BU STUDENTSHIPS 2015

PROJECT DESCRIPTION

PROJECT DETAILS

Project Title

Visual attention, cognitive aging and road safety in older pedestrians

Project Summary

Given the alarmingly high proportion of pedestrian accidents involving older people, it is not surprising that the specific difficulties of this vulnerable population have been extensively reported. Risky street-crossing decisions in older pedestrians have often been attributed to age-related declines in motor, perceptual and cognitive abilities. For example, reduced walking speed with age is strongly related to impaired crossing performance. Similarly, time-to-contact assessment is a particularly robust predictor of impaired road-crossing performance. Finally, to cross a road safely, pedestrians must perceive and pay attention to approaching vehicles, detect traffic, determine its direction and velocity, estimate available time to cross the road and so on. In short, Executive Functions (EF), the cognitive processes responsible for managing the competing demands of complex and dynamic tasks, are crucial for successful crossing behaviours.

Interestingly, very few studies employed eye movements recording, which is surprising considering that 63% of older pedestrians involved in a pedestrian-vehicle crash report a failure to see the vehicle. Moreover, most of the studies in the literature are correlational and use simplistic data analysis. This approach does not allow for characterizing the dynamic interplay between measures.

In this project, we will investigate two crucial questions: 1- In road-crossing situations, are elders' visuo-attentional strategies different from those of young adults? How are these strategies impacted by specific social and visual saliency features? 2- How do elders' behaviour and judgments in road-traffic situations relate to the decline of executive functions?

These questions will be first addressed in highly controlled environments with eye movement recording. Impact of social and visual saliencies, distractors and executive functioning on road-crossing judgements and oculomotor behaviour will be quantified using robust data-driven methods. Our findings will then be considered alongside eye-movement recordings performed in real-life using mobile eye-tracking. Our conclusions will also be validated in immersive, interactive virtual environments allowing for realistic field-of-view and motor responses. Finally, electrophysiological data will allow us to investigate neural mechanisms underlying elders' attentional capture in road-traffic situations. Using a wide range of techniques and state-of-the-art analysis methods will allow us to make fine-grained, robust and generalizable conclusions.

We will recruit two groups of healthy participants for each experiment: young adults and older adults (aged 65+). We will assess executive functioning using established tests. These measures will function as continuous predictors in linear mixed models (LMM), enabling us to distinguish typical ageing from EF decline. Eyesight of the participants will also be collected and all the motor and sensory indexes will be included in the LMMs.

This program will permit the precise characterisation of the perception and action dynamics underlying crossing difficulties, revealing how cognitive and behavioural indicators predict decisions making that may culminate in collisions. The research will thus deliver a novel, experimentally validated account of how impaired executive and sensori-motor functions affects road-crossing in realistic situations, leading to an in-depth understanding of risks in older adults.

Academic Impact

In this project, we will address critical fundamental and applied questions and use a wide range of techniques and state-of-the-art analysis approaches. Hence, this approach will allow us to make fine-grained, robust and

generalizable conclusions. It will also allow developing and reinforcing the computational and analysis skills already present locally and create a collaborative dynamic in the psychology department.

We expect that our findings, once disseminated, will attract attention of researchers who have specific interests in road-traffic safety but also of researchers working in other related fields such as aging, attention and vision. We expect a minimum of 3 publications and will target international journals such as Journal of Vision, PLoS ONE or Psychological Science. Depending on the results, particularly for experiment 3, we might consider submission to higher impact journals. New methods and toolboxes developed might also be subject to publication.

Societal Impact

Walking accounts for a higher proportion of trips undertaken by the 65 plus age group than for the total population aged 15 and over. As people age, the percentage of pedestrian trips increases and the percentage of trips as drivers decreases (Davey and Nimmo 2003). Travel on foot is important for older people, especially when access to private transport is limited or unavailable. Older pedestrian injuries were most likely to occur while crossing a road (O'Hern, Oxley & Logan, 2015).

This project will bridge the gap between underspecified field studies and conclusions from psychophysics research that need to be generalized to ecologically valid situations.

Hence, this ambitious project is of societal importance and the set of studies will arm carers, traffic engineers and prevention campaigns with knowledge of elders' vulnerabilities in road-traffic related visuo-spatial processes as well as effective counter strategies as pedestrians and in infrastructures.

In addition to scientific publishing, we are keen on sharing our data, conclusions and recommendations to any local or national public institution and more generally to any institution interested in using these findings for public benefit. It is worth mentioning that Streetwise and Dorset Police already expressed interest for this line of research.

Training Opportunities

The research team offers a unique combination of skills. Miellet is an expert in eye-movement and developed multiple data-driven analysis method for statistical mapping of eye-movement. Meso has strong expertise in motion perception. Finally Gosling is expert in electrophysiology. Each member of the team will shave her/his expertise to and train the PhD student.

It is important to note that, although this project is technically ambitious, it is realistic for a 3-year PhD. Indeed, most of the computational techniques are being developed and used in a current and related Swiss-funded road-safety project. Moreover, the Virtual Reality part of the project will benefit from on-going collaborations with ViRETS (Virtual Reality Eye Tracking System) at BU and ALIVE (Aston Laboratory for Immersive Virtual Environments) at Aston University where one of the largest CAVE of the country is available.

This project will have strong links with BUDI for the recruitment and screening of older participants but will also benefit from BUDI's experience in terms of executive functioning assessment.

This environment will offer a set of exceptional training opportunities to the PhD student.

SUPERVISORY TEAM	
First Supervisor	Sebastien Miellet
Additional Supervisors	Andrew Meso Angela Gosling
Recent publications by supervisors relevant to this project	Caldara, R., & **Miellet, S.** (2011). iMap: A novel method for statistical fixation mapping of eye movement data. *Behavior Research Methods, 43*(3), 864-878. Lao, J., **Miellet, S.**, Pernet, C., Sokhn, N., & Caldadra, R. (submitted). iMap 4: An Open Source Toolbox for the Statistical Fixation Mapping of Eye Movement

	data with Linear Mixed Modeling. **Meso. A.I.**, & Zanker, J.M. (2009). Speed encoding in correlation motion detectors as a consequence of spatial structure. *Biological Cybernetics, 100*(5), 361-370. doi: 10.1007/s00422-009-0307-8.. **Miellet, S.**, Lao, J., & Caldara, R. (2014). An appropriate use of iMap produces correct statistical results: a reply to McManus (2013) iMAP and iMAP2 produce erroneous statistical maps of eye-movement differences. *Perception, 43*(5), 451-457. DOI:10.1068/p7682. **Miellet, S.**, Zhou, X., He, L., Rodger, H., & Caldara, R. (2010). Investigating cultural diversity for extrafoveal information use in scenes. *Journal of Vision, 10*(6):21, 1–18. Rankin, J, **Meso, A.I.,** Masson, G.S., Faugeras, O., & Kornprobst, P. (2014). Bifurcation study of a neural field competition model with an application to perceptual switching in motion integration. *Journal of Computional Neuroscience, 36*(2), 193-213. doi: 10.1007/s10827-013-0465-5. Towler, J., **Gosling, A**., Duchaine, B., & Eimer, M. (2016). Normal perception of Mooney faces in developmental prosopagnosia: Evidence from the N170 component and rapid neural adaptation. *Journal of neuropsychology, 10*(1), 15-32.

INFORMAL ENQUIRIES
To discuss this opportunity further, please contact Sebastien Miellet via email: smiellet@bournemouth.ac.uk
ELIGBILITY CRITERIA
All candidates must satisfy the University's minimum doctoral entry criteria for studentships of an honours degree at Upper Second Class (2:1) and/or an appropriate Masters degree. An IELTS (Academic) score of 6.5 minimum (or equivalent) is essential for candidates for whom English is not their first language. **Additional Eligibility**
HOW TO APPLY
Please complete the BU Research Degree Application 2015 and submit it via email to the Postgraduate Research Administrator for Admissions **Suzy Kempinski** - pgradmissions@bournemouth.ac.uk by **01/04/16**. Further information on the application process can be found at www.bournemouth.ac.uk/phd-2015