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A New Approach to Detect of Driving Behavior Characteristics of Novice Drivers

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Abstract – The effects of driving behavior on traffic flow and intersection performance are an undeniable reality. Therefore, it is important to understand drivers' driving behavior patterns. In this study, novice driving style and its determining factors were identified using the YOLO image processing tool and in-vehicle and external field observations, presenting an approach based on real-world data. The transition-reaction time, stopping distance [CC0], acceleration and deceleration rates [CC8], and average speed values, which are important driving behavior characteristics mentioned in Wiedeman99 vehicle tracking behavior, were examined in the study. It was observed that the reaction time for novice drivers was 2.2 seconds, the average stopping distance was twice as long as that of normal drivers (1.5m), the acceleration at takeoff was 0.82 m/s2, and the deceleration was 0.75 m/s2. Thus, novice drivers' driving styles were analyzed based on real-world data rather than simulators, using image processing and observation, and a more robust methodological approach was presented. This study has the potential to serve as a guide for transportation planners and driving education institutions to better understand novice drivers' driving behaviors.

Keywords – Detection, Novice Drivers, Driving Behavior Characteristics.

I. INTRODUCTION

Urban transportation networks require significant planning due to increasing populations and the resulting traffic congestion. Poor road planning, inadequate traffic signalization, and an unbalanced distribution of vehicle types can lead to unnecessary traffic congestion and waste of time and money. Traffic regulations can offer an environmentally friendly approach to reducing carbon emissions, as well as cost-effective alternatives such as fuel efficiency. Additionally, these regulations can have a significant impact on human psychology, such as reducing waiting times [1].

It should not be overlooked that people's driving behaviors also have an impact on traffic flow and safety. In a traffic environment, there are not only experienced drivers but also aggressive and inexperienced drivers, which creates a traffic environment with different driving styles. It is not difficult to understand that these different compositions also have an impact on traffic flow and safety. Because inexperienced drivers have insufficient driving skills and their ability to understand traffic conditions is limited [2-8]. Therefore, it is necessary to determine this driving style. This is because novice drivers may exhibit unbalanced braking behavior in response to the maneuvering movements of the vehicle they are following [7]. For this reason, novice drivers prefer longer following distances than experienced drivers. Similarly, novice drivers have longer stopping distances than experienced drivers [9-10]. The acceleration and deceleration of novice drivers also differ from those of experienced drivers.

In the literature, it is possible to find studies on the effects of novice drivers on traffic capacity [11], risk perceptions and collision risk situations [12]. However, when all these studies aimed at understanding aggressive and novice driving behaviors are taken into consideration, it is seen that driving simulators are

frequently used, and this method creates a limitation in terms of reflecting real-world data methodologically. Therefore, in this study, the driving behavior patterns of novice drivers, including transition-reaction time, stopping distances [CC0], acceleration and deceleration rates [CC8], and average speed parameters, were determined based on image processing tools (YOLOv8) and field observations made from inside and outside the vehicle, rather than driving simulators. Thus, a new measurement method has been presented by obtaining more robust and reliable data from a methodological perspective.

II. MATERIALS AND METHOD

Describe in detail the materials and methods used when conducting the study. The citations you make from different sources must be given and referenced in references.

A. Level-2 Heading

Level-2 and level-3 headings can be used to detail main headings.

B. Figures and Tables

Figures and tables must be centered in the column. Large figures and tables may span across both columns. Any table or figure that takes up more than 1 column width must be positioned either at the top or at the bottom of the page.

In order to analyze the driving behavior of novice drivers, a four-way signalized intersection located in the Nilüfer district of Bursa and situated on driving training routes was selected (Fig. 1). This intersection was identified as an ideal location for observing and evaluating the behavior of drivers undergoing training, particularly as it is located on the training route of driving schools. Video recordings and images were obtained using a drone from the relevant intersection between 10:00 and 13:00 on different days (May 6, 2024–June 10, 2024).



Fig. 1. Four-leg signalized intersection selected to measure of novice drivers' driving behavior

In-vehicle observations were recorded using cameras installed inside the training vehicle (Fig. 2). Drivers participating in the training were informed in advance that the study was for academic purposes only, thereby alleviating any anxiety they might have had about being observed while driving. Each novice driver underwent a 45-minute training drive. The average speeds of the novice drivers were observed on a training course located on a three-lane highway between Özlüce and Bursa City Hospital, and their sudden braking accelerations were also observed on a secondary road.



Fig. 2. Observation of novice users undergoing driver training from inside the vehicle

A total of 1950 vehicles of different compositions were introduced to the system using the YOLOv8 program. Movement profiles were carefully examined, focusing on the images of vehicles used for driving training. Specific reference points, such as traffic cones, were measured and introduced into the system. In this way, the stopping distances of the vehicles, as well as their acceleration and deceleration rates, could be measured. Fig. 3 shows that the vehicle classes were correctly identified by the system.

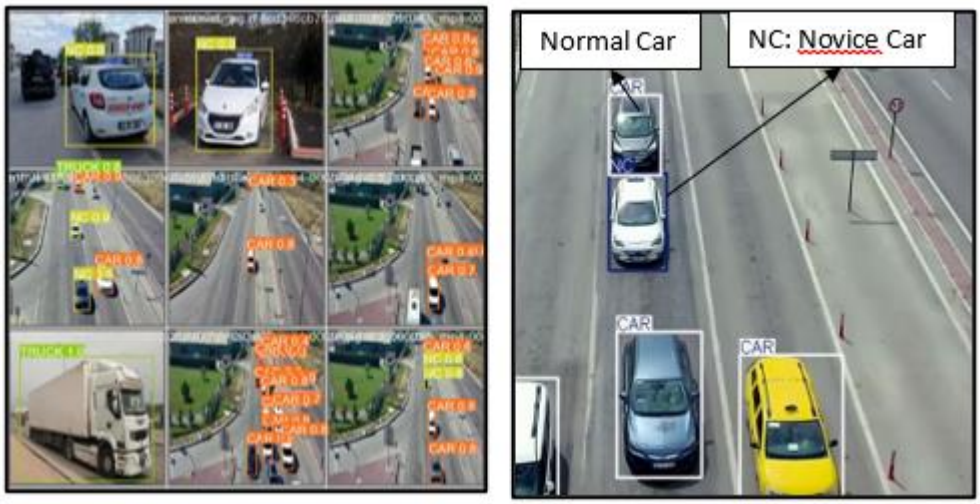


Fig. 3. Vehicle Detection and classification [29]

Location information for vehicles entering a specific area is obtained from an image taken from one arm of the intersection. When vehicles enter the target area, speed and acceleration data are obtained using

location and time information (Fig. 4).

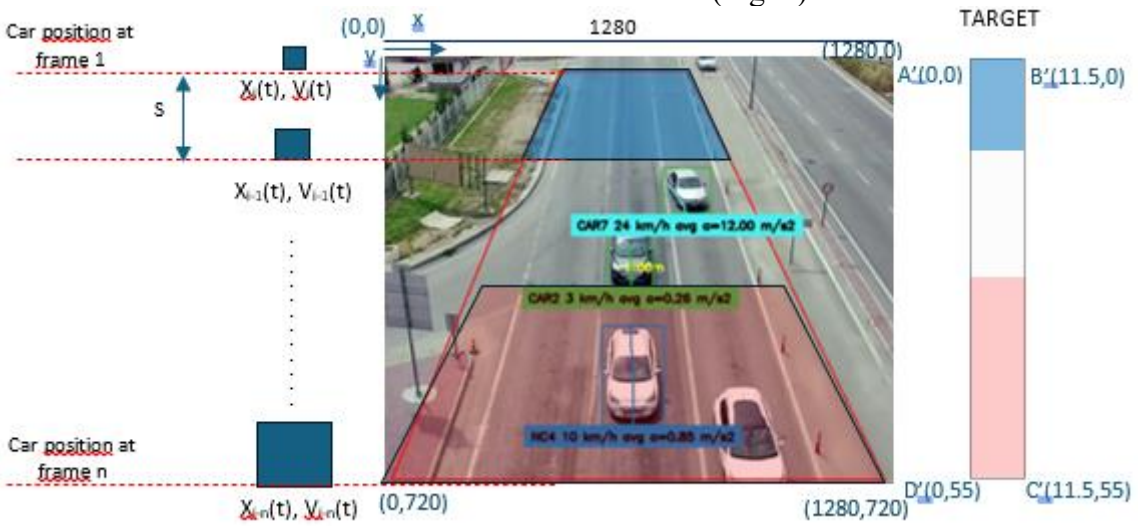


Fig. 4. Illustration of data extraction method based on image processing

$$v_i(t) = \frac{S}{(b_{i,2} - b_{i,1})k} \quad (2)$$

where:
$v_i(t)$ is the spot speed (m/s) of vehicle i at time point t;
S is the distance between observation point 1 and 2
$b_{i,1}$ and $b_{i,2}$ are frame number at observation points 1 and 2, respectively;
k is the number of frames per second, which was 25 frames per second (i.e., 0.04 s per frame)

Time headway of each paired vehicle:

$$t_i = k(b_{i,1} - b_{i-1,1}) \quad (3)$$

where;
t_i is the time headway (s) of each paired vehicle;
$b_{i,1}$ and $b_{i-1,1}$ are the frame number of the tail of vehicles i and i-1 passing observation point 1, respectively.

Drivers' acceleration and deceleration accelerations were determined based on the time it took them to cover two reference points at a given speed.

$$a = \frac{\Delta V}{\Delta t} \quad (4)$$

where;
ΔV is average speed of the vehicle and $\Delta t$is represent average time.

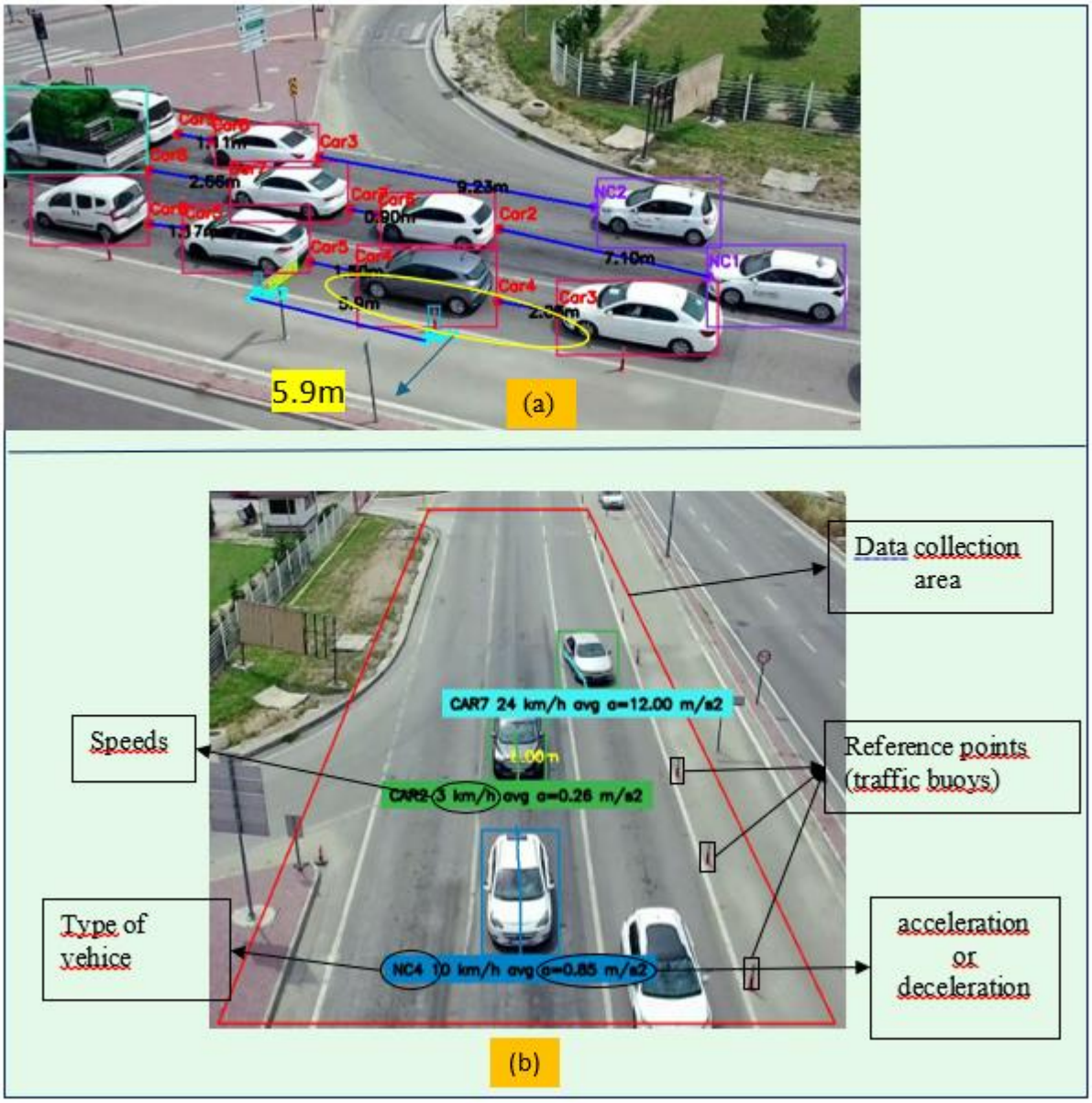


Fig. 5. Behavior characteristics of novice driving; (a): standstill distance [CC0], (b): acceleration [CC8], deceleration [m/s2].

The standstill distances of ND are determined based on the approach distance of a vehicle to the vehicle in front waiting at a signalized intersection. These distances are measured using image processing techniques and are referenced against specific markers (e.g., traffic buoys) at the intersection (Figure 5a). As can be seen from the figure, the distance between the two reference points was measured as 5.9m. Although the standstill distances of vehicles waiting at the intersection vary, NC (Novice Car) vehicles exhibit significantly greater standstill distances compared to normal vehicles.

III. RESULTS

Approximately 45% of the 1950 vehicles examined were novice vehicles. After all vehicles were introduced to the system, their movement patterns (vehicle type, stopping distance [CC0], speed, acceleration [CC8]), particularly at intersections, were examined (see Fig. 5). In this study, Wiedemann99 vehicle tracking behavior was selected as a reference. Accordingly, the transition-reaction time, stopping distance [CC0], acceleration and deceleration [CC8], and average speed values for novice vehicles were examined in this study. It was observed that the transition-reaction time for novice drivers was 2.2 seconds, the average stopping distance was twice as long as that of normal drivers (1.5m), the acceleration at takeoff was 0.82 m/s2, and the deceleration was 0.75 m/s2. Table 1 shows the driving behaviors and statistical values of normal and novice drivers. Novice driving behaviour is significantly different from normal

driving style except for deceleration. This shows that deceleration of novice drivers exhibits a normal distribution. This can be interpreted as a reflection of their excitement and anxiety. Table 2 shows whether novice driving behaviours have a normal distribution by Shapiro-Wilk test.

Table 1. Comparison of normal and novice driving parameters.

	Normal driving (Wiedemann99)	**Novice driving**			
		Mean	**Stand. Dev.**	**Mann Whitney U**	**p-value**
t_r [s]	0.9	2-3	1.62	60	<0.001
CC0 [m]	1.5	3	5.73	13	<0.001
Desired speed distribution [km/h]	90	60	-	97.5	<0.001
Desired acceleration [m/s^2] (CC8)	0-3.5	0.82	0.33	196	<0.001
Desired deceleration [m/s^2]	-3 to -2.5	-0.75	0.96	16	0.1

Table 2. Shapiro-Wilk test

Grup	**tr**	**Acceleration**	**Deceleration**	**[CC0]**	**Speed Variations**
Shapiro-Wilk W	0.842	0.842	0.88	0.77	0.79
Sig. (p)	0.002	0.037	0.08	0.01	0.02

IV. CONCLUSION

In this study, real-world data was used instead of driving simulators to determine the driving behavior data of novice drivers. For this purpose, drone images were taken at a four-way signalized intersection on a route where driving training was provided, and vehicle compositions were introduced to the system. In addition, camera recordings were taken from training vehicles on this route for approximately 45 minutes, and observations were made. As a result, novice drivers' reaction times, stopping distances, acceleration and deceleration rates, and average speeds were determined based on real-world data. The results obtained were found to be statistically significant ($p<0.05$). This study can also consider different regions and driving conditions. It has the potential to serve as preliminary information for researchers working in the relevant field.

REFERENCES

[1] Byungkyu Park, H. & Qi Microscopic simulation model calibration and validation for freeway work zone network - a case study of VISSIM, in: IEEE Intell. Transp. Syst. Conf., IEEE, 2006: pp. 1471–1476. (2006). https://doi.org/10.1109/ITSC.2006.1707431

[2] Lee, S. E., Olsen, E. C. B. & Simons-Morton, B. Eyeglance Behavior of Novice Teen and Experienced Adult Drivers, Https://Doi.Org/10.1177/0361198106198000109 1980 57–64. https://doi.org/10.1177/0361198106198000109. (2006).

[3] Lee, S. E. et al. Detection of road hazards by novice teen and experienced adult drivers. *Transp. Res. Rec J. Transp. Res. Board.* **2078**, 26–32. https://doi.org/10.3141/2078-04 (2008).

[4] Garay-Vega, L., Fisher, D. L. & Pollatsek, A. Hazard anticipation of novice and experienced drivers. *Transp. Res. Rec J. Transp. Res. Board.* **2009**, 1–7. https://doi.org/10.3141/2009-01 (2007).

[5] McKnight, A. J. & McKnight, A. S. Young novice drivers: careless or clueless? *Accid. Anal. Prev.* **35**, 921–925. https://doi.org/10.1016/S0001-4575(02)00100-8 (2003).

[6] DUNCAN, J., WILLIAMS, P. & BROWN, I. Components of driving skill: experience does not mean expertise. Ergonomics 34, 919–937. https://doi.org/10.1080/00140139108964835 (1991).
[7] Van Winsum, W. Preferred time headway in Car-following and individual differences in Perceptual-Motor skills. Percept. Mot Skills. 87, 863–873. https://doi.org/10.2466/pms.1998.87.3.863 (1998).
[8] Guo, Y., Sayed, T., Zaki, M. H. & Liu, P. Safety evaluation of unconventional outside left-turn lane using automated traffic conflict techniques. Can. J. Civ. Eng. 43, 631–642. https://doi.org/10.1139/cjce-2015-0478 (2016).
[9] Li, X., Jiang, J. & Lu, J. Safety Differences between Novice and Experienced Drivers under Car-Following Situations, in: ICCTP 2011, American Society of Civil Engineers, Reston, VA, 2011: pp. 2196–2207. https://doi.org/10.1061/41186(421)219
[10] Zhang, L., Zhang, S., Zhou, B., Jiao, S. & Huang, Y. An improved Car-Following model considering desired safety distance and heterogeneity of driver's sensitivity. *J. Adv. Transp.* **2021**, 1–12. https://doi.org/10.1155/2021/6693433 (2021).
[11] Yang, H. & Wu, Z. Effect of novice driver's car-following characteristic on roadway segment capacity. *Adv. Mech. Eng.* **9**, 168781401771185. https://doi.org/10.1177/1687814017711853 (2017).
[12] Takahashi, R. et al. Driving simulation test for evaluating hazard perception: elderly driver response characteristics. *Transp. Res. Part. F Traffic Psychol. Behav.* **49**, 257–270. https://doi.org/10.1016/j.trf.2017.07.003 (2017).