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Shared road is double happiness:

Evaluation of a “Share the road” sign

A road sign with the text «Share the road» and a picture of a smiling cyclist and a passing car was evaluated in a before-after study with surveys among cyclists and car drivers. The sign was set up at two sites on a test road near Oslo in summer 2014. A similar road was used as a comparison. About two thirds of the participants on the test road had noticed the sign. The majority liked it and agreed with its message. Cyclists have more often noticed the sign than car drivers have and they were somewhat more positive towards the sign. Effects on self-reported behavior and the perceived behavior of others were evaluated by comparing changes from the before- to the after-period between test and comparison road. Self-reported behavior of both cyclists and car drivers has improved on the test road after the sign was set up, especially in overtaking situations, and these results are in accordance with how cyclists and car drivers perceived each other's behavior. The general perception of other road users has improved as well. The results are most likely representative of similar roads with a large proportion of car traffic that is related to recreation and a relatively low level of conflict.

1. Introduction

Cars overtaking too closely are among the most frequent and most important sources of insecurity for cyclists and a leading cause of conflicts (Bjørnskau et al., 2012; Fyhri et al., 2012; Sørensen & Mosslemi, 2009; Walker, 2014). Overtaking crashes are among the most common motor vehicle-bicycle collisions (Pai, 2011). Consequently, most cyclists feel less safe on roads with mixed traffic than on roads with a cycle lane or track (Jensen, 2006). On the other hand, cyclists are often regarded as an annoying moving obstacle on the road and thereby a source of anger and frustration, and sometimes aggression, by drivers of motor vehicles (Oppen, 2008; Lajunen & Parker, 2001). Driver aggression can in itself be a risk factor. For example, Underwood et al. (1999) found that drivers who experienced anger more often are at fault in near-accidents than other drivers.

In order to improve interactions between cyclists and cars and to reduce aggression, the Norwegian Public Roads Administration set up a sign with the text «Share the road» with a picture of a smiling cyclist and a passing car at two test sites near Oslo (figure 1). In contrast to “Share the road” signs used in other countries (for example in the United States), this sign is not an official warning sign. Both test sites are located on a country road frequently used for recreational purposes by car drivers and for recreational or training purposes by cyclists.



Figure 1: Road sign «Share the road» and the test site near Oslo.

The aim of this study was to investigate how the sign is perceived by cyclists and car drivers, and how it affects self-reported attitudes and behavior among cyclists and car drivers, as well as the perception of other road users.

2. Theory

It is well documented that campaigns that aim at changing attitudes and behaviors in traffic are more successful if road users receive the information and message when they are participating in traffic (for example roadside information) rather than in mass media (Phillips et al. 2011). Furthermore, roadside information has been found to be more effective if it addresses a specific behavior than if it gives more general information, for example about road safety of “safe behavior” in general (Luoma et al., 2000).

The “Share the road” sign aims at improving interactions between cyclists and car drivers, especially during passing manoeuvres. The sign shows a smiling cyclist on the right hand side and a car passing the cyclist at a very generous distance. The motive is similar to those that are used in other “Share the road campaigns”. The sign gives some hints as to what behavior is desirable – letting cars pass and passing cyclists at an adequate distance. Cars passing cyclists are the most common interaction between cars and cyclists on this type of road (there are no junctions or traffic lights and few driveways). Therefore, it was of interest to evaluate the effects of the sign on cyclists’ and car drivers’ own (self-reported) behavior and the perceived behavior of the other part. The main focus was on passing maneuvers. It was expected that passing behavior among drivers and cyclists would improve more than other types of behavior because the sign focuses especially on this type of interaction, and the improvements were expected to be found mainly for behavior on the current trip.

Ideally, the sign should affect the behavior of cyclists and car drivers, such that cyclists less often impede car drivers (e.g. by riding two or more abreast or far from the edge of the road) and that car drivers more often keep a reasonable distance to cyclists when overtaking. However, improved *self-reported behavior* is not necessarily related to actually improved behavior but may be affected by social desirability. Undesirable self-reported behavior is especially susceptible to social desirability (Sullman & Taylor, 2010). The “Share the road” sign may have caused such an effect if the participants interpreted the sign as a cue for what type of behavior is “desirable”. Lajunen and Summala (2003) summarize results from other studies about the validity of self-reported driver behavior. The results vary between different types of driver behavior. For example, self-reported speed was found to correspond relatively well to actual speed. For other types of driver behavior self-reports were found to be correlated to actual behavior in some studies but not in others.

Therefore, all participants were additionally asked about the *behavior of other road users* (cyclists were asked about car driver behavior and car drivers were asked about cyclist behavior). Although the participants theoretically also may have answered to questions about the behavior of others according to what they thought was expected of them, the behavior of other road users is not likely to contribute to impression management and such results are therefore most likely less susceptible to a social desirability effect than results that refer to own behavior. Empirical studies about the validity of perceived behavior of other road users were not found.

The perception of others' behavior has been shown to contribute to own behavior in road traffic. For example, Fyhri et al. (2012) found that cyclists who had experienced aggression from car drivers more often than others behaved aggressively towards car drivers themselves, and similarly that those car drivers who had experienced aggression from cyclists more often than others behaved aggressively towards cyclists. In a study of driving diaries Wickens et al. (2013) found that about 10% of all aggressive behaviors of car drivers were related to retaliation. The results of a qualitative study (Christmas et al., 2010) indicate that many drivers become less considerate when irritated. Crundall et al. (2008) identified car drivers' negative attitudes towards motorcyclists as a possible contributing factor in car-motorcycle collisions.

The participants were additionally asked about their *behavior in traffic in general* and about their thoughts in situations that provoke anger or irritation. The sign aims at improving specific behavior in specific (passing) situations and was therefore not assumed to affect general attitudes or behavior in other situations.

3. Method

Roadside surveys were conducted on the road with the two test sites and on a similar comparison road, both before and after the sign was set up. Both test and comparison roads are rural two-lane roads near Oslo in Norway. Neither has a bicycle lane or path, the speed limit is most 50 km/h and 60 km/h on some parts of the roads, there are no major intersections and there is no through traffic. Average traffic volumes are between 500 and 3000 vehicles per day on the test road and about 2000 vehicles per day on the comparison road. Actual volumes depend highly on the time of year, week and day and on the weather with most traffic on sunny weekends. There are several parking lots along both roads that are popular starting points for recreational trips in the forests around Oslo.

The roadside surveys were conducted by students on weekends in May 2014 (before period) and in August and September 2014 (after period) at the two most popular parking lots on each road. The sign was installed in July 2014. All surveys were conducted in fine weather (mostly sunny, no rain or strong wind, above 15°C) and at times with plenty of cyclists and cars on the road. The parking lots on the test road where the interviews were conducted were located 4 and 7 km north of the first sign, which was placed at the “starting point” of the road (right after the last crossroads). There was an additional sign about 1 km south of the northernmost parking lot (the latter was at the end of the dead-end road) in the southbound direction.

Separate questionnaires were used for car drivers and cyclists. They were administered online on a tablet. Several of the questions referred to demographics, cycling and driving habits, and the current trip. Both questionnaires contained additional questions from established questionnaires in order to assess the general level of anger and aggressiveness in road traffic. One item was taken from the Driving Anger Scale (DAS; Deffenbacher et al., 1994, 2003A); two items from the Driving Anger Expression Inventory (DAEI; Deffenbacher et al., 2002, 2003B), and one item from a questionnaire developed by Fyhri et al. (2012) about interactions between cyclists and car drivers. Since interviews were conducted in the field, the questionnaires had to be as short as possible because we did not want to try the participants' patience too much, and it was therefore not possible to ask all questions from the established questionnaires.

All participants were car drivers or cyclists. All types of cyclists were interviewed, except families with children. The response rate was close to 100%. None of the interviewers reported of any cyclists or car drivers who did not want to participate or who obviously avoided them. In theory, there may have been some who refrained from entering the parking lot because of the survey (visible interviewers), but as all others were generally positive to the interviews, these were most likely few, if any. Those who did not enter any of the parking lots could not be interviewed. These were either recreational drivers or cyclists who parked or turned elsewhere, cyclists who continued on a cycling path that is closed for motorized traffic, or non-recreational traffic (e.g. farmers). The latter may be somewhat different from the participants in the interviews but they are only a minor part of all car drivers. On the whole, the most likely type of selection bias is an underrepresentation of non-recreational traffic which is however only a minor proportion of all car drivers on both roads.

The participants were mostly men, both among cyclists (81%) and among car drivers (70%). The average age was 43 years among cyclists and 48 years among car drivers. Most of the cyclists cycle frequently; 91% of them cycle at least 2-3 times a week and 83% of them cycle at least 2-3 times a week solely for training purposes. Most cyclists were well equipped; 82% used a helmet and most of them used dedicated bicycle clothes and other cycling equipment. Among car drivers 50% cycle at least 2-3 times a week and 20% of them cycle at least 2-3 times a week solely for training purposes. Most participants drive a car regularly, both among cyclists (70% drive at least 2-3 times a week) and among car drivers (86% drive at least 2-3 times a week). The relatively high level of cycling among car drivers is probably related to the fact that car drivers share the demographics of a typical cyclist in Oslo (male between 40 and 50) and that most of the car drivers probably are above average interested in physical activity (e.g. walking trips from one of the parking lots). In the general population, cycling is probably somewhat less common (only 8% of all daily trips in summer are made by bicycle in Oslo).

The distribution of age, gender, car driving and helmet use among cyclists in the four study groups is shown in table 1, together with results from an analysis of variance (ANOVA) that refer to the interaction effects between road (test/comparison) and period (before/after) in the two rightmost columns.

Table 1 reveals that significant interaction effects between road (test/comparison) and period (before/after) were found for age, gender, car driving and helmet use among cyclists. The interaction effects indicate that there were changes in these variables from the before to the after period that were different between test and comparison road. These variables were therefore statistically controlled for in all further analyses for both cyclists and car drivers. The decrease of the proportions of cyclists wearing a helmet is probably due to the fact that there was a larger proportion of exercising cyclists in the before period which was earlier in the year where many people still are reluctant to start cycling after the winter (which often lasts until April). The after period was later in summer when “everyone” had started cycling, which is why there was a larger variation of different types of cyclists on the roads. The comparison road may be more popular among recreational (non-exercising) cyclists than the test road.

Table 1: Participants in the interviews.

		Test		Comparison		ANOVA ¹	
		Before	After	Before	After	F	p
Cyclists	Total	79 (100 %)	95 (100 %)	91 (100 %)	46 (100 %)		
	Men	61 (77 %)	75 (79 %)	74 (81 %)	42 (91 %)	0.793	0.374
	Age (average) ²	45	39	44	47	7.772	0.006
	Car driving, times per week ³	3.3	3.2	3.3	3.2	6.644	0.010
	Helmet use	77 (97 %)	72 (76 %)	86 (95%)	21 (46 %)	11.42	0.000
Car drivers	Total	66 (100 %)	203 (100 %)	90 (100 %)	43 (100 %)		
	Men	53 (80 %)	130 (64 %)	65 (72 %)	33 (77 %)	3.809	0.052
	Age (average) ²	47	45	52	51	0.092	0.762
	Car driving, times per week ³	4.2	3.4	3.7	3.7	3.588	0.059

¹ Results from analysis of variance: F and p for interaction Road (test/comparison) * Time period (before/after) (df = 1); main effects of road and time period are controlled for as well.

² Estimated average based on age groups below 20 years, 20 to 29 years, 30 to 39 years, 40 to 49 years, 50 to 59 years, 60 to 69 years, 70 years or above

³ Estimated average based on the following categories: Every day, 4-5 days per week, 2-3 days per week, 2-3 days per month, fewer than 2-3 days per month or never

4. Results

4.1 How was the sign «Share the road» perceived by cyclists and car drivers?

All participants were asked if they had seen the “Share the road” sign, both on test and comparison road, before and after the two signs were put up on the test road. They were asked regardless of whether or not they actually had passed a sign. According to the results from the analysis of variance (table 2) there were significant interactions ($p = .000$) between road (test/control) and time period (before/after). These indicate that the proportions of cyclists and car drivers who had noticed the sign has changed differently from the before-to the after-period on the test and comparison road. Among cyclists and car drivers who had actually passed a sign, about two thirds of both cyclists (71 %) and car drivers (61 %) had noticed the sign. Among those on the comparison road (who could not have seen the sign) 6% of cyclists and 3% of car drivers claimed to have seen the sign. Those who actually had seen the sign (those who said they had seen it on the test road in the after period) were additionally asked what they thought about it. As shown in table 3, more than 90% said they liked it and that they understood and agreed with its message. Cyclists had both noticed the sign somewhat more often and were more positive towards it than car drivers were.

When asked directly if all road users have equal right to the road, over 90% answered in accordance with the sign «Share the road», that cyclists and car drivers have equal right to the road (94% of all cyclists and 91% of all car drivers; not shown in table 3), regardless of whether or not they had seen the sign. Among those who answered otherwise, the majority thought that car drivers have more right to the road than cyclists. The proportion who thought that car drivers have more right to the road was 4 % among cyclists and 7 % among car drivers. The proportion who thought that cyclists have more right to the road was 2 % among cyclists and 1 % among car drivers. There were no significant effects or interactions of road or time period in the analysis of variance (table 2).

Table 2: Analysis of variance of the questions about the “Share the road” sign ($df = 1$ for all effects in each analysis of variance). Statistically controlled for age, gender, car driving and helmet use among cyclists.

	Road		Before/after		Road * Before/after	
	F	p	F	p	F	p
Cyclists						
Have you seen such a sign on this road today?	28.704	0.000	52.283	0.000	33.613	0.000
Do you think that cyclists have as much right to the road as cars on a road like this one without bicycle lane or path?	0.767	0.382	1.613	0.205	0.235	0.629
Car drivers						
Have you seen such a sign on this road today?	31.535	0.000	39.093	0.000	49.460	0.000
Do you think that cyclists have as much right to the road as cars on a road like this one without bicycle lane or path?	0.163	0.687	0.002	0.968	0.656	0.419

Table 3: Reactions to the “Share the road” sign (answers from those who have actually seen the sign on the test road in the after period; all questions had five response categories, only those chosen by at least one respondent are shown).

		Cyclists (N = 67)	Car drivers (N = 123)
How much did you like the sign?	Very much	76 %	54 %
	Much	19 %	33 %
	Neither nor	4 %	11 %
Was it easy to understand its message?	Very easy	93 %	83 %
	Quite easy	4 %	9 %
	Neither nor	3 %	4 %
Do you agree with its message?	Very much	99 %	92 %
	Quite	1 %	6 %

4.2 How did the sign «Share the road» affect attitudes and behavior among cyclists?

The results from the analysis of variance of the answers from cyclists and car drivers to the questions about cyclist behavior are summarized in table 4. Figure 2 shows the results for those questions for which statistically significant interactions between road and time period were found (including the question about riding abreast for which the interaction is not far from being statistically significant). The results indicate that cyclists behaved more positively towards car drivers after the sign «Share the road» was set up at the test site:

- Fewer cyclists said that they rode two or more abreast among those who did not cycle alone ($p = .052^1$)
- Fewer car drivers reported problems passing cyclists ($p = .000$)
- More cyclists said that they do not have a bad conscience when impeding others in road traffic ($p = .044$)
- More car drivers said that cyclists were considerate ($p = .002$).

These results indicate that cyclists became more inclined to letting cars pass, which is confirmed by the answers of car drivers who experienced fewer problems with cyclists. At the same time, cyclists are less bothered by a bad conscience in situations where they impede others.

Other types of self-reported cyclist behavior did not change after the sign was set up. The distance from the edge of the road was unchanged among those who were riding alone. General self-reported cyclist behavior was unchanged (not letting cars pass, cycling in the driving lane on roads with a cycle path or track). These types of behavior are in principal relevant to the “Share the road” sign, but they do not refer specifically to the current situation and were therefore not expected to change after the sign was set up.

Among drivers, the experience of negative reactions or aggression from cyclists did not change. The proportion reporting such behavior was however generally very low. Only 1% of all car drivers said that they had received negative reactions from cyclists on the current trip. Among cyclists, 23 % said that they often or sometimes deliberately did not let cars driving behind them pass (which is not necessarily “negative” behavior but may be intended to prevent risky overtaking).

¹ All reported p values in the text refer to the interaction between road (test/comparison) and time period (before/after) unless denoted otherwise

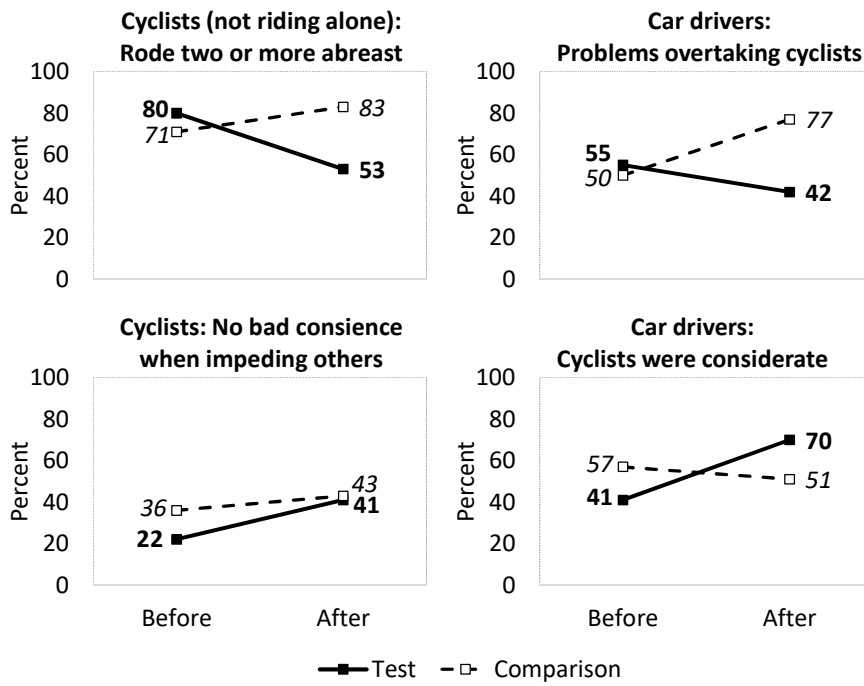


Figure 2: Cyclist behavior according to cyclists and car drivers for which statistically significant (or almost significant) effects of the “Share the road” sign were found.

Table 4: Analysis of variance of the questions about cyclist behavior to cyclists and car drivers. Statistically controlled for age, gender, car driving and helmet use among cyclists.

	Road		Before/after		Road * Before/after	
	F	p	F	p	F	p
Cyclists						
Did you ride two or more abreast? (Among those not cycling alone)	1.432	0.234	0.965	0.328	3.862	0.052
About how far from the road edge did you cycle? (Among those cycling alone)	2.809	0.096	1.346	0.248	0.797	0.373
Do you sometimes deliberately not let cars driving behind you pass?	0.621	0.431	0.099	0.753	0.302	0.583
Do you have a bad conscience when impeding others in road traffic? ¹	3.951	0.048	7.185	0.008	4.097	0.044
How often do you cycle in the driving lane on roads with a cycle lane or path?	1.020	0.313	6.581	0.011	1.438	0.231
Car drivers						
Did you have problems overtaking cyclists on this road today?	9.391	0.002	0.711	0.400	13.552	0.000
Did you get negative reactions from cyclists on this road today?	1.005	0.317	3.503	0.062	1.329	0.250
How do you think cyclists behaved on this road today?	1.454	0.229	3.978	0.047	9.637	0.002

¹ From Fyhri et al. (2012)

4.3 How did the sign «Share the road» affect attitudes and behavior among car drivers?

The results from the analysis of variance of the answers from cyclists and car drivers to the questions about car driver behavior are summarized in table 5. Figure 3 shows the results of those questions for which the interactions between road and time period are statistically significant (or close to). The results indicate that car drivers behaved more positively towards cyclists after the sign «Share the road» was set up at the test site:

- Fewer cyclists said that they have been passed by cars too closely ($p = .001$)
- Fewer cyclists experienced negative reactions from car drivers ($p = .010$)
- More cyclists said that car drivers were considerate ($p = .065$)
- Fewer car drivers said that they had passed cyclists although they should have waited (.046)

The results are consistent between cyclists and car drivers. Too close overtakings have declined according to both groups. Additionally, cyclists experienced more considerate car drivers and fewer negative reactions from car drivers.

Despite the decrease of cyclists reporting negative reactions from car drivers, the proportion of drivers saying that they have honked or yelled at a cyclist on the present trip was unchanged. The proportion was however very low (1 %).

Other types of car driver behavior and attitudes among car drivers did not change after the sign «Share the road» was set up. Cyclists reported unchanged experiences of aggression from car drivers (in other situations) and car drivers reported unchanged thoughts in irritating or frustrating situations in road traffic on the test road in the after period. These results refer to general behavior and experiences in road traffic and were not expected to change as a consequence of the “Share the road” sign.

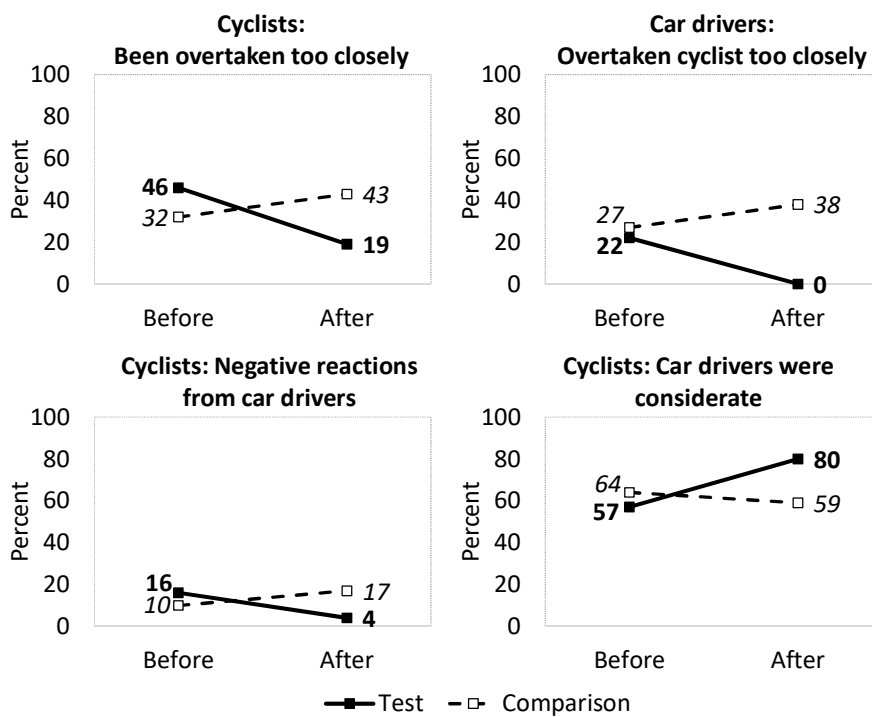


Figure 3: Car driver behavior according to cyclists and car drivers for which statistically significant (or almost significant) effects of the “Share the road” sign were found.

Table 5: Analysis of variance of the questions about car driver behavior to cyclists and car drivers. Statistically controlled for age, gender, car driving and helmet use among cyclists.

	Road		Before/after		Road * Before/after	
	F	p	F	p	F	p
Cyclists						
Have you been overtaken by a car with uncomfortably little passing distance on this road today?	0.458	0.499	1.793	0.182	11.037	0.001
Did you get negative reactions from car drivers (such as honking, yelling) on this road today?	1.160	0.282	0.862	0.354	6.812	0.010
How do you think car drivers behaved on this road today?	1.975	0.161	0.948	0.331	3.418	0.065
Have you experienced aggression from a car driver this year?	2.947	0.087	7.520	0.006	1.963	0.162
Car drivers						
Have you honked or yelled at a cyclist on this road today?	0.929	0.336	9.478	0.002	0.650	0.420
Have you overtaken a cyclist or group of cyclists on this road today although you should have waited?	1.112	0.292	0.547	0.460	3.998	0.046
When you are angry or furious while driving, how often do you just try and accept that there are frustrating situations while driving? ¹	2.583	0.109	0.001	0.974	0.517	0.473
..., how often do you do to other drivers what they did to you? ¹	1.262	0.262	4.363	0.037	0.000	0.985
What is more irritating to you, driving slowly behind a car or a bicycle? ²	2.328	0.128	6.044	0.014	1.265	0.261

¹ Slightly modified from the Driver Anger Expression Inventory (Deffenbacher et al., 2002, 2003B)

² Modified from the Driver Anger Scale (Deffenbacher et al., 1994, 2003A); the original question is "Imagine that each situation described below was actually happening to you and rate the amount of anger that would be provoked: ... A bicyclist is riding in the middle of the lane and is slowing traffic."

4.4 How did cyclists and car drivers interact generally?

The answers of both cyclists and car drivers indicate that there were relatively few conflicts. Those conflicts that occurred involved for the most part cyclists experiencing cars passing too closely. One-third (33%) of all cyclists reported that cars had passed too closely, and 11% of all cyclists reported negative reactions from car drivers. However, 95% of all cyclists said that car drivers were generally very considerate (66%), or considerate (29%), and only 1% said that car drivers generally were reckless. Similarly, 94% of all car drivers said that cyclists were generally very considerate (60%) or considerate (33%) and only 1% said that cyclists generally were reckless. On the other hand, 55% of all cyclists said that they had experienced aggression from a car driver this year (49% in the before period and 62% in the after period; the increase is probably due to the fact that “this year” covers a much longer time period in the after period than in the before period).

Whether or not cyclists experienced uncomfortable passing maneuvers does not seem to be related to the cyclists’ behavior. Cyclists who rode two or more abreast (69% of those not riding alone) and cyclists riding at a long distance from the road edge (40% of those riding alone) did not experience more uncomfortable passing manoeuvres than other cyclists. Thus, car drivers’ experience of difficulties when wanting to pass cyclists may be mostly due to characteristics of the road which in many places is winding with short sight distances, or to the mere fact that there are cyclists on the road, and to a lesser degree to specific cyclist behavior.

Cycling two or more abreast does not seem to imply negative behavior from the cyclists’ point of view. Those who rode two or more abreast do not more often than other cyclists deliberately impede cars (71% vs. 69%) and they are equally likely to have a bad conscience when impeding other road users (70% vs. 68%). However, they said more often that cyclists and cars have equal right to the road (96% vs. 86%), which may explain why more of them they think cycling two or more abreast is okay.

5. Discussion

The survey results indicate that the “Share the road” sign has improved the behavior of both cyclists and car drivers. The majority had noticed the sign, both among cyclists and among car drivers. However, almost one third who actually had passed the sign reported not to have noticed it. Given the large size of the sign (about 3 meters high) this is surprising, but a possible explanation could be that some respondents may have been interviewed several hours after having passed the sign (they may for example have made a trip in the forests). Among those who had noticed the sign, almost all (above 90%) said they liked it and agreed with its message. In accordance with the message of the sign, both car drivers and cyclists have become more considerate in that cyclists occupy less space and that drivers do not pass cyclist too closely. Results regarding self-reported behavior may be vulnerable to social desirability. However, several findings indicate that actual behavior may have improved as well.

Firstly, the improvements of self-reported behavior are in accordance with how cyclists and car drivers were perceived by each other. Cyclist behavior has improved according to the cyclists, and car drivers reported fewer problems passing cyclists and fewer reckless cyclists. Car driver behavior has improved according to the car drivers, which is confirmed by the cyclists who reported fewer close overtakings, fewer negative reactions from car drivers and fewer reckless car drivers. A possible bias may have arisen from a desire either to support the sign (for example, cyclists may have reported more favorable car driver behavior than they actually experienced) or to express the desire that still more should be done (for example, cyclists may have reported less favorable car driver behavior than they actually experienced). However, both types of bias would imply that the respondents thought very rationally and adopted a decision maker’s perspective.

Secondly, improvements were only observed for specific behavior that is relevant in passing situations and experiences on the current trip. No changes were found in how cyclists and car drivers described their general behavior or behavior in other situations. Had other types of behavior on the test road, behavior in other situations or general attitudes changed after the “Share the road” sign was set up, this might have indicated a social desirability-effect and would have challenged the validity of our findings.

Even if the self-reported improvements of cyclists' and car drivers' own behavior may be somewhat exaggerated, the perceived improvements of other road users' behavior can also be seen as a positive effect of the sign. A positive view of other road users may reduce experienced conflicts and thereby irritation and frustration, improve the behavior towards the others and thus provoke fewer conflicts and negative reactions from others.

The only specific behavior that is relevant in passing situations for which no change was found, is where cyclists place themselves in the road. The distance from the road edge where cyclists ride (among those riding alone) did not change. The proportions of participants who agreed with the statement that cars and bicycles have the same right to the road, did not change either. These proportions were however so high in the before situation (about 90% among car drivers and 97% among cyclists) that improvements would have been hardly noticeable.

In summary, the results indicate that there were actual improvements of cyclist and car driver behavior, and that the perception of the behavior of other road users has improved as well, which is likely to contribute to a lower level of conflict. This conclusion is in accordance with the results from a study of the effect of a "Share the road" sign on the lateral placement of cars overtaking cyclists (Kay et al., 2014). In this study, vehicle speeds were reduced after the sign was installed. The lateral average distance between motor vehicles and cyclists was however not significantly affected, although fewer cars passed cyclists in the rightmost lane position. The current study would also have benefitted from measurements of actual behavior, such as passing distances and lateral placement of cyclist in overtaking situations. Measurements of passing distances were actually made but could not be analyzed because of technical problems. Future studies of such roadside campaigns should aim at providing objective measures of road user behavior, in order to validate the current findings.

Other studies of similar signs on driver or cyclist behavior have not been found.

Evaluations of other "Share the road" campaigns have mainly focused on the effects of general information (e.g. on TV, in print media) on the awareness of the campaigns and general attitudes (for example Hall & Shikaze, 2013; Thornton, 2001). Anecdotal evidence (Furth et al., 2010) shows that a "Share the road" sign can be misunderstood by drivers who think that cyclists are supposed to cycle as far as possible to the right. The results of the present study do not indicate that such type of misunderstanding has occurred among car drivers.

The generalizability of the results may be limited to similar roads with mostly recreational traffic and a relatively low level of conflict. Although conflicts between car drivers and cyclists did occur, the general level of conflict was relatively low and the majority of participants in the survey agreed with the message of the “Share the road” sign before the sign was set up on both roads. In fact, the proportion who agreed with the message was so high that it would not have been possible to investigate whether the sign had a different effect among those who did and did not agree.

On other types of rural roads, vehicles and car drivers are likely to be different and the effects of the sign may be different as well. For example, there may be more heavy traffic (there were practically no trucks or buses on the roads at the times of the interviews) and drivers on trips with other purposes than recreation or workout may have more time pressure and thus less tolerance for cyclists. On urban roads with mixed traffic, there is a larger variety of different types of cyclists, vehicles and drivers as well. Whether or not the sign is sufficient to improve road user behavior on roads with an initially high level of conflict or different kinds of road users is not possible to conclude from the results.

Among road users who do not believe that all cyclists and cars have equal right to the road, the sign may be less effective.

6. Conclusions

The results of surveys among cyclists and car drivers on a road where a sign with the text “Share the road” and a picture of a smiling cyclist and a car passing at a generous distance was installed, indicate that the sign has improved interactions between cyclists and car drivers, especially with respect to passing manoeuvres. The results indicate that actual behavior changes are likely to have occurred. Additionally, the perception of other road users has improved. The results are mainly generalizable to similar roads with mostly recreational traffic. On such roads, setting up this or a similar sign can be expected to improve interactions between cyclists and car drivers. However, changes of other types of interactions, traffic behavior in other situations or general attitudes can not necessarily be expected.

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8. References

- Bjørnskau, T., Sørensen, M. W. J., & Amundsen, A. H. (2012). Samspill mellom syklist og bilister - Hva er problemene, og kan de løses med informasjon? (The interplay between bicyclists and car drivers. Problems and possible solutions). TØI-Report 1230/2012. Oslo: Institute of Transport Economics.
- Christmas, S., Helman, S., Buttress, S., Newman, C., & Hutchins, R. (2010). Cycling, safety and sharing the road: Qualitative research with cyclists and other road users. Road Safety Web Publication No. 17. London: Department for Transport.
- Crundall, D., Bibby, P., Clarke, D., Ward, P., & Bartle, C. (2008). Car drivers' attitudes towards motorcyclists: A survey. *Accident Analysis & Prevention*, 40(3), 983-993.
- Deffenbacher, J. L., Oetting, E. R., & Lynch, R. S. (1994). Development of a Driving Anger Scale. *Psychological Reports*, 74, 83-91.
- Deffenbacher, J. L., Lynch, R. S., Oetting, E. R., & Swaim, R. C. (2002). The Driving Anger Expression Inventory: A measure of how people express their anger on the road. *Behaviour Research and Therapy*, 40, 717-737.
- Deffenbacher, J. L., White, G. S., & Lynch, R. S. (2003A). Evaluation of Two New Scales Assessing Driving Anger: The Driving Anger Expression Inventory and the Driver's Angry Thoughts Questionnaire. *Journal of Psychopathology and Behavioral Assessment*, 26(2), 87-99.
- Deffenbacher, J. L., Petrilli, R. T., Lynch, R. S., Oetting, E. R., & Swaim, R. C. (2003B). The Driver's Angry Thoughts Questionnaire: A Measure of Angry Cognitions When Driving. *Cognitive Therapy and Research*, 27(4), 383-402.
- Furth, P. G., Dulaski, D. M., Bergenthal, D., & Brown, S. (2010). More Than Sharrows: Lane-Within-A-Lane Bicycle Priority Treatments in Three US Cities. Paper presented at the Transportation Research Board 2011 annual meeting, Washington, DC.
- Fyhri, A., Bjørnskau, T., & Sørensen, M. W. J. (2012). Krig og fred - En spørreundersøkelse om samspill og konflikter mellom biler og sykler (War and Peace - a questionnaire survey about interplay and conflict among bicyclists and cars). TØI-Report 1246/2012. Oslo: Institute of Transport Economics.

- Hall, K., & Shikaze, S. (2013). Seven Years Later: Evaluating Impact on Active Transportation in Haliburton County.
http://www.haliburtoncooperative.on.ca/CIA/images/stories/pdfs/final%20report%20-%20communities%20in%20action_new%20logos.pdf (last accessed 24.07.2015).
- Jensen, S. U. (2006). Cyklisters oplevede tryghed og tilfredshed – Forskelle i tryghed og tilfredshed afhængig af strækningers og kryds' udformning (Cyclists security and satisfaction – effects of the design of roads and intersections). Trafitec, online available on
http://arkiv.cykelviden.dk/filer/Cyklisters_oplevede_tryghed_og_tilfredshed.pdf (last accessed 23. Dec. 2014).
- Kay, J. J., Savolainen, P. T., Gates, T. J., & Datta, T. K. (2014). Driver behavior during bicycle passing maneuvers in response to a Share the Road sign treatment. *Accident Analysis & Prevention*, 70(0), 92-99.
- Lajunen, T., & Parker, D. (2001). Are aggressive people aggressive drivers? A study of the relationship between self-reported general aggressiveness, driver anger and aggressive driving. *Accident Analysis & Prevention*, 33, 243-255.
- Lajunen, T., & Summala, H. (2003). Can we trust self-reports of driving? Effects of impression management on driver behaviour questionnaire responses. *Transportation Research Part F: Traffic Psychology and Behaviour*, 6(2), 97-107.
- Luoma, J., Rämä, P., Penttinen, M., & Anttila, V. (2000). Effects of variable message signs for slippery road conditions on reported driver behaviour. *Transportation Research Part F: Traffic Psychology and Behaviour*, 3(2), 75-84.
- Oppen, T. (2008). Norsk undersøkelse: Sjåfører mest irritert på syklister. VG nett, 8. July 2008, www.vg.no/bil-og-motor/artikkel.php?artid=193095 (Last accessed July 2014).
- Pai, C.-W. (2011). Overtaking, rear-end, and door crashes involving bicycles: An empirical investigation. *Accident Analysis & Prevention*, 43(3), 1228-1235.
- Phillips, R. O., Ulleberg, P., & Vaa, T. (2011). Meta-analysis of the effect of road safety campaigns on accidents. *Accident Analysis & Prevention*, 43(3), 1204-1218.

- Sullman, M. J. M., & Taylor, J. E. (2010). Social desirability and self-reported driving behaviours: Should we be worried? *Transportation Research Part F: Traffic Psychology and Behaviour*, 13(3), 215-221.
- Sørensen, M. W. J., & Mosslemi, M. (2009). Subjective and objective safety - the effect of road safety measures on subjective safety among vulnerable road users. TØI-Report 1009/2009. Oslo: Institute of Transport Economics.
- Thornton, B. (2001). It takes two to tango: Evaluation of the Share the Road campaign, Queensland. Paper presented at the Safe Cycling Conference, 2000, Brisbane, Queensland, Australia.
- Underwood, G., Chapman, P., Wright, S., & Crundall, D. (1999). Anger while driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, 2(1), 55-68.
- Walker, I., Garrard, I., & Jowitt, F. (2014). The influence of a bicycle commuter's appearance on drivers' overtaking proximities: An on-road test of bicyclist stereotypes, high-visibility clothing and safety aids in the United Kingdom. *Accident Analysis & Prevention*, 64, 69-77.
- Wickens, C. M., Roseborough, J. E. W., Hall, A., & Wiesenthal, D. L. (2013). Anger-provoking events in driving diaries: A content analysis. *Transportation Research Part F: Traffic Psychology and Behaviour*, 19, 108-120.