Institution: Royal Holloway, University of London

Unit of Assessment: Psychology, Psychiatry, & Neuroscience

Title of case study: Vision Science and Road Safety

1. Summary of the impact (indicative maximum 100 words)

The World Health Organization cites road traffic accidents as one of the world's leading health concerns. Research in the Department of Psychology at Royal Holloway, University of London has investigated the relationship between fundamental aspects of human visual processing across the lifespan and the scenarios in which road accidents are most likely to occur. This research has been at the heart of a national campaign to lower urban speed limits, particularly where child pedestrians are present. It has also led to improved driver safety in commercial organisations, and has contributed to the commercial design of driver assistance systems.

2. Underpinning research (indicative maximum 500 words)

This research has been led by Professor John Wann, who joined the Psychology Department at Royal Holloway, University of London in 2006. He has been supported by a team of doctoral and postdoctoral researchers including Dr. J. Billington (now U. Leeds), Dr. D. Poulter (now U. Greenwich), Dr. R. De Oliveira (now South Bank U.), Dr. R. Wilkie (now U. Leeds), Dr. D. Field (now U. Reading), Dr. C. Purcell (now U. Newport), and Dr. M. Gould.

Wann's research has investigated the neural processes underpinning collision detection [1] and the limits of human visual processing in relation to critical road traffic events. Specifically, this research has identified thresholds for the detection of approaching vehicles (including motorcycles), and for the discrimination of speed of vehicle approach. Further, it has done so for three groups that figure disproportionately in road traffic accidents: typically-developing primary-school children [2], primary-school children with perceptual-motor disabilities [3], and drivers over the age of 75 [4].

Based on detection and discrimination thresholds for the populations identified above, this research has established that:

(a) children's judgments of vehicle approach become unreliable for vehicle speeds above 25mph, thus emphasizing the need to reduce speed limits in areas in which children are present [2];

(b) older adults exhibit poor speed discrimination [4], rendering them liable to error, particularly at A-road intersections where traffic approach speeds may vary between 30-60mph (which older drivers fail to discriminate, but which reduce their available pull-out time by up to 50%); and

(c) errors in judging motorcycle approach increase as night falls [5, 6] to a much greater extent than they do for cars due to the lack of dual-headlights (that optically separate as a car approaches), but that the error for motorcycles can be significantly reduced using a tri-light modification that has not to date been introduced for most production models.

This work thus demonstrates that the perceptual acuity for judging vehicle approach in road users is below what would be optimal given the current range of traffic speeds. This research has further demonstrated that children under the age of 11 years [2,3] and drivers over the age of 75 years [4] are likely to make errors, and that motorcyclists are particularly vulnerable as a consequence of these errors [5,6].

This research has been published in scholarly outlets of the highest quality including *Psychological Science*, *Proceedings of the Royal Society: Biological Sciences*, *Journal of Neuroscience* and *Journal of Experimental Psychology: Human Perception & Performance*. It has also attracted over

£1m in research funding in the past 5 years from UK research councils and road safety charities. These indices provide evidence of the quality of the underpinning research.

3. References to the research (indicative maximum of six references)

Outputs (Researchers with * were all PDRAs or PGRs with the Wann research group)

1. *Billington, J., *Wilkie, R.M., *Field, D.T., & Wann, J.P. (2010). Neural processing of imminent collision in humans. *Proceedings of the Royal Society B: Biological Sciences, 1711,* 1476-1481.

2. Wann, J.P., *Poulter, D.R., & *Purcell, C. (2011). Reduced sensitivity to visual looming inflates the risk posed by speeding vehicles when children try to cross the road. *Psychological Science, 22,* 429-434.

3. *Purcell, C., Wann, J.P., *Wilmut, K., & *Poulter, D. (2011). Roadside judgments in children with Developmental Co-ordination Disorder. *Research in Developmental Disabilities*, *32*, 1283-1292.

4. *Poulter, D.R. & Wann, J.P. (2013). Errors in motion processing amongst older drivers may increase accident risk. *Accident Analysis and Prevention*, *57*, 150-156.

5. *Gould, M., *Poulter, D.R., Helman, S., Wann, J.P. (2012). Errors in judging the approach rate of motorcycles in night time conditions and the effect of an improved lighting configuration. *Accident Analysis and Prevention, 45*, 432-437.

6. *Gould, M., *Poulter, D.R., Helman, S., Wann, J.P. (2013). Detection of vehicle approach in the presence of additional motion and simulated observer motion at road junctions. *Journal of Experimental Psychology: Applied*, *19*, 171-184.

Selected Research Funding

Wann's research has attracted £3.34m of research funding since 1993. Some recent examples include:

2007-2010, EPSRC. Neural correlates of collision detection (PI). £260,062.

2008-2011, ESRC. Perceptual judgments of children in a road crossing situation (PI). £324,000.

2010-2011, Royal Society for the Prevention of Accidents. Errors in perceptual judgments amongst elderly road users (Co-PI). £20,000.

2009-2012, EU FP7. Coding of Optimal Decisions for Dynamic Environments (PI). £377,832.

2011-2012, ESRC (Knowledge Transfer). Enhancing driver awareness of perceptual errors in approach speed judgments for road crossing and decisions at junctions (PI). £89,577.

4. Details of the impact (indicative maximum 750 words)

This research is delivering significant and far-reaching impacts in a number of areas concerning road safety. The main beneficiaries of this work are (a) road users including drivers and pedestrians; (b) road safety professionals, organisations, and charities; (c) local authorities; and (d) commercial organisations seeking to reduce the involvement of their drivers in road accidents.

Road Users, Road Safety Organisations and Charities, and Local Authorities. This research

has had substantial impacts across the UK, and increasingly, around the world, because it provides a clear rationale based upon human perceptual abilities for wider use of 20 mph traffic zones. It has been featured in national and regional TV, radio, and print news, and provided the lead story for BBC1's "Bang Goes the Theory" which focused on children's road safety (March, 2013). It was also featured in National Road Safety Week in 2010 and 2012, and in a number of major road safety meetings organised through the campaign body Brake.

Most importantly, this research has been central to a successful UK campaign by 20sPlenty (a national body with nearly 200 regional campaigns), to argue for a reduction in urban speed limits, especially in areas in which children are present. This campaign has resulted in the adoption of default 20mph speed limits for residential streets in 40 local authorities (including e.g. Liverpool, Portsmouth, Bristol, York, Brighton, Bath, Newcastle, Oxford, Cambridge, Hackney) comprising nearly 10 million residents. Twelve further local authorities (including e.g. Birmingham, Wirral, Ealing, Norwich) comprising nearly 2.5 million residents have made a political commitment to implementing default 20mph speed limits for residential streets. Most recently, Wann was invited to give evidence to a transport select committee convened by North Lincolnshire Authority which resulted in a large number of urban speed limits being revised downwards, including the greater use of 20mph zones. Wann's research and advice is cited extensively in the final report (http://tinyurl.com/NLincsReport). Based on epidemiological research (1986-2006; Grundy et al., 2009, *British Medical Journal, 339*, b4469) suggesting that 20mph traffic zones can reduce road casualties by 42%, and based on Department for Transport pedestrian casualty figures for 2011 (5,907 killed or seriously injured, hereafter KSI), we estimate that the speed limit reductions *in these local authorities alone* have the potential to prevent 496 KSI outcomes annually, including saving 38 pedestrian lives each year.

Royal Holloway research on children's road crossing [2] has also been featured by other local campaigns to highlight the importance of school crossing patrols, and it was described in a parliamentary question to the Under Secretary of Transport concerning the impact of budget cuts on these patrols in Dorset (Hansard 16/3/11). This specific campaign was successful in saving 84% of school crossing patrols in Dorset (51 out of 61 patrols).

Road Safety Professionals and Commercial Organisations. Royal Holloway research on human perceptual abilities in relation to critical road traffic events has also had impact through grass-roots interaction with road safety professionals and commercial organisations. During the period, Wann and his team have presented their research at a number of road safety meetings in which road safety officers (RSOs) were attending as part of their continuing professional development. This interaction has been consolidated by RSOs, Police, and Fire Service attendees downloading the interactive computer-based demonstrations designed at Royal Holloway through ESRC Knowledge Transfer funding for use in local driver education programmes. It has also led to active collaborations with the BAA Heathrow safety team, who are responsible for over 11,000 vehicles and over 20,000 drivers operating in a 5sq mile area. Software developed at Royal Holloway that demonstrates what our research has uncovered about drivers' perceptual errors is now being used in BAA Heathrow's safety awareness programme (e.g. Airside Safety Week, 2012).

Finally, as a result of his high-quality research on collision detection, Wann was invited onto the scientific advisory committee for the QUADRA project at Volvo Technology, which has a specific focus on modelling driver interaction with Forward Collision Warning (FCW) and lane departure systems. This is an active committee comprising two leading scientists from the USA, one from Sweden, and one from the UK (Wann) who provide human factors advice on FCW developments. The systems being piloted and developed through advice from this committee have the potential to affect hundreds of thousands of road users, not only those who have purchased a Volvo vehicle, but also those who will benefit from (a) the intervention of advanced control systems in a vehicle that might otherwise have caused a collision and (b) similar vehicle designs by other manufacturers moving towards the standard set by Volvo. Through this link with Wann's research group, Volvo Technology was in turn a collaborator in an EU Network training early career scientists in the field (EU FP7 Marie Curie 2009-2012).

5. Sources to corroborate the impact (indicative maximum of 10 references)

1. The campaigning group 20splenty has highlighted Wann's research in their national campaign, which has led to the adoption of 20mph residential limits in 40 local authorities and commitments to these reductions in a further 12 local authorities (see http://www.20splentyforus.org.uk/press_releases.htm). Verification Contact: 20splenty Founder & Campaign Director.

2. The impact of Wann's research on the decision by North Lincolnshire Authority to reduce their speed limits can be found in this report http://tinyurl.com/NLincsReport. The announcement by North Lincolnshire Authority to reduce their speed limits is on http://tinyurl.com/NLincsAnnouncemt Further verification of Wann's role can be obtained from Policy Officer (Policy Performance and Development), NE. Lincs Authority.

3. Wann's work provided the rationale for a parliamentary question regarding the implications of budget cuts on school crossing patrols. Hansard 16 March, Column 131 WH: http://tinyurl.com/Hansard16March

School Crossing Patrols (Dorset) 4.49 pm: Annette Brooke (Mid Dorset and North Poole) (LD): " Although the United Kingdom has the second lowest road death rate in the EU, its child pedestrian death rate is worse than in 10 other EU countries, and eight times higher than in Sweden. Research by Royal Holloway, University of London shows that children are unable to accurately judge the speed of vehicles travelling at more than 20 miles per hour. The study found that children aged six to 11 suffered from speed illusion, which means that they cannot make a reliable guess at a car's speed if it is going at more than 20 miles per hour, unlike adults, who accurately judge speeds of up to 50 miles per hour. Since 2003, death and injury rates have fallen every year, but road safety groups fear that that trend could end if school crossing patrols were axed. The Minister will be aware that several authorities, including Dorset, propose changes in their provision of school crossing patrols. (contind.)".

4. Wann's research has been central to media debate around the issue of urban speed regulation http://www.bbc.co.uk/programmes/b01rmp0d Multiple media links at http://tinyurl.com/JWannLinks

5. Wann's research has featured in numerous road safety events organised by the road safety charity Brake where road safety officers were brought into contact with the Royal Holloway research team (e.g. http://www.roadsafetygb.org.uk/news/2068.html). Verification contact: Deputy Chief Executive, Brake, The Road Safety Charity.

6. Verification of the role of Wann's research in enhancing the training provided to drivers employed by BAA Heathrow can be obtained from Airside Safety Officer, Airside Operations, Heathrow Airport Limited.

7. Wann is a member of the QUADRA project on Modelling Active Safety Systems at Volvo Technology: http://tinyurl.com/QuadraProject Verification contact: Project manager, AB Volvo.