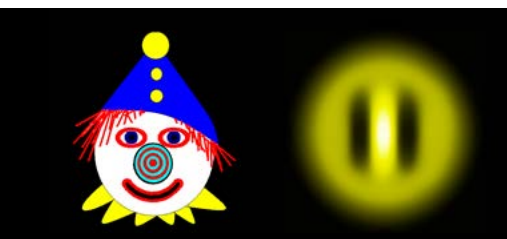


CHILDREN'S VISION

New insights inform changes to clinical practice



The main visual targets we use



A child being tested in the child-friendly
Infant Vision Laboratory

At the Infant Vision Laboratory, University of Reading, we study how ocular alignment and vergence develop and accommodation is controlled. Our findings challenge current theories on the causes of childhood vision problems and highlight the need for a radical re-think of the underlying mechanisms involved and how treatments work.

BRIDGING THE GAP IN CHILD VISION RESEARCH

We are investigating the motor aspects of binocular vision in children. We study accommodation, convergence and motor fusion, their linkages (AC/A and CA/C relationships) and ocular alignment, both in typical development and when these processes go awry and lead to strabismus, heterophoria and asthenopia.

Most clinicians treating strabismus, amblyopia and refractive errors in children use research findings from adult studies to inform their clinical diagnoses and treatment recommendations. These laboratory studies use carefully controlled conditions and co-operative adults who are often "vision specialists", such as students. They rarely involve child patients. Clinicians often extrapolate conclusions from these data to an assumption that all their patients - adults and children - will respond similarly in everyday life. But this just isn't the case. Every day, in our clinics, we see people who do not behave as the textbooks describe.

Our research highlights the need for clinicians to challenge accepted truths about children's vision problems. Our data show that current theories are too simplistic and thinking differently will help us to understand and treat patients more effectively.

Professor Anna Horwood's teaching for orthoptists is changing clinical practice worldwide

Here's what delegates say:

I left feeling empowered. I have the tools to not only improve quality of care for my patients, but to save the Trust money. A win win situation!

The work that has been done by Anna and her team at Reading has made me look at the way I think about accommodation and convergence and helps me when explaining to parents, causes and prognosis.

PREPARED BY

Professor Anna Horwood, Professor of Orthoptics and Visual Development for the Infant Vision Laboratory at the University of Reading.

What is 'normal'?

We've found that most people are happy with variability, imprecision and blur. So why do others complain about visual symptoms?

A large study of undergraduates showed very poor correlation between "eye symptoms" and test results^[7]. We test normal children and adults and find that the difference between "normal" and "abnormal" is not always clear. Primary care optometrists cannot do full binocular vision tests on every patient and hospital and specialist orthoptists, optometrists and ophthalmologists see few people who are totally happy with their eyesight. Consequently, all these groups can be unaware of how many people live their daily lives with similar measurements but no complaints.

Much more work needs to be done to explore the psychological aspects of convergence and accommodation control and eye exercises.

Our research tells us that variable is normal, flexible is normal and that straight eyes matter more to most people than crystal clear vision. Many people live normally with significant levels of blur and only accommodate when they really need to. In essence, most people never think about blur or accommodation at all – and it is probably best left that way!

CHILDREN'S VISION NEW INSIGHTS INFORM CHANGES TO CLINICAL PRACTICE

f For more information, please contact:

Professor Anna Horwood PhD, DBO(T)

University of Reading
Infant Vision Laboratory
School of Psychology and Clinical
Language Sciences
Reading. RG6 6AL

a.m.horwood@reading.ac.uk

Tel +44(0) 118 378 5553

f /theuniversityofreading

t @UniofReading

[www.research.reading.ac.uk/
childrens-vision](http://www.research.reading.ac.uk/childrens-vision)

A CHANGE OF FOCUS FOR PRACTICE AND TREATMENT

In the Infant Vision Laboratory at the University of Reading, we use infra-red photorefractometry to measure how people (from birth to middle age) converge and accommodate to the three main cues to where an object is in depth (blur, binocular disparity and proximal/looming cues). We are interested in how people decide which of these cues carries most weight.

Binocular disparity is the main driver for convergence AND accommodation

Most clinicians learn that blur drives accommodation and binocular disparity drives convergence, but also that the bulk of the total convergence response is driven by accommodative convergence (the AC/A linkage). However, our research demonstrates that binocular disparity is the main driver for both convergence AND accommodation^[1]. Accommodation is significantly disrupted if typical individuals are prevented from being binocular. The stimulus to convergence drives much more accommodation than accommodation drives convergence – so the CA/C linkage (convergence accommodation) is far more important than the AC/A linkage (accommodative convergence).

Many people tolerate blur

As clinicians, we assume that because we are aware of blur, everyone else is too. We assume that the individuals we see in clinic have accommodated, automatically, to within depth of focus, because they don't tell us it has gone blurred. This is not the case. Our studies show that "eye experts", because they know about vision, behave very differently to most adults and children^[2]. Many people, even children^[3] habitually seem to tolerate significant blur without complaint and never think about blur /clarity until presbyopia develops.

Infants and adults differ in how they control their eyes

Although most adults use binocular disparity to drive their accommodation and vergence, infants are different. Before 8-9 weeks of age, infants use proximal looming cues; in later infancy blur, disparity and proximal cues are equally weighted, but by 5-9 years old, disparity takes over^[4].

Accommodation linkages are inherently flexible

Babies learn that convergence and accommodation usually need to go together, leading to "fixed" AC/A ratios. But if we test normal people doing what comes naturally, we find these "ratios" are much less fixed. Convergence is usually accurate at every distance, but accommodation is much more variable, and in a few anisometropic amblyopia cases, can even be asymmetrical^[5]. Our evidence suggests these systems are much more independent and that they respond in parallel to the same stimuli at the same time. "Relative vergences" may be unnecessary if accommodation/convergence linkages are inherently flexible and having too strong a linkage can cause problems (such as in accommodative strabismus).

Different people favour different cues

Patients often fail to respond to treatment predictably. We find that people with specific clinical diagnoses have characteristic "styles" of using their convergence and accommodation. Some people are "blur people" e.g. children with accommodative strabismus, but most are "disparity people", so lenses make little difference to the angle of deviation. By understanding what cues a person favours, and the balance of accommodation and convergence, our model explains most heterophoria, intermittent strabismus nearwork problems, and helps us predict their response to treatment^[6].

1 Horwood A, Riddell P. The use of cues to convergence and accommodation in naive, un instructed participants. *Vision Research*. 2008;48(15):1613-24.

2 Horwood A, Riddell P. Differences between naive and expert observers' vergence and accommodative responses to a range of targets. *Ophthalmic & Physiol Optics*. 2010;30:152-9.

3 Ludden SM, Horwood AM, Riddell PM. Children's Accommodation to a Variety of Targets – A Pilot Study. *Strabismus*. 2017;25(3):95-100.

4 Horwood A, Riddell P. Developmental changes in the balance of disparity, blur and looming/proximity cues to drive ocular alignment and focus. *Perception*. 2013;42:693-715.

5 Toor S, Horwood AM, Riddell P. Asymmetrical accommodation in hyperopic anisometropic amblyopia. *British Journal of Ophthalmology*. 2017.

6 Horwood AM, Riddell PM. Disparity-driven vs blur-driven models of accommodation and convergence in binocular vision and intermittent strabismus. *Journal of American Association for Pediatric Ophthalmology and Strabismus (JAAPOS)*. 2014;18(6):576-83.

7 Horwood AM, Toor S, Riddell PM. Screening for convergence insufficiency using the CISS is not indicated in young adults. *Br J Ophthalmol*. 2014;98(5):679-83.