

# Trap and drag incidents on the London Underground – the role played by passenger mental models

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## ABSTRACT

A trap and drag accident occurs when a passenger gets part of their body, or an object trapped between the train doors and gets dragged along the platform as the train departs causing various consequences of varying severity (Roels, 2018). The primary aim of this study was to understand why trap and drag accidents occur, how they come about and, establish how they can be prevented. A secondary aim was to understand how frequently traps occur and go unreported, and to understand if passengers are aware of the risks at the Platform-Train-Interface (PTI). We found that the majority of participants expect the train doors to work in the same way as lift and automatic shop doors and believe that the doors would automatically reopen if there was an obstruction. This study has also found that 40% of in-person survey participants and 27% of online participants have experienced becoming trapped. 6% of in-person survey participants have experienced being trapped and dragged. None of these incidents were reported. This study shows that passenger mental models of train doors are confused and inconsistent. Passenger's experiences do not correlate with their expectations of how the doors work, their mental models are incomplete, and this can lead to passengers taking risks when boarding or alighting.

## KEYWORDS

Rail passenger safety, platform-train-interface, trap and drag incidents

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## Introduction

From April 2020 to March 2021 there were 2,042 injuries to passengers in stations or on trains (Office of Rail and Road, 2021). 13.5% of severe accidents occurred at the platform edge while passengers were boarding or alighting the train, including trap and drag accidents (RSSB, 2021). A trap and drag accident occurs when a passenger gets part of their body, or an object trapped between the train doors and gets dragged along the platform as the train departs causing various consequences of varying severity (Roels, 2018). The primary aim of this study was to understand why trap and drag accidents occur, how they come about and, establish how they can be prevented. A secondary aim was to understand how frequently traps occur and go unreported, and to understand if passengers are aware of the risks at the Platform-Train-Interface (PTI).

## Methods of study

The study involved the use of a mixed set of methods. An in-person survey was carried out on 53 participants; these surveys took place at four different stations. An online survey was also conducted with 102 participants. 21 RAIB reports on trap and drag accidents were analysed and the causal factors for each recorded. In addition, 5 interviews with industry experts have also been conducted as part of this study.

## Findings

We found that the majority of participants expect the train doors to work in the same way as lift and automatic shop doors and believe that the doors would automatically reopen if there was an obstruction. This study has also found that 40% of in-person survey participants and 27% of online participants have experienced becoming trapped. 6% of in-person survey participants have experienced being trapped and dragged. None of these incidents were reported. This study shows that passenger mental models of train doors are confused and inconsistent. Passenger's experiences do not correlate with their expectations of how the doors work, their mental models are incomplete, and this can lead to passengers taking risks when boarding or alighting. It was found that although the majority of participants are aware of the possibility of traps and the risks of obstructing the doors their motivations to board are stronger than their fear of entrapment or injury. The study also suggests that traps and traps and drags happen more frequently than previous research shows.

## Discussion

The data shows that passenger expectations of what happens when there is an obstruction differs from actual events. Most participants expect the doors to reopen automatically when it detects an obstruction and do not understand the potential severity of their actions. We also show that the traps and traps and drags occur more frequently than previous research shows. The most popular response to passenger's expectations of what would happen if there was an obstruction of the doors, was that the doors automatically reopen. This was shown by 68% of participants from the in-person survey and 47% from the online survey. Other expectations given for what would happen if there was an obstruction included, the doors reopening depending on the size of trapped object, an alert being sent to the driver, and the emergency button being pressed. 4% of responses in the in-person survey and 17% in the online survey thought that injuries, drags, or the doors remaining shut were possible outcomes of entrapment. This shows that most participants do not expect serious consequences following entrapment, this belief can lead to passengers carrying out risky behaviours which are more likely to lead to trap and drag accidents because they do not expect them to be a possibility.

From the data collected two mental models of how passengers expect the train doors to work have been created. The first model is for those participants who believe that the doors will automatically reopen if there is an obstruction. The second model is for those who do not expect the doors to open automatically and instead expect there to be a mechanical element to the doors which either sends a signal alerting the driver of the obstruction or causes the doors to stay closed. The mental models created are incomplete and confused models if looked at on an individual basis, many who believe that the doors work in the same ways as lifts have had experiences becoming trapped and have had to push the doors open themselves to become free, others who expect the doors to work this way understand that fingers and coats can become trapped in the doors and be undetected. Passengers using the second model expected the doors to automatically reopen if rucksacks, arms, or fingers became trapped but when asked separately what happens when something gets trapped thinks a signal is sent to the driver or the door button must be pushed for the doors to reopen.

## Conclusions and future work

In conclusion this study shows that passenger mental models of train doors are confused and inconsistent. Passenger's experiences do not correlate with their expectations of how the doors work, their mental models are incomplete, and this can lead to passengers taking risks when boarding or alighting. The study also suggests that traps and traps and drags happen more frequently than previous research shows. The majority of participants expect the doors to automatically reopen if there is an obstruction just like lift doors. These findings are consistent between the two surveys as well as with the research carried out with the RSSB (2017). This misconception can lead to

passengers believing that there is little risk in boarding late or obstructing the doors which can lead to an increased risk of the passenger becoming trapped and potentially dragged. The paper concludes with a set of recommendations for future work, as well as implications for the design of interventions to improve passenger safety at the PTI (e.g., the design of warnings and public messaging campaigns).

## References

- Office of Rail and Road, 2021. Rail Safety 2020-21. [online] Office of Rail and Road. Available at: <<https://dataportal.orr.gov.uk/media/1999/rail-safety-2020-2021.pdf>> [Accessed 14/11/2022].
- Roels, R., 2018. Rail passenger behaviour invites ‘trap and drag’ incidents. [online] DNV. Available at: <<https://www.dnv.com/article/rail-passenger-behaviour-invites-trap-and-drag-incidents-199979>> [Accessed 14/11/2022].
- RSSB, 2017. T1102-Optimising door closure arrangements to improve boarding and alighting. London: Rail Safety and Standards Board.