



# Ethics or Self-Preservation?

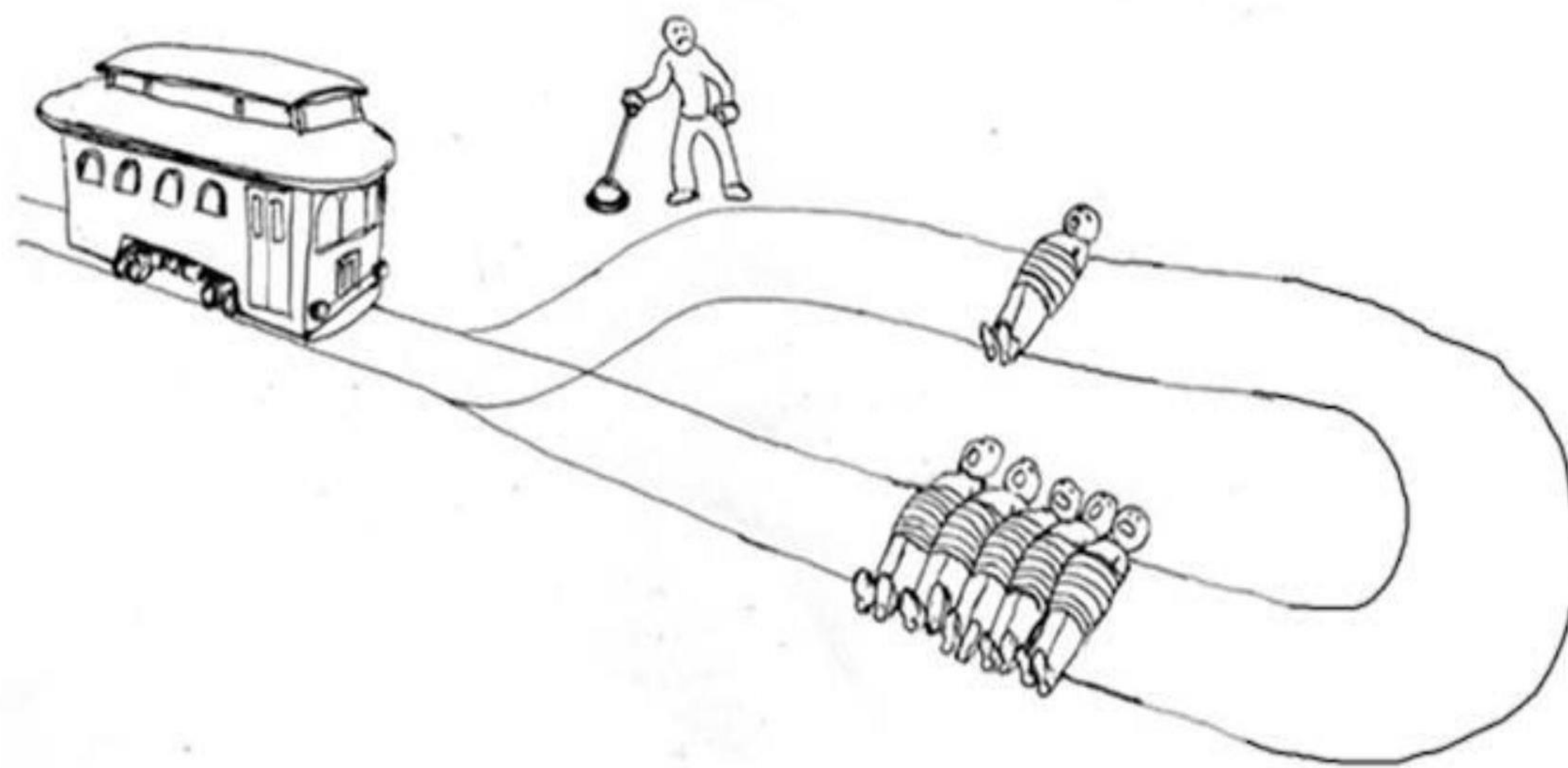
## An Online Study Examining Driver Response to On-road Obstacles During Automated Driving

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### Introduction

- The trolley problem is a well-known thought experiment where a person must decide between letting five people die on the tracks in front of a trolley or pulling a lever that causes the trolley to switch to a separate track and kill one person instead.



**Fig. 1** Illustration of trolley problem paradigm.

- Past studies have found that in trolley problem scenarios, people tend to prefer the utilitarian decision that saves the most lives (Navarrete et al., 2012).
- Our previous study found that people reacted more randomly as Time-to-Collision (TTC) decreased to 1 second before the impact with pedestrians, suggesting that people may need at least two seconds to generate an ethical decision that follows their ethical preference (Yahoodik et al., 2021; Samuel et al., 2020).
- This study examined the effect of TTC on participants' ethical decision and asked whether people respond differently to bollard avatars rather than pedestrian avatars due to the less ethical scenario.
- We hypothesized that drivers would make decisions consistent with the prediction of utilitarianism but become more random as TTC decreases.

### Method

- Thirty participants were recruited from the community of Old Dominion University but only 19 could be included.
- The study employed a 2 x 2 x 3 within-subjects design with three factors: placement of bollards (right vs. left), alternative bollard (present vs. absent), and TTC (1, 2 vs. 3 seconds).
- Participants viewed 16 videos rendered by a driving simulator and presented in PsychoPy in a random order in an online driving simulator experiment.
- Participants were instructed to imagine that they were piloting a partially automated vehicle and press the space bar on their keyboard if they wanted the car to switch to the opposite lane or withhold their response if they wanted the car to remain in the right lane.
- Participants were also asked to rate the perceived acceptability of utilitarian ethical decision making on a scale between 1-5.



**Fig. 2** Screenshot of driving scenario with bollards in the current study.

### Discussion

- As with Yahoodik et al. (2021), participants generally preferred to change lanes when they were approaching five bollards and remain when the alternative response leads to a collision with five bollards.
- This study is important for determining how long people need to make ethical decisions in the context of automated driving systems and how the algorithm of AVs should be designed.
- The current study showed no evidence for the effect of TTC on their response patterns. Anecdotal evidence, however, suggests that participants' responses are trending to be more random as TTC decreases as shown by Yahoodik et al. (2021).
- Further research on this topic should involve an in-person driving simulator experiment that measures steering and braking responses to get more accurate response data.

### Results

- There was a significant effect of Version, with participants being more likely to press the space bar when there was a group of bollards in front of them (96%) compared to when the bollards were in the other lane (54%),  $\beta = -6.144$ ,  $p = .025$ ,  $OR = 1/465.11$ .

### References

- Navarrete, D. C., McDonald, M. M., Mott, Michael, L., & Asher, B. (2012). Virtual morality: Emotion and action in a simulated three-dimensional "trolley problem". *Emotion*, 12(2), 364-370.
- Yahoodik, S., Samuel, S., Yamani, Y. (2021). Ethical decision making under time pressure: an online study. *Proceedings of Human Factors and Ergonomics Society Annual Meeting*, October 2021.
- Samuel, S., Yahoodik, S., Yamani, Y., Valluru, K., & Fisher, D. L. (2020). Ethical decision making behind the wheel—a driving simulator study. *Transportation Research Interdisciplinary Perspectives*, 5, 1-7.