which might be one reason for the scarcity of previous controlled experimental studies. In the context of Safety in Numbers, a relevant experience from a bicyclist's point of view is that of being overlooked by other road users. However, whether a bicyclist is overlooked in a given situation will depend on the bicyclists' own behaviour in that situation as well as the behaviour from the surrounding road users.

In order to overcome these challenges a multidisciplinary approach is needed. Traditional surveys function quite well to provide valid descriptions of different road users perceptions and own experiences and can also to a certain extent describe interaction patterns (Bjørnskau and Fyhri, 2012). Observational techniques can function well to supplement the picture. One promising approach that has gained a renewed interest in later years is to use surrogate accident measures, such as conflicts and to record these with video. The Swedish Traffic Conflict Technique (TCT) is one among several such methods (Hydén, 1996; Laureshyn, 2010), but is the only one that has been validated with strong relation found to the number of police-reported accidents (Svensson, 1992). The method also exhibits strong *process validity* (similarity in how conflicts to accidents develop), and is especially valuable for the studies of vulnerable road users' safety since this group is under-represented in the accident statistics (Transportstyrelsen, 2012).

2. Objectives

The objective of the current study is to investigate if interplay between bicyclists and car drivers improves when more bicyclists enter the streets throughout the cycling season. In order to investigate this, we use data from two data collection procedures, a combined field and panel survey of road users and video observation of conflicts at selected intersections.

Specifically, we hypothesize that:

1. The number of times bicyclists are not seen by car drivers is reduced, from April to June and from June to September (survey data);
2. The number of times bicyclists are not seen by pedestrians is reduced, from April to June and from June to September (survey data);
3. The number of times car drivers are surprised by a bicyclist is reduced from April to June and from June to September (survey data);
4. The number of times pedestrians are surprised by a bicyclist is reduced from April to June and from June to September (survey data);
5. The number of times cyclists are involved in safety critical situations (near-misses) with other road users is reduced from April to June and from June to September (survey data);
6. The number of traffic conflicts between car drivers and bicyclists are reduced from April to June and from June to September (video observations).

We present the methodology, results and initial discussion separately for each data collection procedure, and provide a discussion synthesising the results from both procedures at the end.

3. Survey data

3.1. Method

Data were collected in a series of field surveys among road users in some preselected streets and parking lots in Oslo, Norway. The surveys were conducted at three time-points in 2013: April (15th–29th), June (10th–21st) and September (02nd–13th). The data collection period spanned over two weeks at each time point. Interviews were conducted on weekdays, and during daytime. Most interviews were conducted in the morning and afternoon, during rush hours, in order to recruit enough respondents at each location.

Pedestrians and bicyclists were interviewed at three different locations in Oslo. The locations were selected so that we would recruit "average" road users, have enough traffic, and to ensure that those interviewed would have had sufficiently long travels so that they could have experienced interactions with other road users. The interviewers were in principle asked to stop any pedestrian or bicyclists approaching them. However, as we were mostly interested in bicyclists' perceptions, on some days the interviewers were asked to recruit twice as many bicyclists as pedestrians. The interview took approximately 4–5 min to complete, and data were registered using tablet PCs. All who participated were promised a ticket in draw for a prize worth 5000 NOK (approx. 600 €). Interviews were only conducted on days with no rain.

Respondents were asked a range of questions, all regarding the trip they just had made (or were in the process of undertaking):

- Trip length in minutes
- Number of times they had experienced specific situations with poor interplay
- Assessment of interplay with cars and pedestrians (bicyclists for pedestrians)
- Experiences of near-misses
- Feeling of safety