



Why do three-wheelers carrying schoolchildren suffer very low fatal crashes?



Gaurav Pandey ^{a,1}, Dinesh Mohan ^b, K. Ramachandra Rao ^{c,*}

^a Transportation Research and Injury Prevention Programme, Department of Civil Engineering, Indian Institute of Technology Delhi, New Delhi, India

^b Transportation Research and Injury Prevention Programme, Indian Institute of Technology Delhi, New Delhi, India

^c Department of Civil Engineering, Transportation Research and Injury Prevention Programme, Indian Institute of Technology Delhi, New Delhi, India

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ABSTRACT

This paper investigates the possible causes of low fatalities in three-wheelers (autorickshaw) carrying schoolchildren in India. The data was collected in the form of First Information Report (FIR) from local police stations from 2007 to 2012 and video-graphic surveys were done on four arterial roads running through Ludhiana, Punjab, India. Surveys were also done on one subarterial road near school zone which was used by three-wheelers carrying schoolchildren. The objective of the study was to investigate the hypothesis that drivers behave differently while following or overtaking three-wheelers carrying children. Many researchers have investigated the effect of passengers on the driver of the same vehicle, but there was no evidence of any study which investigated the effect of child passengers on nearby vehicles. It was found that heavy vehicles maintain more gaps while following or overtaking three-wheelers carrying children as compared to those not carrying children. It was also found that this effect is more prominent at speeds higher than 40 km/h. On the other hand lighter vehicles keep the highest lateral and longitudinal gaps to heavy vehicles and three-wheelers without children respectively.

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1. Introduction

Road fatalities are one of the leading causes of deaths in the world today. According to a report by Peden et al. [1], each year 1.2 million people are killed and 50 million are injured in road crashes [1]. Bockholdt and Schneider [2] found that road accidents constituted nearly 50% of total deaths in children in Berlin. Hyder et al. [3] found that children constitute 40% of total road traffic injuries in south Asia. However, these fatalities are not uniformly distributed across different travel modes. Our observation reveals that three-wheelers and two wheelers carrying schoolchildren are seldom involved in fatal crashes. One of the theories could be that drivers drive more cautiously while carrying children as passengers. This theory can be extended to say that other drivers in the stream also drive safely when following or overtaking vehicle carrying schoolchildren. Many researchers have studied the effect of passengers on a driver's behaviour. Evans and Wasielewski [4] stud-

ied the headways maintaining behaviour for different driver and vehicle characteristics using photographic technique. They found that older vehicles tend to keep larger headways in order to avoid situations requiring larger deceleration. They also found that medium sized vehicles (1600–1900 kg) had shorter headways than other vehicles. Parker et al. [5] found that male drivers are much more likely to drive cautiously due to the presence of female passengers than vice-versa. One of the theories they proposed was that of female passengers playing an active role in modifying the male driving pattern. They also found that younger drivers (18–24 years old) are much less likely to get affected by this phenomenon than older drivers (45 years old or more). Regan and Mitsopoulos [6] found that younger drivers drove more cautiously in the presence of very old and very young passengers owing to increased sense of responsibility. Domingo et al. [7] found that number of occupants in the vehicle had a protective effect on driving behaviour thereby reducing risk. The magnitude of this effect depended on age and sex of passenger and driver. The study showed that young drivers were more cautious when accompanied by female passengers (regardless of age) and male passengers age between 45 and 60. Similar results were obtained by other researchers ([8] and [9]) who also found that the presence of passengers has a positive effect on driving pattern and encourages safer driving by drivers. Lee and Abdel-Aty [10] studied the effect of number of passenger and age of passengers on driver behaviour and hence the crash propensity. They found that drivers exhibit safer driving pattern as the number of passengers increased. However,

* Corresponding author. Tel.: +91 11 2659 1235.

E-mail addresses: gauravpandey2006@yahoo.co.in (G. Pandey), dmohan@cbme.iitd.ac.in (D. Mohan), rrrkalaga@civil.iitd.ac.in (K. Ramachandra Rao).

¹ Tel.: +91 8376040299.

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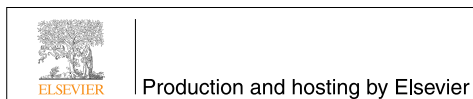




Fig. 1. Examples of three wheelers carrying schoolchildren [ovals indicate three-wheelers with children (3WCs) while rectangles indicate three-wheelers (3Ws)].

risk increased for younger drivers in the presence of younger passengers. Hoogendoorn and Ossen [11] studied heterogeneity in driver's behaviour using trajectories of cars and trucks obtained from a helicopter. They found that car drivers kept larger gap when following another car than a truck. This is owing to the assumption that trucks have larger braking distance than cars and hence following vehicles require lesser safety distance to trucks. Koppel et al. [12] studied the effect of the presence of child occupant (1–8 years old) on the amount of distraction (looking away from the front road for more than 2 s) to the driver. They found that drivers were much more likely to have their eyes off the road for more than 2 s while engaged in non-child related activities than in child related activities. It was also found that male drivers were more prone to distraction than female drivers. Kawato et al. [13] studied the injury severity to children pedestrians by different vehicle types namely sedan, box type and sports utility vehicles and found that head injuries were less severe for sedan type while that for lower extremities were more severe for sedans. Orsi et al. [14] found a negative influence of passengers on younger drivers (age less than 25 years) whereas a positive influence for older drivers (age more than 25 years). Chung et al. [15] studied the effect of the presence of an adult occupant in a vehicle on driving speed of young driver and compared the adults giving advice regarding driving to those who were silent. They found that young drivers drove much slower when adults gave advice and also this effect continued in subsequent driving sessions by young drivers. While a number of researchers have found that passengers motivate drivers to drive more safely some researchers have suggested that the presence of more than one passenger especially in the case of younger male drivers can increase crash propensity by increasing distractions ([16], [17], [18], [19], [20]).

It can be seen from literature that road accidents are a major cause of deaths in children in the world. While some studies have been done to determine the factors that lead to children fatalities, most of them are limited in developed countries and very few to no studies have been done in developing countries like India. It was also found that while pedestrian and bicyclist children share a significant burden of total road fatalities, very few children fatalities happen in vehicles such as three-wheelers and two wheelers carrying schoolchildren. One of the reasons

for this could be that drivers act more responsibly when carrying schoolchildren due to expectations from children's parents. Many researchers have found a positive relationship between number and type of passengers (especially vulnerable passenger like very young or very old) in a vehicle and safe driving behaviour of the driver. While this could be true, there is a possibility that other vehicles sharing the road with vehicles carrying children also act responsibly. This was not investigated in any study until date. Almost all previous studies have focused on the effect of passengers on the driver of the same vehicle but not on the drivers of nearby vehicles. The reason for this can be that it is not possible to see occupants of other vehicles but this is not the case with two wheelers and three wheelers carrying children in India. These vehicles are very easy to spot owing to the school bags hanging by hooks on the exterior of these vehicles. Studying the effect of these vehicles carrying children on driving behaviour of nearby vehicles could shed new light on driver's attitude and give way to new kinds of measures to increase vehicular safety.

This paper makes an attempt to study the effect of three-wheelers carrying children on the gap maintaining behaviour of nearby vehicles in traffic stream. Data was collected from accident records of Ludhiana, India and video-graphic surveys were done to obtain lateral/longitudinal gaps as explained in Section 2. The information was then grouped by vehicle pair for different speeds and tested for significance which is presented in Section 3.

2. Methodology

Ludhiana, India was selected for the study owing to its injury severity rate as one of the highest in the country. It was found during reconnaissance of the study area that most three-wheelers (3WCs) carrying children only used sub-arterial roads due to the fact that most children lived in the neighbourhoods around the school. Hence in order to get a statistically significant sample of 3WCs, traffic surveys had to be done

Table 1
Vehicle trajectories by vehicle type.

Vehicle type	Sub arterial	Arterial
Light motorized vehicles	582	1012
Heavy motorized vehicles	74	207
3Ws	239	487
Two wheelers	1320	1782
3WCs	219	0
Total	2427	3488

Table 2
Speed characteristics on intersection and straight road for different road users (Pandey et al. [22]).

Mode type	Speed (km/h)					
	Straight road			Intersection		
	15th percentile	Mean	85th percentile	15th percentile	Mean	85th percentile
Two wheelers	25.70	32.86	39.93	8.64	11.95	15.23
3Ws	20.43	26.18	31.95	4.00	8.45	12.85
Light motorized vehicles	29.82	38.79	48.53	9.30	13.01	16.50
Heavy motorized vehicles	28.71	37.52	46.35	6.67	10.81	14.89

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