

# Vision and falls research: the story so far

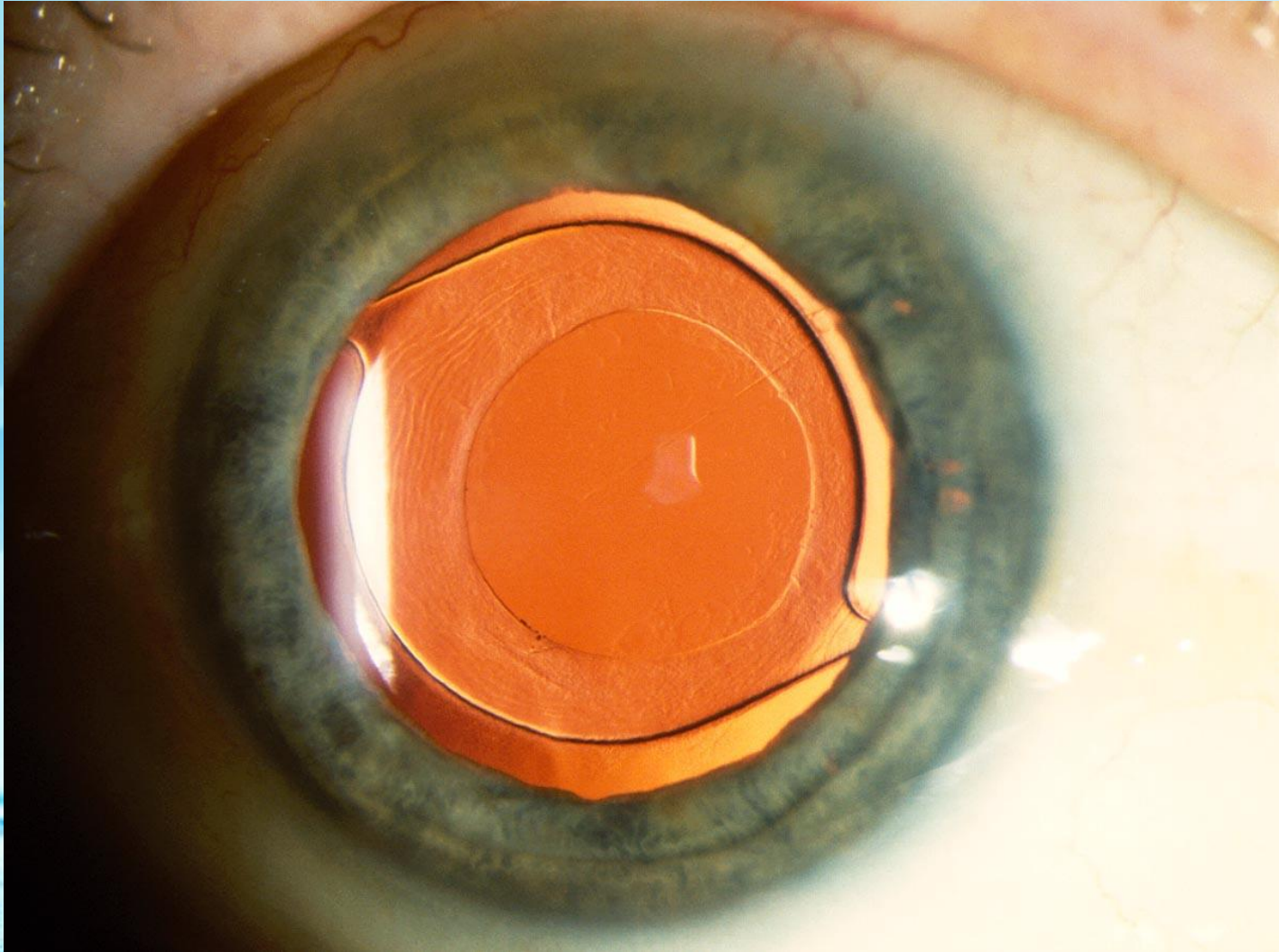
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# Vision and falls research: the story so far

- Vision, refractive error & spectacle correction, eye disease and surgery, two eyes
- Vision and its correction and falls
  - Epidemiological studies
  - Lab based studies
  - Intervention trials
- Cataract surgery and falls
  - Past and current research
- Optometrists and ophthalmologists role in falls prevention

# Key definitions



visual

classes

active

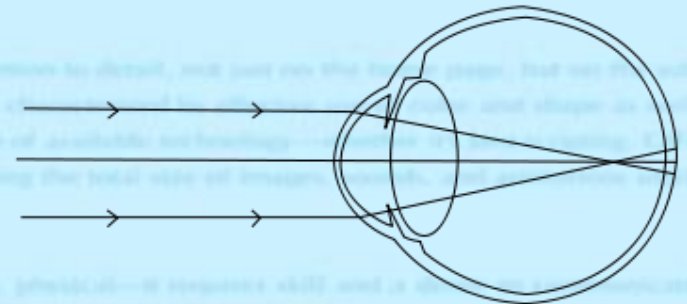
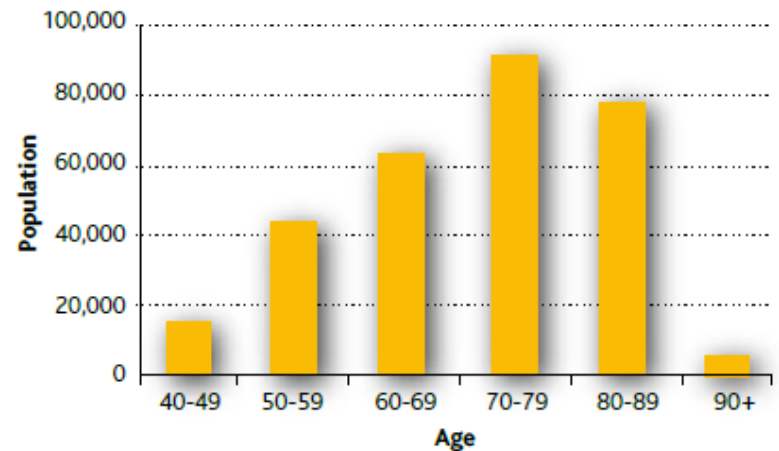
- 2

eyes

# Refractive error

- Refractive errors affect ~1/5 of persons 40 years or older in Australians<sup>1</sup>
- Approx 300,000 Australians may have visual impairment due to refractive error
- ~17% prevalence of myopia in Australia<sup>2</sup>

*Vision impairment due to uncorrected refractive error by age cohort. Estimated numbers, Australia 2004.*

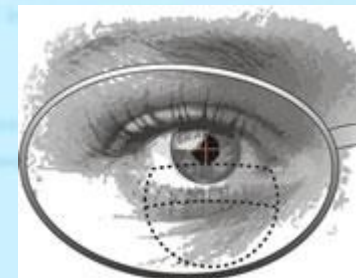
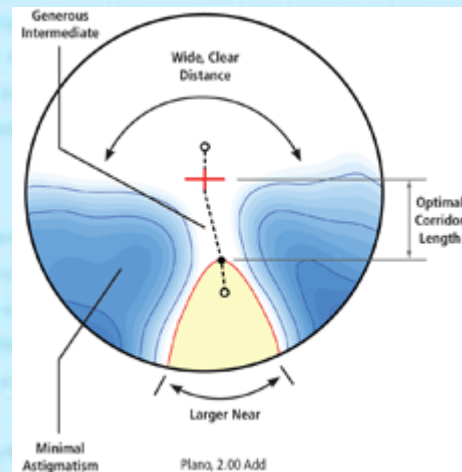
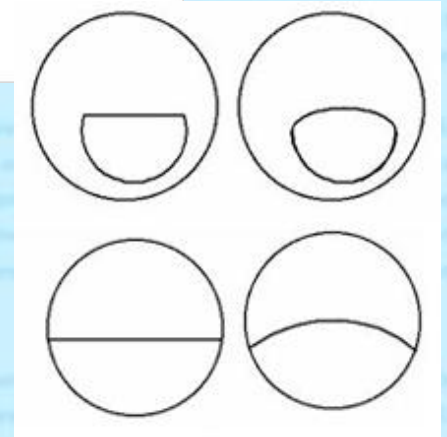
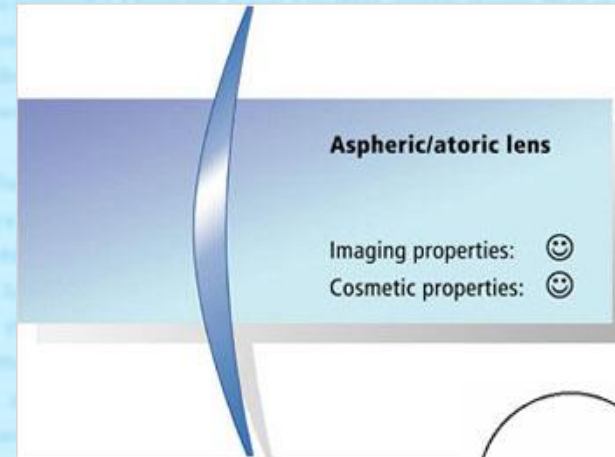


<sup>1</sup>The Eye Diseases Prevalence Research Group *Arch Ophthalmol.* 2004;122:495-505

<sup>2</sup>Wensor et al *Arch. Ophthalmol.* 1999;117:658-63.

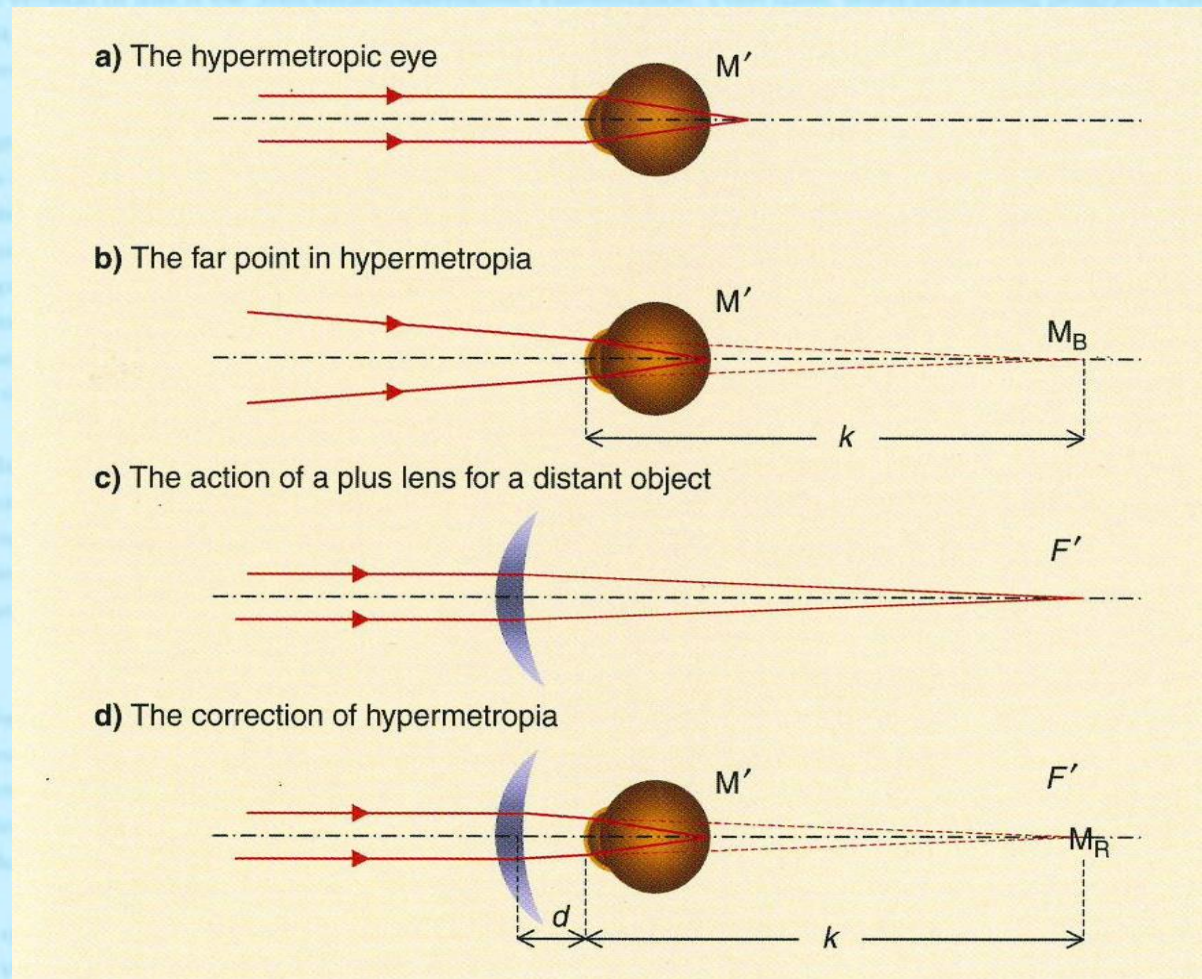
# Types of spectacle lenses

- Single vision lenses  
sphere, astigmatism
- Bifocal
- Trifocal
- Progressive /  
multifocal / varifocal



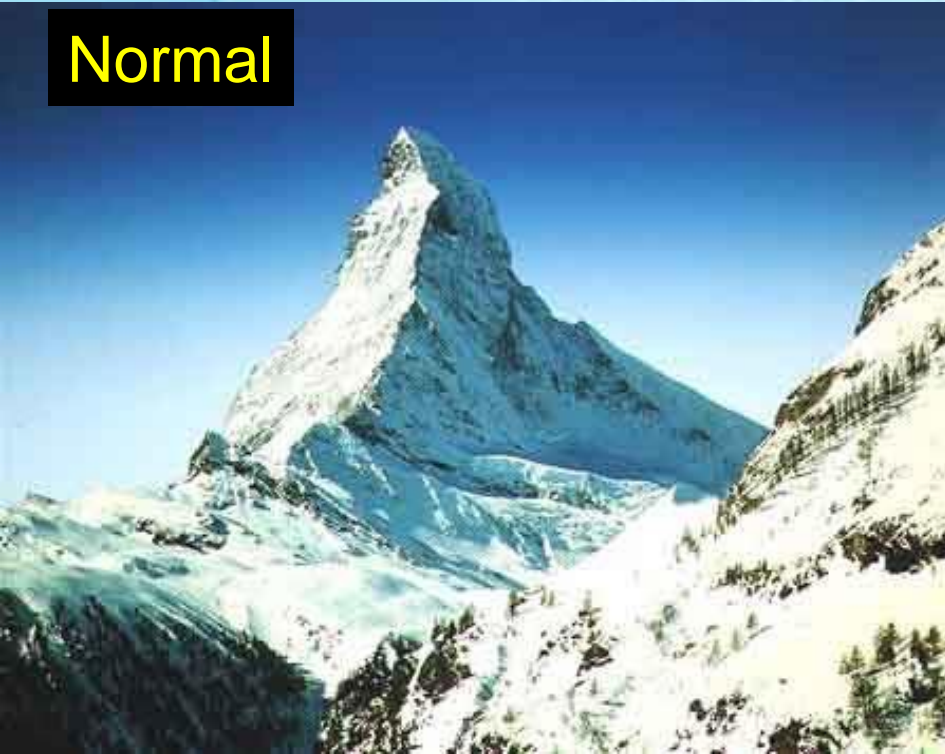
# Spectacle lenses and magnification

- Myopic correction minifies
- Hyperopic correction magnifies
- Alters the view of the world



# Spectacles and Visual Distortion

**Normal**



Distortion of the image:  
Every 1D difference causes  
2% change in image size

**Barrel- hyperopia**



**Pin cushion- myopia**



# Vision and falls



- Vision used to spot hazards and obstacles around us and negotiate steps.
- Vision also used in balance control. Standing with eyes closed, for example, increases sway up to 70%.



# Vision & refractive correction and falls: the evidence

■ Epidemiological studies

■ Clinic studies

■ Lab-based studies

■ Intervention trials



# Vision and falls

## Epidemiological studies

- Visual acuity is a major risk factor for falls (mean odds ratio or OR of ~ 2.5).
- Other aspects of vision (e.g. visual fields, contrast sensitivity, depth perception) may be even more important.

Rubinstein, 2006; *Age & Aging*.

Ivers *et al.*, 2000; *Am J Epidemiol*.

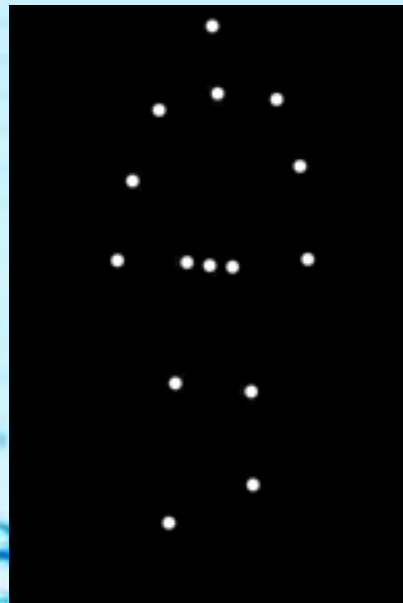
Freeman *et al.* 2007; *Invest Ophthalmol Vis Sci*.

# Clinic studies

- UK geriatric clinic study.
- 51% of fallers had visual impairment (VI).
- 79% of this VI was correctable:  
40% refractive error, 39% cataract.
- 60% had not had an eye exam in the last 3 years.

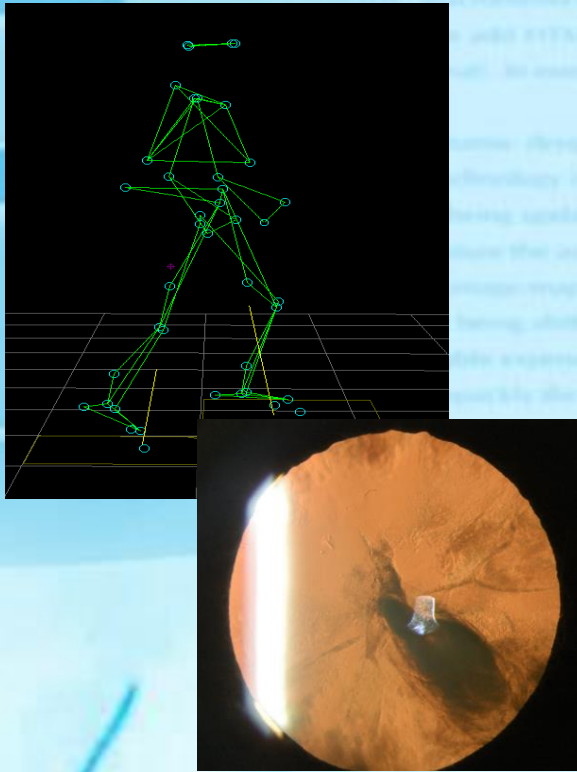
Jack *et al.*, 1995; *Gerontology*

# Bradford vision & mobility lab



- Prof David B Elliott
- Optometry, Medical Engineering and Health Studies staff.
- Two AMTI forceplates.
- 8 - camera Vicon assessment system.
- Balance control and stepping up or down with refractive blur, cataract and multifocals.

# Lab-based studies: reduced vision from refractive & cataract blur



- Refractive blur decreases standing balance control.
- With cataract: slow down and increase toe clearance
- This increases single support time and increases M-L instability.
- Elderly people particularly suffer from 'sideways' falls.

Anand *et al.*, 2003; *Invest Ophthalmol Vis Sci.*  
Heasley *et al.*, 2004; *Invest Ophthalmol Vis Sci.*  
Buckley *et al.*, 2005; *Gait & Posture.*

# Does visual impairment cause falls? (Can we correct visual impairment?)

- Epidemiological studies; clinical studies and lab. based studies – all “YES”.
- Bilateral visual impairment ( $VA < 6/12$ ) up to 30% in older population in the UK.
- 50-75% of this appears to be correctable by updating spectacles and cataract surgery.

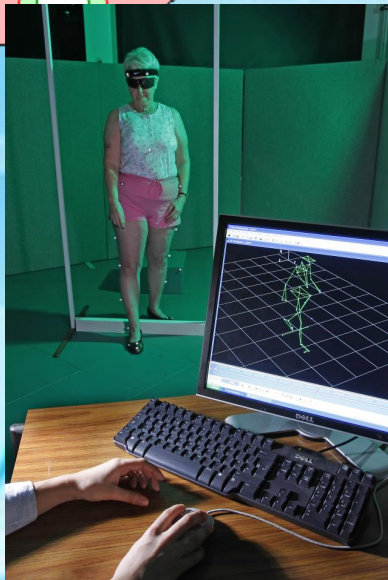
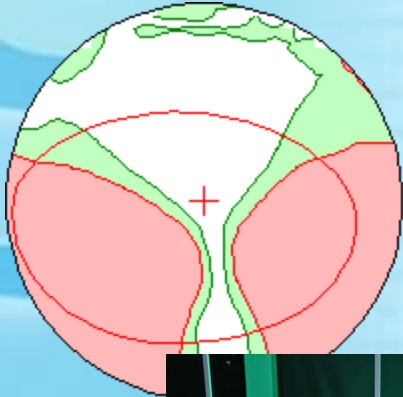
# Epidemiological studies: Multifocals and bifocals



- Reading area of multifocals blurs (and magnifies) steps etc.
- Other problems of 'jump', double vision, peripheral distortions.
- Multifocal wearers over twice as likely to fall.
- Involved in more edge-of-step accidents.

Lord *et al.*, 2002; *J Am Geriatr Soc*  
Davies *et al.*, 2001; *Safety Science*.

# Lab. studies: Multifocals



- No increased toe clearance.
- Multifocals increase step hits and reduce precision of toe clearance and foot placement.
- Less control when stepping down
- Single vision lenses improve all these factors in adapted multifocal wearers.

Johnson *et al.*, 2007; *Invest Ophthalmol Vis Sci.*

Johnson *et al.*, 2008; *J Am Geriat Soc.*

Timmis *et al.*, 2010; *Invest Ophthalmol Vis Sci.*



# Intervention trials

- Surprisingly limited improvements.
- One study showed improvement only when combined with exercise; two cataract surgery studies show good improvement in falls rate, but two others show no significant improvement.

## ■ Why?

*Day et al., 2002; Br Med J*

*Brannan et al., 2003; Br J Ophthalmol*

*Harwood et al., 2005; Br J Ophthalmol*

*McGwin et al., 2006; J Am Geriat Soc*

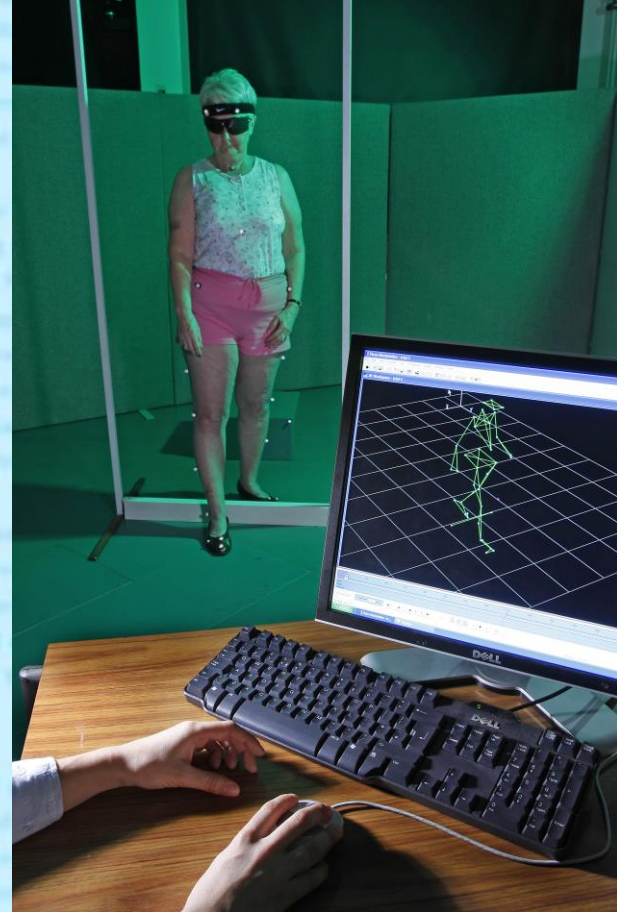
*Foss et al., 2006; Age & aging*

# Cumming et al. (2007) *J Am Geriat Soc*

- Optometric intervention study (~300 intervention and 300 control).
- Found *increased* falls rate in study group!
- Likely due to adaptation problems.
- Full prescription given in all cases.
- The study did not control for spectacle type (control group had more single vision lens wearers, intervention group more multifocal wearers).

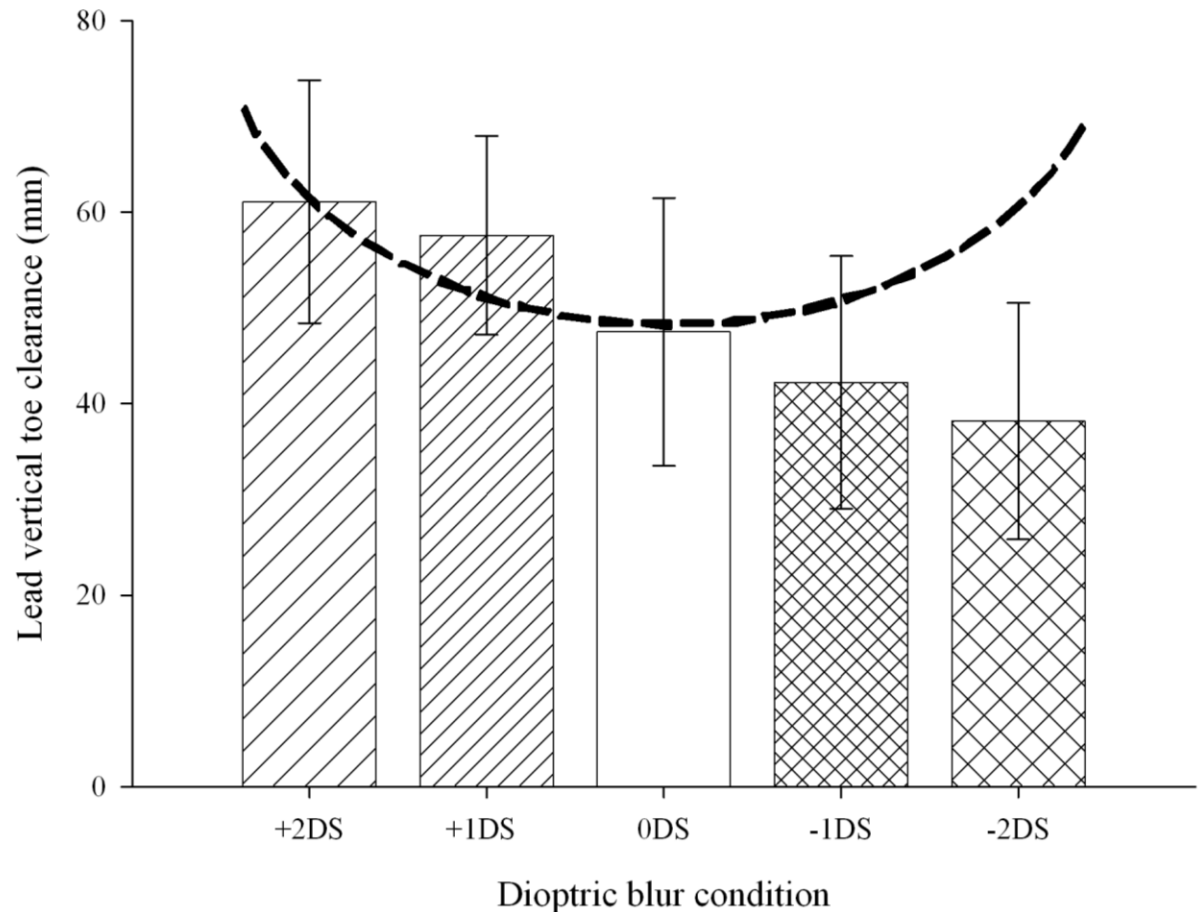
# Adaptation problems

- Why; if vision is better?
- Magnification effects can make:
- Steps look bigger or smaller.
- Steps look closer or further away.

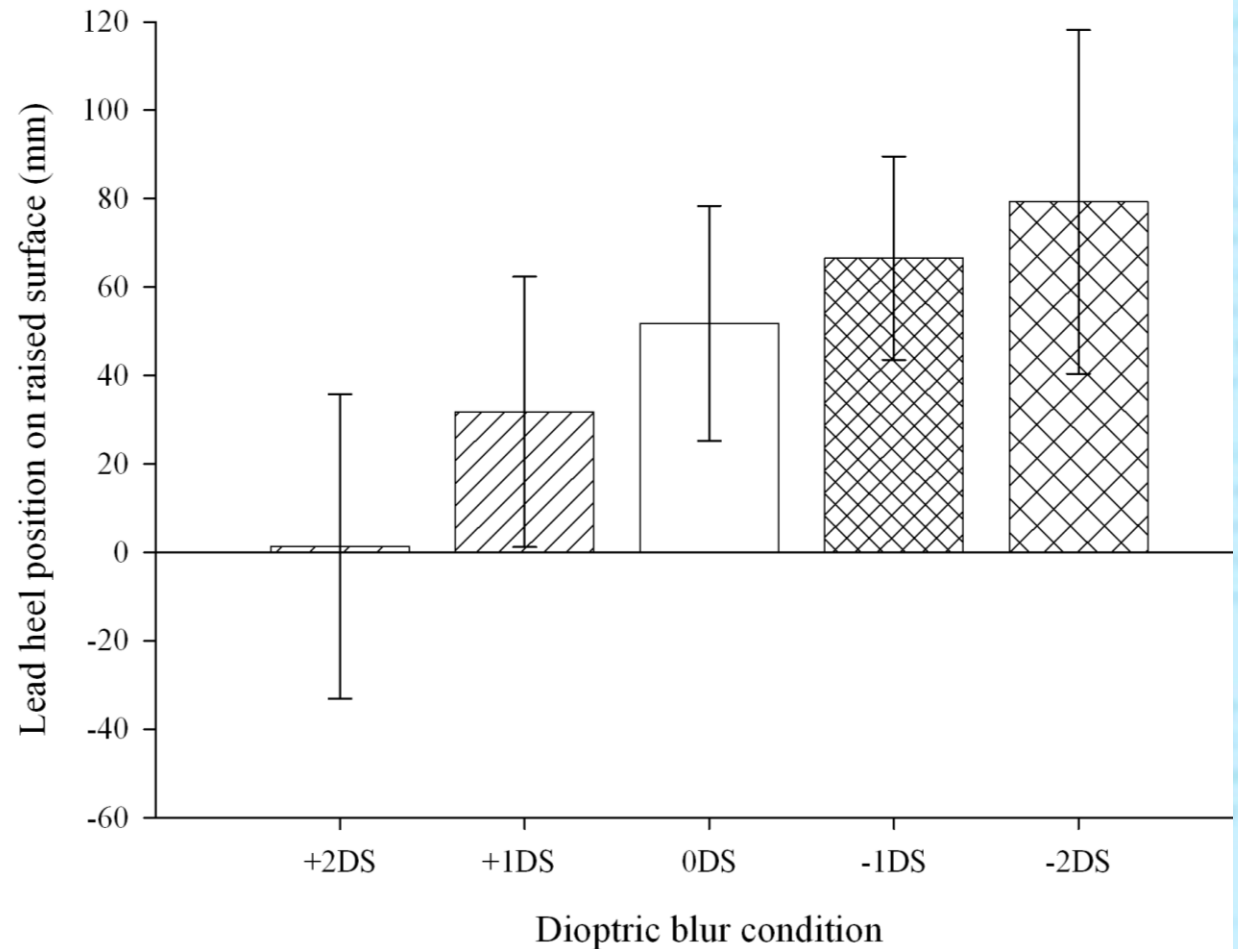


Elliott & Chapman (2010). *Invest Ophthalmol Vis Sci*

# Spectacle magnification effects



# Spectacle magnification effects



# Recommendations for optometrists

- Avoid large changes of refractive correction
- Elderly 'at risk' single vision lens wearers must not be swapped into multifocals.
- Regular multifocal wearers who subsequently fall into an 'at risk' group, should be advised distance SV lenses when walking outside (BUT only if they regularly go outside) and multifocal lenses for other tasks such as watching TV, shopping, driving etc.

Haran et al. (2010). *Br Med J*

# Cataract surgery intervention studies

- UK RCT into cataract surgery & falls
- Reduction in falls rate with first eye surgery:  
rate ratio 0.66 (CI 0.45 – 0.96)
- Not with second eye surgery:  
rate ratio 0.68 (CI 0.39 – 1.19)

Harwood et al 2005

# WA hospital linkage data

- 15,000 cataract surgeries
- Linked hospitalisation data
- Did not reduce risk of falls requiring hospitalisation

Meuleners et al 2012

- Second analysis showed falls risk highest between first and second eye cataract surgery

Meuleners et al 2013

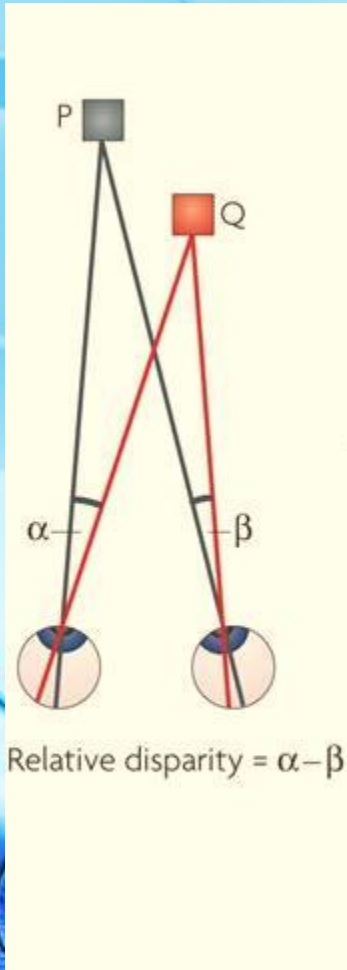


# Monet post-cataract surgery (1922)



- RE: +10.00/-4.00x90      6/18
- “The distortion and exaggerated colours that I see are quite terrifying. As for going for a walk in these spectacles, its out of the question for the moment”
- (Letter to G. Clemenceau, 30<sup>th</sup> August 1923)

# Binocularity and stereopsis



# Loss of depth perception



...increases viable, perhaps the terms "screen" or "show-up" will be used. The terms "link," "button," and "signature" are terms digital content, marking non-linear experiences, as does the term "Web" itself. It is exciting to know that there are vibrant young individuals, young and old, who are entering a field designing and shaping the Web of the future. Surely that Web will dramatically differ from today's Web.

...web designers derive their tools from print publishing applications such as Adobe PageMaker or QuarkXPress, which have



...of qualifications. Not most are for simple, physical—It requires skill and a desire to communicate. If other Web design will become accepted as a critical part of the new right.



# Falls and binocularity

- 40% of population attributable risk for hip fracture due to poor visual acuity or stereopsis

Ivers et al 2000

- Older persons with poor stereopsis increased falls risk

Cummings et al 1995

Nevitt et al 1989

# Recommendations for ophthalmologists

- Perform cataract surgery to improve vision and reduce falls risk
- Minimise the time between first and second eye cataract surgery
- Consider the refractive impact of cataract and cataract surgery on timing of surgeries
- However, the evidence is limited at this time

# Current research

- NHMRC Project Grant 1048302
- Falls risk associated with cataract and after first and second eye cataract surgery
- Keay, Meuleners, Pesudovs, McCluskey, Boufous, Ng, Morlet, Stapleton
- \$775,261.89 (2013-2015)

# The FOCUS Study

- Falls in Older people with Cataract, a longitudinal evaluation of impact and risk
- Prospective, 24 month, cohort study
- N=717, 5 sites, 3 states
- Systematically investigate falls and falls-related injury in older people with cataract

Keay L, Palagyi A, McCluskey P, Lamoureux E, Pesudovs K, Lo S, Ivers R, Boufous S, Morlet N, Ng J, Stapleton F, Fraser M, Meuleners L. Falls in Older people with Cataract, a longitudinal evaluation of impact and risk: the FOCUS study protocol. *Inj Prev* 2014 Jan 15 [Epub ahead of print]



# The FOCUS Study

- Separate effects of first and second eye cataract surgery
- Type and timing of refractive correction
- Vision
- Risk factors
- Depression, community participation, mobility and quality of life
- Current recruitment 68/717

# Summary



- The role of vision in falls is complex
- Visual impairment and wearing multifocals are significant risk factors for falls
- Reducing visual impairment helps
- Optometrists can help by careful prescribing in frail, older patients
- Ophthalmologists can help by reducing time between cataract surgery
- More research is required

# Thank you for your attention

■ Any questions?

