

Relation of On-Dash Cam Observation of Passing Stop Intersections Behavior and Emergency Braking of Elderly Drivers

- Study on Driver Characteristics for Delaying Driving Cessation (33)-

Takashi Yonekawa¹⁾ Hirofumi Aoki¹⁾ Kan Shimazaki¹⁾ Takahiro Tanaka¹⁾ Kazuhiro Fujikake¹⁾
 Makoto Inagami¹⁾ Masae Kojima¹⁾ Kunitomo Aoki¹⁾ Akio Hirano¹⁾ Natsuka Takeda¹⁾

1) Institute of Innovation for Future Society, Nagoya University

Furo-cho, Chikusa-ku, Nagoya, Aichi, 464-8603, Japan (E-mail: takashi.yonekawa@mirai.nagoya-u.ac.jp)

KEY WORDS: Human engineering, Elderly person, Driving characteristics, Driving recorder [C2]

Introduction: In traffic accidents involving elderly drivers, the number of accidents caused by failure to stop or failing to check safety at stop sign intersections is higher than any other age groups. Thus, we put on-dash cams for 22 drivers aged 50-82 years old to measure their driving behavior at passing stop sign intersections. The relationship between the driving behavior and emergency braking frequency at stop sign intersections and the cognitive/physical characteristics and driving attitude questionnaires of the elderly drivers was analyzed. This research is supported by the Center of Innovation Program from Japan Science and Technology Agency, JST.

Test Method: Experimental participants were 11 participants (male 6, female 5) in the 70s, 5 participants (male 2, female 3) in the 60s, 6 participants (male 4, female 2) in the 50s, totaling 22 participants drove with driving recorder in natural driving. Additionally, the relationship of elderly driver's cognition test (MMSE: Mini-Mental State Examination, UFOV: Useful field of view and Cognitive aging test of AIST, etc.), driving performance test (CRT driving aptitude test device: Takei Scientific Instruments, T.K.K.7053), driving attitude questionnaire, was analyzed. The driving data was measured by the drive recorder (Yupiteru, DU-DRHD421) including GPS, 3-axis accelerometer, vehicle front view camera.

The emergency braking frequency and driving behavior at stop sign intersections were analyzed by the drive recorder data. Then the relationships were examined in a multiple regression model using a stepwise method with the frequency of emergency braking and approaching time at stop sign intersections as the dependent variable and the driving behavior characteristics, cognitive/physical characteristics and driving attitude questionnaire as the independent variables.

Test Results: Table1 shows estimate multiple regression model of emergency braking frequency at stop sign intersections. The emergency braking frequency tends to be lower for the experimental participants who have good UFOV, driving attitude of methodical driving and non-hesitation for driving, and a high rate of waiting percentage for cross vehicle at stop sign intersection.

Table2 shows estimate multiple regression model of approaching time at stop sign intersections. The approaching time tends to be longer for the experimental participants who have driving attitude of check safety carefully at lane change and intersections, and longer side attention response time of CRT driving attitude tests. The participants who high rate pass cross single lane and left turn at stop sign intersection tended to have longer approaching times. On the contrary, the participants who have driving attitude of ensure that driving maneuvers such as slowing down and stopping at stop sign and give priority to roads you are familiar with driving on tended to have shorter approaching times. The participants are aware of the need to slow down and stop at stop sign, but in actual driving, they check for safety, but do not reliable stop.

Figure 1 shows the relationship between the UFOV and the approaching time at stop sign intersections, and the frequency of emergency braking is shown as the area of the circle of the plot point. Among the participants with low UFOV accuracy, two participants have taken a long time to approach the intersection and reduced the frequency of emergency braking. Participant 3 had a good of UFOV and a long approach time at intersection, which may have resulted in a zero-emergency braking frequency. On the contrary, Participant 14 had a poor UFOV and a short approach time, which resulted in a high frequency of emergency braking. Participants with good UFOV tended to have a low emergency braking frequency even when the approach time was short.

Conclusion: The relationship between cognitive/physical characteristics, driving attitude questionnaires, intersections approaching time, and emergency braking frequency was analyzed.

Even if the cognitive physical characteristics are inferior, if driving attitude is safety, the frequency of emergency braking is low.

The participants are aware of the need to slow down and stop at stop sign, but in actual driving, they check for safety, but do not reliable stop.

It is considered that tow elderly participants can perform compensatory driving behaviors such as approaching long time at stop intersections to reduce the frequency of emergency braking even though their cognitive and physical characteristics have deteriorated.

Table1 Estimate multiple regression model of emergency braking frequency

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	75.467	23.281	0	.	3.242	0.005
UFOV	-69.622	14.423	-0.566	0.943	-4.827	0
DSQ:Methodical driving	-35.03	6.091	-0.781	0.702	-5.752	0
DSQ:Hesitation for driving	20.001	7.264	0.363	0.744	2.753	0.014
Waiting percentage of cross vehicle at stop sign	289.058	71.564	0.486	0.897	4.039	0.001
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	14297.82	4	3574.455	15.046	0	
Residual	4038.579	17	237.563			

Table2 Estimate multiple regression model of approach time at stop sign intersection

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	-3.823	1.289	0	.	-2.965	0.01
DSQ13: Check safety carefully at lane change and intersections	1.587	0.338	1.497	0.162	4.69	0
DSQ4: Ensure that driving maneuvers such as slowing down and stopping at stop sign	-0.907	0.273	-1.006	0.18	-3.326	0.005
Compensatory strategies: Give priority to roads you are familiar with driving on	-1.058	0.328	-0.78	0.282	-3.225	0.006
CRT Driving attitude tests: Side attention response time	0.006	0.002	0.488	0.731	3.247	0.005
Percentage of left turn at stop sign intersection	3.936	1.565	0.682	0.225	2.515	0.024
Percentage of passing cross single lane at stop sign intersection	2.836	1.122	0.592	0.3	2.526	0.023
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	6.885	6	1.148	7.599	0.001	
Residual	2.265	15	0.151			

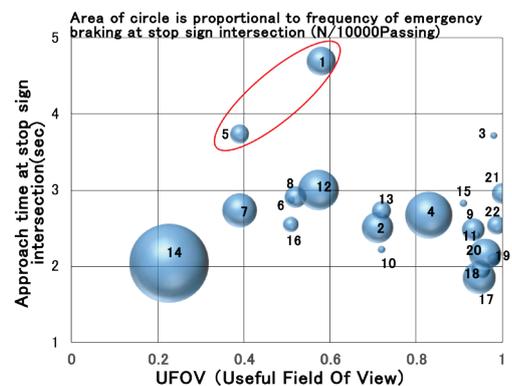


Fig.1 Relation between UFOV and approach time at stop sign intersection