



The Application of the Framing Effect on Speeding Intervention: A Review on Previous Studies

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ABSTRACT

Speeding is a universal and detrimental problem in many countries, leading to casualties and enormous social costs. Intervention and prevention of speeding are essential, including using the framing effect. The framing effect denotes the effect of rephrasing the problem that individuals face. It triggers other heuristics like loss aversion. Together with the triggered heuristics, they alter people's behaviour. Framing could affect multiple steps in the decision-making process, guaranteeing wide applications. This article reviews two major applications of the framing effect on speeding prevention. Firstly, it reviews and compares the effect of a gain-framed message and a loss-framed message on speeding prevention. The second application is a re-framing of the speed limit. It might also be effective in reducing the speeding problem. After analysing the merits and shortcomings of current applications, this review provides further suggestions for future research in this field.

Keywords: *The Framing Effect; Speeding; Intervention;*

1. INTRODUCTION

The invention of motor vehicles has brought numerous benefits to society, making individuals from different regions have tight connections. While appreciating the convenience of cars, it is still essential to consider the potential negative externalities brought by cars. One significant negativity is the subsequent traffic rules violations. One of the violations drawing much attention is speeding. Speeding is a significant and common issue in numerous countries. According to the survey conducted by Kim et al. (2022), nearly half of 2,930 drivers claim that they have driven over the speed limit [1]. The actual proportion of speeding drivers may be more than half since some participants may not reveal the truth in the survey. The high speeding rate is destructive since speeding can lead to detrimental consequences. Indeed, in 2019, the US recorded 9,478 deaths caused by car accidents, constituting 26% of total fatalities due to traffic accidents [2]. The number of injured people is even more significant, reaching 326,000 [2]. The high number of casualties caused by speeding generates enormous costs for society. According to the Centre for Disease Control (2022), accidents caused by speeding would result in a social cost of 19.5 billion US dollars [3]. So, it is essential to find ways to alleviate the speeding behaviour. If the government can effectively

intervene in speeding behaviour, it could considerably save social costs.

Currently, there are multiple ways to prevent and alleviate the speeding problem. The most common way is to set the speed limit and vigorously enforce the speed limit, including deploying more law enforcement units on the street and installing traffic cameras. This measure should have successfully intervened in the speeding problem. However, the recent empirical analysis provides a counter-intuitive result. Multiple empirical analysis shows that the driver is more likely to receive speeding tickets again or involve in an accident after being punished by law enforcement [4, 5]. The reason might be that enforcing and punishing the speeding drivers does not treat the root cause of speeding, which could be undesirable driving habits. Arguably, they would sustain undesirable driving habits after legal punishments, either due to the insufficiencies of law enforcement on the road or the lack of respect for the laws. In order to integrate a more comprehensive solution, it is essential to consider some additional alleviation methods.

This paper will discuss modifying the drivers' behaviour using the framing effect. It will first review the framing effect theory mainly based on the very first publication of the framing effect by Tversky and Kahneman (1981) and some recent extensions. Also, it

will discuss a few merits and shortcomings of the framing effect. Then, two existing significant applications of the framing effect in the speeding intervention will be introduced and reviewed. After reviewing those applications, some suggestions for future research will be provided.

2. MAIN BODY

2.1 *The Framing Effect Theory*

In 1981, Tversky and Kahneman defined the framing effect as ‘describing the option as a gain or a loss would change people’s perception and behaviour’ [6]. Simply expressing the problem as gains or losses could change the solution that people propose for that problem. For example, suppose in medical surgery, the survival rate is 90 per cent. Although the probability is fixed, telling patients the survival rate in different manners could change their attitude towards the surgery. Patients would perceive the surgery as safer if the doctor tells them, ‘The probability of survival is 90 per cent.’, rather than ‘The probability of death is 10 per cent.’ [7]. If patients think about the problem rationally, the above two expressions are logically equivalent. However, those patients may employ heuristics rather than rational thinking [7]. Even though they think rationally, the negative or positive feeling from the heuristics would still affect their decision-making. So, a proper framing could guide people to the proper perception of choices or problems, which may modify their behaviours or choices.

In subsequent years, some researchers widen the definition of the framing effect. Chong and Druckman (2007) state that the framing effect is the effect of reconceptualizing a problem and reorienting people’s thinking over that issue [8]. It focuses on a broader context, considering more than gain and loss problems. This broader definition of framing also has practical applications. For example, Thomas and Morwitz (2004) examine the effect of framing price tags on consumers’ perception of the magnitude of price [9]. Rather than framing it as a gain or a loss, they explored whether modifying the left-most digit of the price would change people’s perception of that price magnitude [9]. For example, people would commonly perceive that \$9.9 is much smaller than \$10.

The framing effect has an attractive property. In many circumstances, the framing effect does not act alone. Firstly, it affects the decision-making process in conjunction with people’s norms, characteristics, and habits [6]. The framing effect might induce various reactions among different groups of individuals because they may have different norms, characteristics and habits. Secondly, unlike other heuristics, the framing effect modifies humans’ behaviour indirectly. It would trigger other heuristics. For example, according to Tversky and Kahneman (1981), the framing effect could trigger loss

aversion if the information provided emphasizes the loss of particular behaviour [6]. The loss aversion heuristic is the one that directly modifies people’s behaviour. The example of survival rate could vividly explain the triggering process. In that example, telling people the death rate triggers their loss aversion. The death is a significant loss to almost everyone involved, and they would have a negative attitude towards it. The detailed triggering process will be introduced in the application section.

2.2 *The Merits and Shortcomings of the Framing Effect*

The framing effect is essential and valuable in the following aspects. Firstly, there are multiple scopes of modification through the framing effect, either qualitatively or quantitatively. The multiple framing channels ensure its broad application. Tversky and Kahneman (1981) state that framing is feasible through acts, contingencies and outcomes [6]. The framing of action and outcome concentrates on making qualitative characterization. The framing of the action focuses more on the process. By reconceptualizing the behaviour that people choose, they may have a different attitude. One feasible way is to frame the difficulty of implementing certain behaviours. In the speeding context, the framing of actions could explain how challenging for people to react to unexpected road conditions while speeding.

Meanwhile, the framing of the outcome concentrates on the results. Framing the outcome as a gain or a loss would change people’s perception of the outcome. In alleviating speeding issues, the framing of the outcome is widely used, such as informing people that speeding could lead to casual accidents.

On the contrary, the framing of contingencies emphasizes quantitative reconceptualization. It indicates that people would change their choice if the probability is framed differently, although logically, the payoff is the same [6]. People are not good at judging the contingency using the heuristic instead of rational thinking. The framing of contingencies could change people’s perception of the chance of certain things happening, and it is suitable for things with contingencies to happen.

Secondly, although it may require effort to configure the framing effect in the message, the implementation of framing is relatively straightforward. In many cases, framing is about creatively describing a problem. The implementations are about changing the phrasing of a slogan, lecturing the public or sending a message to the public [10, 11]. The implementation is straightforward once researchers figure out how to phrase the sentence.

However, the framing effect still has some drawbacks. Thaler and Sunstein (2009) state that framing is only effective when people decide passively and mindlessly [7]. So, the adoption of framing on rational agents may

be less effective. In the application of framing, the passiveness of people should be tested or assumed to infer the effectiveness of framing. However, this drawback is not prominent in the speeding intervention. People are usually concentrated on the road conditions while driving. For example, drivers usually monitor the movement of other cars and the directions of the road. When people concentrate on specific events, they will likely take additional information more passively [7]. So, the framing effect should be relatively practical for drivers.

2.3 Road traffic Applications of the Framing Effect

In order to intervene in the speeding behaviour, the authorities and researchers widely adopt the framing effect to enhance road traffic safety. There are multiple heuristics that the framing effect could trigger, and all of them are proved to be adequate to some extent. The most dominant way is through presenting the gain-framed and loss-framed message on the side of the road. There are multiple pieces of research stating it is helpful to intervene against speeding. However, there is a debate over whether one framed message is more practical than the other one. Also, in recent years, some researchers have offered some innovative framing ideas. It is also arguably effective in alleviating speeding behaviours.

2.3.1 Message Framing on Speeding – Gain-framed and Loss-framed Message

One potential solution is to convey framed messages. The message is carefully designed and could induce the framing effect and the heuristics triggered by the framing effect. More specifically, the policymakers could convey the social cost of speeding to the drivers by printing a framed slogan on the side of the roads. When drivers see the enormous cost of driving above the speed limit, they may stop speeding and drive slowly. There are numerous ways to design the message. Tversky and Kahneman (1981) state that the policymakers can convey the message in either a gain frame or a loss frame by changing the reference point of the outcome [6]. Different framed messages may lead to different results.

On the one hand, the government could use the gain-framed message to alleviate speeding problems. According to Tversky and Kahneman (1981), when framing the saving of a particular cost, the status quo is usually the reference point [6]. The gain-framed message uses the current social cost of speeding as the reference point. It focuses on the scenario where drivers reduce their speeding behaviour. For example, 'Driving under the speed limit can help the society save \$10 billion.' is a gain-framed message. The message tries to inform drivers that fewer casualty accidents due to speeding will occur if they drive slower. Assuming the other accidents

do not change, they save the social cost. When drivers see the surplus of not speeding, they may be attracted to it. They would like to harvest the benefit. As stated in the message, the only way to obtain the benefit is to drive safely and follow traffic regulations. As a result, they will drive slower.

On the other hand, the government could use the loss-framed message. The loss-framed message uses the most desirable scenario as the reference point [6]. In this case, the reference point could be the ideal scenario where no one drives over the speed limit. It is framed based on the situation that people continue speeding, leading to costly casualty accidents. The enormous social cost of casualty accidents is directly presented to drivers. For example, 'Speeding could cost the society \$30 trillion a year.' is a loss-framed message. A loss-framed message would potentially trigger another heuristic, loss aversion. Tversky and Kahneman (1981) describe loss aversion as 'the displeasure associated with losing a sum of money is generally greater than the pleasure associated with winning the same amount.' [6]. In the speeding context, the expensive social cost of an accident leads to the driver's displeasure. The negative attitude might be larger than the happiness of seeing the same gain. It may also be larger than the happiness of speeding. The displeasure may make drivers drive slower.

There are some conflicts in the previous literature. In the speeding case, some researchers point out that the gain-framed message effectively alleviates the speeding problem, while others have the opposite idea. Millar and Millar (2000) report that the gain-framed message is more effective when promoting safe-driving behaviour [12]. The participants of the experiment report that the gain from safe driving convince them to obey the traffic rules [12]. Also, Delhomme et al. (2009) assert the hypothesis proposed by Millar and Millar (2000) [13]. They also state that the positive framing of the message is more effective than the negative framing.

On the contrary, Horan (2015) proved by another experiment that displaying the negative-framed anti-speeding message is more influential [14]. More participants claimed that the negative advertisement is astonishing, and they would drive slower after seeing the loss-framed. The conflict among the pieces of literature could make the government hesitate when choosing the intervention. So, it is essential to discover the reason behind the different results.

One potential reason for the conflict might be that all those studies are conducted in a simulated condition. The subjects did not truly immerse themselves in the actual driving situation. As Rothman et al. (1993) point out, the gain-framed or loss-framed message is only compelling when the individuals are genuinely involved and interested in the issue [15]. It is not easy to guarantee that all participants are involved in the driving context in the studies mentioned above. For example, Millar and Millar

(2000) and Horan (2015) only test people's reactions to gain-framed and loss-framed messages in the lab [12,14]. They either let the participants self-report their feelings towards the message or observe the difference using the driving simulator. The participant may make a different choice when they are actually in the car and driving it. So, conducting the survey or experiment in a controlled environment might obstruct subjects from reacting genuinely.

Researchers testify the theory using real-world data under actual conditions in recent years. Chaurand et al. (2015) conduct an experiment on the highway to test the effectiveness of gain-framed and loss-framed messages in reducing speeding [16]. It turns out that both messages could reduce the occurrence of speeding, but the percentage of drivers speeding decreases by 3 per cent more when using the gain-framed message [16]. It proves that using the gain-framed message could further reduce the occurrence of speeding.

However, it is still not rigorous enough to conclude that a gain-framed message is more effective than a loss-framed message. There are still some shortcomings in the experiment that might compromise the results after the extrapolation of the intervention. Firstly, Chaurand et al. (2015) state that drivers are only exposed to the message once, and the speed test is only conducted once 2 kilometres after the displayed message, which makes the long-term effect ambiguous [16]. Indeed, drivers might get used to the message and stop being touched by the message in an extended timeframe. It is also possible that the drivers would forget the content of the message and continue speeding. More importantly, it is not easy to guarantee that the driver will see the framed message on the display. When drivers are driving, they will concentrate on the dynamic movement instead of the static display. For example, they care more about the movement of other cars. Drivers would likely ignore the slogan. If the drivers do not see the message, the framing effect would not be practical.

2.3.2 Framing on the Speed Limit Sign – The Application of Framing and the Anchoring Effect

As described above, in the previous literature, researchers intervene against speeding by displaying a framed slogan on the side of the road [16]. However, it may undermine the framing effect. The driver is so concentrated on the car movement that they may ignore the message. In order to ensure the effectiveness of the framing effect, a framing of the speed limit sign may be helpful.

Framing the speed limit could potentially alleviate the shortcoming of ignorance. While driving, drivers tend to focus on the speed limit to avoid punishment such as speeding tickets. The modification to the speed limit could quickly draw drivers' attention. As for specific

implementation, Rubaltelli et al. (2021) suggest the government could reduce the speed limit by 1 km/h if and only if reducing the speed limit would change the left-most digit [17]. For example, if the speed limit is 50 km/h, the authority could change it to 49 km/h. However, the effect may not be evident if the original speed limit is 55 km/h.

Then, it is essential to explore the triggering process of the framing effect. The framing of the speed limit triggers the anchoring effect. Thomas and Morwitz (2005) show that the initial value of the number matters [18]. When reading a number, people would focus more on the left-most digit and be anchored on the left-most digit [18]. So, the decreased initial digit due to framing acts as an initial speed limit value. Kahneman and Tversky (1977) described that when perceiving the magnitude of a number, people would start from the initial value and adjust to the final answer, but the adjustment would be typically insufficient [19]. So, drivers would adjust the perceived speed limit higher after seeing the last digits, but not as high as the number before modification. They would still think the speed limit is much lower than before. Haglund and Aberg (2000) state that the speed choice positively correlates with the perceived speed limit [20]. If they have a low-speed perception, they may choose a lower speed, and the chance of speeding may decrease.

Indeed, Rubaltelli et al. (2021) show that people drive slower after seeing the modified speed limit in some speed range [17]. For example, the median speed would decrease by 2 km/h if the speed sign is changed from 50 km/h to 49 km/h [17]. A decreased median speed indicates that more people are driving slower. However, some results contradict others to some extent. The effect is entirely different when the speed range changes. For example, in another group of experiments, the median speed increases by 3 km/h after changing the speed limit from 70 km/h to 69 km/h. It indicates that more people are speeding after changing the speed limit. So, there is no clear-cut effect of framing the speed limit based on the experiment.

There are a few reasons why the result is contradictory. Firstly, the experiment is conducted under the driving simulator [17]. Some participants might take driving on the simulator as a game. Although it simulates the actual situation, some participants might not be able to be completely involved. For example, they may consider the driving simulation as a racing game. They might drive faster than they do in reality. As a result, the experiment outcome might be compromised. Secondly, the researchers only experiment twice. It does not study the long-term effect of the speed limit. Under a longer timeframe, when drivers are continuously exposed to the modified environment, their behaviour may change. One probability is that they may sufficiently notice the sign and drive slower. However, it is also possible that drivers

may get used to the new sign and understand the difference is small, and they may continue speeding. It is ambiguous only considering the outcome by Rubaltelli et al. (2021) [17]. Only the more extended experiment could tell the more robust effect of the intervention.

2.3.3 Suggestions to Future Researchers about the Applications

Both applications of the framing effect are worth conducting further research. For the utility of gain-framed and loss-framed messages, the first application introduced, it is still essential to conduct more comprehensive research to determine which type of framing is more beneficial. When conducting the research, there are a few aspects worth investigating. Firstly, it is essential to extend the scope of the experiment. In further research, to capture the framing effect in the longer term, researchers could test the average speed of a particular road segment instead of the speed at a particular point. Also, the researcher could extend the time frame of the study. Instead of testing the effect for one day, the researcher could extend it to 30 consecutive days. They could follow the same drivers exposed to the treatment and investigate whether they drive over the speed limit. If the result indicates that drivers get used to the message and drive over the speed limit again, it may complicate the application of the framing effect. Governments may need to change the message to draw drivers' awareness regularly. For instance, the hybrid use of the positive and negative framing is one way to diversify the framed content.

Secondly, it is worthwhile to explore the effectiveness of those messages in different cultures. Tversky and Kahneman (1981) stated that the framing effect works with social norms, culture, and personal habits [6]. People with different cultures and norms may react differently to the gain-framed or loss-framed message. Indeed, when reading the product evaluation, South Korean individuals are more convinced by the loss-framed message, while Americans are more convinced by the gain-framed message [21]. So, in the speeding intervention context, the effectiveness of framed messages may depend on countries and regions.

Lastly, the experiment would be more desirable if there was a way to draw more drivers' attention to the message. As stated above, drivers may ignore the message on the side of the road while driving. So, policymakers could make the message more attractive. However, there is a potential trade-off. Drivers may focus less on the road condition if they are fully attracted by the message, which might compromise road safety. Further research could focus on the balance between the attractiveness of the message and road safety issues.

There are even more fields for subsequent research for the second application, the framing of the speed limit.

Firstly, researchers need to investigate the contradiction of the result further. It is essential to determine why the framing effect is prominent and positive in some groups but not in others. In order to investigate the contradiction, researchers could experiment with the actual situation. As stated above, the participants may take the experiment as a racing game in the previous experiment. Researchers could avoid those complications if they experimented with the actual situation. Secondly, evaluating the intervention under a longer timescale is essential, similar to the framed message case. If the drivers could quickly realise that the modified speed limit makes little difference to the regular speed limit, policymakers could add more complications. For example, it is worth investigating whether the effect is different between changing the speed limit to 49 and changing it to 48. Lastly, there could be potential research on the government's willingness to switch the speed limit and the related costs. Although the modification process is straightforward, such as changing the speed limit from 50 to 49, the scale of the switching process could be massive. It could involve a lot of time and cost, and support from the government is essential.

3. CONCLUSION

To conclude, speeding is a common and severe problem for traffic management. The universality and harmfulness of speeding are worth the articulation of a comprehensive solution. The government could potentially alleviate the speeding problem through multiple methods. The employment of the framing effect is a valuable way to intervene.

Unlike other heuristics, the framing effect indirectly influences people's behaviour. The primary implementation of framing is through the reconceptualization of a problem. Afterwards, another heuristic might be triggered by the reconceptualization and alters people's behaviour. Together with the framing effect, they will affect people's behaviour. The framing effect has considerable merits. The most prominent advantage is that the framing effect can be widely applied in multiple steps and aspects of a decision-making process, and the implementation of framing is relatively straightforward. However, there are potential threats. Framing is effective when people think passively. Luckily, in speeding alleviation, passiveness can be assumed when people are driving.

This essay discusses two meaningful applications of the framing effect to alleviate the speeding problem. Firstly, the transportation management agency could consider using a gain-framed or a loss-framed message on the road. Those two messages are both effective in speeding intervention. Nevertheless, research shows that drivers are more attracted to the gain-framed knowledge. The potential gains more convince drivers of obeying the traffic rules. Secondly, a framing of the speed limit could

trigger the anchoring effect. Due to those two effects, a slight reduction in the speed limit would cause a significant drop in the driver's perception of that speed limit. As a result, drivers reduce their speed when driving and the occurrence of speeding decreases.

There are still some ambiguous points in those two applications that require further research. In the future experiment of both applications, researchers could extend the timeframe of the experiment and investigate those effects in the natural environment. Moreover, researchers could investigate whether drivers from different cultures have different perceptions of the gain-framed and loss-framed message for the first application. For the second application, researchers also need to consider the cost of implementation.

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