

Section A		
Institution: Durham University		
Unit of Assessment: 4 Psychology, Psychiatry and Neuroscience		
Title of case study: An app that is improving the quality of life of patients suffering with visual field defects after brain injury.		
Period when the underpinning research was undertaken: Between 2005 and 2018		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Alison Lane	Associate Professor	2008 -
Amanda Ellison	Professor	2002 -
Daniel Smith	Associate Professor	2004 -
Thomas Schenk	Senior Lecturer	2002 – 2010
Period when the claimed impact occurred:		
Between August 2019 and December 2020		
Is this case study continued from a case study submitted in 2014?		Yes
Section B		
1. Summary of the impact		
<p>Durham Reading and Exploration (DREX) is a computerised training for the rehabilitation of brain injury related visual field defects, which has been converted into an app in order to maximise accessibility and effectiveness. Use of the app increases general vision-related functioning and thereby confidence, independence, and quality of life. Through an iterative process involving NHS professionals, patients, and carers we addressed perceived barriers to use, and implemented changes that improved usability. With tablets being a more amenable technology to people with limited technical experience, having a multiplatform app has improved the reach of this vital rehabilitative aid, with DREX currently having more than 2,250 registered users.</p>		
2. Underpinning research		
<p>The underpinning research involves projects at Durham University during which a computer-based rehabilitation tool for people with hemianopia was developed, improved, and continuously evaluated. Hemianopia (partial blindness for one side of space) is a relatively common consequence of brain injury; approximately one third of stroke survivors have hemianopia, which means it affects more than 30,000 people in the UK annually, and 5,000,000 people worldwide. Treating visual impairments has been identified as a top stroke research priority. The impacts of visual impairment are highly disabling, and sufferers often experience impairments in exploration and reading, significantly reducing their quality of life and their ability to live independently. Limited rehabilitation has been hitherto available and it is important to try and improve therapeutic practices by developing an evidence-based, maximally effective and easily accessible training, which was the primary research aim overall.</p> <p>Training programmes were developed and evaluated, with a clinical trial comparing supervised exploration training and a control (2005-2009) [R1]. This study demonstrated that participants who completed the exploration training showed significantly greater improvements than those in the control group, however there was training specificity (i.e. reading did not improve after exploration training). Therefore the training programme was modified to incorporate both</p>		

reading and exploration training, and was the first training to do this. Furthermore, the training could be completed in an unsupervised manner. A trial was conducted between 2009 and 2012, revealing significantly greater benefits of experimental relative to control training with regards to measures of visual search, reading, and quality of life [R2].

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

3. References to the research

Key research outputs:

1. Lane, A.R., Smith, D.T., Ellison, A. & Schenk, T. (2010) Visual exploration training is no better than attention training for treating hemianopia. *Brain*, 133: 1717-1728 [Impact factor: 11.337; Ranked 11/312 for Neuroscience journals; Citations: 57]. DOI:[10.1093/brain/awq088](https://doi.org/10.1093/brain/awq088)
2. Aimola, L., Lane, A. R., Smith, D. T., Kerkhoff, G., Ford, G. A. & Schenk, T. (2014). Efficacy and feasibility of home-based training for individuals with homonymous visual field defects. *Neurorehabilitation and Neural Repair*, 28(3):207-18 [Impact Factor: 4.711, Citations: 39]. DOI:[10.1177/1545968313503219](https://doi.org/10.1177/1545968313503219)

Evidence of quality:

Based on the work, the researchers have been invited to provide multiple international presentations and plenaries; “What can visual deficits teach us about the mechanisms and anatomy of visual perception?” (European Conference on Visual Perception symposium, August 2013); “DREX: Effective compensation for individuals with visual field loss” (American Academy of Optometry symposium, September 2015); “Seeing solutions after stroke: Promoting the facilitators and removing the barriers to telerehabilitation following visual loss after stroke” (Organisation for Psychological Research into Stroke, October 2017), “Seeing Solutions after Stroke: Durham Reading and Exploration Training” (UK Stroke Forum, November 2017); and “Biosciences for Health – Healthy Ageing: Innovation Skills and Enterprise (University Alliance DTP conference keynote, July 2019). Information regarding funding sources can be found in the table attached (all peer reviewed, competitive national grants), and the Aimola et al. paper [R2] was awarded the British Psychological Society’s William Inman Prize in 2015.

4. Details of the impact

We have created an accessible treatment that works. In 2015 our hemianopia training paradigm was converted into a multiplatform app (Durham Reading and Exploration; DREX), such that it can be completed unsupervised on either a computer or a touchscreen tablet. The app has been available for free to download since July 2015 via Google Play, the App Store, and our webpage. End-users including patients, carers, and healthcare professionals were consulted to understand the facilitators and barriers to using DREX (2015-2017), with their input incorporated via an iterative process to improve the functionality and accessibility of the training package. The DREX app was subjected to a randomised controlled trial (2015-2018), and both computer- and tablet-based usage significantly improves search behaviour and reading [see Figure 1; E1], in addition to activities of daily living and motivation for rehabilitation [E1].

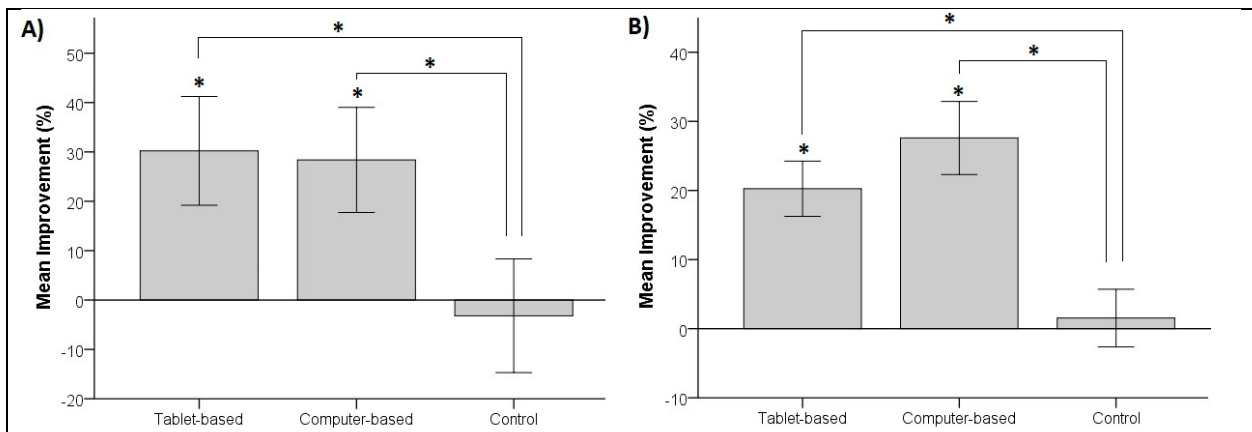


Figure 1: Bar graphs depicting the mean post-training improvement in a) visual search, and b) reading for patients completing DREX on a tablet or computer, as well as a standard care control group.

Many users have reported that DREX has helped them to overcome their visual loss, resulting in drastic improvements in their everyday life. Example quotes from some of our patient testimonials highlight this further; “The training helps using the remaining vision ability in an effective exploring way and therefore compensates a lot. I’m so grateful for having access to your programme”; “My peripheral vision loss seems to have improved so much I don’t even notice it any more”; “I managed ... a review of a 57 page document. The progress is, I am sure, through the focusing exercises I have done through DREX ... your software is certainly helping me to reclaim my life” [E2]. One of the primary complaints of patients with hemianopia is that they have their driving licence revoked which reduces their independence, and DREX has the potential to overcome this; “My recent field test ... showed that my field of vision is now within DVLA standard, thanks largely I think to regular use of DREX” [E2]. Furthermore, users indicate improvements in hobbies such as bike riding, archery, cross-stitch, and reading [E2], and often report generalised benefits such as in confidence and attention (e.g., “I can concentrate more”) [E2]. The user testimonial evidence indicates the positive impact that the DREX app is having on the ability of people to live independently and enjoy their lives with renewed hope.

The earlier CD-ROM version of the training (discussed in a REF 2014 impact case study) was requested by approximately 50 people. However, **converting the DREX training into a free multiplatform app has improved its accessibility substantially** by allowing patients from all over the world to take control of their own rehabilitation independently of the research team; **the DREX app currently has over 2,250 unique users.** Furthermore, the unique clinician portal (with at least 40 current users) allows healthcare professionals to remotely access patient data, thus personalising care for each patient and resolving a need for cost-saving efficiency in treatment not reliant on hospital visits. Anecdotal evidence tells us that **DREX users are primarily UK-based, but we have also reached international users in countries such as the United States of America, Malaysia and New Zealand** [E2, E3, E4].

From the very beginning of the app’s development, and during updates since, we worked with patients and healthcare professionals to address barriers such as accessibility, technical expertise etc., to ensure its efficacy is not hindered by peripheral issues [E5]. Part of this stakeholder integration included DREX workshops conducted over the summer of 2015, which were attended by 39 patients and 15 healthcare professionals from the North East of England (Teesside, County Durham, Newcastle, and Northumbria). 100% of the attendees reported the DREX app as being worthwhile [E6] and based on their feedback we created a YouTube channel which includes instructional/informational videos. This has **helped to extend awareness of hemianopia and its rehabilitation** (for example, one of our DREX YouTube videos has over 900 views), as well as providing additional support to users. Feedback from a healthcare professional emphasised the value of the DREX informational videos; “It is brilliant because ... their curiosity is still piqued by technology but they do lack the skills ... It’s really

good you've got those videos" [E3]. The social media and online profiles for DREX also provide a means for users to support one another. For instance, DREX has been shared publicly on Facebook with stroke survivors referring DREX to one another after positive experiences with the training [E7].

In order to generate impact, **the work has been communicated via multiple channels including directly to NHS trusts, relevant charities, and also at national and international conferences.** Such activities have increased awareness within both the clinical and patient community of the DREX training tool; "I certainly got a lot from the session and I know the rest of the team did as well" [E3], and it is perceived as a helpful tool (e.g., "It's really good", "...everyone is rather excited about having someone to refer visual patients") [E3]. Feedback from attendees at the UK Stroke Forum (UKSF) in 2017 indicated their enthusiasm for DREX (e.g., "Free app for treating hemianopia! Not just free but also evidence-based"), with comments highlighting some of its features ("DREX app for hemianopia has a button that allows MDT to log on and see how well their patient are doing") [E8]. **Healthcare professionals are also sharing knowledge of DREX between one another** as evidenced by example quotes from a UKSF attendee "Will be sharing this with my colleagues!" [E8], and email testimonials, "I will forward the below email to our teamleader so it can be distributed to all our staff" [E3].

We are also aware that **healthcare professionals are recommending DREX to patients** in the UK, and that both staff and patients appreciate having the resource available (e.g., "Thank you for DREX. I am so glad my neurologist suggested it!!") [E2]. Furthermore, DREX is being recommended to patients by clinicians in Malaysia, where low vision hospital practitioners have been using it [E3]. Not only that, but some of the assessment tasks built into the app have also been used to extend the assessment practices of these same clinicians; "The optometrist ... has used the search assessment from DREX ... This is something new for her as there was no such testing done in her hospital" [E3]. This indicates that DREX not only has value within rehabilitation, but also in the initial assessment of visual field defects that enables more effective overall management of the condition.

DREX is not only being used as a rehabilitation tool, but also has influenced teaching practice in Malaysia; "Now I am using DREX for teaching. Introducing final year optometry students to DREX, so that they can use this app at their own practice or hospital in the future" [E3, E4]. Furthermore, occupational therapy researchers at **Otago Polytechnic in New Zealand asked to collaborate on a project investigating whether using DREX can provide a vehicle for clinical training and education** about neurological vision impairment. An email excerpt from their lead researcher shows their enthusiasm for DREX, and the potential that they see in the tool; "I am very excited by DREX and I believe that it is the perfect tool to integrate clinical/educational focus that will upskill our clinicians, while providing a real service. I believe that DREX could become the focus of our educational efforts over the next year" [E4]. New Zealand is a geographical area notorious for the lack of knowledge and viable rehabilitation options for visual deficits, and so informing therapists of DREX can help to raise awareness. This ongoing project permits verification of the training in New Zealand whilst also continuing to raise awareness about the DREX training tool on another continent.

Increased interest in DREX within the stroke and acquired brain injury communities is evidenced by **professionals choosing to include DREX in their publications and amongst their featured resources.** For example, the British and Irish Orthoptic Society (BIOS) booklet highlighting the available technology for stroke rehabilitation features DREX, and the app is also included on the Stroke Association's "My Stroke Guide", an online platform which provides advice and videos on how to manage stroke recovery [E9].

In short, we have revolutionised the rehabilitation of brain-injury related visual field defects, increasing patients' independence, confidence, and vision-related quality of life. In the words of one of DREX's users, "an amazing bit of kit!" [E2].

5. Sources to corroborate the impact

Evidence item

1. Results of the DREX app clinical trial (2015-18)

A copy of Azuwan Musa's thesis which reports the efficacy of the DREX app.

2. DREX user testimonials

Anonymised testimonials from patient users, including email, audio, and video testimonials.

3. Healthcare professional testimonials

Anonymised email and audio testimonials from healthcare professionals.

4. New Zealand Collaboration Project

Email communication regarding a collaborative research project.

5. DMT paper

A copy of a manuscript accepted for publication which outlines the outcomes of some qualitative work conducted with stakeholders (patients, carers, and healthcare professionals) and modifications made to DREX based on this.

6. Workshop survey feedback report

Report summarising the feedback from attendees at DREX workshops conducted in 2015.

7. Facebook referral impact

Screenshots from Facebook patient-to-patient referrals and mentions.

8. UK Stroke Forum engagement impact

Impact from the UK Stroke Forum 2017. Attendees were given notes with which to write information regarding the talks they had heard; DREX as an e-therapy featured heavily.

9. DREX Features

Professional publications and resources where DREX has been featured.