



Determinants of safe and productive truck driving: Empirical evidence from long-haul cargo transport



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ABSTRACT

Using GPS data of 370 long-haul trips in India, survey data of 49 truck drivers, and ERP data, this study examines the role of driver personality characteristics in predicting risky and productive driving. The results show that more conscientious drivers display more risky driving behavior. More extravert drivers are less productive, whereas driver safety consciousness positively relates to productivity. These results can serve as a starting point for further studies into how long-haul transport companies may use individual truck driver characteristics in their training and selection procedures to meet operational safety and productivity objectives.

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1. Introduction

Road safety is a prime concern for drivers and public policymakers worldwide. Especially professional truck drivers, commonly driving for long monotonous periods and in irregular shifts, have a relatively high risk of encountering accidents during their work (Bunn et al., 2005). In the United States alone, 333,000 large trucks (gross vehicle weight rating more than 4.5 tons) were involved in traffic crashes in 2012, resulting in 3921 fatalities and 104,000 people injuries (NHTSA, 2012). In developing countries, the situation is even more severe. For example, India has one of the highest number of road traffic fatalities in the world, with more than 231,000 people killed in road traffic crashes annually (WHO, 2013). In approximately 65% of these fatal crashes, trucks are the striking party (Mohan et al., 2009). Besides the obvious direct consequences of these accidents such as lost lives, injuries, and liabilities, unsafe driving practices and accidents can also result in disrupted operations, reputation damage, driver absence due to injuries, increased vehicle maintenance and insurance costs, late customer deliveries, and overhead costs for incident investigation and follow-ups. Therefore, reducing the number of truck accidents by focusing on increasing safety in professional driving is of utmost importance.

Infrastructural improvements, technological advancements, and the alteration of traffic rules have contributed to a higher level of safety for truck drivers (Hauer, 1997), but at the same time, it has become increasingly clear that preventive measures should also focus on the principal agent of long-haul transport: the truck driver (Dewar and Olson, 2007; Shinar, 2007). Nowadays, truck drivers should not only have excellent driving skills, but should also be able to carry out other tasks during their trips. These include dealing with administration, planning route and delivery, communicating with transport compa-

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nies and customers, searching for pick-up cargo, addressing common truck mechanical problems, and all of these while meeting client expectations in terms of timely delivery (European Agency for Safety and Health at Work, 2011). Operations practices such as just-in-time delivery can result in additional work pressure on truck drivers. Simultaneously managing all these demands requires truck drivers to multitask, but the ability to do so successfully can differ substantially among individuals (Watson and Strayer, 2010). Some people might be particularly capable of dealing with conflicting demands, whereas others might thrive better when confronted with more straightforward objectives. This suggests that taking driver-specific factors into account can help in explaining and improving safety and productivity in professional driving.

Estimates on the proportion of traffic accidents caused by human factors are consistently high, with estimates around 90% (Lewin, 1982). Similarly, 87.7% of truck accidents are estimated to be caused by driver-related factors (FMCA, 2006). It is therefore not surprising that several studies have investigated the role of individual characteristics, such as the Big Five personality traits (Digman, 1990), in predicting dangerous driving behavior and accidents. For example, Oltedal and Rundmo (2006) demonstrated that personality traits and gender accounted for approximately 37% of the variance in risky driving behavior, Chen (2009) showed that drivers' attitudes towards traffic safety was directly related to risky driving behaviors, and according to Sullman et al. (2002) the driver behavior questionnaire (DBQ) explains approximately 11% of the variability in crash involvement. Several studies in the field of Operations Management have investigated the role of the driver in trucking accidents (e.g. Cantor et al., 2010; Sullman et al., 2002). However, the point raised by Elander et al. (1993) is still highly relevant: more studies are needed on the influence of driver factors on accident risk that employ methodologies other than driver self-reports or databases, which do not provide information detailed enough to control for the circumstances of accidents. Furthermore, by only considering accidents as outcome variable, the external factors over which the truck driver has no influence make it difficult to identify meaningful relationships. In this study we therefore aim to validate earlier findings using detailed and objective data sources, as well as using an outcome measure that is tightly linked to driver behavior.

Besides having to focus on driving safely, truck drivers are exposed to productivity targets that might conflict with safe driving behavior. Research on the link between truck driver characteristics and productivity is relatively scarce. Such research is essential to evaluate the safety performance of an individual or organization without also taking productivity performance into account (Wolf, 2001). Several recent studies have emphasized the role of individual differences in determining performance outcomes of operational processes (De Vries et al., 2016a, 2016b; Grosse et al., 2015), which suggests that also the field of professional driving could benefit by taking individual differences among drivers into consideration to enhance productivity.

This field study uses survey data measuring individual characteristics of 49 truck drivers combined with GPS data measuring highly detailed trip characteristics such as the duration, speed, and idle time of 370 trips on 124 distinct routes. We contribute to the literature on safety in operations management and transportation in three ways. First, we test to what extent the personality of truck drivers affects driving performance in terms of safety, but also in terms of productivity. Second, we combine subjective survey measures, outcome measures that tightly relate to behavior, and objective detailed GPS data to address the common method bias that is often present in the research on this topic, leading to conclusions based on rigorous testing. Third, we provide an example of the impact of personality characteristics on practical outcomes. Operations managers can use these insights to increase company performance by focusing training and selection efforts on ensuring that their truck drivers are better equipped to complete their trips faster and more safely.

2. Literature review and hypothesis development

2.1. Safety in professional driving

Worldwide, approximately 1.24 million people die in road traffic every year (WHO, 2013). Large trucks account for a disproportionately large share of these traffic deaths. Trucks are subject to maneuvering limitations, and crashes often have more serious consequences due to their size and weight. This is not only true in developed economies, but even more so in emerging economies. In these countries, highways commonly pass through densely populated areas, sharing the road with vulnerable road users such as pedestrians, bicycles and motorized two-wheelers (Mohan et al., 2009). The high numbers of road traffic fatalities illustrate the importance of research on the risk factors for road traffic injuries, especially among professional drivers.

Several factors related to road accidents (or road safety) have been studied and can be broadly categorized in three groups: vehicle characteristics, environmental (including company) characteristics, and driver characteristics. Examples of vehicle characteristics include the physical attributes of the vehicle, truck load capacity (Castillo-Manzano et al., 2016), the state of maintenance, and the presence or absence of an electronic logbook (Cantor et al., 2009). Environmental characteristics include infrastructure and traffic conditions, safety regulations and enforcement activities (Welki and Zlatoper, 2007). In a commercial setting, these environmental characteristics also refer to safety culture, leadership, unionization (Corsi et al., 2012), wage, turnover, and the incentive system employed by the trucking company (Cantor et al., 2010; De Koster et al., 2011; De Vries et al., 2016c; Rodriguez et al., 2006, 2003). Because the driver has been identified to be the primary cause of the large majority of traffic accidents (e.g. FMCA, 2006), we are particularly interested in the relationship between individual driver characteristics and risky driving behavior. An example of such a driver characteristic is age. Older drivers generally respond to potential hazards more slowly than younger drivers (Quimby and Watts, 1981), and more expe-

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