Institution: Durham University

Unit of Assessment: Psychology, Psychiatry and Neuroscience

Title of case study: Visual Field Defects and their Rehabilitation

1. Summary of the impact

This case study has improved the quality of life for patients suffering with visual field defects after brain injury such as hemianopia, which affects more than 4,000 people in the UK each year. Different types of rehabilitation, such as those aimed at enhancing exploration or reading, have been shown to have a direct positive impact on patients, improving their confidence, independence, self-esteem and general quality of life. Approximately 200 individuals have benefitted from Durham University's visual rehabilitation programmes to date, including some patients internationally, with a CD toolkit being provided to countries such as Belgium, Denmark, and Chile. This research therefore has direct impacts on health and wellbeing worldwide and has influenced the care offered by NHS practitioners.

2. Underpinning research

The underpinning research involves three main projects at Durham University between 2006 and 2011, which were conducted in the Psychology department by the following members of staff and research students: Professor Charles Heywood (Head of Department); Dr. Robert Kentridge (Reader); Susanne Schuett (PhD student 2006 - 2009); Dr. Thomas Schenk (Senior lecturer, 2002 - 2010); Dr. Daniel Smith (PDRA 2004-2007; Lecturer since 2007); Dr. Amanda Ellison (Senior Lecturer); Dr. Lina Aimola (PDRA 2009 - 2011) and Dr. Alison Lane (PhD student 2005 - 2008; PDRA 2008 - 2010; Lecturer since 2010). The studies involved developing and evaluating computer-based rehabilitation tools for individuals with homonymous hemianopia: a disorder involving lost vision in one half of the visual field as a result of brain injury, which occurs in ~8% of stroke sufferers. Consequently such individuals often experience impairments in exploration and reading, significantly reducing their quality of life and their ability to live independently. Limited rehabilitation is available and it is important to try and improve therapeutic practices by demonstrating the efficacy of compensatory training techniques, which was the primary research aim overall.

1) One project conducted by staff at Durham University's psychology department directly compared the efficacy of a training programme utilising words to improve the reading eye-movements of patients with a number-based version of the training (Schuett, Heywood, Kentridge & Zihl, 2008). The study found the novel non-text training to be as effective as conventional text training with regards to improving reading performance and eye-movement behaviour. This original research demonstrated that training does not require lexical-semantic processes to be effective.

2) A clinical trial, the first comparing compensatory exploration training with a control, was conducted by staff at Durham University (Lane, Smith, Ellison & Schenk, 2010). Training programmes were developed and then evaluated, with the work completed between 2005 and 2009. This study demonstrated significantly greater benefit of the exploration training relative to the control only for those outcomes most similar to the training (i.e. visual search).

3) The final project was an extension of the second, conducted by Durham University staff between 2009 and 2012. The previously developed training (project 2) was modified to enable participants to complete it in an unsupervised manner, and combined both reading and

exploration within the experimental condition, the first study doing so. The results revealed significantly greater benefits of experimental relative to control training with regards to measures of visual search and reading (Aimola et al., in press).

This original body of evidence demonstrates that specific training for individuals with hemianopia is available and is effective at improving exploration and reading behaviours when trained directly, and can have a positive impact on quality of life. Furthermore, the training need not be expensive (utilising simple computer-based tasks) nor time-consuming (generally being effective after 1-2 months).

3. References to the research

Key publications:

1) Schuett, S., Heywood, C.A., Kentridge, R.W., & Zihl, J. (2008) Rehabilitation of hemianopic dyslexia: Are words necessary for re-learning oculomotor control? *Brain, 131:* 3156-3168 [Impact Factor: 9.457; Ranked 11/312 for Neuroscience journals; Citations: Web of Knowledge = 16, Google Scholar = 25]. DOI:10.1093/brain/awn285

2) Lane, Smith, Ellison & Schenk (2010) Visual exploration training is no better than attention Training for treating hemianopia. *Brain, 133:* 1717-1728 [Impact factor: 9.457; Ranked 11/312 for Neuroscience journals; Citations: Web of Knowledge = 9, Google Scholar = 15].
DOI: 10.1093/brain/awq088

3) Aimola, Lane, Smith, Kerkhoff, Ford & Schenk (accepted) Efficacy and feasibility of home-based training for individuals with homonymous visual field defects. *Neurorehabilitation and Neural Repair*

Key research awards and supporting grants:

The underpinning research in this case study was supported by the following grants:

Lane, A. (2004 - 2008) *Clinical evaluation of behavioural interventions for patients with homonymous visual field defects.* Joint ESRC/MRC 3+1 Doctoral Studentship [PTA- 037-2004-00025].

Schuett, S. (2006 - 2009) *Rehabilitation of reading in hemianopia.* German Academic Exchange Service PhD Scholarship (DAAD)

Schenk, T., Smith, D. & Heywood, C.A. (2008 - 2011) *Home-based training for patients with visual field deficits.* National Institute for Health Research; Research for patient benefit scheme [RfPB-PB-PG-0407-12038]. £195,000.

Evidence of quality:

The first reading training study (Schuett et al., 2008) was a research highlight in Nature Reviews Neurology [1]. The clinical trial comparing the efficacy of exploration training with a control training (Lane et al., 2010) received media attention throughout May 2010, including press articles in for example Scientific American, local television (Tyne Tees News) as well as national radio coverage (*i.e.* BBC Radio 3) [2]. The work was disseminated by the different staff members from Durham University at numerous conferences including Euroacademia Multidisciplinaria Neurotraumatologica (2007), European Conference on Visual Perception (2011), and European Association of Neurological Societies (2011). On the basis of the research, Dr Smith was invited to give a research talk at an ECVP symposium (August 2013) titled “What can visual deficits teach us about the mechanisms and anatomy of visual perception?”

4. Details of the impact

Research carried out by the psychology department at Durham University has led to significant improvements in the quality of life of patients suffering with visual field defects such as hemianopia. Hemianopia is an eye condition which affects more than 4,000 people in the UK each year, and is characterised by individuals losing half their visual field due to stroke or other brain injury. Patients who took part in the research (~150 individuals) saw significant improvements in their visual abilities and general quality of life, with an average improvement of approximately 20% in everyday activities like reading.

The primary impact from the latter two projects carried out by researchers from the psychology department at Durham University (Lane et al., 2010; Aimola et al., in press) comes from the development of the Durham Reading and Exploration (DREX) training programme – a computer based, self-adjusting tool that allows people to treat themselves in their own home [3]. The tool, available for free to interested parties, promotes more efficient eye-movements and increased visual awareness. More than 50 CDs have been sent directly to patients across the globe, including those based in Belgium, Australia, Spain and Chile. Copies have also been sent to practitioners to trial with their own patients, both nationally and internationally, with instruction as appropriate [4]. A neuropsychologist in Denmark began using the technique in June 2012, with three patients so far experiencing significant benefits in their condition [4].

In the UK some 150 patients took part in the three clinical trials underpinning the research, benefitting from improvements in their self-confidence, independence, self-esteem and general comfort. Many patients restrict their activities, become withdrawn and dependent, and can suffer from depression as a consequence of their visual impairment. Any improvement in their ability to perform simple tasks like reading or self-care can therefore have a positive impact on their quality of life. Patient testimonials [5] include:

- *"I now find using a dictionary … and the Telephone Directory much easier and also continue to enjoy my general reading, tapestry, and knitting, and I certainly pay more particular attention to my environment when I am out".* (MH)
- *"I went for a week on a canal boat last week so I was able to steer the boat and implement my new visual awareness skills".* (MS)
- *"The research has helped me greatly, it has made me concentrate much more … I find I read a lot more now, because I find it easier and more comfortable".* (GS)
- *"There is no doubt in my mind that I have learned to cope much better visually with the help of the training programme. I can read and write much better … the programme has taught me patience, given me confidence and raised my self-esteem in such a way as to enable me to take challenges in my stride".* (SS)

Further impact came from the wide dissemination of the research in the media (both locally and internationally) [2], with interested parties contacting the research team directly to request the toolkit after it was publicised on television and radio [6]. A website has been developed by the researchers to further promote the DREX training (www.durham.ac.uk/psychology/research/drex/), and to make it easier to for interested individuals to find out more details as well as gain more direct access to the training programme.

The research team collaborated with NHS trusts to gain participants for the studies, leading to increased awareness within the clinical community of the possibility of this rehabilitation being made available. The team has worked with professionals from numerous specialities including neurosciences,

ophthalmology and stroke units. The work has been disseminated at fifteen educational seminars and workshops attended by NHS staff [7], improving rates of assessment for visual field defects at the bedside and improving the quality of information available to patients in the acute setting [8]. The charity Action for Blind People, which became aware of the project during a presentation, also used the training and found patients were able to read more efficiently [9].

The high quality of the toolkit was commented on by experts in the field. The research team was approached by the Foundation for Assistive Technology (FAST) – the primary source of information about developments in assistive technology in the UK – who included the training details in an online database [10]. Also an occupational therapist at Newcastle Primary Care Trust said the research was hugely beneficial:

- *"I have referred approximately 31 patients to Durham University Psychology Department for compensatory training since the research began. … I do think that research has offered hope to those who may not have received any specialist compensatory training in the community. … We would be keen to be involved with any further research in the future."* [8]

5. Sources to corroborate the impact

1) Research Highlight: Rehabilitation of hemianopic dyslexia: no words necessary. Press review for Schuett et al. (2008, Brain), in: Nature Reviews Neurology (February 2009, Vol. 5).
http://www.nature.com/nrneurol/journal/v5/n2/full/ncpneuro0973.html

2) Examples of the media coverage relating to compensatory training for patients with hemianopia:
http://news.bbc.co.uk/1/hi/england/wear/8691278.stm
http://www.blinkx.com/watch-video/scientists-help-woman-see-again/xhWTpVHVHhBs0nvGVxEf6g

3) Copy of the Durham Reading and Exploration (DREX) training CD

4) Neuropsychologist, Glostrup Hospital, Denmark *[email correspondence]*

5) Anonymised patient testimonials

6) Anonymised personal correspondence with patients
[i.e. emails from clients after seeing coverage on Tyne Tees]

7) NHS seminars/workshops supplied by the researchers.
[i.e. Newcastle Neurosciences Ward seminars, most recently in November 2012; North East Stroke Research Network Achieving Potential within Research workshop, March 2012; Sunderland Eye Infirmary research meeting, February 2012; South Tyneside Occupational Therapy research meeting, June 2013]

8) Occupational Therapist, Newcastle Primary Care Trust

9) Personal correspondence, eye clinic liaison officer, Action for Blind People.

10) The details of the research projects on the FAST database can be found using the following:
http://www.fastuk.org/research/projview.php?id=1652
http://www.fastuk.org/research/projview.php?id=1656