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Understanding psychological determinants of driver error: A case study of the 2024 Kurla bus crash

Mrunal Kshirsagar * and Mustafa Patanwala

Vidyavardhini's College of Engineering and Technology, Vasai, 2. AutoInstitute, Mumbai, India.

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Abstract

This study examines the 2024 Kurla BEST electric bus accident in Mumbai, which resulted in seven fatalities and 42 injuries, through the lens of automotive safety and human factors engineering. Despite advancements in vehicle design and automation, human error remains a critical vulnerability in transport systems. The incident involved a driver with minimal exposure to the electric bus's automatic transmission system, who lost control due to distraction and panic under duress—exacerbated by passenger interference. Using frameworks such as Cognitive Load Theory, the Yerkes-Dodson Law, and the Dunning-Kruger Effect, the paper identifies key psychological and cognitive contributors to the crash. Comparative analyses of similar cases—the 2022 Kobe Expressway crash and the 2021 Tesla Autopilot fatality—underscore the global implications of inadequate driver training and automation complacency. The study employs the Human Factors Analysis and Classification System (HFACS) to categorize latent and active failures, proposing critical interventions: electric vehicle-specific training programs, driver monitoring systems (DMS), advanced driver assistance systems (ADAS), and improved human-machine interface (HMI) standards. The findings stress the importance of integrating behavioral risk assessment within automotive safety frameworks to address human limitations in increasingly automated transport environments.

Keywords: Psychology; Accident; Electrical Vehicle; Driver Error; Human-Machine Interface

1. Introduction

Road traffic accidents (RTAs) have emerged as a global public health and safety crisis, causing an estimated 1.35 million fatalities and 50 million non-fatal injuries annually (World Health Organization [WHO], 2023). The economic costs of these accidents, including healthcare expenses, loss of productivity, and damage to infrastructure, account for approximately 3% of the global GDP (WHO, 2023). Despite continuous advancements in vehicle safety technologies, road infrastructure, and traffic regulations, human error remains the predominant cause of RTAs, contributing to over 90% of accidents worldwide (Dingus et al., 2016; Treat et al., 1979).

The role of human error in road accidents has been widely studied in psychological and transportation research, identifying key contributing factors such as inattention, cognitive overload, poor decision-making, overconfidence, and skill deficits (Fuller et al., 2008; Wickens, 2008). Cognitive load theory suggests that when individuals encounter high-pressure or complex situations, their ability to process information and make critical decisions diminishes (Sweller, 1988; Wickens, 2008). In driving scenarios, distractions, unfamiliarity with vehicle systems, and emotional stressors can significantly impair reaction times and judgment, leading to catastrophic outcomes (Endsley, 2017).

A notable real-world example demonstrating the complex interplay of psychological factors in RTAs is the Kurla BEST bus accident (India, 2024). This incident, which resulted in seven fatalities and 42 injuries, occurred due to a

* Corresponding author: Mrunal Kshirsagar **Email id**: mrunalkshirsagar19@gmail.com

combination of driver distraction, inadequate training, and panic-induced misjudgment (Mid-Day, 2024). Investigations revealed that the driver had received only five minutes of training on the electric bus's automatic transmission system, making him ill-prepared to handle an emergency. Additionally, an intoxicated passenger interfered with the steering, causing cognitive overload and a loss of control over the vehicle. The Kurla accident underscores the critical need for comprehensive driver training, stress management, and stricter passenger safety enforcement policies to prevent similar tragedies.

To further contextualize the psychological dimensions of human error, this study compares the Kurla accident with two other notable international cases of the Kobe Expressway crash (Japan, 2022) and Tesla Autopilot fatality (USA, 2021).

- The Kobe Expressway crash (Japan, 2022): A truck driver unfamiliar with his vehicle's braking system miscalculated stopping distances, leading to a multi-vehicle collision that killed six people (Japanese National Police Agency, 2022).
- The Tesla Autopilot fatality (USA, 2021): A driver, over-relying on automation, was distracted by his phone, failing to notice a stationary truck in his lane, resulting in a fatal crash (National Highway Traffic Safety Administration [NHTSA], 2021).

By analysing the Kurla BEST bus accident in depth and comparing it with similar international cases, this paper seeks to:

- Examine the psychological and cognitive factors that contributed to these incidents.
- Identify patterns in human error, particularly in scenarios involving driver distraction, inadequate training, and automation complacency.
- Propose evidence-based interventions, including enhanced driver training programs, regulatory enforcement, and technological solutions such as fatigue monitoring systems and Advanced Driver Assistance Systems (ADAS).

Through a multifaceted psychological approach, this study aims to provide practical recommendations for reducing road accidents and enhancing global road safety.

2. Psychological Factors Contributing to Human Errors:

Human error is the leading cause of road accidents, often influenced by cognitive, behavioural, and situational factors (Dingus et al., 2016). The Kurla BEST bus accident (Mumbai, 2024) is a striking example of how psychological limitations—such as inattention, inadequate training, panic responses, and cognitive biases—can result in catastrophic outcomes. This section explores the key psychological factors that contributed to the incident, analysing them within the broader framework of traffic psychology and cognitive science.

2.1. Inattention and Distraction

Inattention refers to a lack of focus on the primary driving task, while distraction occurs when external or internal stimuli divert cognitive resources away from critical decision-making (Strayer & Drews, 2007). Research has shown that even brief moments of inattention can impair a driver's ability to perceive hazards and react in time (Regan et al., 2011).

2.1.1. Relevance to the Kurla Accident:

- The Kurla accident was partly triggered by an external distraction—an intoxicated passenger interfering with the bus steering (Mid-Day, 2024). The driver's attention was momentarily diverted from controlling the vehicle to handling the disruptive passenger, resulting in delayed reaction times and loss of situational awareness.

2.1.2. Scientific Analysis:

- Cognitive Load Theory (Sweller, 1988) suggests that humans have limited cognitive processing capacity. When additional demands—such as handling passenger disturbances—are placed on a driver, the ability to focus on primary driving tasks diminishes (Wickens, 2008).
- Studies on driver distraction indicate that manual, visual, and cognitive distractions significantly impair driving performance (Dingus et al., 2016). In the case of the Kurla accident, diverted cognitive attention and emotional stress likely led to delayed corrective actions.

2.1.3. Comparative Case:

- Tesla Autopilot Crash (USA, 2021): The driver was distracted by using a mobile phone while relying on automation, resulting in a failure to notice an obstacle in time (NHTSA, 2021). This demonstrates how distractions—whether from passengers or technology—reduce reaction times and increase accident risks.

2.1.4. Preventive Measures:

- Driver training on situational awareness and handling passenger disturbances without compromising control.
- In-vehicle monitoring systems that detect driver distraction and issue real-time alerts (Liu et al., 2020).
- Public awareness campaigns discouraging disruptive passenger behavior.

2.2. Inadequate Training and Skill Deficits

Skill deficits arise when drivers lack sufficient knowledge or experience to handle specific vehicles or challenging road conditions. Research indicates that training gaps increase reaction time and error rates, particularly when transitioning to new vehicle technologies (Fuller et al., 2008).

2.2.1. Relevance to the Kurla Accident:

- The BEST bus driver had received only five minutes of training on the automatic transmission system of the electric bus before being assigned to operate it (Mid-Day, 2024). This minimal exposure likely led to confusion and errors under pressure, as he was unfamiliar with the vehicle's response dynamics and emergency controls.

2.2.2. Scientific Analysis:

- Transfer of Learning Theory (Schmidt & Bjork, 1992) states that skills acquired in one context (e.g., driving manual buses) do not always transfer seamlessly to another context (e.g., automatic electric buses).
- Muscle memory and instinctual responses developed from operating conventional buses may have led the driver to react incorrectly in a high-stress situation.
- Studies on driver training (Salmon et al., 2012) emphasize that short-duration training programs do not adequately prepare drivers for emergency situations.

2.2.3. Comparative Case:

- Kobe Expressway Crash (Japan, 2022): A truck driver unfamiliar with his new braking system miscalculated stopping distances, leading to a multi-vehicle collision that killed six people (Japanese National Police Agency, 2022). This highlights how insufficient training on new vehicle systems increases accident risks.

2.2.4. Preventive Measures:

- Mandatory training programs covering all vehicle-specific features, including emergency handling procedures.
- Simulator-based training to help drivers experience stress scenarios before operating vehicles in real traffic.
- Probation periods where new drivers are monitored before being assigned full responsibility.

2.3. Panic-Induced Risky Behavior and Overconfidence

Panic responses occur when individuals face unexpected, high-pressure situations and react impulsively or incorrectly. Overconfidence, on the other hand, leads drivers to underestimate risks and overestimate their ability to handle complex situations (Fuller et al., 2008).

2.3.1. Relevance to the Kurla Accident:

- The driver, unfamiliar with the electric bus system, panicked when confronted with an emergency. Instead of executing a controlled stop, his confusion and stress response led to misjudgment, worsening the impact.
- Overconfidence in minimal training exposure might have contributed to a false sense of readiness, leading to improper reactions under pressure.

2.3.2. Scientific Analysis:

- The Yerkes-Dodson Law (Yerkes & Dodson, 1908) explains that moderate stress enhances performance, but excessive stress leads to cognitive impairment and poor decision-making.

- The Dunning-Kruger Effect (Kruger & Dunning, 1999) suggests that individuals with limited knowledge or experience often overestimate their competence, which can be dangerous in high-stakes environments like driving.

2.3.3. Comparative Case:

- Pune Bus Incident (India, 2019): A reckless driver, overconfident in his driving abilities, was speeding through narrow streets, colliding with a rickshaw and injuring four people (Times of India, 2019). This illustrates how overconfidence leads to risk-taking behaviour.

2.3.4. Preventive Measures:

- Driver stress management training, including decision-making drills under pressure.
- Regular assessment of driver competency before being assigned to new vehicle models.
- Psychological screening for overconfidence and risk-taking tendencies among public transport drivers.

2.4. Cognitive Biases and Misjudgement

Cognitive biases are systematic errors in thinking that affect risk perception and situational awareness (Tversky & Kahneman, 1974). In driving, these biases distort judgment and lead to poor decisions.

2.4.1. Relevance to the Kurla Accident:

- The driver misjudged the control mechanisms of the new electric bus, likely due to a familiarity bias—assuming it would handle like a conventional diesel bus.
- Optimism bias may have caused the driver to underestimate the risks of inadequate training.

2.4.2. Scientific Analysis:

- The Familiarity Heuristic (Gigerenzer, 2008) suggests that individuals rely on past experiences, even when they do not apply to new contexts.
- The Optimism Bias (Sharot, 2011) explains that drivers often believe they are less likely to be involved in accidents, leading to risky behaviours.

2.4.3. Preventive Measures:

- Cognitive training programs to increase risk awareness in new driving environments.
- Automated driver assistance systems (ADAS) that provide real-time feedback and prevent misjudgements.

3. Conclusion

The Kurla BEST bus accident highlights the urgent need to recognize and address human psychological vulnerabilities within modern transportation systems. Key contributing factors and actionable insights include:

- Driver distraction, resulting from cognitive overload and external interference, critically impairs reaction time and judgment.
- Inadequate training in electric and automated vehicle systems increases the probability of operational errors during high-risk situations.
- Panic responses under stress, especially in high-pressure environments with passenger interference, compromise decision-making.
- Cognitive biases, such as overconfidence and performance degradation under stress, significantly influence driver behavior and error.
- Comprehensive, vehicle-specific training programs are essential to ensure drivers are well-equipped to handle modern vehicle systems.
- Stress management techniques should be integrated into driver education to build psychological resilience.
- Behavioral risk assessments can proactively identify drivers at risk, enabling early intervention.

Compliance with ethical standards

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No conflict of interest to be disclosed.

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