Institution: Royal Holloway, University of London

Unit of Assessment: UoA3 Allied Health Professions, Dentistry, Nursing and Pharmacy

Title of case study: Enhancing reading in people with Macular Degeneration

Period when the underpinning research was undertaken: 2011- Present

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:
Robin Walker	Professor of Cognitive Neuroscience	1997- Present

Period when the claimed impact occurred: 2012- Present

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact

Macular Degeneration is the leading cause of vision loss in elderly populations in the Global North (World Health Organisation- *World report on vision* 2019), with wide ranging effects on quality of life. Reading difficulty is one of its most commonly reported consequences. For many, the answer is audio texts, however, for those who wish to continue reading, Professor Walker's research has enhanced their reading experience. Walker's research into how people read text presented dynamically, in a horizontally-scrolling format, led to him developing reading aids for people with Macular Degeneration using the scrolling text format. The apps are freely available and have improved reading experiences and extended the reading life of people with Macular Degeneration in the UK and internationally.

2. Underpinning research

Walker's research at Royal Holloway (since 2011) focussed on how people read text that scrolls horizontally, from right-to-left (like a news ticker, see Figure 1). This work led to him developing the MDevReader (*Macular Degeneration eccentric viewing reader*) eBook app for iPads in 2013 that uses the scrolling text format (reference 1).

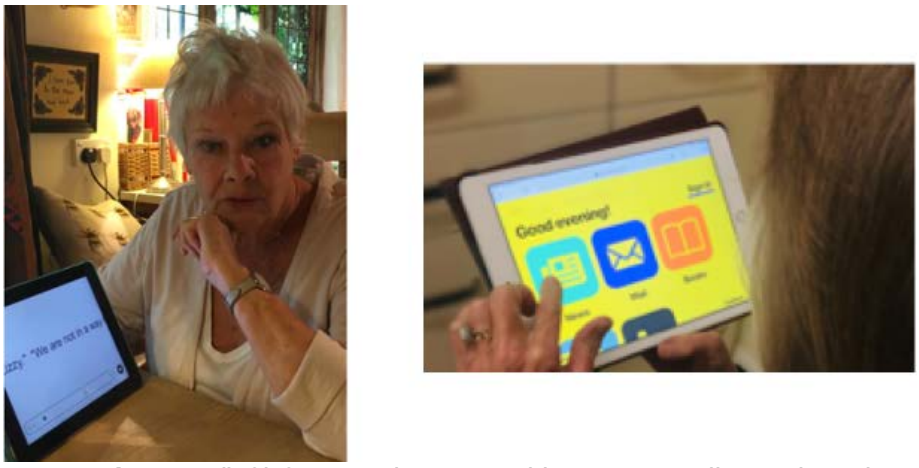

Fig 1. The **MDevReader** app (left) for eBooks as used by Dame Judi Dench and **EV-platform** (right) a web app for presenting current news content, eBooks, and email, developed as reading aids for people with Macular Degeneration.

Macular Degeneration is an irreversible progressive condition that affects around 4.8% of people in the UK aged 65 and over, and also younger working-age people with juvenile genetic forms of the disease. The main characteristic of Macular Degeneration is the gradual loss of central (or *foveal*) vision that is required for seeing fine details. The loss of central vision results

in difficulties in performing everyday tasks, such as recognising another person, watching TV and reading, with profound consequences on quality of life. At the present time, Macular Degeneration cannot be cured, and until recently, the main alternative to reading was to substitute text with audio. Audio is, however, of limited value for elderly people with poor hearing and is also not appropriate for many social situations, or in the workplace. One strategy that enables people to make use of their remaining vision, called '*eccentric viewing*', involves the individual making use of their remaining (peripheral) vison by looking away from the visual stimulus of interest. This simple technique can be difficult to use for a task such as reading, but Walker's research has shown that reading with eccentric viewing is enhanced by using the scrolling text format.

Research in Professor Walker's laboratory (2012-13) used an eye-tracker to simulate the loss of central vision characteristic of Macular Degeneration in a study of reading with scrolling text. The results showed that people were better able to apply the eccentric viewing strategy when reading, with scrolling lines of text rather than with static text (reference 2). A subsequent study (reference 6), also using the simulated loss of central vision technique, showed that reading with the eccentric viewing technique can be improved simply by increasing the spacing between words. As text can easily be manipulated when presented on electronic devices the use of increased word spacing was incorporated into the MDevReader app.

The MDevReader app was the first app developed by Walker in collaboration with the Macular Society (UK), designed as an eBook reader (released for Apple iPads in 2012 and Android in 2014). An initial study involving participants with Macular Degeneration found that a majority (67%) reported that they found reading was better when reading with the MDevReader app, compared to their normal method of reading (reference 1). A subsequent study funded by the ESRC (ES/L001934/1) showed that reading accuracy was improved when reading scrolling text compared to reading static text (reference 3). Responses to a questionnaire indicated that they also found reading easier with the MDevReader app than with their normal visual aid and the majority (80%) reported that the app would encourage them to read more often (reference 3). The latest research, undertaken as part of the Macular Society's PhD studentship(2017-2020), has shown that for reading with a central vision loss, comprehension (understanding and reasoning) is greatly enhanced with the scrolling text format (presented at the 20th European Conference on Eye movements, Alicante, Spain 2019; submitted to Journal of Vison).

Professor Walker also performed some of the first detailed experimental studies of eye-movements made when reading scrolling text in typical readers (references 4 and 6). These studies can inform the use, and potential limitations, of this format as a method of presenting text on technological devices with small screen sizes. These studies have shown that the normal pattern of eye movements is altered when reading scrolling text, but basic effects are similar to those observed with static text (reference 4). In a 2018 study performed to examine how well typical readers perform with scrolling text, he showed that comprehension was well preserved (reference 5) demonstrating the usefulness of this method for presenting text on digital displays with small screen sizes.

3. References to the research

The following references to the research were all published in peer-reviewed journals, with high rankings in their fields (source Scimago): *British Journal Ophthalmology (9/124), Ophthalmic and Physiological Optics (14/124), Optometry and Vision Science (34/124), Vision Research (25/124), Quarterly Journal of Experimental Psychology (30/154); Journal of Experimental Psychology: HPP (19/154). They were underpinned by grants from ESRC and the Macular Society (see Additional Contextual Data)*

1. Walker, R. (2013). An iPad app as a low-visual aid for people with macular disease. *British Journal of Ophthalmology*. *2013; 97:*110-112 *doi:10.1136/bjophthalmol-2012-302415.* Available from HEI on request.

2. Harvey, H., & Walker, R. (2014). Reading with peripheral vision: A comparison of reading dynamic scrolling and static text with a simulated central scotoma. *Vision Research*, *98*, 54-60. doi.org/10.1016/j.visres.2014.03.009.
3. Walker, R., Bryan, L., Harvey, H., Riazi, A., & Anderson, S. J. (2016). The value of Tablets as reading aids for individuals with central visual field loss: An evaluation of eccentric reading with static and scrolling text. *Ophthalmic and Physiological Optics*, *36*(4), 459–464. doi:10.1111/opo.12296.
4. Harvey, H., Godwin, H. J., Fitzsimmons, G., Liversedge, S. P., & Walker, R. (2017). Oculomotor and linguistic processing effects in reading dynamic horizontally scrolling text. *Journal of Experimental Psychology: Human Perception and Performance*, *43*(3), 518. doi.org/10.1037/xhp0000329. Available from HEI on Request.
5. Harvey, H., & Walker, R. (2018). Reading comprehension and its relationship with working memory capacity when reading horizontally scrolling text. *Quarterly Journal of Experimental Psychology*, *71*(9), 1887-1897. doi: 0.1080/17470218.2017.1363258.
6. Harvey, H., Anderson, S. J., & Walker, R. (2019). Increased Word Spacing Improves Performance for Reading Scrolling Text with Central Vision Loss. *Optometry and Vision Science*, *96*(8), 609-616. doi.org/10.1097/OPX.0000000000001411 .

4. Details of the impact

Professor Walker developed the MDevReader app in collaboration with the Macular Society, the UK's leading organisation for people with Macular Degeneration (15,000 members). It was launched for Apple iPads in 2012 and extended to include Android devices in 2014. The app presents text as a single horizontal-scrolling line, to support reading using a strategy ('*eccentric viewing*') which enables people with Macular Degeneration to make the most effective use of their remaining vision. EV News, a web app, provides freely available news and magazine content using the same scrolling text format as released in 2018. These apps were brought together in EV-platform (released January 2020) to combine the features of both apps in one place as well as additional features including for reading emails. The main beneficiaries are individuals with Macular Degeneration although practitioners and therapists working with patients also benefit. This is achieved by using the app to demonstrate the use of reading strategies and to demonstrate the potential of electronic devices such as tablets as reading aids.

The societal impact of these apps has been to enhance reading experience and extend the reading-life of people with Macular Degeneration. For example, Dame Judi Dench, has described her experience of using the app showing how it can extend reading life: *"I suffer from Macular Degeneration, and I find it very very difficult to learn scripts or to read in any way. This is an app [MDevReader] that has been developed by Royal Holloway and it's enormously beneficial…it really is a huge help"* (>6000 views on YouTube by December 31 2020 **E1**). The Macular Society CEO – Ms. Cathy Yelf noted that: *"Robin's work and that of a PhD student is 'providing evidence that reading performance [in someone with macular degeneration] improves with scrolling text compared to normal static lines of text"* (**E2**). The app is also used by the Society in their 'Skills for seeing' program: *''Our volunteer trainers use the app to demonstrate the use of the eccentric viewing technique and also as a way of promoting the wider use of technology as a visual aid. Feedback from trainers indicates that the app is useful as a way of demonstrating the eccentric viewing technique and[sic] also helps as a tool for practicing this skill''* (**E3**).

Feedback from users (**E3**) has shown that the apps have helped visually-impaired people to read, for example: "*It's a fantastic concept and the app is certainly helping my mother to read again, where before she could not*", and "*For the first time in 17 months, I was able to read more than a very enlarged word*". Mrs C. a volunteer eccentric viewing trainer for the Macular Society, who also has Macular Degeneration says *"I am on my third book! That fact alone sums it up really! It is so good to be able to sit and read comfortably, without getting tired"* (**E3**). Mr W a development manager at the Thomas Pocklington Trust, a UK charity for the visually impaired, provides a case study of how the app can support people, with vision loss, in their home and work environments: *"I'm a fan of the app and have used it to read to my children when they were younger. I've recently*

started using it for work, loading the app with agenda and notes" (**E4**). Mr Ward discussed his experience of using the app on the BBC Radio 4 program 'In Touch' (21-1-2020).

Since 2014 the MDevReader app and Ev News/Ev Platform webapps show an increasing number of users. Download and usage data (**E5**) show that the MDevReader app has 3,976 users (2,666 IOS; 1310 Android) as of November 2020. Analytical data suggests that users are from the UK and Europe (66 %), North America (26 %), Asia (7 %), Latin America and Africa. The MDevReader website has seen 4359 sessions with 2779 unique visitors up to June 2020. Ev News and Ev-platform usage has also increased with 5440 sessions between 2018 and November 2020. In the first two months of the release of Ev-platform, 18 % of users were outside of the UK including the North America, Japan, Greece, and China.

The apps have impacted on professionals (Rehabilitation workers, Optometrists, Eye Clinic Liaison Officers, Orthoptists) in the UK and US as part of their professional practice with individuals with Macular Degeneration. It provides them with a useful (free) tool for demonstrating the use of the eccentric viewing technique in the clinic and the wider role technology can have as a visual aid beyond traditional aids, such as magnifiers. Ev-platform is featured in continuing professional education and training courses for The College of Optometrists (Directorate of Optometric Continuing Education and Training 2020 – **E6**) as a practical demonstration of how eccentric viewing works and how it supports patients to make the most of their remaining vision. Macular Society volunteers train people with Macular Degeneration, on a one-to-one basis, in how to make the most of their remaining vision in their 'Skills for seeing' program. Since 2011, some 315 volunteers have been trained to use and demonstrate the app to people with Macular Degeneration. The c.315 trainers see around 260 people per year and the Macular Society estimate that the app has been used in over 1300 therapy sessions (2011-20) (**E6)**. Dr Lewerenz, an Ophthalmologist based in the US, uses the app in his clinic and has found it useful for eccentric viewing and also for other visual disorders: *"I recommend MDevReader to my patients in two different scenarios: For those who could benefit from eccentric viewing, and those who have visual processing problems or left hemianopia and have a difficult time going from one line of text to the next line. We also have it on an iPad in our clinic and our OTs use it for eccentric viewing training."* (**E7**). The app may also have potential for people with dementia as shown by this feedback: *"she (elderly mother) doesn't have trouble with her vision, but she gets 'stuck' due to her Dementia bringing on perseveration when she's reading static text. Really easy to set up and Mum finds that she can 'go with the flow' of the scrolling text."* (**E3**).

Professor Walker's research has commercial impact via his collaboration with two independent technology developers. Since 2013 Humboldt Solutions Ltd developed the MDevReader based on Walker's research. This is now used by them as a case study enabling them to demonstrate their capabilities to other potential clients. Mr Adrian Cox the CEO said: *'This was Humboldt's first mobile app for public release…since this initial release, we have gone on to develop mobile applications for several other clients and the MDevReader has been valuable to us as a demonstration of our capabilities'*. (**E8**). Codica Ltd developed EV News and Ev-platform (in 2018-2020) and have found that these are useful as examples of their social impact work in health and ageing. "*Ev Platform has been a valuable addition to our social impact portfolio and a showcase of our product design capabilities.. Most notably, it has contributed to establishing our relationship with We+Care, a Swiss non-profit association focused on care coordination, where Codica has been a founding member*" (testimonial from Mr K. Papagiannopoulos CEO of Codica Ltd **E9**).

The MDevReader app was selected by Universities UK as one of 20 top examples of innovative university research in 2014 (**E10**).

5. Sources to corroborate the impact

E1. Video Recording of Dame Judi Dench speaking about the app EV News https://www.youtube.com/watch?v=8roiil3sEvo

E2. Testimonial from Cathy Yelf of the CEO Macular Society

E3. Feedback from EV trainers and other professionals

E4. Testimonial from Mr J Ward a visually impaired user from the Thomas Pocklington Trust and a transcript of his appearance on BBC radio 4

E5. Usage data is available from Apple iTunes connect for iOS version and from Fabric for the Android version and Google analytics for EV News and Ev-platform

E6. DOCET eLearning CPD for Optometrists and Macular Society Skills for seeing program

E7. Testimonial from Dr David Lewerenz,, Ophthalmologist in Denver Colorado

E8. Testimonials from Adrian Cox, CEO at Humboldt solutions Ltd

E9. Testimonial from Konstantinos Papagiannopoulos, CEO of Codica Ltd

E10. Universities UK ‘Ideas for Life’ Press Release