DRIVER'S OVERTAKING BEHAVIOR ON SINGLE CARRIAGEWAY ROAD

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To my beloved husband and son...
Suhairul Hashim and Muhammad Luqmanul Hakim,
Thanks for your support and understanding,
May Allah bless us

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ABSTRACT

Overtaking is one of many important criteria considered in the analysis of road traffic accidents and performance of single carriageway road. It is undeniable that the inappropriate driver behavior is the major contributing factor to road crashes. This study was carried out to develop a mathematical model of overtaking behavior. The study focused on the factors considered by drivers before committing overtaking maneuver. The study was conducted for rural single carriageway roads. Overtaking maneuvers were recorded using video camera. The data abstracted from the recordings include the decision times, overtaking times, overtaking distances, safety margins, accepted and rejected gaps, headways at the start of the overtaking maneuvers, headways at the end of the overtaking maneuvers, speed of the overtaken vehicle, speed of the overtaking vehicle at the end of the overtaking and acceleration of the overtaking vehicle during the overtaking. The data were analyzed statistically using Minitab 14 software to establish mathematical relationships between the various overtaking parameters. It was found that the speed of overtaking vehicle dependant of the speed of overtaken vehicle, decision times, start headway, overtaking distance and acceleration.

ABSTRAK

Kelakuan memotong di jalan raya merupakan satu kriteria penting yang perlu dipertimbangkan dalam analisis kemalangan jalan raya dan tahap keberkesanan jalan raya dua lorong dua hala. Tidak dapat dinafikan bahawa kelakuan pemandu yang salah merupakan faktor utama yang menyumbang kepada nahas jalan raya. Kajian ini dibuat untuk membentuk model matematik tentang kelakuan memotong. Kajian difokuskan kepada faktor-faktor yang perlu dipertimbangkan oleh pemandu sebelum memulakan gerakan memotong. Kajian ini telah dijalankan di jalan raya dua lorong dua hala di kawasan luar bandar. Data kelakuan memotong direkodkan menggunakan kamera video. Data yang dicerap daripada rakaman adalah masa membuat keputusan memotong, masa memotong, jarak memotong, jarak selamat, jarak yang boleh diterima dan ditolak untuk memotong, jarak antara kenderaan memotong dengan kenderaan dipotong sebelum mula untuk memotong, jarak antara kenderaan memotong dengan kenderaan dipotong selepas selesai memotong, kelajuan kenderaan yang dipotong, kelajuan kenderaan yang memotong dan pecutan kenderaan memotong semasa pergerakan memotong. Data dianalisis secara statistik dengan menggunakan perisian Minitab 14 untuk memperolehi hubungan matematik antara parameter-parameter kelakuan memotong. Didapati kelajuan kenderaan yang memotong mempunyai hubungan dengan kelajuan kenderaan yang dipotong, masa membuat keputusan memotong, jarak antara kenderaan memotong dengan kenderaan dipotong sebelum mula pergerakan memotong, jarak memotong dan pecutan kenderaan memotong semasa pergerakan memotong.

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LIST OF ABBREVIATIONS

DT - Decision Time

OT - Overtaking Time

ONS - Speed of overtaken vehicle

SH - Start Headway

EH - End Headway

OD - Overtaking Distance

OGS - Speed of overtaking vehicle

OA - Accelerationof overtaking vehicle

SF - Safety Margin

AG - Accepted Gap

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Overtaking is one of the most risky maneuvers on highways. The practice of overtaking maneuvers is to visualize in advance every detail of what might happen during the operation. Motorists and road safety authorities commonly see inappropriate driver behavior as the major contributing factor to road crashes.

The road safety system essentially comprises vehicle, road infrastructure and road user which influence each other in their actions (Wadhwa, 1999). The combinations of these three elements make driving a motor vehicle is a complex task. Driver's error contributes to over 75 percent of road crashes especially in overtaking maneuvers (Lamm et. al, 1999). These errors include lack of driver attention, poor observation skills, excessive speed, incorrect evasive action and failing to obey the road rules.

The specific behaviors which may lead to driver errors also include tailgating, weaving in and out of traffic, improper passing (eg. cutting in too close in front of

vehicle being overtaken), passing on the road shoulder, improper lane changes (failure to signal), failure to yield the right of way to other road users, preventing other drivers from passing, unwillingness to extend cooperation to motorists unable to merge or change lanes due to traffic conditions, driving at speeds far in excess of the norm which results in frequent tailgating, frequent and abrupt lane changes, running stop signs and running red lights.

Drivers are more likely to engage in these behaviors if they are relatively young, male, in traffic situations which confer anonymity and/or where escape is highly likely, generally disposed to sensation-seeking or aggressiveness in other social situations, angry (possibly due to events unrelated to traffic situation), believe they possess superior driving skills and obstructed by unexpected traffic congestion.

In contrast, Stamatiadis (1994) suggested that older drivers are more often involved in accidents at intersections and are more frequently cited as being at fault. Furthermore, some researchers conclude that older driver behavior can be characterized as ambiguous (Schlag, 1991). According to these authors, older drivers maintain greater distances from the cars ahead than younger drivers, less careful when reducing their speed in the proximity of an intersection or when changing traffic lanes, tend to overestimate their driving abilities and the notion that aging characteristics affect their driving performance. On the other hand, older drivers seem to have great difficulty driving on high-speed roads such as motorways and also exhibit high perception–reaction times during some driving maneuvers such as overtaking (Schlag, 1991). According to Cerreli (1989), Benekohal, et. al (1994), and Ranney and Pulling (1990), older driver accident rates are higher than those of younger drivers. Further, older drivers seem to be more injury prone when involved in accidents because they present higher injury and fatality rates.

Wigmore and Alley (2001) had stated that road deaths involving overtaking have been rapidly increasing in New Zealand with 31, 42 and 45 deaths for the 12 months to January 1997, 1998 and 1999 respectively (a 45% increase over the 3 years). Hegeman (2004) revealed that between 1995 and 2000, about 26 (2.6% of the total fatalities) traffic participants die yearly in the Netherlands because of overtaking failures and in the UK, 7.9% of fatal accidents is caused by overtaking.

Common sense dictates that less time spent on the wrong side of the road during the overtaking maneuver, lesser the chances of an accident. Minimizing exposure to danger is one of the first rules of overtaking. It is common for the driver to maximize acceleration by using the best gear to conclude the overtaking maneuver in the shortest time. Taking that gear in advance helps avert the unwise and risky course of changing during the overtaking.

While driving, driver's behavior is affected by different aspects of the road environment such as road width, road encroachment and movements of other vehicles on road. It is assumed that driver's actions are motivated by two different considerations: the need to reach his destination within a reasonable period of time, and the need to reach destination safely. The driver satisfies these considerations by maneuvering his vehicle through steering as well as through changes in the speed by either accelerating or decelerating.

From the design and analysis of single carriageway road performance point of view, provision of overtaking sections requires overtaking behavior data such as decision times, overtaking times, overtaking distances, safety margins, accepted and rejected gaps, headways at the start of the overtaking maneuvers, headways at the end of the overtaking maneuvers, speed of the overtaken vehicle, speed of the overtaking vehicle at the end of the overtaking and acceleration of the overtaking vehicle during the overtaking.

1.2 Aim and Objectives

The aim of the study is to develop a mathematical model of overtaking behavior. To achieve this aim, the study is based on the following objectives:

(i) To define the effect of speed of overtaken vehicle and accepted gap on overtaking behavior parameters.

(ii) To define the distribution of accepted gap.

(iii) To define factors considered by drivers before committing overtaking maneuver.

1.3 Scope

The study encompassed the overtaking on single carriageway road section. The overtaking road sections considered are flat and straight such that the overtaking is not restricted by the sight distance. The overtaking data includes the decision times, overtaking times, overtaking distances, safety margins, accepted and rejected gaps, headways at the start of the overtaking maneuvers, headways at the end of the overtaking maneuvers, speed of the overtaking vehicle at the end of the overtaking and acceleration of the overtaking vehicle during the overtaking.

1.4 Problem Statement

Overtaking maneuver always involved in road accidents especially a high-speed overtaking maneuver. Previous research revealed that drivers behave more aggressively when behind the wheel of car, compared with non-driving situations. However, the study on driver's overtaking behavior is not easy to conduct as it is complicated. To model the behavior correctly, a good understanding of this behavior is needed. Predicting the success of a passing maneuver is complicated in that many factors play into it. These include the performance of the passing vehicle, driving style of the operator of that vehicle, volume of traffic flow in the opposing direction, and characteristics of the impeding vehicle.

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