

IMPACT OF WAITING TIMES ON PEDESTRIANS' AND CAR DRIVERS' BEHAVIOR AT SIGNALIZED INTERSECTIONS

SÉCURITÉ ROUTIÈRE TOUS RESPONSABLES

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ABSTRACT

In order to guarantee high speed and punctuality, tramways and buses are given full priority when they cross signalized intersections. The increasing number of tramway lines keep extending the waiting times for every driver, pedestrian and cyclist. French road sign regulation decrees that the waiting time at traffic lights must not exceed 120 seconds. The transport ministry has opened discussions about modifying this rule and financed research work to assess the impact of waiting times on users' behavior and safety.

The behavior of 44,000 drivers was observed in five cities. The rate of running red lights clearly depends on the length of waiting times. The 120 seconds maximum could be extended for drivers on tramway crossings.

8,000 pedestrians were also observed. Even if the waiting time is short, 64% of the pedestrians do not comply with the red light. If it is long (between 90 and 300 seconds), it rises to 80%. An acceptability and credibility threshold exists and is less than 90 seconds. The research suggests waiting time limits should not be extended for pedestrians.

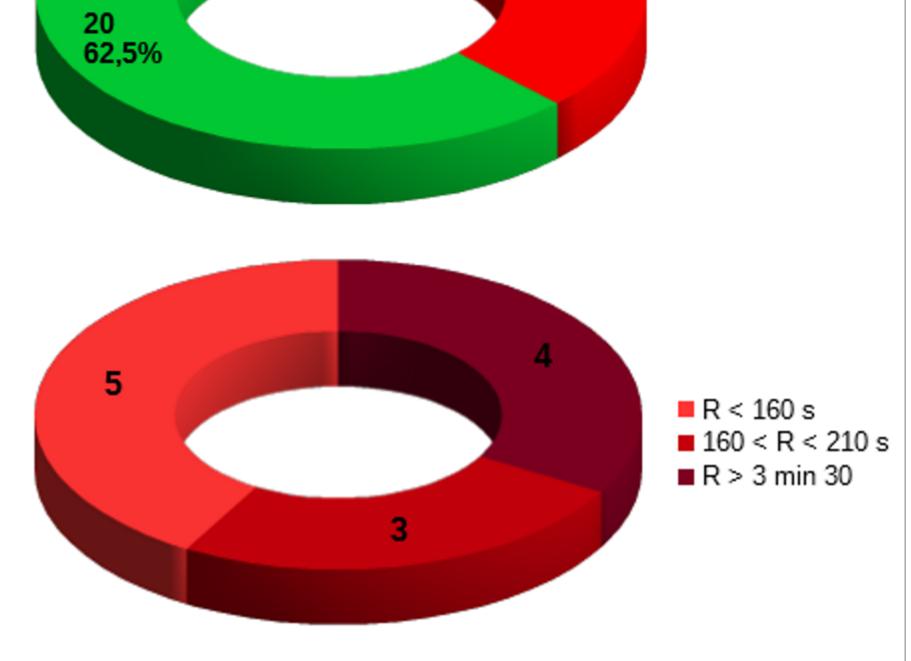
BACKGROUND

French legislation on road signalization:

"the waiting time imposed on road-users should never exceed two minutes under normal circumstances."

Cities have questioned this rule because they cannot comply with this requirement, especially on tramway crossings.

Limiting the waiting time is not a French particularity. For instance, the German traffic light guidelines recommend that the waiting time should not exceed 120 seconds for car drivers and 60 seconds for pedestrians and cyclists. In the USA, a cycle length between 50 and 120 seconds is recommended, with an optimum of 90 seconds.



But these rules are technical recommendations and not part of national legislation.

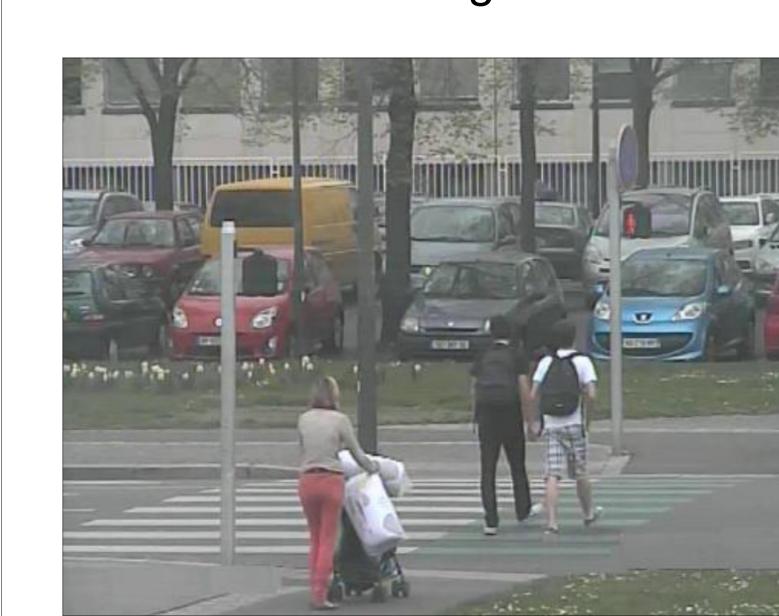
Before changing the maximum waiting time of 120 seconds, we had to make sure that increasing the waiting times would not lower levels of safety for all concerned.

METHODOLOGY

Nine junctions studied in five cities :

Four pedestrian behaviours :

- « Red »
- « Red after waiting »
- « Decide to wait for green »
- « Have to wait for green »





The behavior of 44,000 car drivers was studied on six signalized crossings. Every color change of the lights was systematically noted. We counted every car crossing both during green and red periods.

RESULTS

The road accidents that occurred from 2010 to 2015 on the nine studied crossings were reviewed. Few crashes happened, therefore we have not been able to find a link between the waiting times and the number of accidents.

Pedestrians' behavior

Even if the waiting time is short, up to 64% of the pedestrians do not respect the red light. At crossing P3 with an average red time of 113 seconds and a maximum red time of 302 seconds (5 minutes), 20% of pedestrians wait.

Table 1. Behaviour of pedestrians on crossings P1, P2 and P3

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Name of the crossing	Average red time (seconds)	Maximum red time (seconds)	Behaviour "Red"	Behaviour "Red after waiting"	Behaviour "Decide to wait for green"	Behaviour "Have to wait for green"	Total
Crossing P1	42	99	58 %	6 %	27 %	9 %	36 %
Crossing P2	88	112	78 %	2 %	11 %	9 %	20 %
Crossing P3	113	302	74 %	6 %	15 %	5 %	20 %

Cyclists' behavior

When the waiting time is short, about 60 % of cyclists run the red light. When it is long, from 90 to 300 seconds, more than 85 % of cyclists run the red light.

Table 2. Behaviour of cyclists on crossings P1, P2 and P3

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Name of the crossing	Average red time (seconds)	Maximum red time (seconds)	Behaviour "Red"	Behaviour "Red after waiting"	Behaviour "Decide to wait for green"	Behaviour "Have to wait for green"	Total
Crossing P1	42	99	54 %	6 %	20 %	20 %	40 %
Crossing P2	88	112	87 %	2 %	7 %	4 %	11 %
Crossing P3	113	302	81 %	5 %	10 %	4 %	14 %

Cyclists respect the lights even less than pedestrians. If they can physically cross the road, and if the traffic is not too heavy, most cyclists will not wait at signalized intersections.

Drivers' behavior

On crossing D6, with an average red time of 162 seconds, and a maximum red time of about 12 minutes, the acceptability threshold is exceeded. 25% of car drivers run the red light.

Table 3. Behaviour of car drivers on 6 crossings

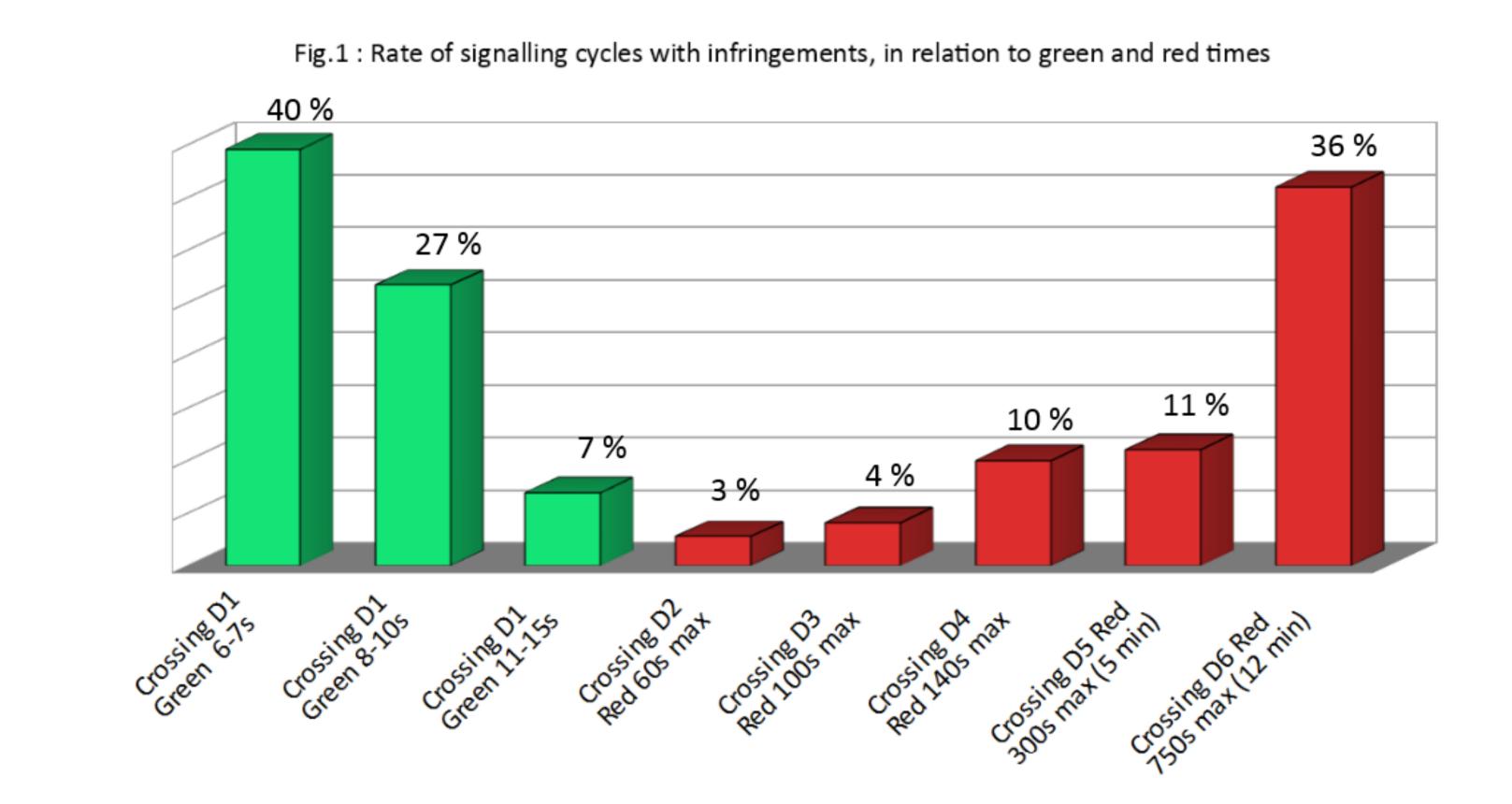
Name of the crossing	Average red time (seconds)	Maximum red time (seconds)	Number of observed cars	Number of red-light runners	Percentage
Crossing D1	24	87	16,755	134	0.80 %
Crossing D2	21	58	1,036	11	1.06 %
Crossing D3	41	105	9,590	28	0.29 %
Crossing D4	87	143	11,280	145	1.29 %
Crossing D5	82	298	4,923	58	1.18 %
Crossing D6	162	758	687	176	25.6 %

Too long red time periods can cause an increase of red light runnings. But too short green time can have the same effect because it creates a frustration effect on drivers. When those green periods last 6 or 7 seconds, 32 % of drivers crossed during red times.

Table 4 Behaviour of car drivers on crossing D1 depending on the green period length

Green light period length	Number of studied periods	Traffic (vehicles)	Number of red-light runners	Percentage
6 - 7 seconds	24	60	19	32 %
8 - 10 seconds	15	63	8	13 %
11 - 15 seconds	36	154	5	3 %

If we want to compare the figures precisely, we have to compare the rate of signalling cycles during which a driver ran the red light.



CONCLUSION

The pedestrians who respect meticulously the lights are more than often children, elderly or disabled people. Pedestrians are vulnerable. It is inadvisable to extend the maximum waiting time of 120 seconds for pedestrian crossings. According to the evidence, the waiting times should last less than 90 seconds for pedestrians and cyclists.

A waiting time from three to five minutes is accepted and respected by car drivers. A waiting time over six minutes exceeds the acceptability threshold and must be avoided. On tramway crossings, the waiting time limit could be extended to a maximum of three to five minutes without lowering levels of

The green periods of 6 or 7 seconds for car drivers should be avoided to keep the lights' credibility and maintain the users' safety.

The research contributed to quantify the rates of red light running in accordance to the length of waiting time. We also estimated the duration of an acceptability threshold for pedestrians, cyclists and car drivers.

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