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Lane splitting experiment: comparative analysis of how this is accepted by motorcyclists and car drivers

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Abstract

Lane splitting is a common riding practice although forbidden by the traffic rules in France. Since February 1st, 2016, a secure shape of traffic, respectful of certain rules is allowed on motorways and urban expressways in several French departments. The objective here is to present the results concerning the acceptability of this secure form of lane splitting for motorcyclists and car drivers.
908 car drivers and motorcyclists, representative samples of the French population (in terms of sex, age and socio-professional category) were interviewed. 751 lived in the experimental area and 157, in the control area where lane splitting is not allowed.
The results show that the car drivers and the motorcyclists evaluate positively the experiment, the attitude of the experiment is even more positive for the motorcyclists. But, the car drivers have some reservations about the difficulty to understand where lane splitting is allowed. The results are discussed. As we will be replicating this research in 2017 and 2018, in order to study changes in how the experiment is accepted in the long term, at the end we will have some helpful elements, to decide if LS could be allowed in France.

Keywords: lane splitting, powered two-wheelers; acceptance.

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1. Introduction

Although mobility using powered two-wheelers (PTW) accounts for only a small percentage of mobility for all modes of transport combined - 2.5% in terms of kilometres travelled - (ONISR, 2011), it is greatly over-represented in highly urbanized areas (Commissariat General for Sustainable Development, 2013). Lane splitting (LS), which consists of powered two- or three-wheelers moving between stationary or slowly moving queues of vehicles, or riding at slower speeds in dense and congested traffic, and more generally all types of overtaking between lanes, is in fact most often the consequence of an increase in the number of motorcyclists in increasingly congested traffic. These practices allow motorcyclists to take advantage of a section of unused road that allows them to pass between the lanes of other vehicles when stationary or moving slowly (Sperley and Pietz, 2010).

Untill 2016 , although common practiced by motorcyclists, LS was not authorized by the highway code throughout France.The *Conseil National de la Sécurité Routière* (National Concil of Road Safety) that brings together all the main actors in road safety adopted in 2013, a measure to experiment this practice.
In this context, since 1 February 2016, LS by powered two- or three-wheelers, less than one meter wide, is being tested over a period of four years in the 11 *departments*. In these *departments*, a secure form of cross-line traffic complying with certain rules is allowed on motorways and motorway-like roads. The road users were informed about the experiment by spot radio, flyers or on the web site of the *Délégation à la Sécurité et à la Circulation Routières* (French delegation for road safety and traffic) .

In order to have a complete picture of the effects produced by authorizing LS in experimental areas, the *Délégation à la Sécurité et à la Circulation Routières* (French delegation for road safety and traffic) commissioned Cerema to study the behaviour of motorcyclists and car drivers (section 1), and to examine the acceptance of this new measure (section 2). The purpose of this paper is to present only this second part of the study for the first year of the experiment. Our objective is to study the acceptability of the experiment by the motorcyclists, those LS is a common practice, and by the car drivers that have to deal with this practice. The results could help to decide if the LS could be authorized by the highway code throughout France.

2. Theoretical background

From a global point of view, the rare accident analyses, recent or older, at national or international level (MAIDS, 2009, Clarke, et al. 2004, Hurt, et al. 1981), referring to this specific practice, conclude it has little impact on the occurrence of accidents ranging from less than 0.5% to 5% depending on the geographical area concerned. Not surprisingly, Crundall, Clarke, Ward and Bartle (2008) found that these accidents occur more often on weekdays and at peak times (8 am and 5 pm).

In France, traffic accident analysis bulletin (*bulletins d'analyse d'accident corporel de la circulation* - BAAC) data for the year 2010 reveals an accident rate involving motorcyclists "between two lanes" of traffic averaging 4%. Moreover, this specific accident rate is concentrated in Ile-de-France (Paris region) with a rate of 89.1% in 2010 and more particularly on the Paris ring road, with nearly one accident out of three (31.4%) (Roy and Machu, 2012). However, specific work in France and more locally situated suggests that the issue related to PTW lane splitting is probably underestimated. The reason for this is that the manoeuvre identified in the BAAC as close to lane splitting is limited to the item "between 2 lanes". Specifically, these are situations where motorcyclists are moving at a moderate speed while vcar drivers are stationary or almost so. This results in deducing low accident severity, given the generally low speeds. The BAAC indication also does not take into account lane-changing accidents caused by motorcyclists moving to a position between lanes A detailed reading of the records for the year 2007 Clabaux and Michel (2012) shows that lane splitting accidents on the non-concessionary motorway network of the Marseille urban area probably amounted to 7 cases, whereas according to manoeuvres identified only from the BAAC, it is noted that the police identified among these 7 cases only 2 for which the motorcyclists' "main manoeuvre before the accident" was "lane splitting".

The literature does not report information against lane splitting, but only in favour of it. However, we have no idea of the objective reality of the benefits put forward (Sperley & Pietz, 2010). Lane splitting, and more generally all types of overtaking between lanes, is said to have environmental benefits by reducing traffic congestion (Wigan, 2002), greenhouse gas emissions and damage to roads, infrastructure and cars. It is said of the specific practice of lane splitting that it might potentially reduce certain types of accident involving motorcyclists such as rear or front impacts in vehicle queues in the event of a sudden slowdown in traffic. But, driving in a narrow space can make

accidents happen by simple lateral contacts with vehicles. Here too, available data on the question, for example on the Paris ring road, show no convincing effect (Guyot, 2012). The observation made by CETE Méditerranée (2012) in the south-east of France regarding lane splitting by certain motorcyclists (a minority) at a speed lower than that of vehicles in the left-hand lane could provide a basis for a strategy to prevent this risk of sudden slowdowns in queues during congested periods. As for the main perceived advantages of lane splitting by motorcyclists themselves, these are a reduction of journey time and reliability of travel time (Hurt et al. 1981; Burge et al. 2007), by keeping vehicles moving. But for the car drivers, if motorcyclists lane splitting is a common practice for motorcycslits, it should be better to make a secure form of cross line trafic complying with certain rules (Autofil, Ragot-Court et al. , 2014).

3. Presentation of the experiment

The rules governing LS in the experimental zone are presented in the box below (Table 1):

Table 1: Rules governing lane splitting

In the *départements* mentioned above, lane splitting is allowed...

- on roads with several traffic lanes in the same direction
- when traffic flowing in the opposite direction is separated by a central reservation
- when motoryclists are travelling between the two leftmost lanes of the carriageway
- when traffic is dense and it is running in uninterrupted lines on all lanes
- when the maximum authorized speed is greater than or equal to 70 km/h

Lane splitting is prohibited ...

- for motorcyclists more than 1m wide
- when the space between the lines of vehicles is insufficient
- when roadworks are being carried out on at least one of the lanes
- when weather conditions are unfavourable (snow, ice or strong wind)

Motorcyclists when lane splitting ...

- must not exceed 50 km/h
- must indicate when entering and exiting lanes
- must not overtake another motorcyclists engaged in lane splitting

Motorists must ...

- leave sufficient space to facilitate lane splitting by motorcyclists
- check their rear-view mirror and check blind spots before changing lanes
- indicate before changing lane
- avoid sudden manoeuvres

4. Aim

The aim of this work is to learn how motorcyclists and car drivers understand, judge, conform to, or appropriate the rules of lane splitting. We made the hypothesis that motorcyclists have a more positive attitude on the experiment that the car drivers. We base this hypothesis on the idea that for the motorcyclists, LS is a common practice, while car drivers have to deal with it.

5. Method

5.1 Population examined

The scope of study on the acceptability of lane splitting covers:
two distinct areas: the experimental zone, which includes all the *departments* subjected to the experiment, and the control area (one department) not subjected to the experiment
the 2 main populations concerned by lane splitting:

- Dual-mode drivers defined as motorcyclists
- Single-mode drivers defined as car drivers

5.2. Method

After a pre-test phase with 61 respondents, the final questionnaire to study LS was distributed by a survey institute, from June 16 to June 29, 2016 to 908 respondents distributed equally among the 12 *departments* (11 in the experimental area and 1 in the control area).
The data collected in this way were weighted in order to obtain representative samples of the French population (in terms of sex, age and socio-professional category).
The data from the questionnaires were processed using SPSS software. ANOVA and χ^2 were used for statistical analysis.

5.3. Questionnaire

In addition to socio-demographic information (age, gender, vehicle type), the questionnaire was divided into several separate sections to examine acceptance of the experiment as fully as possible.

However, here we will present only the main results dealing with

- knowledge of the experiment: the experiment was presented in a few lines. Respondents were then asked whether they had any knowledge of it

- the various dimensions composing the acceptability of the experiment were presented to the respondents who had to evaluate each according to whether they judged it to be more or less relevant on a 4-point scale: 1 perfectly relevant, 2; fairly relevant; 3 fairly irrelevant; 4 not at all relevant

- the acceptability of the experiment was then evaluated by 8 items. 6 of them are about the understanding of the instructions, the dangerousness of the LS in link with its authorization or its , the ban, the ease of compliance with instructions and the utility of the experiment. Respondents had to score each of the 8 items on the scale 4-point scale: 1 perfectly agree, 2; fairly agree; 3 fairly disagree; 4 perfectly disagree.

- the practice of driving: the impact of the experiment on practices: whether LS had had an impact on how they drive both on and off urban expressways. More precisely, it was asked if they changed or not their practice since the beginning of the experiment.

6. Results

6.1. Population

In the experimental area, 379 LV and 372 motorcyclists were interviewed. Motorcyclists represent 82.5% (N = 296) of motorcyclists and female motorcyclists represent 17,5% (N=76) of motorcyclists. Car drivers represent 55,3% (N=214) of car drivers and female car drivers represent 44,7% (N=165). The mean age of car drivers is 49.98 years old (SD=15,09) and those of motorcyclists is 42.69 years old (SD=12,62). Concerning driving

experiment of motocycle, the mean is 2.51 years (SD=1,09). Most of the motorcyclists ride a moto (65,5% N=298) and 34,5% a scooter.

In the control area, 82 users are car drivers and 75 motorcyclists. Male motorcyclists represent 79,8% (N=71) of motorcyclists and female motorcyclists represent 11,2 % (N=4) of motorcyclists. Male car drivers represent 38,7% (N=25) of car drivers and female car drivers represent 61,3% (N=57). The mean age of the respondents is quite the same as those of the experimental area 43.10 years (SD=14,99) for motorcyclists and 45.49years (SD=14,62) for car drivers. Concerning driving experiment of a motorcyclist, the mean is 2.68 years (SD=1.11). Most of the motorcyclists drive a moto (71,1% N=64) and 28,9% (N=26) a scooter.

6.2. Knowledge of the experiment

More than half of the users reported having had knowledge of the experiment, except for the car drivers in the control group with 42% of informed users. For each of the studied population, the road users in the experimental areas are better informed about the experiment than car drivers in the control area [car drivers ; χ^2=10.672 p=0.001 ; motorcyclists, χ^2=4.068 p=0.044]. However, motorcyclists were better informed about the experiment than car drivers (experimental area :χ^2=18.80 p=0.0001 ; control area :χ^2=9.682 p=0.002) (table 2) with, in keeping with the previous data, a person rate having knowledge of the experiment higher for motorcyclists (75,7 vs. 65,2%) (table 2).

Table 2: Knowledge of the experiment

Experimental group		Control Group	
PTW	LV	PTW	LV
75,7% (N=271)	60,7% (N=224)	65,2% (N=58)	41,9% (N=39)

6.3. Relevance of the dimensions making up the measure

Whatever the types of road users or the area of living (experimental or control), the users evaluate the relevance of the measures positively. The means are between 1, 23 and 1,88. In other words, the respondents evaluate the measure as fairly relevant or perfectly relevant. About the measures about the speed limit, the means are between 2,02 and 2,32, in other words the respondents evaluate this item as fairly relevant or fairly irrelevant.
In fact, on a positive backdrop evaluation, the fact of whether or not they reside in the experimental area does not seem to have an impact on the acceptability of the experiment. On the other hand, it is essentially the type of user that seems to affect the relevance of the measure.

Motorcyclists evaluate the relevance of the following measures more positively compared to car divers in each of the experimental and control conditions (Table 3):

- LS is allowed on multi-lane roads going in the same direction
- LS is allowed when traffic flowing in opposite directions is separated by a central reservation,
- LS is allowed when motorcyclists are travelling between the 2 leftmost lanes of the carriageway
- LS is allowed when traffic is dense and is running in uninterrupted lines in all lanes (experimental condition
- motorists must leave sufficient space to facilitate lane splitting by motorcyclists (experimental condition
- motorists must avoid sudden manoeuvres

However, some differences are found only with respect to one or the other condition, experimental or control . So for the experimental condition, motorcyclists find that it is better for LS to be allowed only when the speed is limited to 70 km / h while car drivers are more supportive of the idea that LS should be prohibited when there are roadworks on at least one lane .
For the control condition, motorcyclists are more favourable to the following items than car drivers:

- Motorcyclists must indicate when entering or exiting lanes
- Motorists must check their rear-view mirror and check blind spots before changing lanes
- Motorists must indicate before changing lanes

Table 3: Evaluation of the measures governing LS

	Experimental group			Control Group		
	Motorcyclists (M)	Car drivers (M)	Test and significance	Motorcyclists(M)	Car drivers (M)	Test and significance
LS is allowed on roads with several traffic lanes going in the same direction	1.68	1.95	F(1 ;724)=42.51; p=0.0001)	1.69	1.92	F(1 ;179)=3.98; p=0.048
LS is allowed when traffic flowing in the opposite direction is separated by a central reservation	1.55	1.91	F(1 ;724)=21.99; p=0.0001	1.72	2.07	F(1 ;179)=3.98; p=0.005
LS is allowed when PTWs are travelling between the two leftmost lanes of the carriageway	1.74	2.08	F(1 ;724)=36.38; p=0.0001	1.68	1.95	F(1 ;179)=36.38; p=0.003
LS is allowed when traffic is dense and is running in uninterrupted lines in all lanes	1.64	1.97	F(1 ;724)=33.06; p=0.0001	1.74	2.08	F(1 ;179)=5.66; p=0.0001
LS is allowed when the maximum authorized speed is greater than or equal to 70 km/h	2.02	2.31	F(1 ;724)=18.64; p=0.0001	2.32	2.25	Non-significant result
Lane splitting is prohibited for motorcyclists more than one metre wide	1.72	1.7	Non-significant result	1.62	1.76	Non-significant result
LS is prohibited when the space between the lines of vehicles is insufficient	1.61	1.62	Non-significant result	1.56	1.65	Non-significant result
LS is prohibited	1.85	1.65	F(1 ;724)=9.17; p=0.003)	1.75	1.76	Non-significant result

when roadworks are being carried out on at least one of the motorcyclists lanes						
LS is prohibited when weather conditions are unfavourable (snow, ice or strong wind)	1.73	1.64	Non-significant result	1.65	1.74	Non-significant result
Motorcyclists must not exceed 50 km/h	1.85	1.9	Non-significant result	1.88	1.81	Non-significant result
Motorcyclists must indicate when entering and exiting lanes	1.48	1.44	Non-significant result	1.32	1.6	F(1 ;179)=8.99; p=0.003)
PTW drivers must not overtake another motorcyclist engaged in lane splitting	1.56	1.51	Non-significant result	1.46	1.53	Non-significant result
Motorists must leave sufficient space to facilitate lane splitting by motorcyclists	1.52	1.85	F(1 ;724)=20.85; p=0.0001	1.57	1.95	F(1 ;179)=13.68; p=0.0001
Motorists must check their rear-view mirror and check blind spots before changing lanes	1.33	1.39	Non-significant result	1.23	1.54	F(1 ;179)=13.678; p=0.0001)
Motorists must indicate before changing lane	1.31	1.35	Non-significant result	1.24	1.43	F(1 ;179)=5.316; p=0.022
Motorists must avoid sudden manoeuvres	1.3	1.85	F(1 ;724)=42.513; p=0.0001	1.29	1.64	F(1 ;179)=14.941; p=0.0001

6. 4. Attitude to the experiment

First, regarding the set-up for the experiment, in terms of ease of application, dangerousness and utility of the measure, motorcyclists and car drivers have a positive (or a very positive) attitude : no respondent choose the " irrelevant" point of the scale. But we can note some differences, motorcyclists differ from car drivers independently of their area of residence (Table 4). motorcyclists consider that:

- the instructions are clear
- it is easy to observe the instructions
- it is useful
- LS should be allowed everywhere

However, the understanding of the areas where the LS is allowed seem difficult for the two types of road users, in keeping with the idea that « the experiment tends to make motorcyclists engage in lane splitting even where it is prohibited ». Futhermore, motorcyclists and car drivers have different answers on the more negative items about the LS and the experiment. So the motorcyclists consider that « Lane splitting is not dangerous per se: it should be allowed everywhere » and the car drivers do not agree with this item.

As a corollary, even having a mixed advice, the car drivers agree this the idea that « Lane splitting is dangerous per se, so it should remain prohibited » against the opinion of the motorcyclists. The car drivers are more worried about some perverse effects of the experiment tends to make motorcyclists engage in lane splitting even where it is prohibited, but only in the experimental area . The motorcyclists do not have a very different attitude on this item, which is coherent with the difficulty understanding in which areas lane splitting is allowed.

Table 4: Attitudes to the LS experiment

	Experimental Area			Control Area		
	Motorcyclists	Car drivers	Test and significance	Motorcyclists	LV	Test and significance
The instructions are clear	1.8	2.18	F(1 ;724)=14.863; p=0.0001)	1.84	2.1	F(1 ;179)=5.13; p=0.025)
It is easy to respect the instructions of the experiment	1.83	2	F(1 ;724)=9.606; p=0.002)	1.69	2.02	(F(1 ;179)=10.10; p=0.002)
You have difficulty understanding in which areas lane splitting is allowed	2.44	2.43	Non-significant result	2.33	2.27	Non-significant result
This experiment is useful in order to assess whether or not lane splitting is dangerous	1.86	2.07	F(1 ;724)=12.601; p=0.0001)	1.69	2.02	F(1 ;179)=5.175; p=0.024)
Lane splitting is not dangerous per se: it should be allowed everywhere	2.21	2.78	F(1 ;724)=76.294; p=0.0001)	2.13	2.74	F(1 ;179)=26.054; p=0.0001)
Lane splitting is dangerous per se, so it should remain prohibited	2.83	2.27	F(1 ;724)=64.889; p=0.0001)	2.69	2.25	F(1 ;179)=9.677; p=0.002
The experiment tends to make motorcyclists engage in lane splitting even where it is prohibited.	2.27	2.06	(F(1 ;724)=10.12; p=0.002)	2	1.99	Non-significant result
This experiment is pointless because it will not influence the behaviour of those motorcyclists who already engage in lane splitting	2.08	2	Non-significant result	1.94	1.93	Non-significant result

6.5. Modification of behaviour

Most of the users declare not having modified their behaviour since the beginning of the experiment. However car drivers users in the experimental group were more likely to report that they changed their off-motorway and urban expressway behaviour than those in the control condition ($\chi 2 = 4.65$; $p = 0.03$). On the other hand, this result cannot be found for car drivers on motorways and urban expressways, in other words in areas where lane splitting is allowed ($\chi 2=0.96$ ns).
Opposite result are observed with motorcyclists. For motorcyclists, more people report having modified their behaviour in areas where experimentation is permitted than motorcyclists in the control area ($\chi 2^2 = 4.74$, $p = 0.03$). There were no differences off motorways and urban expressways between the two conditions for this population of users ($\chi^2 = 2.025$) (table 5).

Tableau 5: Number of people report having modified their behaviour since the beginning of the experiment

	Car drivers		Motorcyclists	
	Experimental area	Control area	Experimental area	Control area
Motorways and urban expressways	37,4% (N=138)	31,9% (N=29)	25,5% (N=91)	14,6% (N=13)
Off-motorway and urban expressway	35,8% (N=132)	23,9% (N=22)	21,5% (N=77)	16,7% (N=15)

7. Conclusion

The results show that it is more the type of user, motorcyclists vs car drivers, which has an impact on the acceptability of the LS experiment than whether the respondents live in the experimental zone or the control zone. The knowledge of the experiment varies from one area to an other with about 2/3 of the users that are already informed in the experimental area and only half of them in the control area. It should indeed be noted that motorcyclists are more likely to have been aware of the experiment than car drivers, regardless of where they live. When one looks at the relevance of the different measures that govern lane splitting, all users judge them positively but motorcyclists consider them to be more relevant overall than car drivers, regardless of where they live.
In other words, the experiment is judged positively and even more positively for the motorcyclists, probably because they already had this practice, lane splitting, before the experiment. This interpretation is based on the items that were more positively evaluated by the motorcyclists than by the car drivers in the control area (*i.e. motorcyclists drivers must indicate when entering and exiting lanes / Motorists must check their rear-view mirror and check blind spots before changing lanes / Motorists must indicate before changing lane*) . We will note a drawback that seems share by the two types of users, the understanding of the line in which areas lane splitting is allowed. This drawback could be explained by the fear expressed by the car drivers that the line splitting could tend to make motorcyclists engage in lane splitting even where it is prohibited. Maybe in the same logic, we can observe that more car drivers declared having modified their behaviour off-highway and urban expressed ways in the experimental area.
For them, LS is a dangerous behaviour and many of them think that it should be forbidden.
About changing behaviours since the beginning of the experiment, first, most of the users declare not having changed their behaviours since the beginning of the experiment. However, if more car drivers than motorcyclists declare not having changed their behaviours on the type of road where the LS is allowed, it is perhaps because they think that their behaviours were already adapted to this practice that is not new . The other explanation could be that they feel less concerned and/or they think that they do not have to change their behaviour to conform a measure that is perceived as in favor to motorcyclists.
The main limitation of this work is that we do not interrogate the road users *before* the implementation of the experiment (acceptability). We could not compare the acceptability of the experiment with its acceptance. But as we will be replicating this research in 2017 and 2018, in order to study changes in how the experiment is accepted in the long term, at the end we will be able to know if LS could be allowed in France.

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