

Analysis of The Psychological State of Vehicle Drivers at The Intersection at The End of The Green Light and The Impact of Their Behavior

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ABSTRACT

Driving safety is a core area of road research, and the casualties and property damage caused by traffic accidents are enormous. Since most accidents are related to drivers, studying their behavior and psychology is essential to improve driving safety. This paper mainly focuses on the driver's psychological state at the end of the green light of the traffic light (countdown 3s), and the behavior and detention of the driver at the end of the green light. Through psychological investigation, drivers who choose to pass the stop line at the end of the countdown to the green light can be divided into three types: adventurous, cautious, and peaceful. Comparing the situation of the on-site investigation with the psychological investigation, it is found that the driver's judgment of the driving process has a certain error with the real situation.

Keywords: intersections; the end of the green light; driver psychology

INTRODUCTION

Intersections, as the control nodes and hubs of the urban road network, are also places where urban traffic accidents frequently occur. Nowadays, there are mainly studies on the countdown period of the green light, and there are few studies on the driver's behavior and psychology at the end of the green signal, and the end of the green light is the period of high incidence of accidents, and a person's personality often determines the way he deals with the problem, such as in the environment of traffic congestion and low traffic, people in a hurry and people who play, after the green light countdown starts, It is very likely that they will have different psychology and thus make different driving behaviors [1], so it is extremely important to study the behavior and psychology of drivers at the end of the green light, which can provide a basis for the adjustment of traffic lights, the upgrading of traffic facilities and the safety education of drivers. In addition, with further research, these findings may also provide useful references for the improvement of vehicle warning systems and the revision of traffic regulations.

Current Status of Academic Research

At the end of the countdown of the green light signal, through the analysis of the complex psychology of drivers entering the intersection through the method

of game theory, Huang Xuanwei divided the drivers into three categories: impulsive, cautious and gentle, and concluded that cautious drivers are more inclined to choose to slow down, gentle drivers prefer to slow down or accelerate through, and impulsive drivers are more likely to choose to slow down. However, this is the conclusion that only a single model and one car participate in the game and the model is simplified, and its accuracy needs to be further studied [2].

Through investigation, Qian Hongbo found that there are two sides to the countdown of the green light signal: for some drivers, the countdown of the green light signal is a good information prompt, which can effectively reduce the occurrence of illegal driving behavior; However, for the other group of drivers, the gradual reduction of green light time creates a sense of anticipation and competition, prompting drivers to accelerate through intersections, which will cause great safety hazards [3].

Wu Wenjing believes that the driver's decision to pass through the intersection is a risky decision, and she found that the driver generally slows down when entering the intersection, and the presence or

absence of signal lights has no obvious effect on this, but has a significant impact on the point speed at the first 20 meters of the stop line [4].

Through video analysis, Pan Fuquan and Zhang Lixia et al. found that there is a certain relationship between driving behavior and vehicle value during the green light countdown, and when the remaining time of the green light countdown is greater than 3 seconds, the green light behavior and conservative behavior have the greatest relationship with the vehicle value [4].

Yu Xuan found that the length of the green light countdown will have different effects on the driver, and the shorter the time, the more likely the driver is to be agitated, and vice versa, it can calm the driver's impatience [5].

RESEARCH METHODS AND CONTENTS

Research Methods

The methods used are video and questionnaire. A typical intersection is selected for research, before the formal recording of the video, the signal intersection is first investigated on the spot, and the traffic environment around the intersection is briefly understood, and the information such as the intersection style, size, and the position of the signal light is briefly understood, and the installation position of the video recording equipment has a preliminary judgment. Then a sample is recorded on the spot, the time length is 30 minutes, and the optimal installation position of the video equipment is determined by analyzing the sample, and the scheme of driving behavior data collection of the straight vehicle is preliminarily determined. This was followed by a pre-recording based on the preliminary recording plan previously determined by the prototype, again with a duration of 30 minutes. A questionnaire was used to investigate the psychological state of drivers at the intersection at the end of the green light.

Psychological survey of drivers at the end of the green light

The margins must be set as follows: Drivers of different ages, occupations and driving ages were selected to conduct a questionnaire survey, and the results are shown in Table 1.

TABLE 1: Driver psychology survey results at the end of the green light countdown (within 3 seconds).

Options	A. Accelerated pass	B. Slow down	C. Drive at a constant speed
Occupancy	9.3%	51.16%	39.54%

9.3% of drivers who chose option A (accelerate through and exit the intersection before the red light goes on)

are mostly nervous that they will accelerate through the intersection if they are in a hurry. "This time you must pass, if the car in front is slow, you will complain, the mood is a little impatient and nervous, and your attention is more concentrated."

There are 51.16% of drivers who choose B (slow down and stop in front of the stop line at the end of the green light), and the psychology of these drivers is mostly "want to accelerate but will not put it into practice", "don't worry, grab the last few seconds is not safe, worry about accidents", "there is no need to rush over, in case you run the red light again, you have to pay a fine", "there is a bloody lesson, safety first, you must stop and wait near the red light".

39.54% of the drivers who chose option C (driving at a constant speed, observing whether the surrounding situation is possible to pass, and then choosing to accelerate through or slow down to stop) have the psychology of "observing the surrounding situation when driving at a constant speed, slowing down and stopping when there are pedestrians and other interference, and accelerating through when there is no other interference, so as to facilitate the response to illegal vehicles from other directions", "will judge whether it can pass the intersection according to the road conditions at the time, and if the situation is good and there is no interference from pedestrians and vehicles, it will accelerate to pass, If there is interference, slow down and stop", "Because I know that there is a yellow light, I can pass safely with my driving skills, and I am ready to stop at any time when there is an emergency, and I am a little anxious and nervous, and I will silently think about the car in front of me a little faster", "For safety, you can't pass it, don't grab the light, and have a peaceful mind", "Accelerate through within 2 seconds, otherwise stop and wait".

Through the above three situations, the style of the driver passing through the intersection at the end of the green light can be divided into three types: adventurous, cautious, and peaceful.

Driving at the end of the green light into the intersection and detention situation

Based on the results of the pre-recorded video, the video information is aggregated to extract the required metrics: whether the vehicle going straight at the end of the green light countdown (the last three seconds of the green light countdown) will pass the stop line and exit the intersection before the red light is on. The size of the intersection is large and the flow of north-south vehicles going straight is large, so the typical group of north-south straight vehicles was selected for observation and analysis. Figure 1 shows whether vehicles going straight through the stop line at the end of the countdown to the green light at the north entrance and whether vehicles passing through the stop line can leave the intersection before the red light is on.

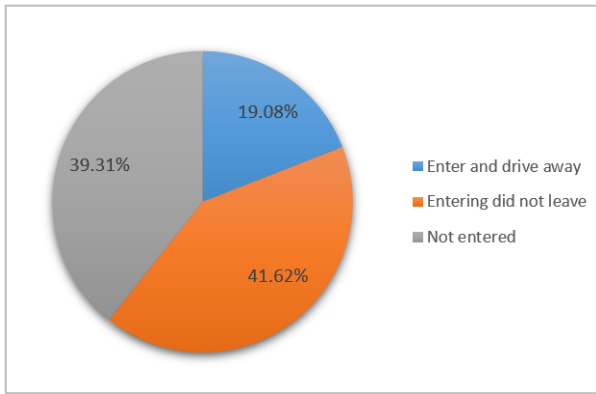


FIGURE 1: Behavior at the intersection of vehicles going straight at the end of the green light (reverse 3s) during the peak period.

From the above figure, it can be clearly seen that at the end of the countdown (within 3 seconds) of the green light at the north entrance during the peak period, among all the statistics of straight-going vehicles that arrived near the stop line, the vehicles that chose to pass the stop line but failed to leave the intersection in time before the red light turned on were the most, accounting for 41.62%. Secondly, 39.31% of vehicles will not pass through the stop line, but choose to wait for the next green light before passing through the intersection before the stop line. There are also 19.08% of vehicles that pass through the stop line and leave the intersection before the red light is on. There is little difference between the number of vehicles that do not cross the stop line at the end of the green light and the number of vehicles that pass through the stop line but fail to exit the intersection before the red light is on.

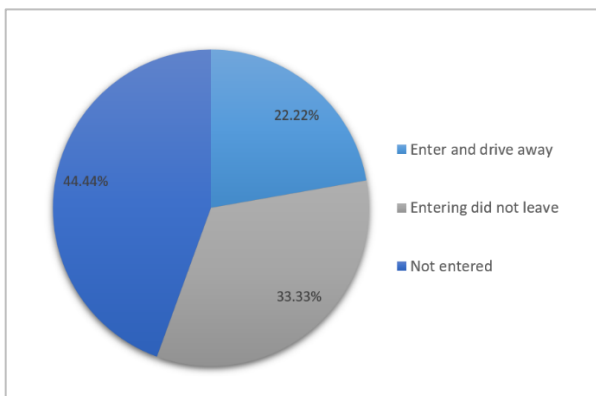


FIGURE 2: Behavior at the intersection of vehicles going straight at the end of the green light (reverse 3s) during the north entrance and off-peak hours.

It can be found from Figure 2 that at the end of the countdown (within 3 seconds) of the green light at the north entrance during the off-peak period, 44.44% of the vehicles that arrived at the stop line did not pass the stop line, but chose to wait for the next green light before passing through the intersection before the stop line. 33.33% of the vehicles chose to pass through the stop line but failed to leave the intersection in time before the red light was on. The least number of vehicles chose to pass the stop line and leave the intersection before the red light was on, accounting for 22.22% of the corresponding vehicles counted.

Figure 3 shows the statistical results of whether the vehicles going straight at the end of the countdown to the green light at the south entrance will pass the stop line, and whether the vehicles passing the stop line can leave the intersection before the red light is on:

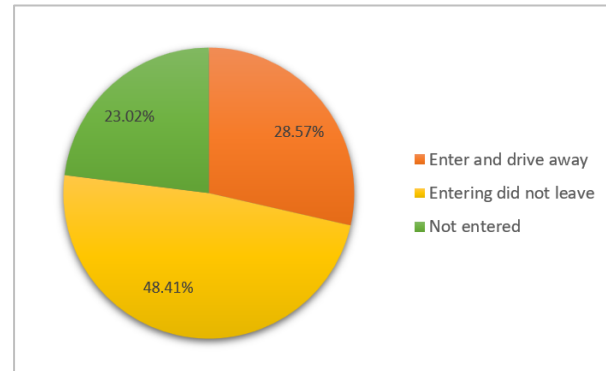


FIGURE 3: Behavior at the intersection of vehicles going straight at the end of the green light (reverse 3s) during the peak period.

From the above figure, it can be clearly seen that at the end of the countdown to the green light at the south entrance during the peak period (within 3 seconds) of all the statistics to reach the parking line near the straight driving vehicles, the largest number of vehicles that choose to pass the parking line but fail to leave the intersection in time before the red light is on, accounting for 48.41%, nearly half. 23.02% of vehicles do not pass the stop line, but choose to wait for the next green light before passing through the intersection before the stop line. There are also 28.57% of vehicles that pass through the stop line and leave the intersection before the red light is on.

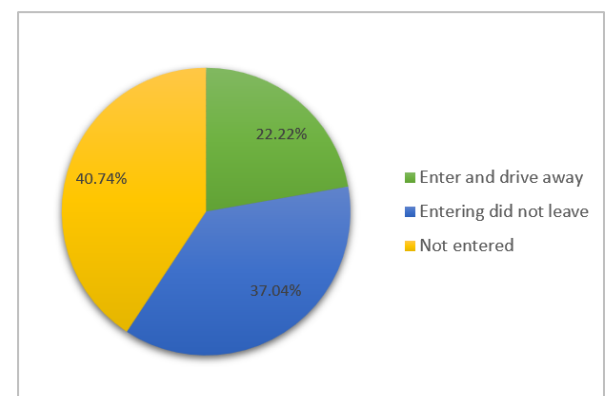


FIGURE 4: Behavior at the intersection of vehicles going straight at the end of the green light (reverse 3s) at the end of the green light during the south entrance and off-peak hours.

It can be found from Figure 4 that at the end of the countdown (within 3 seconds) at the south entrance during the off-peak period, 40.74% of the vehicles that arrived at the stop line will not pass the stop line, but choose to wait for the next green light before passing through the intersection before the stop line. 37.04% of the vehicles chose to pass the stop line but failed to leave the intersection in time before the red light was on.

The least number of vehicles chose to pass the stop line and leave the intersection before the red light was on, accounting for 22.22% of the corresponding vehicles counted.

By comparison, it can be found that the most vehicles pass the stop line at the end of the green light countdown during off-peak hours but fail to exit the intersection before the red light comes on, while the most vehicles choose not to pass the stop line at the end of the green light countdown during off-peak hours and wait for the next green light to come on.

But whether it is the peak period or the off-peak period, the drivers who choose to stop in front of the stop line at the end of the green light countdown and wait for the next green light to pass through the intersection are always a small number of people, and more than half of the drivers will choose to enter the intersection at the end of the green light countdown regardless of whether they can drive out of the intersection in time, and at most 6 straight vehicles will choose to pass through the stop line at the end of the green light countdown, but they have not been able to drive out of the intersection before the red light is on. This shows that most drivers are unwilling to choose to stop in front of the stop line at the end of the green light countdown, and wait for the next green light to go through the intersection again, but the driver's willingness is more obvious in the peak period when the traffic volume is relatively large, only a small number of drivers will slow down and stop in front of the stop line at the end of the green light countdown, and have the patience to wait for the next green light to light up.

In both rush hour and peak hours, only a small number of vehicles that pass the stop line at the end of the countdown at the green light will be able to leave the intersection in time, while most vehicles will stay in the intersection and cannot exit the intersection in time before the red light is on. Figure 5 shows the actual scenario of vehicles going straight at the intersection during the red-light period:

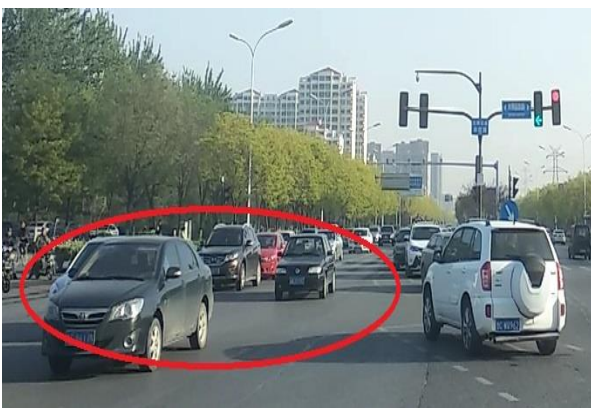


FIGURE 5: Vehicle detention at the red light at the north entrance during peak hours at the signalized intersection.

CONCLUSIONS

At the end of the green light countdown, when the driver of the vehicle going straight chooses to slow down and stop and do not pass the stop line, it is mostly for safety reasons, and this type of driver has a more conservative and cautious driving style. There are also drivers who choose to stop in front of the stop line at the end of the countdown at the green light because they are worried about paying a fine for running a red light. There are also drivers who originally planned to pass through the intersection at the end of the green light, but had to stop and wait due to some distractions. Drivers who choose to pass the stop line at the end of the countdown at the green light can be divided into three types: adventurous, cautious, and peaceful.

Video statistics show that among the vehicles that pass the stop line at the end of the green light countdown, only a few vehicles can leave the intersection before the red light is on, and most vehicles will stay in the intersection for a while, and through the questionnaire survey, it was found that drivers choose to pass the stop line at the end of the green light countdown and generally think that they can leave the intersection before the red light comes on. This shows that the driver's judgment of the driving process has a certain error with the real situation. Based on this, education and publicity should be strengthened to strengthen the safety education of drivers, remind them to pay attention to the risks at the end of the green light, and encourage compliance with traffic rules; Optimize the timing and sequence of traffic lights to ensure drivers have enough time to make safe decisions; develop and apply intelligent transportation systems, such as adaptive traffic control systems, to reduce the risk of drivers making mistakes in signal judgment; Introduce more driver assistance technologies in vehicles, such as automatic emergency braking systems, to reduce accidents caused by driver misjudgments.

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