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Analysis of the Possibility of Introducing a Traffic Sign with a Green Border in Poland

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Abstract

Road traffic accidents constitute a significant societal challenge, leading to substantial losses in human life and material resources. The escalating number of vehicles, driven by increasing motorization rates and population growth, has exacerbated this problem. Although traffic collisions are stochastic events in temporal and spatial dimensions, their global impact remains severe, with millions of fatalities and injuries recorded annually.

A survey-based methodology was employed to assess public perception of this proposed traffic management solution. The findings indicate that the introduction of such signage could contribute to a reduction in accident frequency on Polish roads. Despite isolated dissenting opinions, statistical analysis reveals majority support among respondents for adopting green-bordered advisory speed signs. The research underscores the potential efficacy of non-binding speed recommendations as a supplementary measure to enhance road safety while highlighting the importance of aligning traffic regulations with driver behavior and preferences.

The article analyzes the possibility of introducing a traffic sign with a green border in Poland. The survey showed that the majority of respondents (63%) support the introduction of a sign with a green border indicating the recommended speed on Polish roads. The sign is seen as a tool that can improve traffic safety, educate drivers and increase the smoothness of driving. Among the advantages of the proposed solution, respondents pointed out to the following: educating drivers on safe speed (38%), reducing the stress of mandatory speed limits (23%), increasing traffic flow (18%) and reducing exhaust emissions (10%).

Keywords

sign with a green border, Poland, safety

1 Introduction

Road accidents are a serious social problem that needs to be addressed in every country. Numerous factors, such as the driver's intoxication, the weather, and the vehicle's speed, can contribute to traffic accidents. According to the World Health Organization (2018), traffic accidents claim the lives of over 1,35 million people each year, while millions more suffer serious injuries and long-term health consequences. Traffic accidents also result in financial losses. Every year, the number of traffic accidents has decreased; the Covid 2019 pandemic has been the primary factor in this fall in recent years.

However, a high number of traffic accidents occur in Poland (Fig. 1), with an average of 62 occurrences each day, resulting in 72 injuries and 6 fatalities. The aforementioned incidents increase medical costs, require repairs to vehicles and road infrastructure, and have a negative impact on the environment (for instance, because of fuel

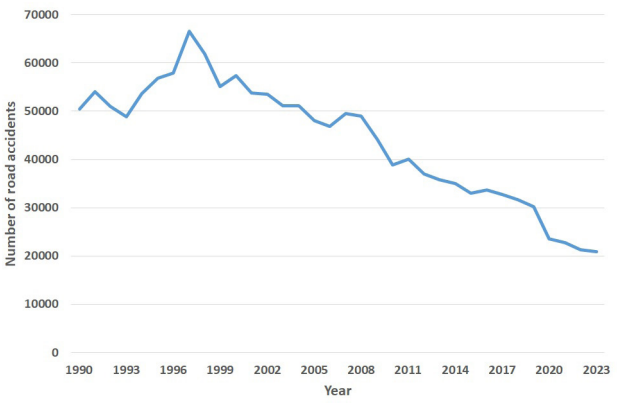

Fig. 1 Number of road accidents in Poland between 1990 and 2023 (Polish Police (online))

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and operating fluid leaks). Numerous strategies are being employed to prevent and reduce the number of traffic accidents. Examining the factors affecting the frequency of traffic accidents is one such metric (European Union (online);Polish Police (online)). Another is the analysis of methods for predicting the number of traffic accidents based on the factors that affect accident frequency.

In addition to injuring or killing other drivers, traffic accidents can cause property damage. According to the WHO, road accidents claim the lives of almost 1.3 million people annually. Traffic accidents account for about 3% of the GDP of most countries in the world. The leading cause of death for children and adolescents between the ages of 5 and 29 is road accidents (WHO, 2018). The ambitious goal of halving traffic-related deaths and injuries by 2030 has been established by the UN General Assembly.

There are several different sources of accident statistics. Government authorities frequently collect and review them through certain government agencies. Among the sources of information are police reports, insurance databases, and medical records. The incomplete information on traffic events is subsequently processed on a larger scale by the transportation business (Gorzelanczyk et al., 2020).

2 Literature review

Currently, the most important data source for traffic accident research and predictions is intelligent transportation systems. This data may be processed by GPS devices that are mounted in automobiles (Chen, 2017). According to Khaliq et al. (2019), roadside microwave vehicle detection systems can continuously record a variety of vehicle metrics, including speed, traffic volume, and vehicle type. A vehicle license plate recognition system may also collect large amounts of traffic data over a monitored period of time (Rajput et al., 2015). Social media is another source of information on traffic and accidents, although the accuracy of this information may be inadequate due to reporters' limitations (Zheng et al., 2018).

To ensure the accuracy of accident data, a thorough comparison of many data sources is necessary. Combining heterogeneous traffic accident data from many data sources can increase the accuracy of study results (Abdullah and Emam, 2015).

To ascertain the extent of the accident and the relationships between road users and the accidents, Vilaca et al. (2017) conducted a statistical study. Enhancing road safety laws and putting in place more transportation-related safety measures are the study's recommendations.

Bak et al. (2019) conducted a statistical study of traffic safety in a specific region of Poland based on the number of traffic accidents in order to determine the causes of accidents. The research looked at the safety of accident investigators using multivariate statistical analysis.

Several accident data sources should be taken into consideration for the analysis, depending on the type of traffic issue being treated. Combining statistical models with extra real-world driving data or data from intelligent transportation systems improves accident prediction accuracy and decreases accidents (Chand et al., 2021).

The existing literature on traffic management and sustainable road infrastructure reveals extensive research on eco-friendly transportation policies, including low-emission zones, electric vehicle incentives, and green urban mobility strategies. However, a notable gap exists regarding the potential introduction of green-bordered road signs as a visual tool for promoting environmental awareness or regulating eco-sensitive zones in Poland. While countries such as Germany and the Netherlands have experimented with color-coded traffic signs to denote environmental zones or sustainable transport routes, no academic or policy studies have examined the feasibility, public perception, or regulatory challenges of implementing such signage in the Polish context.

3 Materials and methodology

The purpose of the survey is to find out the opinion of Poles about the sign with a green border. It indicates the recommended speed. It is a value considered safe, but exceeding it does not result in a fine. It is a suggestion to adjust speed to road conditions, not a legal obligation.

The survey was conducted in March 2025 among Polish residents. The survey was conducted via the Internet. The electronic survey was created using the Lime Survey application. The assigned link was distributed on social networks, transport portals and among friends. The survey was fully anonymous and consisted of 19 closed-ended questions, but with the option to enter your own answer.

At the beginning of the form were metrics on gender, age, population, education, labor market status and location, as well as whether they had a driver's license and what type of traffic participation they had and whether they were a vehicle driver.

Respondents were asked if they had heard of a traffic sign with a green border. If yes, they were asked what they knew about it. If they marked no, its definition appeared.

Respondents were then asked to answer questions about the meaning of the sign, drivers' understanding of it, its advantages and disadvantages.

Another group of questions concerned safety-related aspects. Respondents were asked whether they would obey the sign, whether it would affect their driving habits, whether it could improve road safety, whether it could reduce accidents, and where such a sign could be installed.

Before conducting the target survey, a pilot study was conducted, which consisted of sending a form with survey questions to a selected group of people. After the survey was modified, the actual survey followed. An important step during the implementation of the survey was the calculation of the survey sample. For Poland (population 38.151 million), assuming a confidence level of 95% and a maximum error of 5%, the required number of people taking part in the survey was 384 respondents. The survey on changes in mobility and its impact on the environment was completed by 1,498 respondents (Glówny Urzad Statystyczny (online)).

Then the sample was calculated using the following formula:

$$n = \frac{Z^2 \cdot p(1-p)}{\delta^2}, \quad (1)$$

where:

- n: sample size number,
- Z: significance level dependent coefficient, 95% – 1.96,
- p: proportion in the population, (52% – 0.52, 48% – 0.48),
- δ: estimation error, 5% – 0.05.

$$n = \frac{1.96^2 \cdot 0.52(1-0.52)}{0.05^2} = \frac{3.84 \cdot (0.52 \cdot 0.48)}{0.0025} = 384 \quad (2)$$

Respondents' answers were also analyzed in terms of metric questions, namely gender, age, labor market status, place of residence, education and possession of a driver's license. In addition, the analysis, by gender, were considered in terms of the Chi-square statistic. This statistical test is used to test hypotheses for random variables. One can test whether the variables are related to each other based on the common pattern of the results obtained. If the Chi-square has a greater value than the theoretical Chi-square, then there is no relationship between the variables (Wegner, 2013). The formula for the Chi-square test of concordance is of the form:

$$\chi^2 = \sum_r^{i=1} \frac{\left(f_i - np_i\right)^2}{np_i}, \quad (3)$$

where:

- χ^2 - Chi-square test;
- f_i: number of values in a given range;
- np_i: the number of units that are in a given range.

In view of the above, two hypotheses can be put forward:

- H0: The introduction of a road sign with a green border will not reduce the number of traffic accidents on Polish roads.
- H1: The introduction of a road sign with a green border will reduce the number of traffic accidents on Polish roads.

4 Results

The subjects of the survey were residents of Poland, including place of residence, gender, number of residents and their labor market status. The survey was conducted on a random group of 4,627 respondents, but only 1,498 correctly completed questionnaires were used for further analysis. Women accounted for 60% of respondents and men for 40%.

Most of the people were adults. 32.78% of them were young people aged 18–35. Respondents aged 36–55 accounted for almost 58%, and 4.75% were over 60 years old. Nearly 1.3% were under the age of 18. Most women (36%) and men (30%) were between the ages of 36–45. Most respondents lived in small towns with up to 5,000 residents (43.4%), regardless of gender. Respondents, irrespective of gender, lived in urban and rural areas in similar numbers (Table 1).

Among the respondents, nearly 77% were people with higher education. 80.8% of female respondents had a college degree, compared to 71% of male respondents.

Another question concerned labor market status. More than 82% were employed and 5% were self-employed. 83.7% of women and 80.5% of men were working. The remaining group was, respectively, unemployed, students and those on maternity, parental or parental leave. A negligible percentage were also retirees or pensioners (Table 2).

Another group of questions, concerned traffic participants. Nearly 66% among respondents were drivers and 20% were pedestrians. Among women, it was 68% and 21%, respectively, while among men it was 62.2% and 17.5%. 94% of respondents had a driver's license, including 93% of women and 95.3% of men. 74% of respondents use a vehicle daily, and 13% once a week. Among men and women, this percentage is similar (Table 3).

In the next question, respondents were given the opportunity to answer: prior to this study, had you previously heard of a sign with a green border indicating the recommended speed used in the UK? If the answer was no, information was displayed about what it was. To this question, 8.88% of respondents, including 6% of women and 13.3% of men, responded positively. They indicated that it is:

Table 1 Socio-demographic characteristics of survey respondents

Category	Number	%	Female		Male	
			Number	%	Number	%
Sex						
Female	596	39%	–	–	–	–
Male	902	60%	–	–	–	–
Age						
Under 18 years	19	1%	2	0%	17	2%
18–25 years	154	10%	98	10%	56	9%
26–35 years	318	21%	191	21%	127	21%
36–45 years	504	33%	325	36%	179	30%
46–55 years	362	24%	229	25%	133	22%
56–60 years	70	4%	36	3%	34	5%
Over 60 years	71	4%	21	2%	50	8%
Place of residence						
Urban area	738	49%	419	46%	319	53%
Rural area	760	50%	483	53%	277	46%
Number of inhabitants						
Up to 5,000	650	43.39%	405	44.90%	245	41.11%
5,001–10,000	226	15.09%	126	13.97%	100	16.78%
10,001–25,000	197	13.15%	131	14.52%	66	11.07%
25,001–50,000	90	6.01%	53	5.88%	37	6.21%
50,001–100,000	166	11.08%	88	9.76%	78	13.09%
101,000–200,000	41	2.74%	21	2.33%	20	3.36%
200,000–500,000	85	5.67%	58	6.43%	27	4.53%
Over 500,000	43	2.87%	20	2.22%	23	3.86%

Table 2 Socio-demographic characteristics of survey respondents

Category	Number	%	Female		Male	
			Number	%	Number	%
Education						
No education	2	0.13%	1	0.11%	1	0.17%
Primary	32	2.14%	6	0.67%	26	4.36%
Basic vocational	31	2.07%	13	1.44%	18	3.02%
Secondary technical	151	10.08%	64	7.10%	87	14.6%
Secondary	130	8.68%	89	9.97%	41	6.88%
Higher education	1152	76.9%	729	80.8%	423	70.9%
Status on the labor market						
Pupil	35	2.34%	8	0.89%	27	4.53%
Student	64	4.27%	51	5.65%	13	2.18%
Employed	1235	82.4%	755	83.7%	480	80.5%
Self-employed	75	5.01%	28	3.10%	47	7.89%
Unemployed	24	1.60%	18	2.00%	6	1.01%
Pensioner	32	2.14%	14	1.55%	18	3.02%
Person on maternity	21	1.40%	17	1.88%	4	0.67%
Other	12	0.80%	11	1.22%	1	0.17%

Table 3 Responses given by respondents

Category	Number	%	Female		Male	
			Number	%	Number	%
Traffic participant						
Driver	1,327	65.50%	789	67.96%	538	62.20%
Driving a unicycle	49	2.42	12	1.03%	37	4.28%
Cyclist	251	12.39%	112	9.65%	139	16.07%
Pedestrian	399	19.69%	248	21.36%	151	17.46%
Time since obtaining a driver's license						
No driver's license	90	6.01%	62	6.87%	28	4.70%
Less than 2 years	43	2.87%	22	2.44%	21	3.52%
2–5 years	86	5.74%	60	6.65%	26	4.36%
6–10 years	158	10.55%	109	12.08%	49	8.22%
more than 10 years	1,121	74.83%	649	71.95%	472	79.19%
Frequency of driving a vehicle						
Daily	1,109	74.03%	645	71.51%	464	77.85%
Several times a week	201	13.42%	124	13.75%	77	12.92%
Several times a month	62	4.14%	41	4.55%	21	3.52%
Rarely	40	2.67%	29	3.22%	11	1.85%
Not at all	86	5.74%	63	6.98%	23	3.86%

- recommended speed;
- safe speed;
- no fine for exceeding;
- information to improve traffic safety;
- driving at the recommended speed;
- this is the value considered safe, but exceeding it does not result in a fine.

As can be seen, most survey respondents did not know what it was. For this reason, there was information, in the survey with an explanation of what the sign with a green border means.

To another question about the introduction of a sign with a green border in Poland, 43% of respondents firmly said yes. This included a similar number of women and men. In contrast, about 30% of respondents were opposed and 26% had no opinion on the subject.

The next question concerned Polish drivers' understanding of the sign. This question, like the previous one, was answered positively by 43% of respondents, 24% had no opinion and 34% were opposed. By gender, the responses were similar.

Do you think Polish drivers would comply with this designation? This is another question that respondents had to answer. Only nearly 13% of respondents spoke positively on this topic. On the other hand, 35% marked difficult to say, and 52% were opposed. This confirms the fact that Polish drivers do not obey traffic regulations.

Another question from this group asked: Would such a sign affect your driving? This question was answered in the affirmative by 53% of respondents. This included 56% of women and 48% of men. This confirms the fact that women drive more safely. To this question, 21% of respondents had no opinion, and 26% were opposed.

The next question, "Do you think a recommended speed sign could improve road safety?" was answered positively by 41% of respondents, including 43% of women and 38% of men. Nearly 30% of respondents answered this question negatively.

The last question in this group concerned the reduction in the number of accidents on Polish roads after the introduction of the sign. To this question, 41% of respondents answered affirmatively, 31% had no opinion, and 28% were against. In summary, women spoke more positively about the introduction of this sign (Table 4).

Respondents also had the opportunity, to point out advantages and disadvantages of the proposed solution. Among the advantages, respondents indicated (Table 5):

- increasing traffic flow: 18%;
- reducing emissions: 9.5%;
- educating drivers on safe speed: 38.5%;
- less stress on drivers compared to mandatory speed limits: 23.4%;
- other: 10.3%.

Table 4 Responses given by respondents

Category	Number	%	Female		Male	
			Number	%	Number	%
Before taking this survey had you previously heard of the sign with a green border indicating the recommended speed used in the UK?						
Yes	133	8.88%	54	5.99%	79	13.26%
No	1,365	91.12%	848	94.01%	517	86.74%
Do you think a sign with a green border should be introduced in Poland?						
Definitely yes	295	19.69%	170	18.85%	125	20.97%
Rather yes	353	23.56%	227	25.17%	126	21.14%
Hard to say	392	26.17%	257	28.49%	135	22.65%
Rather not	238	15.89%	155	17.18%	83	13.93%
Definitely not	220	14.69%	93	10.31%	127	21.31%
Do you think such a sign would be understood by Polish drivers?						
Definitely yes	159	10.61%	99	10.98%	60	10.07%
Rather yes	474	31.64%	278	30.82%	196	32.89%
Hard to say	361	24.10%	243	26.94%	118	19.80%
Rather not	349	23.30%	211	23.39%	138	23.15%
Definitely not	155	10.35%	71	7.87%	84	14.09%
Do you think Polish drivers would abide by this designation?						
Definitely yes	22	1.47%	15	1.66%	7	1.17%
Rather yes	180	12.02%	103	11.42%	77	12.92%
Hard to say	521	34.78%	342	37.92%	179	30.03%
Rather not	530	35.38%	327	36.25%	203	34.06%
Definitely not	245	16.36%	115	12.75%	130	21.81%
Would such a sign affect your driving habits?						
Definitely yes	238	15.89%	148	16.41%	90	15.10%
Rather yes	552	36.85%	357	39.58%	195	32.72%
Hard to say	321	21.43%	215	23.84%	106	17.79%
Rather not	259	17.29%	142	15.74%	117	19.63%
Definitely not	128	8.54%	40	4.43%	88	14.77%
In your opinion could a recommended speed sign improve road safety?						
Definitely yes	157	10.48%	93	10.31%	64	10.74%
Rather yes	458	30.57%	297	32.93%	161	27.01%
Hard to say	443	29.57%	279	30.93%	164	27.52%
Rather not	299	19.96%	175	19.40%	124	20.81%
Definitely not	141	9.41%	58	6.43%	83	13.93%
Do you think compliance with such a sign could reduce the number of accidents?						
Definitely yes	168	11.21%	99	10.98%	69	11.58%
Rather yes	439	29.31%	279	30.93%	160	26.85%
Hard to say	459	30.64%	294	32.59%	165	27.68%
Rather not	288	19.23%	166	18.40%	122	20.47%
Definitely not	144	9.61%	64	7.10%	80	13.42%

Among others, responses related to improving traffic safety predominated.

On the other hand, among the disadvantages, respondents indicated (Table 5):

- confusion among drivers: 15.9%;
- lack of knowledge of the sign by most road users: 21.1%;
- difficulty in enforcing compliance with the recommended speed: 18.7%;
- possibility of drivers ignoring the sign: 25.4%;
- unnecessary complication of road signage: 16.7%;
- other: 2.2%.

Table 5 Responses given by respondents

Category	Number	%	Female		Male	
			Number	%	Number	%
What advantages do you see for such a solution?						
Increasing traffic flow	382	18.33%	203	16.58%	179	20.81%
Reducing emissions	197	9.45%	110	%8.99	87	10.12%
Educating drivers on safe speed	803	38.53%	533	43.5%	270	31.40%
Less stress on drivers compared to mandatory speed limits	488	23.42%	298	24.35%	190	22.09%
Other	214	10.27%	80	24.35%	190	22.09%
What do you see as the disadvantages of such a solution?						
Confusion among drivers	513	15.87%	296	15.56%	217	16.30%
Lack of familiarity with the sign by most road users	682	21.09%	405	21.29%	277	20.81%
Difficulty in enforcing compliance with the recommended speed	605	18.71%	378	19.87%	227	17.05%
Possibility of drivers ignoring the sign	822	25.43%	518	27.23%	304	22.84%
Unnecessary complication of road markings	540	16.70%	282	14.83%	258	19.38%
Other	71	2.20%	23	1.21%	48	3.61%

Among other drawbacks, the following responses appeared:

- Confusion.
- Another sign by the side of the road.
- Unnecessary sign.
- A sign that contributes nothing to safety.
- Unfortunately, Poles ignore the recommendations, and excessive speed will cause many accidents.
- Unnecessarily spent taxpayers' money.
- Unfortunately, this will be another sign, which by the multitude of signs in Poland will be illegible, will be another littering of the road, which is not needed, because every driver can adjust their speed to the prevailing road conditions and the quality of the road on which they are traveling.
- There is no driving culture in Poland. What is not imposed by law does not exist.
- Many drivers would consider the sign as a speed limit, which could exacerbate the intensity of traffic jams, especially in large cities.
- This means an increase in the cost of road marking and more signs, of which there are already too many in the Polish road system.

The next question was: Where do you see the use of this sign in specific places in Poland? (1 - Definitely yes. 2 - Rather yes. 3 - Hard to say. 4 - Rather not. 5 - Definitely no). The majority of respondents indicated the vicinity of schools (51%), in areas requiring special care (48.5%) and in residential areas (47%) (Table 6). As others, respondents indicated, among others:

Table 6 Sign location

	1	2	3	4	5
Surrounding schools	33.85%	17.22%	8.41%	8.68%	25.77%
In residential areas	24.37%	22.63%	13.68%	11.62%	20.63%
In areas requiring special care	29.91%	18.62%	11.21%	10.88%	22.43%
Outside the city	15.69%	12.82%	17.76%	18.96%	24.37%
Surrounding public buildings	15.69%	22.36%	19.49%	13.68%	19.69%
Unless there is other signage	20.89%	20.56%	18.49%	10.21%	17.49%
Other which	6.07%	3.07%	13.28%	3.87%	14.02%

- dangerous road sections, curves, forest – animal crossings;
- areas subject to special emissions cautions, green areas, etc.;
- intersections with bike paths and roads
- near playgrounds;
- in the vicinity of pedestrian crossings;
- i see potential use on roads with varying conditions, such as areas that become technically difficult to traverse during rain or snowfall;
- along the forest – due to the possibility of forest animals;
- curves, pedestrian crossings outside built-up areas.

Respondents also had the opportunity, to indicate other comments about the sign with a green border. Among the answers given, there were positive and negative responses about the proposed idea. Among these we can include:

- It would be appropriate to use it on synchronized light routes, indicating the optimal speed to pass on a green light (possible use as a variable content sign).
- Nice graphics on the green. Pleasant association.
- Pointless to increase the cost of signage and complicate it. Definitely better to allocate the funds to improve the driving skills of drivers, instead of putting up more signs that will not contribute anything.
- Compliance with regulations and reducing speed will improve road safety.
- Pointless spending of taxpayers' money. There are more important things.
- Pointless sign.
- No visibility in green areas.
- None, completely unnecessary.
- Interesting proposal, but still a lot would have to change in the minds of drivers.
- For me the green border is a misunderstanding!!!
- In Poland, bans do not apply. Suspending the sign will not make drivers obey traffic regulations. Exceeding the recommended speed does not result in a fine, so most are unlikely to pay attention to it, but from their own experience they will adjust their speed to the driving conditions.
- A good solution to draw attention to the recommended speed reduction in forest areas where accidents occur on animal migration routes. For this purpose in particular, such signage should be used and then could be better respected. Putting up these signs everywhere will not change anything. Besides, cities have restrictions, thresholds, residential zones.
- Good idea, but seeing the ignoring of the "now built-up" sign, it will be hard to introduce such a sign and encourage drivers to obey.
- If drivers respected the current regulations and restrictions there could be fewer accidents. If maximum limits are not respected, then lower values will not be respected either, even less so if they are not subject to penalties. On the other hand, putting up an additional sign that would be difficult to specify could introduce irregularities on the roads.
- In general, in our country we put up too many road signs, making the information for the driver not very clear, the introduction of another one will only worsen this situation. Even if certain issues arise directly from the general traffic regulations, we still demand (including the uniformed services) confirmation of this in the form of setting up vertical signage, such as the B36 sign in the intersection area.
- The number of road signs on Polish roads is too high, drivers get lost and drive intuitively without observing the speed limits.
- How will a person who does not see colors distinguish this sign from the speed limit?
- If it is introduced then only in areas where roads run through or along a forest, park, protected area, etc. It would be a warning (along with a forest game caution sign) that animals run across the road in this section that it is easier to collide with them. I don't see any other point in using this sign to avoid confusing drivers. Green is eco/wildlife... it would make more sense because this sign as just a suggestion that would not be penalized if not followed is just a waste of money to buy such signs and create confusion because in some places there are already so many signs that sometimes you look longer at the signs instead of in front of you which leads to dangerous situations.
- If it is a sign to which fines will not be applied there will be other penalties (restrictions) and opportunities for control no one will even pay attention to the sign.
- If someone does not obey the signs, they will not obey the green perimeter either – and unfortunately we have the biggest problem with such a group of drivers. Therefore, I currently have doubts whether it makes sense to introduce such a solution in Poland.
- If you put a sign with a green border near a school, for example, 30 km/h, and someone causes an accident... the driver will make excuses for the recommended speed and not for the fact that they were supposed to be extra careful The same, for example, with icy roadways. Why put up recommended signs, unnecessarily adding signs which are already far too many, and anyway some drivers do not obey them.... It would be better if the funds allocated for putting up unnecessary signs were allocated, for example, to illuminate all pedestrian crossings.
- If it is a recommended speed and not a required speed then no one will obey it.
- Any driver who knows the traffic rules should be aware of what speed they should travel in a given place. The current signs specify this accurately, so I see no special need to duplicate it with an additional sign. Moreover, knowing the mentality of Polish drivers, a sign whose disobedience does not carry any consequences will often be ignored. In short – it is a waste of effort.
- Drivers already disobey speed signs despite heavy fines, why should they suddenly start complying with the new ones, which are not sanctioned in any way.

- Drivers may temporarily reduce their speed, but after a while no one will comply anyway. If some drivers don't follow the signs with a red border, they won't these either.
- Drivers in Poland are unlikely to follow the recommendation, even the threat of a fine does not cause them to reduce speed. We still have a long way to go in terms of education.
- Another public money spent on something that will not improve road safety. Such a sign on Polish roads will definitely be ignored by most drivers.
- Another sign will increase the expenses of road managers. A speed limit (threatened by a fine or revocation of the driver's license) does not reduce the number of those fined - unless I have misinformation. In addition, the lack of legibility on the road, among often a dozen signs (prohibition, order and informational) on a short stretch of road suggests measures to reduce the number of signs.
- Another sign that will not be obeyed. Most drivers do not obey the already existing speed limits. And if there were to be another one, but only recommended then it would be even more so.
- The driving culture of Polish drivers is at a low level, if the sign is a suggestion not an order in most cases it will be ignored.
- I have a bit of concern if surely all road users will understand this sign.
- We have enough signs. Educating drivers from an early age should be a priority.
- Fewer signs are definitely clearer than introducing more signs.
- You could exchange the D40 signs entering a residential zone for such a green one, where it is up to the driver to judge whether they can drive faster than 20 km/h.
- I think drivers would ignore the sign and not follow the safety rules.
- 100% it will be widely ignored and will only introduce unnecessary confusion.
- It will definitely get the attention of drivers.
- In an area not marked as a built-up area, with numerous property entrances or intersections.
- First, a year-long media campaign explaining what the sign is all about and a lot more police patrols with radars on the roads would be important.
- First, improve the sense of the current signs, do not introduce new ones.
- Unfortunately, it is quicker for a driver to obey an order sign than a "suggest" sign.
- Currently few people drive at the prescribed speed. The introduction of lower values will be unrealistic to enforce and obtain, although it is worth educating I am pessimistic on this issue , people will ignore it.
- When introducing this sign, it would be worthwhile to ensure its education for all drivers.
- Poles would not obey it.
- The idea is unlikely to work.
- Would improve road safety.
- It should additionally be placed next to speed limit signs.
- Problem with people with daltonism who happen to drive.
- Visually friendly, encouraging compliance and not threatening.
- Suggesting smooth eco-driving.
- Green color is calming.

The next step was to correlate the answers given by respondents by their gender. Based on the study, it can be concluded that the answers given by the respondents were not dependent on their gender (Table 7).

In Table 7:

- df: the degrees of freedom;
- α: the significance level;
- χ^2: the Chi-square statistic;
- χ^2_d: the critical Chi-square value.

5 Conclusions

The article analyzes the possibility of introducing a sign with a green border in Poland. The survey showed that the majority of respondents (63%) support the introduction of a sign with a green border indicating the recommended speed on Polish roads. The sign is seen as a tool that can improve traffic safety, educate drivers and increase the smoothness of driving. Among the advantages of the proposed solution, respondents pointed out to the following: educating drivers on safe speed (38%), reducing the stress of mandatory speed limits (23%), increasing traffic flow (18%) and reducing exhaust emissions (10%). On the other hand, among the related disadvantages, respondents included: drivers ignoring the sign (25%), lack of awareness of the sign among road users (21%) difficulty in enforcing the recommended speed limit (18.7%), and confusion and excess signage (15.9%).

Respondents felt that a sign with a green border should be used primarily in areas requiring special care, such as around schools (51%), residential areas (47%), and areas with a higher risk of accidents (48.5%).

Table 7 Correlation of answers given by gender

Criterion	df	α	χ^2	χ^2_d	Conclusion
Age range	6	0.05	55.65	12.59	There is a correlation
Place of residence	1	0.05	7.17	3.84	There is a correlation
Population	7	0.05	17.01	14.07	There is a correlation
Education	5	0.05	55.62	11.07	There is a correlation
Employment status	7	0.05	61.88	14.07	There is a correlation
Type of traffic participation	3	0.05	44.42	7.82	There is a correlation
Time since obtaining	4	0.05	15.17	9.49	There is a correlation
Frequency of driving a vechicle	4	0.05	11.67	9.49	There is a correlation
Prior to taking this survey, had you previously heard of a sign with a green border indicating the recommended speed used in the UK?	1	0.05	23.43	3.84	There is a correlation
Do you think that a sign with a green border should be introduced in Poland?	4	0.05	39.92	9.49	There is a correlation
Do you think such a sign would be understood by Polish drivers?	4	0.05	21.79	9.49	There is a correlation
Do you think Polish drivers would obey such a sign?	4	0.05	26.79	9.49	There is a correlation
Would such a sign affect your driving?	4	0.05	59.06	9.49	There is a correlation
In your opinion, could a recommended speed sign improve road safety?	4	0.05	27.36	9.49	There is a correlation
Do you think compliance with such a sign could reduce the number of accidents?	4	0.05	20.73	9.49	There is a correlation

The analysis showed significant correlations between gender, age, education and occupational status of respondents and their opinions on the introduction of the sign. Women were more likely than men to have a positive opinion of the sign's impact on traffic safety.

More than 90% of respondents were not previously familiar with the concept of a sign with a green border.

Despite skeptical voices, the survey confirms that the introduction of a sign with a green border can contribute to improving safety on Polish roads. Key to the success of this solution, however, will be proper implementation, including driver education, clarity of signage and monitoring of its effectiveness.

6 Recommendations

Taking into account the considerations presented in the article, the results of the analyses carried out, and the assessment of legal, organizational, and road safety conditions, the following recommendations are proposed regarding the legitimacy, scope, and conditions for the possible introduction of a road sign with a green border in Poland.

1. Pilot implementation and effectiveness monitoring
   - Conduct test installations of a sign with a green border on selected road sections (e.g., near schools, residential areas or dangerous intersections).
   - Use intelligent transportation systems (ITS) to collect data on adherence to the recommended speed and impact on accident rates.
   - Comparing results with similar locations without the sign to assess its actual effectiveness.
2. Educational and promotional campaigns
   - Develop outreach materials (flyers, videos, radio and TV spots) to explain the significance of the sign and its role in improving safety.
   - Collaborate with traffic organizations, driving schools and the media to reach the widest possible audience of drivers.
   - Using social media to raise awareness, such as through interactive quizzes or discussions with experts.
3. Adapt signage to the needs of road users
   - Conduct public consultations with drivers, pedestrians and traffic safety experts to determine optimal locations for the sign.
   - Consider introducing variable message signs (e.g., on synchronized light tracts) to dynamically adjust recommended speeds to road conditions.
   - Take into account the needs of people with disabilities (e.g., daltonists) through appropriate selection of colors and symbols.
4. Strengthen enforcement
   - While exceeding the recommended speed limit will not be punishable by a fine, it is worth considering police campaigns to encourage compliance (e.g., information campaigns with road patrols).
   - Introduce reward systems for drivers who regularly comply with the recommendations (e.g., points in insurers' loyalty programs).
5. Further research and analysis

- Regularly update public opinion surveys to monitor changes in drivers' perceptions of the sign.
- Analyze the long-term effects of the sign, including the impact on accident rates, emissions and traffic flow.
- Compare experiences from other countries where similar solutions are already in place (e.g., the UK) to learn lessons and adjust strategy.

6. Cost optimization and cooperation with local governments
   - Evaluate costs of sign production and installation and seek sources of funding (e.g., EU funds, public-private partnerships).
   - Work with local authorities to implement the sign in areas with the highest accident risk.
7. Integration with smart transportation systems
   - Linking the sign to navigation applications (e.g., Google Maps, Yanosik) so that drivers receive notifications about recommended speed.
   - Using data from traffic monitoring systems (e.g., cameras, sensors) to automatically adjust recommendations based on weather conditions or traffic volume.

The introduction of a sign with a green border requires a comprehensive approach, taking into account not only the signage itself, but also education, monitoring and cross-sector cooperation. These activities can significantly increase the effectiveness of the solution and contribute to improving safety on Polish roads

According to respondents, H0 (Introducing a sign with a green border will not reduce the number of traffic accidents on Polish roads) can be rejected. While H1 (Introducing a sign with a green border will reduce the number of traffic accidents on Polish roads) can be retained.

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