Institution: University of Bradford

Unit of Assessment: A3 – Allied Health Professions, Dentistry, Nursing and Pharmacy

Title of case study: Improved knowledge and understanding of optometrists regarding the link between spectacle correction and adaptive gait and falls in elderly patients

Period when the underpinning research was undertaken: 2001 - 2020

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:
David B Elliott	Professor of Clinical Vision Science	1995 - present
John Buckley	Reader in Movement Biomechanics	2002 - present
Louise Johnson	Lecturer in Physiotherapy	2001 - 2015
Andrew Scally	Senior Lecturer in Health Studies	1996 - 2018
Alison Alderson	Clinic Director, Optometry	2015 - present
Chris Davey	Lecturer in Optometry	2015 - present

Period when the claimed impact occurred: 2014-2020

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

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

Optometrists' understanding of the link between spectacle correction, unsafe gait and falls just 15 years ago was minimal. Our research on how appropriate spectacle prescribing can help provide safer gait and avoid falls now forms the basis of not only new national guidelines (College of Optometrists), but also international guidelines (European Council of Optometrists and Optics; Optometry Australia). Feedback from Continuing Professional Development (CPD) articles, lectures and videos that cite our research show that optometrists gain new knowledge and understanding of the link between spectacle correction and safer gait which helps them reduce fall risk in their older patients.

2. Underpinning research (indicative maximum 500 words)

Visual impairment leads to poor balance control and unsafe adaptive gait (the negotiation of step and stair ascent and descent, which is highly dependent on good visual information, 1-6) and is a major risk factor for falls. This suggests that if the leading causes of visual impairment in older people were corrected via updated spectacles and cataract surgery, this could reduce fall rate. However, a major 2007 optometric intervention randomised controlled trial (RCT) by an Australian group found that updated spectacles *increased* falls. This hugely unexpected finding (that was deemed unreliable by many optometrists at the time) led us to investigate the potential problems with updated spectacles on gait safety. We found that adaptive gait was driven by changes in lens magnification, with the highest magnifications causing unsafe adaptive gait (3). For example, the minification provided by myopic increases in spectacles leads to older people reducing their toe clearance of a step because the step looks smaller than it is. Hitting a step, trips and subsequent falls are thus more likely to occur in the early weeks of new spectacle wear prior to adaptation. When this explanation was provided to clinicians, it helped them to understand how large spectacle changes could influence gait safety and the need for

conservative prescribing of refractive changes in older people. We have also shown that changes in the refractive error of oblique astigmatism (which provides magnification at oblique meridians and distorts objects, including steps) leads to increases in dizziness (5) and unsafe adaptive gait (4) and changes should particularly be prescribed conservatively.

Unsafe gait patterns were also found with older people who wore multifocal (varifocal or bifocal, the lower part of the lens is used for reading at about 40cm) lenses due to the blurred view of steps and stairs in the lower visual field, plus image jump in bifocals and peripheral distortions in varifocals (2,4,6). These unsafe gait patterns on both stair and step ascent and descent disappeared if distance single vision lenses were used instead (2). An RCT subsequently showed that active long-term wearers of multifocals fell less frequently when provided with distance single vision lenses for outdoor wear and our recent clinical cohort study (5) similarly showed a doubling of the fall rate in patients switching into multifocals (30%) after cataract surgery compared to those patients who discontinued multifocal wear (15%). Patients are often reticent to give up their bifocals/varifocals because of their convenience, so that our study (6) that showed that a lower-powered reading segment provides safer adaptive gait due to clear vision of steps and stairs and less image jump and peripheral distortion, yet sufficient power to read menus, phones and price tags for short periods, is a very useful option for clinicians to offer.

Elliott (1995-present, Professor in Optometry) set up a Vision and Gait Lab with Buckley (2001-present, Medical Engineering) in Bradford in 2001. The multi-disciplinary team has also included Scally (2001-18, Health Studies), Johnson (2005-16, Physiotherapy); Alderson (2012-present, Optometry) and Davey (2014-present, Optometry).

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

1. Buckley JG, Heasley KJ, Twigg P, Elliott DB. The effects of blurred vision on the mechanics of landing during stepping down by the elderly. *Gait & Posture*, 21: 65-71, 2005. doi.org/10.1016/j.gaitpost.2003.12.001

2. Johnson L, Buckley JG, Scally AJ, Elliott DB. Multifocal spectacles increase variability in toe clearance and risk of tripping in the elderly. *Investigative Ophthalmology & Visual Science*, 48: 1466-1471, 2007. https://doi.org/10.1167/iovs.06-0586

3. Elliott DB, Chapman GJ. Adaptive gait changes due to spectacle magnification and dioptric blur in older people. *Investigative Ophthalmology & Visual Science*, 51: 718–722, 2010. https://doi.org/10.1167/iovs.09-4250

4. Elliott DB. The Glenn A. Fry award lecture 2013: Blurred vision, spectacle correction, and falls in older adults. *Optometry & Vision Science,* 91: 593-601, 2014. http://doi.org./10.1097/OPX.0000000000000268

5. Supuk E, Alderson A, Davey CJ, Green C, Litvin N, Scally AJ, Elliott DB. Dizziness, but not falls rate, improves after routine cataract surgery: the role of refractive and spectacle changes. *Ophthalmic & Physiological Optics*, 36:183-190, 2016. https://doi.org/10.1111/opo.12243

6. Elliott DB, Hotchkiss J, Scally AJ, Foster R, Buckley JG. Intermediate addition multifocals provide safe stair ambulation with adequate 'short-term' reading. *Ophthalmic & Physiological Optics* 36: 60-68, 2016. https://doi.org/10.1111/opo.12236

Evidence of Quality

Elliott has received the Glenn A. Fry (2013) and the William Feinbloom (2018) Awards from the American Academy of Optometry for leading this research (4) and disseminating the information to lecturers and clinicians respectively.

Research Grants

The PPP Foundation, 2001-2004, GBP150,000. Falls in the elderly: the link with visual impairment and ophthalmic intervention. PI: Elliott, CI: Scally.

The Health Foundation, 2004-2008, GBP150,000. Impact of correctable visual impairment upon balance control and stepping strategies. Training Fellowship for Buckley, sponsor: Elliott

College of Optometrists Research Studentship Award, 2009-12, GBP54,000. The science of prescribing spectacles. PI: Elliott.

Nursing & Allied Health Professions Award Scheme, Research Capacity Development, 2005-2008, GBP211,000. Effects of visual impairment upon gait biomechanics during stair/step negotiation in the elderly. Research Fellowship for Johnson; sponsors: Elliott and Buckley.

Dunhill Medical Trust, 2012-214, grant TDMT-SA14/0711, GBP71,000. Dizziness and falls after cataract surgery: are they related to large changes in refractive correction? PI: Elliott. CI: Scally.

National Institute for Health Research, Public Health Research Programme, grant 10/3009/06, 2012-2015, GBP196,000. Manipulating the appearance of steps and stairs to make them safer for older people to negotiate. PI: Elliott. CIs: Buckley, Scally.

College of Optometrists Research Studentship Award, 2014-17, GBP54,000. The role of vision and refractive correction in patients with dizziness. PI: Elliott.

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

Falls and fall-related injuries are a common and very serious problem for older people. Approximately 33% of people aged over 65 and 50% of those over 80 fall at least once a year. Falls cause bruising, fractures, loss of confidence and independence and are the leading cause of accidental death in older people. They are estimated to cost the NHS more than GBP2,300,000,000 per year.

The understanding of the link between spectacle correction and falls by optometrists just 15 years ago was negligible. For example, the major Australian RCT in 2007 that investigated the hypothesis that an optometric intervention and provision of new spectacles would improve fall rate in elderly people, found an *increased* fall rate in the optometric intervention group, the exact opposite of their hypothesis (1). This was because they prescribed the full refractive correction change to all their elderly frail participants and ignored the influences on falls of multifocal wear. Our research provided an evidence-based explanation to clinicians of this very unexpected outcome and have suggested effective ways to avoid the problems. These papers are now cited in fall-prevention guidelines by the professional bodies of Optometry in the UK (2, representing 12,000 practitioners), Europe (3, c 110,000 practitioners) and Australia (4,c 5300 practitioners), and in CPD articles, textbooks, lectures and videos (5-10) and are used by optometrists (6-10). The guidelines and CPD material use the information from our studies to emphasise how to

safely prescribe bifocals and varifocals (and when not to), when to prescribe additional single vision or multifocal spectacles with lower-powered reading segments and how to prescribe refractive correction changes conservatively (i.e. make partial changes) to older people at risk of falling.
Continuing professional development (CPD) articles in professional journals (including a Portuguese translation, LookVision 2014), an internationally best-selling clinical textbook (5), CPD videos (e.g., 6,7) and CPD lectures (e.g. 8) all cite our research papers and change to practice is indicated by comments from clinicians below (6,7,8) and from an Australian Delphi study of clinical practice (10). Lectures that cited the papers listed were given to optometrists at CPD events in Nottingham (2014), Owen Aves Medal lecture, Yorkshire Optical Society (2014), Brighton (2015), Chester (2015), Preston (2015), Manchester (2015) (9), Hereford (2016), Teesside (2017), Leeds (2017), Hull (2017), Elland (2019) and Oxford (2020); plus Monopoli, Italy (2016), Brisbane, Australia (2017), Berkeley, USA (2018), Rome, Italy (2018), Amsterdam, The Netherlands (2019), Killarney, Ireland (2019), and Odense, Denmark (2019).

Attendance levels at CPD lectures were between 30-500, and feedback regarding articles, lectures and videos have all indicated that the material was considered of high quality, relevant to optometry practice and improved their knowledge and understanding. Examples include the DOCET video (6; N=620; 91%+ 'good' or 'excellent'), Optometry Today video (7; N=561; 96% 'good' or 'excellent') and College of Optometrists Optometry Tomorrow lecture (8; N =196; 60% 'excellent', 32% 'good').

Typical comments include: DOCET (6): "*Brilliant - should be made available to other professionals", "My team felt we can make a difference with the knowledge gained. Even more relevant as we had a recent fall px.", "I am changing the way I practice in this respect", "Good practical information which will benefit my patients*."
Optometry Today (7): "*This was a truly excellent piece of CET, of outstanding quality. I wish they were all like that!", "Really relevant. more like this please", "Very enlightening, having an elderly parent myself who is at high risk of falls, I am already very aware of this problem but it helped me understand the problems better", "Excellent, thought provoking and extremely useful information for practice use*".

Optometry Tomorrow (8): "*very interesting, not something I've really thought of before but will have an impact on how I practice in the future", "really helped my understanding of how particularly the elderly can be helped from an optometric perspective", "superb information - new thinking, very interesting and useful", "very informative great advice given, easy to apply in daily practice".*

Research and dissemination in this area plus the development of links between optometrists and falls teams across the UK have ongoing support from the College of Optometrists (9) and these are important steps nationally. The international impact is similar to that in the UK as stated by the Head of Optometry in Sydney, Australia: "*Professor Elliott has devoted efforts to translating this research into policy and practice. For example, he jointly authored Guidelines for Optometrists to help prevent falls in older patients. These guidelines have been published by the Optometry Association, Australia, disseminated widely in the Optometry Profession in Australia in 2019 and were scrutinised independently by my research team in 2019-2020 (data on file) using a Delphi Consensus study to investigate implementation issues. The Delphi Consensus study determined that there was strong support for their use in practice (73-100% of panel) and also that they were considered important to practitioners in this setting (3.0-3.6 on a 0-4 scale)".* (10)

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

1. Cumming RG, Ivers R, Clemson L, Cullen J, Hayes MF, Tanzer M, Mitchell P. Improving vision to prevent falls in frail older people: a randomized trial. *Journal of the American Geriatrics Society* 2007; 55: 175–81. https://doi.org/10.1111/j.1532-5415.2007.01046.x

2. College of Optometrists (UK). *The Importance of Vision in Preventing Falls.* 2020 Professional guidelines, endorsed by Age UK, the Royal College of GPs and the British Geriatrics Society. https://www.college-optometrists.org/the-college/policy/focus-on-falls/importance of vision in preventing falls.pdf

3. Professional guidelines of the European Council of Optometry and Optics, which represents over 110,000 clinicians in 25 European countries. https://www.ecoo.info/wp-content/uploads/2020/01/Guidelines-to-Help-Prevent-Falls-in-Older-Patients-January-2020.pdf

4. Professional guidelines of Optometry Australia. https://www.optometry.org.au/wp-content/uploads/Professional_support/Guidelines/Falls_Guidelines_v8.pdf

5. Elliott DB. *Clinical procedures in primary eye care*. 5th edition, Elsevier, 2020 (4th edition 2013, ISBN: 9780702051944). This is an international bestselling optometry textbook with sales by region of UK & Ireland 38%, Western Europe 29%, USA 16%, Asia 13% and rest of the world 4%. Testimonial letter from Senior Content strategist, Elsevier.

6. Feedback from the Directorate of Optometric Continuing Education and Training (DOCET) video “The ageing eye: Vision and falls” (2017). Testimonial letter from the Continuing Professional Development (CPD) Manager, College of Optometrists.

7. Testimonial letter from Clinical Multimedia Editor, *Optometry Today* regarding a 2015 recorded CPD lecture.

8. Feedback from the Optometry Tomorrow Continuing Professional Development (CPD) lecture, 2015. Testimonial letter from the Head of Events, College of Optometrists.

9. College of Optometrists (UK). “Focus on Falls” report, May 2019. https://www.college-optometrists.org/the-college/policy/focus-on-falls.html

10. Testimonial Letter from the Head of the School of Optometry, University of New South Wales, Sydney, Australia.