

| | | |
|--|---|--|
| Institution: Nottingham Trent University (NTU) | | |
| Unit of Assessment: A04 - Psychology, Psychiatry and Neuroscience | | |
| Title of case study: Improving driver safety training and assessment | | |
| Period when the underpinning research was undertaken: 2013-present | | |
| Details of staff conducting the underpinning research from the submitting unit: | | |
| Names: David Crundall Thom Baguley John Groeger Petya Ventsislavova Petrova Andrew Mackenzie Rowena Hill Viv Brunsden Nadja Heym Alexandra Sumich | Roles: Professor Professor Professor Senior Lecturer Senior Lecturer Associate Professor Principal Lecturer Senior Lecturer Associate Professor | Periods employed at NTU: 2013-Present 2004-Present 2017-Present 2018-Present 2017-Present 2005-Present 2003-2016 2014-Present 2010-Present |
| Period when the claimed impact occurred: 2016–2020 | | |
| Is this case study continued from a case study submitted in 2014? N | | |
| 1. Summary of the impact <p>In 2018-2019, 27,820 people were killed or seriously injured (KSI) on British roads. NTU researchers found that identifying hazardous precursors is a vital safety-related skill that likely underpins many such KSIs. This led to the development and implementation of award-winning hazard tests for fire-service drivers, a hazard test for a national bus operator, VR hazard training for 25,000 London bus drivers, and a free-to-download VR app for learner drivers. NTU advised the Dutch and Irish Governments on the development of national hazard tests and has licensed tests to a leading health & safety e-learning provider (Human Focus International).</p> | | |
| 2. Underpinning research <p>NTU researchers have concluded that <i>predicting</i> imminent hazards based on hazardous precursors (i.e. clues in the driving scene) is the vital skill that makes drivers safe, rather than simply reacting quickly to hazards. This finding underpinned development of more robust tests of driver safety [R1, R2, R3] that are preferred by drivers, viewed as fairer tests [R4, R5] and are better suited to professional and international driving contexts [R2, R3, R6].</p> <p>NTU's new tests are based on <i>hazard prediction</i>: Drivers watch clips of driving which occlude just as the hazard begins. When asked "What happens next?", they choose an answer from on-screen options. This test mitigates flaws in the official UK driving test, including scoring subjectivity and criterion bias. Based on the Situation Awareness Global Assessment Technique, this new test has fared better than more traditional hazard perception tests in differentiating safe and less-safe drivers in many circumstances [R2, R3, R5].</p> <p>These insights arose from research, including externally-funded projects, that created and validated tests to differentiate safe from less-safe drivers, refining protocols for test development and expanding understanding of the underlying skill.</p> <p>Two grants from the Fire Service Research and Training Trust (2015-18; £72k; Crundall, Brunsden, Hill) funded development of video-based tests for fire drivers, with clips filmed from fire engines and cars on blue-light runs. This was the first study to directly compare <i>prediction</i> and <i>perception</i> test-formats, with the former found to be more successful. The resultant tests are now</p> | | |

use in fire service driver training and are freely available on testmydriving.com. This research won the Fire Magazine research award (2017) and led to three publications [R2, R6].

The Department for Transport (2017-2018; £90k; Crundall, Groeger) funded research to identify which scenarios best suit the prediction or perception test-format using a novel hazard test constructed from Computer Generated Imagery. This test had several innovations, such as driving theory questions embedded in the clips. The tests were well received, successfully differentiated between safe and less-safe driver groups, resulting in a publication [R5].

Several other grants have allowed NTU to validate and iterate the test-development process for specialist populations. Funders include Stagecoach, to develop a hazard test for bus drivers (£60k, Crundall, Ventsislavova), the Road Safety Trust (RST), to develop a hazard training for mobility scooter users (£88k, Guest, Crundall, Young, Mackenzie), and a French company (IMRA), to develop hazard tests for autonomous vehicle algorithms (£66k, Crundall). The findings from these projects have refined NTU protocols for hazard assessment and training.

PhD research (Ventsislavova, Crundall), supported by small grants from Santander and the Anglo-Israeli Association (£4k), has confirmed the appropriateness of the hazard prediction approach for international audiences [R3] while also further refining the methodology [R4].

The most recent grant (RST/RAC Foundation/DVSA; 2018-2021; £135k; Crundall, Ventsislavova, Sumich, Heym) has allowed NTU to develop 360-degree hazard tests for virtual reality (VR) headsets. In comparisons with traditional tests, VR is more effective for assessment and training purposes. The project also led to the launch of 'Hazard Perception VR' in the Oculus Store (Nov., 2020), and the subsequent incorporation of a University spinout company (Esitu Solutions Ltd.) with £166k funding from Innovate UK (March, 2020) and £100k investment from NTU.

3. References to the research

- **R1:** Crundall, D. (2016). Hazard prediction discriminates between novice and experienced drivers. *Accident Analysis and Prevention*, 86, 47-58. doi: 10.1016/j.aap.2015.10.006
- **R2:** Crundall, D., and Kroll, V. (2018). Prediction and perception of hazards in professional drivers: Does hazard perception skill differ between safe and less-safe fire appliance drivers? *Accident Analysis and Prevention*, 121, 335-346. doi: 10.1016/j.aap.2018.05.013
- **R3:** Ventsislavova, P., Crundall, D., Baguley, T., Castro, C., Gugliotta, A., Garcia-Fernandez, P., Zhang, W., Ba, Y., and Li, Q. (2019). A comparison of hazard perception and hazard prediction tests across China, Spain and the UK. *Accident Analysis and Prevention*, 122, 268-286. doi 10.1016/j.aap.2018.10.010
- **R4:** Ventsislavova, P., and Crundall, D. (2018). The hazard prediction test: a comparison of free-response and multiple-choice formats. *Safety Science*, 109, 246-255. doi: 10.1016/j.ssci.2018.06.004
- **R5:** Crundall, D., van Loon, E., Baguley, T., and Kroll, V., (2021; available online 18 Nov, 2020). A novel driving assessment combining hazard perception, hazard prediction and theory questions. *Accident Analysis and Prevention*, 149, 105847. doi. 10.1016/j.aap.2020.105847
- **R6:** Kroll, V. R., Mackenzie, A. K., Goodge, T., Hill, R., Davies, R. L., and Crundall, D. (2020). Creating a hazard-based training and assessment tool for emergency response drivers *Accident Analysis and Prevention*, 144, 105607. doi.org/10.1016/j.aap.2020.105607

The high quality of the underpinning research is indicated by the wide range of funding organisations continuing to invest in its development and application, as well as rigorous

external peer review.

4. Details of the impact

Road traffic collisions are the 8th leading cause of global death and are predicted to rise to the 5th leading cause by 2030. Though Great Britain is considered one of the safest countries for driving, there were still 1,752 fatalities in 2018-19 and nearly 26,000 serious injuries. Two driver groups are of particular concern: young drivers who are over-represented in collisions (3x more likely to have a crash than older drivers), and commercial drivers (involved in approximately 30% of fatal collisions). These data contextualise the need for better training and assessment of hazard avoidance skills, acknowledged to be a leading cause of such collisions.

NTU's impact has been to change the paradigms and resources used to train and assess the hazard avoidance skills of various categories of road user, developing and promulgating evidence-based techniques with the aim of a longer-term impact on collision statistics.

In regard to impact on learner driver hazard assessment and training, TSO (formally The Stationary Office) asked Crundall to contribute to the Learner Driver DVD [S1; see Section 5], which is sold nationwide as a resource for drivers preparing to take their test. Based on their work in hazard perception, Crundall and Groeger were then funded by the Department for Transport to develop a novel abs innovative hazard perception test [S2, R5]. The report recommended (1) longer and more complex hazard clips; and (2) combining theory knowledge and hazard awareness in a single test, (3) introducing hazard prediction clips into a future test. Based on these results [and R2-6], Crundall was called to advise the DVSA (UK), and their counterparts in Ireland (The Road Safety Authority) and the Netherlands (the Centraal Bureau Rijvaardigheidsbewijzen). The RSA is pushing forwards with a hazard test, based primarily on Crundall's data [S3, R2-6]. The CBR were already planning a national hazard perception test, but they have changed this to a hazard prediction test based on evidence presented by Crundall [S4, R2-5]. Meanwhile, in the UK, the importance of our research to UK national test development is acknowledged in the Government's 2019 Road Safety Statement [S5, section 2.32]. Most recently, externally-funded research has allowed the release of an Oculus app designed for learner drivers entitled 'Hazard Perception VR'. Launched in November 2020 it has been well received by users and has received media coverage from road safety outlets [S6].

The second target impact group was professional drivers. Crundall and Brunsden were funded to develop a hazard perception test for fire-appliance drivers by the Fire Service Research and Training Trust, leading to three publications (R2/R6/Kroll and Crundall, 2019). The award-winning resources (FIRE Magazine 2017) are now being used by Nottingham Fire and Rescue Service (NFRS) to train new and existing fire drivers [S7] and have been made available nationally via testmydriving.com. A recent NFRS update includes positive feedback from their trainers including, "The "What happens next" section is good for drivers at all stages in their development and encourages them to re-examine their perceptions of everyday driving hazards" [S7]. On the strength of the products produced by these research projects, East Midlands Ambulance Service have recently asked us to create a series of bespoke tests to support their ambulance drivers.

In the field of commercial van drivers, Human Focus International has licensed our driver hazard perception tests for use with van driver fleets. They have spent 12 months developing the software platform to deliver the test (based completely on NTU assets), with an October 2020 launch. Though the pandemic has delayed roll-out of this tool to commercial clients, Human Focus have recently attracted their first major client for this tool (a large aggregates company with over 3000 vehicles). They report that *"the research work that you and your team have undertaken to validate this hazard prediction test format, and the provision of your video clips, has enabled us to develop an evidence-based test for our clients which has been a game changer – both for our company and the market more generally"* [S8].

Finally, Crundall was asked to help develop a VR hazard prediction training tool for 25,000 London bus drivers on behalf of Transport for London. Working with STEPS Drama (a London-based training company), Crundall designed the VR assessment and training package, building on NTU

published outputs [R1-6] and new insights from recently funded VR research (see Section 2). Entitled Destination Zero, the training package was commissioned as part of the Mayor of London's drive towards 'Vision zero' with the aim of zero bus-related fatalities by 2030. Though the pandemic paused training (with only 7000 out of 25,000 drivers trained so far), the feedback from trainers and trainees was very positive [S9]. The Operator Staff Development Manager at TfL noted,

"The work of Professor Crundall and colleagues has been instrumental in guiding the development of our training..." and,

"The course has proved very impactful for drivers and trainers and we hope it will contribute to a reduction in accidents and injuries."

Despite a COVID-related delay in an independent assessment of training effectiveness (by TRL), TfL are engaged in continuous evaluation to identify training benefit [S10].

The success of the impact to date resulted in the creation of a spinout company in July 2020, funded by £166k from Innovate UK (won in March 2020 through their ICURE competition) and a further £100k investment from NTU. With one full-time employee and two part-time employees, the company aims to commercialise the research assets and knowhow developed by the group [S11].

5. Sources to corroborate the impact

- **S1:** Evidence from TSO: Letter from the Head of Content at TSO (including the cover of The Official DVSA Guide to Hazard Perception. DVD-ROM. The Stationary Office).
- **S2:** Crundall et al., (2019). Developing an integrated hazard perception and Highway Code training and assessment tool. Report to the Department for Transport.
- **S3:** Evidence from RSA, Republic of Ireland: Letter from the Director.
- **S4:** Evidence from the CBR, The Netherlands: Letters from the Senior Product Manager and Theory Manager.
- **S5:** UK Road Safety Statement 2019, DfT.
- **S6:** Hazard Perception VR in the Oculus Store and as reported on websites.
- **S7:** Evidence from the Fire Service: Letter from the Chief Driving Instructor at NFRS; Letter from the E-learning Manager at the NFRS; Letter from the Health, Safety and Environment Advisor at the NFRS
- **S8:** Evidence from Human Focus Ltd. regarding NTU licensed materials.
- **S9:** Interim evaluation of Destination Zero: VR training for London Bus drivers.
- **S10:** Evidence from TfL regarding the NTU input into their driver training.
- **S11:** Screenshots that confirm the incorporation of the NTU spinout company (Esitu Solutions Ltd.) and detail its engagement on a business accelerator program.