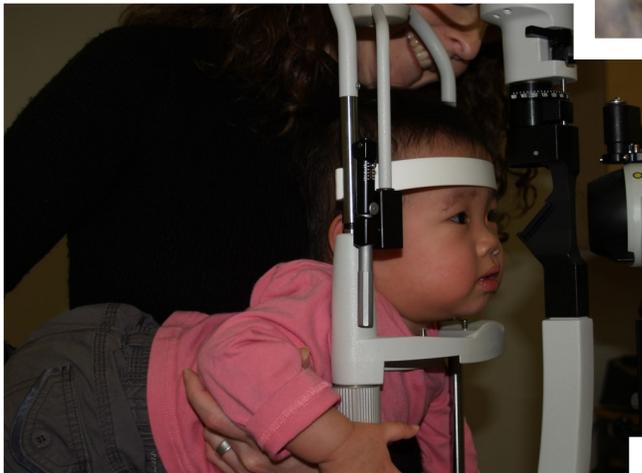
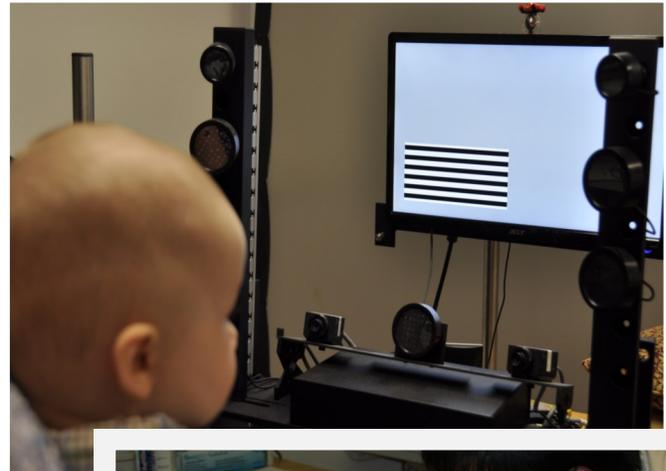


# CVRS 2013

**WATERLOO  
OPTOMETRY &  
VISION SCIENCE**

**The XIV Biennial Meeting of the Child Vision Research Society**

June 17 to 19th 2013, Ontario, Canada



In partnership with The Hospital for Sick Children

**SickKids<sup>®</sup>**

# XIV Biennial Meeting of the Child Vision Research Society

University of Waterloo, Waterloo  
Hospital for Sick Children, Toronto'

June 17-19, 2013

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## **Welcome to CVRS 2013**

Dear colleagues and friends,

It is our great pleasure to welcome you to the 14<sup>th</sup> Child Vision Research Society conference, hosted by the University of Waterloo School of Optometry and Vision Science and the Hospital for Sick Children, Toronto. The CVRS has been held biennially since the inaugural conference in 1987 in Oxford, England. Since then it has been held in the Netherlands, France, Germany, Italy, Sweden, Slovenia and Wales. This is the first time that the CVRS has been held outside of Europe. For this reason we are doubly honoured to host the conference. We are anticipating delegates from as far away as New Zealand, Nepal, Korea and Israel, as well as many from Europe, UK, US, and of course, this year, from Canada.

The purpose of the conference is to provide a unique venue for bringing together clinicians and researchers who have an interest in infant and child vision and to share research on aspects of typical and atypical visual development from basic research through to clinical management.

We are also delighted to present a strong and diverse programme with topics ranging from amblyopia, refractive and visual assessment to perceptual development, prematurity and ocular disease. An extensive poster session will cover similar topics plus issues around children with developmental disabilities and low vision. We thank all of you who have submitted papers and posters. You all have helped make this conference a success and we hope that you will enjoy it and go home stimulated with more ideas for research and applications for practice.

Susan J. Leat

Debbie Jones

Carol Westall

## Programme for Child Vision Research Society Meeting 2013

Monday 17<sup>th</sup> June,

School of Optometry and Vision Science, University of Waterloo

8:00 Registration

9:00 Welcome and Introduction by Professor Susan Leat (Chair, CVRS 2013 Organising Committee, School of Optometry and Vision Science)

9:05 Welcome by Professor Paul Murphy (Director, School of Optometry and Vision Science)

9.15 **Keynote Address:**

**Susan Cotter**, Professor, Southern California School of Optometry

**“The Multi-Ethnic Paediatric Eye Disease Study: Implications for Clinical Practice”**

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**Susan Cotter, O.D., M.S.**, is a Professor at the Southern California College of Optometry where she teaches in the classroom and clinic and does clinical research. She is a Vice Chair of the Pediatric Eye Disease Investigator Group (PEDIG), a National Eye Institute (NEI)-funded clinical research network of pediatric optometrists and ophthalmologists who perform clinical investigations related to pediatric eye conditions. Sue was co-principal investigator for the Multi-Ethnic Pediatric Eye Disease Study (MEPEDS) and on the Executive Committee of the Convergence Insufficiency Treatment Trial (CITT) and the Collaborative Longitudinal Evaluation of Ethnicity and Refractive Error (CLEERE) studies. Sue’s primary research interests are related to clinical management strategies for strabismus, amblyopia, non-strabismic binocular vision disorders, and childhood refractive error.

**Session A: Refractive management (Moderator: Kathryn Saunders)**

- |          |                    |  |
|----------|--------------------|--|
| 10.05 am | Vivian M.W. Wong   | Longitudinal Follow-up of Infants with Significant Refractive Error at 3-5 Months of Age   |
| 10.25 am | Susan J. Leat      | Symptoms and their Optometric Correlates Among Children with Hyperopia in a University-Based Optometry Clinic                                |
| 10.45 am | E Eugenie Hartmann | Relationship Between Patient Baseline Characteristics and Monocular Grating Acuity at 12 Months in the Infant Aphakia Treatment Study (IATS) |

**11.05 am Poster session 1 (Odd numbered posters) Refreshments will be served**

**Session B: Amblyopia 1 (Moderator: Deborah Giaschi)**

- |          |                                |   |
|----------|--------------------------------|---|
| 12.00 pm | Rana Arham Raashid             | Short-term Saccadic Gain Adaptation in Amblyopia  |
| 12.20 pm | Ewa Niechwiej-Szwedo           | The Effect of Amblyopia on the Spatiotemporal Characteristics of Saccadic Eye Movements |
| 12.40 pm | Rajkumar Nallour<br>Raveendran | Microsaccades in Strabismic Amblyopes with Ocular Alignment and Binocular Summation     |

**1.00 pm Lunch, Networking and posters**

**Session C: Visual perception and reading disability (Moderator: E. Eugenie Hartmann)**

- |                |                    |   |
|----------------|--------------------|---|
| 2.00 pm        | T. Rowan Candy     | Remembrance of past Paediatric Vision Researchers   |
| 2.15 pm        | Cathy Williams     | Pragmatic Normative Data for Tests of Visual Perceptual Function in Primary School Children |
| 2.35 pm        | Rebecca A Lundwall | Visual Attention: Longitudinal Associations in Infants & Children                           |
| 2.55 pm        | Teri Lawton        | Improving Magnocellular Function in the Dorsal Stream Remediate Reading Deficits            |
| <b>3.15 pm</b> |                    | <b>Refreshment break</b>  |

**Session D: Visual assessment (Moderator: J. Margaret Woodhouse)**

- |         |                   |  |
|---------|-------------------|--|
| 3.45 pm | Anna O'Connor     | Testing Vision Testing   |
| 4.05 pm | Sarah Kalwarowsky | A Novel Colour Discrimination Test Suitable for Children with Low Vision |
| 4.25 pm | Hélène Verbunt    | Crowding, What's in a Name?  |

**6.00 pm Evening Dinner Event, University Club, University of Waterloo**

**Tuesday 18<sup>th</sup> June**

**9:00 am Keynote Address:**

**Daphne Maurer**, Professor, Department of Psychology, McMaster University

**“Critical Periods Re-examined: Evidence from Children Treated for Congenital Cataract”**



**Daphne Maurer** is a Distinguished Professor at McMaster University, where she has studied the normal development of visual perception and its alteration by a period of deprivation caused by cataracts. She is a member of the Royal Society of Canada and the current President of the International Society for Infant Studies. Her book, *The World of the Newborn*, written with her husband, Charles Maurer, won the APA Book Prize and has been translated into five languages.

**Session E: Amblyopia 2 (Moderator: Deborah Jones)**

- 9.50 am Maria Fronius Declining Efficiency of Electronically Monitored Amblyopia Treatment Between Age 5 and 16 Years: Insight into Plasticity of the Visual System?
- 10.10 am Deborah Giaschi Motion Perception Deficits and Occlusion Therapy for Amblyopia
- 10.30 am Sonia Toor Aniso-Accommodation in Anisometric Amblyopia

**10.50 am Poster Session 2 (Even numbered posters) and Refreshments**

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**Session F: Binocular vision (Moderator: William Bobier)**

- 12.00 pm T. Rowan Candy The Role of Heterophoria and its Adaptation in Typically Hyperopic Infants and Children
- 12.20 pm Eric Seemiller The Retinal Information Available to Drive Vergence Eye Movements During Early Development
- 12.40 pm Anna Horwood Does – And How Does - Vision Therapy (Orthoptic Treatment) Work?

**1.00 pm Lunch, Networking and Posters**

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**Session G: Visual assessment 2 (Moderator: Susan Cotter)**

- 2.00 pm Amithavikram Hathibelagal Validation of Remote Gaze Tracking for Measuring Infant Visual Acuity
- 2.20 pm John Lowery Comparison of Acuity Measures Between Teller Acuity Cards, Lea Symbols, Lea Numbers Low Vision Book and Pacific Acuity Test in Children with Visual Impairment
- 2.40 pm Nadia Northway A Validation of iSight app in Pre-School Vision Screening

**3.00 pm Refreshment break**

**Session H: Ocular disorders and Disease (Moderator: Benjamin Backus)**

- 3.30 pm Carol Westall The Role of Visual Electrophysiology Testing in Pediatric Early Onset Horizontal Nystagmus (EOHN)
- 3.50 pm Ananthavalli Kumarappah Association Between ERG Associated Vigabatrin Toxicity and Subsequent Visual Field Reduction
- 4.10 pm Wylie Tan Spatial Findings of Neuro-Retinal Damage in Adolescents with Type 1 Diabetes
- 4.30 pm Laura Finkelberg Cone Density is Nasal vs. Temporal Retina in Adolescents and Young Adults with Type 1 Diabetes

**5.00 pm Group Photograph**

**5.30 pm Business meeting (open to all those interested in the future of CVRS)**

**7.00 pm Optional dinner at Bauer Kitchen, Waterloo**

## Wednesday 19<sup>th</sup> June

07.15 am Bus to Toronto, The Hospital for Sick Children, 555 University Ave Toronto, ON M5G 1X8

10.00 am Refreshments at the Hospital for Sick Children

10.30 am Welcome by Professor Carol Westall, (Director, Visual Electrophysiology, The Hospital for Sick Children)

10.35 am **Keynote Address:**

**Dave Saint-Amour**, Professor, Department of Psychology, Université du Québec à Montréal

### “Binocular vision processing: From integration to suppression”

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**Dr Saint-Amour** is adjunct professor in the Department of Ophthalmology at the Université de Montréal and associate professor in the Department of Psychology at the Université du Québec à Montréal. He is the director of the new "Centre de recherche en neurosciences de l'Université du Québec à Montréal" and the president of the "Société Québécoise pour la Recherche en Psychologie".

He is a FRQS (Fonds de Research Santé Québec) research scholar since 2007 and has accumulated numerous awards in the course of

his career. His primary research interests are within the fields of visual neuroscience with high interests in development of children's visual system in normal with or without neurodevelopment disorders. By combining psychophysics and brain recording techniques, he investigates the links between brain physiology and visual perception. His work in binocular vision has important implication for understanding the underlying cortical processing of amblyopia.

### **Session I: Amblyopia 3 (Moderator: Carol Westall)**

11.20 am	Robert Hess	A New Binocular Treatment for Amblyopia
11.40 am	Benjamin T. Backus	Use of Dichoptic Random Dot Kinematograms to Measure Suppression in Adult Amblyopes
12.00 pm	Eileen Birch	Binocular iPad Treatment for Amblyopia

### **12.30 pm Lunch and Networking**

### **Session J: visual development (Moderator: Robert Hess)**

1.30 pm	Eliza Burton	Development of Global Form, Motion and Biological Motion Processing in Patients with Congenital Achromatopsia
1.50 pm	Terri L. Lewis	The Development of Sensitivity to the Direction of Motion
2.10 pm	Valldeflors Vinuela Navarro	The Effect of Different Motion Paradigms on Smooth Pursuit Performance in Children
2.30 pm	Announcement of poster winners and poster presentations	

### **2.50 pm Refreshment Break**

### **Session K: Prematurity and vision (Moderator: Eileen Birch)**

3.10 pm	Daphne L. McCulloch	Post-Natal Retinal Development in Very Low Birth Weight Infants Enrolled in a Randomised Controlled Trial of Early High Dose Vitamin A
3.30 pm	C.J.A. Geldof	Visual Sensory and Perceptive Functions in Very Low Birth Weight Children
3.50 pm	Catriona Macintyre-Beon	Perceptual Visual Dysfunction in Children Born Prematurely: Common But Easily Missed
4.10 pm	Anna & Barbora Zobanová	Presentation of CVRS 2015 in Prague
4.20 pm	Susan Leat	Closing remarks and close of meeting

## Poster Presentations:

### Poster#

- |    |                    |  |
|----|--------------------|--|
| 1  | Krista Kelly       | Morphological Changes in Anterior Visual System Development Following the Loss of One Eye Early in Life                                      |
| 2  | Stefania Moro      | Audition Dominates Vision After Loss of One Eye Early in Life When the Systems Are in Competition but not When They Are Integrated           |
| 3  | Michael Slugocki   | The Effect of Convexity in the Biasing Children's Perception of Figures  |
| 4  | Kathryn Saunders   | Information is Not Communication: Meaningful Reporting of Visual Status  |
| 5  | J-A Little         | The Representation of Visual Information on Educational Statements for children with Special Educational Needs                               |
| 6  |                    | Withdrawn  |
| 7  | Cathy Williams     | What Can Be Done to Help? A Scoping Review of Interventions Designed to Help Children with Both Visual and Neurodevelopmental Problems       |
| 8  | Stephanie Campbell | Corneal Hysteresis and its Potential Use for Diagnosing Keratoconus in Teenagers and Young People with Down's Syndrome - A Preliminary Study |
| 9  | Anna Zobanová      | Silicon-Hydrogel Contact Lenses in Multi-Disabled Visually Impaired Children: the Options and and Indications for Use                        |
| 10 | Barbora Zobanová   | Low Vision Therapist as a Team Member in the Comprehensive Care of MDVI Children in Health Care in Czech Republic.                           |
| 11 | Michelle O'Reilly  | Associations Between EEG Alpha Response to Emotional Vocalizations and Social Behaviour in Infants with Visual Impairment                    |

12	Naomi Dale	Optimum VI Project: Evaluation of Early Intervention and Development in Babies and Young Children with Visual Impairment (VI)
13	Julie McClelland	Retrospective and Longitudinal Study of Onset and Progression of Spherical Refractive Error in Albinism and Idiopathic Infantile Nystagmus (IIN)
14	Catriona Macintyre-Beon	Methodology for International Validation of Posterior Retinal Blood Vessel Diameter and Tortuosity in Retinopathy of Prematurity Clinical Trials - The Retinal Image Digital Analysis (RIDA) Study
15	Larissa McKetton	Abnormal Visual System Development and Morphology in Human Albinism
16	Lotte Welinder	Blue Cone Monochromatism in a Female Due to Skewed X-Inactivation
17	Jingyun Wang	Interocular Difference of Foveal Thickness in Children with Unilateral Cataracts
18	Rachel Dragas	The Origins of Retinal Toxicity Attributed to the Anti-epileptic Drug Vigabatrin in Infantile Spasms
19	Durgaa Rajendran	Association Between Inner Retinal Layer Thickness and Neuroretinal Function in Adolescents with Type 1 Diabetes and no background Diabetic Retinopathy
20	Chloé Cartier	Effect of Prenatal Exposure to Organochlorinated Pesticides on Visual Evoked Potentials in Inuit Children
21		Withdrawn
22	Frea Sloot	Disinvestment Study of Population-Based Peverbal Vision Screening in the Netherlands
23	Lisa Hamm	The Use of Computer Generated Faces to Measure the Perception of Facial Expression
24	Pete Jones	Novel Approaches to Automated, Real-Time Eye-Movement Classification in Infants and Adults
25	C.J.A. Geldof	Visual Search and Attention in Very Low Birth Weight Children
26	Koen Van Braeckel	Dorsal and Ventral Visual Stream Functioning in Very, Moderate and Late Preterm Born School-Aged Children

27	Boram Hong	Visual Function in School-Age Children with a History of Prematurity
28	Amanda Thomas	The Development of Optic Flow Sensitivity
29	Kimberly M. Meier	Resolving Inconsistencies in Human Global Motion Maturation
30	Valldeflors Vinuela Navarro	Normative Values for Smooth Pursuit Eye Movements in School-Age Children: A Preliminary Study
31		Withdrawn
32		Withdrawn
33	Tzu-Ying (Sandy) Yu	Global Motion Detection is Related to Motor and Cognitive Development at Two Years of Age
34	Claudia Polevoy	Behavioural and Electrophysiological Measurement of Visual Acuity in Infants: Evidence of a Linear Relationship Only During Late Infancy.
35	Valldeflors Vinuela-Navarro	Scoping Exercise: The Assessment of "Tracking Difficulties" and Eye Movements in Children
36	Manokaraanathan Chandrakumar	Comparing M&S Smart System II with the Pelli-Robson Chart for Measuring Contrast Sensitivity Thresholds in a Clinical Setting
37		Withdrawn
38	Branka Stirn Kranjc	Rat Ocular Medial Rectus Muscle Regeneration After Marcaine Degeneration
39	Dinesh Kaphle	Treatment of Anisometropic Amblyopia In Children with Refractive Correction
40	Anna Horwood	The Convergence Insufficiency Symptom Score Questionnaire in an Asymptomatic Undergraduate Sample

**Monday 17<sup>th</sup> June 2013**

**Session A: Refractive management**

**10.05 am**

## **Longitudinal Follow-up of Infants with Significant Refractive Error at 3-5 Months of Age**

**Presenting Author:** Vivian M.W. Wong, *School of Optometry, Indiana University, United States of America*

**Co-Author(s):** T.L. Roberts, *School of Optometry, Indiana University, Bloomington, USA* ; T.R. Candy, *School of Optometry, Indiana University, Bloomington, USA*

### **Purpose**

The American Academy of Ophthalmology Preferred Practice Pattern (PPP) provides consensus-based guidelines for prescribing optical correction for infants from birth to one year, a time during which significant emmetropization typically occurs. Increased lags of accommodation have been demonstrated in infants with hyperopia  $\geq +4.00D$  (Ingram et al 1994, Mutti et al 2009, Horwood & Riddell 2011, Candy, et al 2012, Tarczy-Hornoch 2012), especially in those who do not emmetropize. The goals of this study were to determine the proportion of 3 month-olds with significant refractive errors that would go on to emmetropize prior to one year of age and to determine the association with accommodative accuracy during this period.

### **Methods**

102 infants were recruited at 3-5 months of age and followed longitudinally to track changes in cycloplegic refraction and accommodative accuracy for a target at 33cm using Nott retinoscopy. Criteria for significant anisometropia ( $\geq 2.50D$ ) and astigmatism ( $\geq 3D$ ) were established based on the PPP and for hyperopia ( $\geq +4D$ ) based on prior studies of accommodation.

### **Results**

16 of 102 infants had refractive errors above the criteria at 3-5 months of age and were followed at 2-3 month intervals. Of 13 with hyperopia  $\geq +4D$ , 9 had insignificant refractive error by the end of the first year. Of 3 others with astigmatism, 2 had insignificant refractive error by the end of the first year. Using a criterion lag of 1.25D in the most accurate meridian, accommodative accuracy at 3-5 months of age was not predictive of emmetropization ( $p > 0.05$ ). After that age, only one infant who lost their hyperopia demonstrated a large lag, while all infants with persistent hyperopia or anisometropia demonstrated lags  $\geq 1.25D$  prior to being prescribed optical correction. None of the astigmatic infants demonstrated a lag  $\geq 1.25D$ .

### **Discussions & Conclusions**

65% of infants with refractive errors greater than these criteria at 3-5 months of age no longer met the criteria by the first year of age. Although it has been shown that accommodative accuracy decreases with high hyperopia this metric was not predictive of emmetropization until after 3-5 months of age. In this study, using a  $\geq +4D$  criterion for hyperopia at 3-5 months based on prior studies of accommodative accuracy identified numerous infants who went on to emmetropize.

**Acknowledgements:** NIH EY014460 (TRC), K23 EY022357 (TLR)

**Disclosure(s):** None

**Web Page:** [www.opt.indiana.edu/people/faculty/candy/index.html](http://www.opt.indiana.edu/people/faculty/candy/index.html)

**Keyword(s):** accommodation, refractive error

Monday 17<sup>th</sup> 10.25 am

## **Symptoms and their Optometric Correlates Among Children with Hyperopia in a University-Based Optometry Clinic**

**Presenting Author:** Susan J. Leat, *School of Optometry and Vision Science, University of Waterloo, Canada*

**Co-Author(s):** A. Mittelstaedt, *Department of Computer Science, U Waterloo, Waterloo, Canada* ; CM. Machan, *Optometry and Vision Science, U Waterloo, Waterloo, Canada.* ; PK. Hrynychak, *Optometry and Vision Science, University of Waterloo, Waterloo, Canada.* ; EL. Irving, *Optometry and Vision Science, U Waterloo, Waterloo, Canada.*

### **Purpose**

There is considerable variability of opinion among optometrists and ophthalmologists regarding the amount of hyperopia that should be corrected in the school age population. The purpose of this retrospective clinical population study was to determine whether the presence of symptoms can help to determine a guideline for the correction of hyperopia in children.

### **Methods**

We reviewed the files of 401 uncorrected hyperopes ( $\geq 0.25D$  in at least one meridian, excluding those with strabismus or anisometropia  $>1D$ ) aged 4-19 years who attended the Primary Care or Pediatric Clinic at the School of Optometry and Vision Science, University of Waterloo. For a subgroup ( $n=78$ ) who returned after glasses were prescribed, two clinic visits were analysed; the visit at which the child was first prescribed glasses and the subsequent eye examination. Data on refraction, distance and near phoria, near point of convergence (NPC), uncorrected visual acuity, presence or absence of presenting symptoms and the number of different symptoms per patient (e.g. headache, blur etc) were collected and analysed.

### **Results**

The amount of astigmatism and hyperopia, uncorrected visual acuity, NPC and age were each significantly associated with the presence of symptoms ( $p<0.05$ ). The presence of symptoms increased with the amount of uncorrected hyperopia from 25% in the 0.25-1.5D group to 62% in the 1.75+D group, although symptoms were still quite common among children with low amounts of hyperopia. There was a significant decrease in the number of symptoms after spectacle correction for the hyperopes as a whole, when separated into those under 5 years and 5+, and when separated into hyperopic groups (0-0.75D, 1-1.75D, 2-2.75D & 3+D) [Wilcoxon signed-rank test;  $p<0.05$ ]. Multiple regression analysis indicated that age, hyperopia, astigmatism, distance phoria, NPC and the number of symptoms are associated with the prescription of spectacles.

### **Discussion & Conclusions**

The prevalence of symptoms increased substantially at  $>1.5D$  of uncorrected hyperopia and there was a significant decrease in symptoms after correction. We conclude that this amount of hyperopia should be considered for correction. The level of hyperopia for which a prescription was issued decreased as the child became older in this clinic population. Optometrists take symptoms into account when prescribing, together with refractive error (sphere and cylinder), phoria, NPC and age.

**Acknowledgements:** *Supported by Vision Services Plan, Canadian Research Chair and NSERC*

**Disclosure(s):** *None.*

**Web Page:** <https://uwaterloo.ca/optometry-vision-science/people-profiles/susan-leat> **Keyword(s):** *refractive management, refractive error, visual function*

Monday 17<sup>th</sup> 10.45 am

## Relationship Between Patient Baseline Characteristics and Monocular Grating Acuity at 12 Months in the Infant Aphakia Treatment Study (IATS)

**Presenting Author:** E Eugenie Hartmann, *Vision Sciences, University of Alabama at Birmingham, United States of America*

**Co-Author(s):** MJ Lynn, *Department of Biostatistics and Bioinformatics; Rollins School of Public Health, Emory University, Atlanta, GA, United States* ; SR Lambert, *Department of Ophthalmology, School of Medicine, Emory University, Atlanta, GA, United States* ; IATS Group

### Purpose

To evaluate the influence of baseline characteristics on monocular grating visual acuity (VA) in the treated eye for infants enrolled in IATS.

**Methods** IATS is a multi-center, RCT for unilateral congenital cataracts in infants 1-7 months of age. 114 infants were randomly assigned to contact lens (CL) treatment or initial implantation of an intra-ocular lens (IOL). Monocular VA was estimated at 12m of age ( $\pm 2m$ ) by a traveling tester using the Teller Acuity Cards. Median logMAR VA was not significantly different between the two groups (CL: 0.80; IOL:0.97;  $p=.19$ ). Given this finding we conducted the following analyses on the 114 infants as one group.

### Results

The relationship between 12 month VA and individual variables was analyzed using Spearman Rank Correlation (continuous)\* or Wilcoxin Rank Sum Test (categorical)\*\*. We considered three types of characteristics: physiology of treated eye; infant and sociological characteristics. (See Table) Of the nine variables, VA was significantly associated only with type of medical insurance (private vs Medicaid), Median VA private insurance was 0.80 logMAR; median VA Medicaid was 0.97 logMAR ( $p=0.012$ ).

### Discussion & Conclusions

These analyses suggest that the overall treatment outcome depends on socioeconomic status of the family measured by availability of private insurance rather than other baseline characteristics. We have reported that caregivers with greater socioeconomic status (maternal education and private insurance) were more likely to adhere to patching 3 months after surgery. Surgeons should be aware that parental understanding and acceptance of the treatment regimen is critical and provide educational and social support for parents who are less likely to adhere to the occlusion treatment.

**Acknowledgements:** *Supported by National Eye Institute grants EY13272 and EY13287.*

**Disclosure(s):** *No proprietary interests.*

**Keyword(s):** *monocular congenital cataract, amblyopia, visual development atypical*

	Baseline	r *	p	Baseline	r*	p
	pupil diameter	.06	.52	gestational age	.12	.23
	corneal diameter	.10	.31	birth weight	-.05	.61
	axial length	.12	.23	sex	**	.67
	K-reading	.07	.45	age of caregiver	-.09	.33
	IOP	.01	.92	Hispanic	**	.69
	PFV	**	.46	race	**	.21
	orthotropia	**	.52	private insurance	**	.012

## **Session B: Amblyopia 1**

**Monday 17<sup>th</sup> 12.00 pm**

### **Short-term Saccadic Gain Adaptation in Amblyopia**

**Presenting Author:** Rana Arham Raashid, *Neuroscience and Mental Health, Hospital for Sick Children, Canada*

**Co-Author(s):** M Chandrakumar, *Neuroscience and Mental Health, Hospital for Sick Children, Toronto, Canada* ; A Blakeman, *Dept of Ophthalmology and Vision Sciences, University of Toronto, Toronto, Canada* ; HC Goltz, *Dept of Ophthalmology and Vision Sciences, Hospital for Sick Children, Toronto, Canada* ; AMF Wong, *Dept of Ophthalmology and Vision Sciences, Hospital for Sick Children, Toronto, Canada*

#### **Purpose**

Saccadic adaptation is an important motor learning mechanism that maintains the accuracy of goal-directed saccades. It is believed to be driven by visual error signal at the end of saccades. Amblyopia is a neuro-developmental disorder characterized by impairment of spatiotemporal visual processing. The purpose of this study is to investigate the effects of spatiotemporal visual deficits in amblyopia on saccadic adaptation.

#### **Methods**

Eleven patients with amblyopia (7 anisometropic, 2 strabismic, 2 mixed) and 11 visually-normal participants were instructed to follow a visual target on a screen while their eye movements were recorded. Saccadic adaptation was induced experimentally using a double-step target paradigm, in which the visual target (at 18° eccentricity) was displaced toward initial fixation (by 4°) during the saccade. The experiments included a single-step pre-test, a double-step adaptation test, and a single-step post-test, performed during binocular viewing and monocular viewing with the amblyopic and fellow eye (non-dominant and dominant eye in normal participants) in three different sessions. Percentage change and variability in saccadic gain, as well as saccadic latencies were measured.

#### **Results**

Patients with amblyopia exhibited a reduced percentage change in saccadic gain when viewing with the amblyopic eye ( $46\pm 14\%$ ) as compared to normal participants viewing with the non-dominant eye ( $72\pm 10\%$ ), and also during binocular viewing (patients= $60\pm 17\%$ , normal= $78\pm 12\%$ ;  $p=0.014$ ). Moreover, the adapted saccadic gain was more variable in patients ( $0.06\pm 0.02$ ) when compared to normal participants ( $0.04\pm 0.01$ ) under all viewing conditions ( $p=0.005$ ). Saccadic latency was longer in patients during amblyopic eye viewing ( $236\pm 36$  ms) when compared to non-dominant eye viewing in visually-normal participants ( $202\pm 27$  ms;  $p=0.007$ ).

#### **Discussion & Conclusions**

The short-term adaptation of the saccadic gain in response to a double-step target was less robust and more variable in patients with amblyopia during amblyopic eye and binocular viewing. Our findings suggest that processing of visual error information necessary for adaptation is imprecise in amblyopia, and support the hypothesis that the error signal that drives saccadic adaptation is visual in nature.

**Disclosure(s):** *No financial disclosures for all authors.*

**Keyword(s):** *sensorimotor adaptation, amblyopia, eye movements*

**Monday 17<sup>th</sup> 12.20 pm**

## **The Effect of Amblyopia on the Spatiotemporal Characteristics of Saccadic Eye Movements**

**Presenting Author:** Ewa Niechwiej-Szwedo, *Department of Kinesiology, Waterloo, Canada*

**Co-Author(s):** H.C. Goltz, *Department of Ophthalmology and Vision Sciences, The Hospital for Sick Children and University of Toronto, Toronto, Canada* ; M. Chandrakumar, *The Hospital for Sick Children, Toronto, Canada* ; A.M. Wong, *Department of Ophthalmology and Vision Sciences, The Hospital for Sick Children and University of Toronto, Toronto, Canada*

### **Purpose**

Amblyopia is a developmental visual impairment associated most commonly with early childhood strabismus (eye misalignment), anisometropia (significant difference in refractive error between the eyes), or both (mixed mechanism). Impairment of spatiotemporal visual processing in amblyopia has been studied extensively, but its effects on the oculomotor system have rarely been studied systematically. Here we examine the effect of amblyopia type (i.e., anisometric, strabismic and mixed), acuity and stereoacuity losses on the temporal-spatial characteristics of saccades.

### **Methods**

Forty nine patients participated: 21 with anisometropia, 15 with strabismus and 13 with mixed amblyopia. In the anisometric group, acuity ranged from 0.18 to 2.00 logMAR, and 14 patients had residual stereopsis (50 - 3000 arc sec). In the strabismic group, acuity was between 0.18 and 1.00 logMAR, and only 5 patients had residual stereopsis (120 - 800 arc sec). In the mixed group, acuity ranged from 0.18 to 2.00 logMAR and only 4 patients had residual stereopsis (200 - 3000 arc sec). Participants executed horizontal saccades to a computer-generated target presented randomly at 5° or 10° eccentricity while viewing with the amblyopic eye. Saccades were recorded with a binocular video-based eye-tracker and performance was characterized by latency, accuracy (gain) and precision (variability). A multiple regression model was fitted to examine the effect of amblyopia type, acuity and stereoacuity losses on saccade performance.

### **Results**

Regression analysis showed that amblyopia type was not a significant predictor of saccade performance. Acuity of the amblyopic eye was a significant predictor of saccade latency ( $p=0.002$ ) and accounted for 18% of variance in saccade latency. Regardless of the type of amblyopia or stereoacuity, a reduction in logMAR acuity of 0.05 was associated with saccade latency increasing by 1 ms. Stereoacuity was a significant predictor of saccade precision ( $p=0.0002$ ), which explained 26% of variance in saccade amplitude precision.

### **Discussion & Conclusions**

Our data show a differential effect of acuity and stereoacuity losses on saccade performance. Specifically, acuity impairment is a predictor of saccade initiation, whereas stereoacuity is a predictor of saccade amplitude precision. Importantly, these predictors were independent of amblyopia subtype.

**Disclosure(s):** *None.*

**Keyword(s):** *amblyopia, eye movements*

**Monday 17<sup>th</sup> 12.40 pm**

## **Microsaccades in Strabismic Amblyopes with Ocular Alignment and Binocular Summation**

**Presenting Author:** Rajkumar Nallour Raveendran, *School of Optometry and Vision Science, University of Waterloo, Canada*

**Co-Author(s):** RJ Babu, *School of Optometry and Vision Science, University of Waterloo, Waterloo, Canada* ; WR Bobier, *School of Optometry and Vision Science, University of Waterloo, Waterloo, Canada*

### **Purpose**

Previously, we have shown that fixation stability (FS) of the amblyopic eye (AME) and the fellow fixing eye (FFE) were improved when binocular integration was established through ocular alignment and the reduction of inter-ocular suppression (Raveendran et al, ARVO, 2013). This report examines changes in the amplitude and peak velocity of microsaccades for the same subjects under these conditions.

### **Methods**

The data set taken from 6 strabismic amblyopes (age:  $30.8 \pm 9.7$  yrs) (5 esotropes and 2 exotropes) (VA: AME= $0.50 \pm 0.30$ ; FFE= $-0.12 \pm 0.04$ ) showing clinical characteristics of central suppression was examined. One subject had been excluded as suppression could not be quantified. Ocular alignment was established with a haploscope. Suppression of the AME was then attenuated by reducing the contrast to the FFE (Baker, 2007). Participants dichoptically viewed similar targets [a cross ( $2.3^\circ$ ) surrounded by a square ( $11.3^\circ$ ) visual angle] set at 40cm. Target contrasts presented to each eye were either equal (EQ) or attenuated in the FFE (UNEQ) by an amount defined by the Global Motion Task. Fixation was measured over a 5 min period (Viewpoint® Eye Tracker, Arrington Research) in four different binocular conditions; unaligned/EQ, unaligned/UNEQ, aligned/EQ and aligned/UNEQ. Then, microsaccades were detected using the software [Ilab, Gitelman (2002)] and depending on the criteria; minimum initial velocity -  $5^\circ/s$  and minimum duration - 10ms. Similar measures were taken for 6 control participants.

### **Results**

Alignment of the AME was transient and lasted between 30 to 80 seconds. Accordingly, the amplitude and peak velocity of microsaccades were analyzed over the first 30 seconds for the different viewing conditions using Non-Parametric analysis. There were no statistically significant differences in either amplitude or peak velocity across the conditions for AME & FFE.

### **Discussion & Conclusions**

Although fixational stability improved with bifoveal alignment and reduced interocular suppression, microsaccadic amplitude and peak-velocity remain unchanged.

**Acknowledgements:** NSERC-Canada to WRB

**Disclosure(s):** No Commercial interests

**Keyword(s):** strabismus, amblyopia, eye movements

## Session C. Visual Perception and Reading Disability

Monday 17<sup>th</sup> 2.15 pm

### Pragmatic Normative Data for Tests of Visual Perceptual Function in Primary School Children

**Presenting Author:** Cathy Williams, School of Social and Community Medicine, University of Bristol, United Kingdom

**Co-Author(s):** S Fraser, Optometry Dept, Bristol Eye Hospital, Bristol, UK ; H McCarthy, Orthoptic Dept, Bristol Eye Hospital, Bristol, UK ; J Parker, Orthoptic Dept, Bristol Eye Hospital, Bristol, UK ; P Warnes, Orthoptic Dept, Bristol Eye Hospital, Bristol, UK ; K Northstone, School of Social and Community Medicine, University of Bristol, Bristol, UK ; J Young, Emerson's Green Primary School, South Gloucestershire Council, Bristol, UK ; L Hyvarinen, Dept of Developmental Neuropsychology, University of Helsinki, Helsinki, Finland

#### Purpose

Children with neurodevelopmental disorders may have abnormal visuoperceptual skills. Tests exist to assess visual perceptual function in laboratory settings and some have been adapted for use in clinical settings. However there are few reports of the results obtained when administered to unselected children not known to have developmental problems – we sought to obtain such normative data.

#### Methods

We invited children to a “vision games” session held at their school. They underwent pre-specified test procedures, with their glasses if worn, comprising binocular visual acuity using age appropriate LogMAR crowded test, the contour test (assesses perceptual grouping) using a previously-reported staircase procedure, the postbox test and the rectangles test - the last two using instructions on a specialist website. The school separately notified the research team about any children who had been identified as having developmental or educational problems.

#### Results

A total of 231 children (4 – 11 years) came to the sessions and the schools reported that 17 had developmental or educational problems. Presenting binocular acuity was 0.2 LogMAR or better for 95% of children. The contour test median score remained constant between ages 6 – 11. All children without problems could do the postbox test and only 4% (all < 9 years) made misjudgements when posting. Performance in the rectangles test improved with age - the Odds ratio (95%) for making major errors, per year of increasing age was OR = 0.34 (0.20 to 0.59)  $p < 0.001$  and performance was worse if the child was known to have a developmental problem - OR for major errors = 13.6 (4.1 to 45.0  $p < 0.001$ ). By contrast minor errors with the rectangles were more frequent and seen in 9% of even the oldest children.

#### Discussion & Conclusions

These data provide preliminary guidance as to what levels of performance are seen with these tests among primary-school age children who are not known to have developmental problems. At least 98% of children aged 7 or older could do the postbox test without any errors and the rectangles test without major difficulties but even the oldest children sometimes made minor errors with the rectangles. These data will aid interpretation of results obtained with clinic patients but further data will also be needed.

**Acknowledgements:** Many thanks to the staff, parents and pupils who helped with this study; NIHR who fund CW and IDG

**Disclosure(s):** Confirmation awaited

**Keyword(s):** visual perceptual skills, cortical processing, visual development typical

Monday 17<sup>th</sup> 2.35 pm

## **Visual Attention: Longitudinal Associations in Infants & Children**

**Presenting Author:** Rebecca A Lundwall, *Psychology, Rice University, United States of America*

**Co-Author(s):** JL Dannemiller, *Psychology, Rice University, United States of America*

### **Purpose**

To determine if an infant visual attention task can predict various child attentional outcomes, including visual attention in childhood. The longitudinal design allows us to report on the development of reflexive attention between infancy and childhood.

### **Methods**

Data are available from 200 children who participated as infants in visual attention studies (see Dannemiller, 2004) and who are now approximately 9-15 years old. This study is part of a longitudinal follow-up study examining genetic associations with various measures of attention.

Parents provided academic scores, health diagnoses, and responses to a psychiatric symptom checklist for their children. Children completed two attention tasks. One task simply measured eye movement latency and accuracy to saccade to a moving bar in the presence of numerous static, distracting bars, and the other is modified from a Posner exogenous cueing task (Posner & Cohen, 1984).

### **Results**

Several measures that were obtained in infancy were found to be associated significantly with measures on two child attention tasks. We found that birthweight (all had normal birthweights) and infant Force Choice Preferential Looking (FPL) percent correct to a moving bar in the presence of distracting stimuli are associated with the attentional costs of invalid pre-cues on the Posner task. In addition, several parental report symptom scores (e.g., inattention, anxiety, sleepiness) were associated contemporaneously with scores on the Posner cued orienting task.

### **Discussion & Conclusions**

Outcomes from an infant FPL orienting task were useful in predicting child attentional outcomes 9-15 years later. We will begin genotyping these children shortly on genetic markers related to brain development and/ or to the availability of neurotransmitters such as acetylcholine, dopamine, or serotonin (e.g., APOE, CHRNA4, SLC5A7, COMT, DRD1, DRD4, SLC6A3 (aka DAT1), BDNF, HTR2A, HTR4, SLC6A4 (aka 5HTT), MAOA, SNAP25, ADRA1A, IGF2). Genetic results should be available by the end of April and will be included in the presentation if they are available.

**Acknowledgements:** *Social Science Research Institute grant to RAL Lynette S. Autrey Research support to JLD*

**Disclosure(s):** *None.*

**Web Page:** *ralundwall.rice.edu/*

**Keyword(s):** *visual attention, visual development typical, visual function*

Monday 17<sup>th</sup> 2.55 pm

## Improving Magnocellular Function in the Dorsal Stream Remediate Reading Deficits

**Presenting Author:** Teri Lawton, *Computer Sciences & Engineering, UCSD, and Reading and Cognitive Remediation, Perception Dynamics Institute, United States of America*

**Co-Author(s):** Jordan Conway, *Dept of Computer Sciences & Engineering, UCSD, La Jolla, CA 92093* ; Kelly Lawton, *Dept of Computer Sciences & Engineering, UCSD, La Jolla, CA 92093* ; Steven Edland, *Depts of Preventive Medicine, Neurosciences, UCSD, La Jolla, CA 92093*

### Purpose

There is no greater educational problem facing our schools than students who have trouble reading. We hypothesize that a temporal processing deficit in both the auditory and visual pathways may be a key factor limiting reading performance. To investigate the efficacy of reading interventions designed to improve temporal processing speed, we compared two timing interventions, *FastForWord (FFW)* targeting the temporal dynamics of the auditory pathway, and *PATHtoReading (PATH)* targeting the temporal dynamics of the visual pathway. Both interventions, designed to increase the sensitivity and temporal precision of magnocellular neurons in the motion-sensitive dorsal stream, have been shown to be efficacious in randomized trials.

### Methods

This study examined whether *FFW* and *PATH* can be combined into an intervention that results in an even greater benefit. We ran a randomized trial on dyslexic second graders in 6 public elementary schools in San Diego comparing business-as-usual (control group), *PATH*, *FFW*, *PATH+FFW*, Orientation Discrimination (OD) to activate parvocellular neurons in the pattern-sensitive ventral stream, and a group that did *PATH* followed by OD to train the ventral stream after training the dorsal stream. Standardized tests of reading fluency, spelling, and attention were the measures used to evaluate improvements in reading skills. ANCOVAs controlling for age, sex, ethnicity, English as second language status, and school enrolled were used to compare treatment response across groups. Recruitment is ongoing. Sample size for this interim analysis is 126 students distributed approximately equally across the 6 treatment arms.

### Results

Arms that include *PATH* tended to outperform other arms in the trial, especially for attention, spelling, phonological processing, and reading skills, although confidence intervals about treatment effects are large, so most comparisons did not reach statistical significance. Among 66 students enrolled in traditional (not year-round) schools, *PATH* improved reading grade level significantly more than controls.

### Discussion & Conclusions

Training visual magnocellular function improves the reading skills of dyslexics, contrary to claims that reading is only phonologically-based.

**Acknowledgements:** *Funded by IES Award R305A100389 to UCSD and Perception Dynamics Institute.*

**Disclosure(s):** *Dr. Teri Lawton is the Founder and Director of Research at Perception Dynamics Institute.*

**Web Page:** [www.pathtoreading.com](http://www.pathtoreading.com)

**Keyword(s):** *perceptual learning -cortical plasticity, cortical processing, reading and learning disabilities*

## **Session D: Visual assessment**

**Monday 17<sup>th</sup> 3.45 pm**

### **Testing Vision Testing**

**Presenting Author:** *Anna O'Connor, Orthoptics and Vision Science, University of Liverpool, United Kingdom*

**Co-Author(s):** *L Tidbury, Orthoptics and Vision Science, University of Liverpool, Liverpool, UK.*

#### **Purpose**

Assessment of visual acuity (VA) is an integral part of ophthalmic care, informing decisions on diagnosis and management. VA results are dependent on the correct test distance being maintained, a particular challenge when assessing children, but the amount of movement that occurs during testing and subsequent impact on VA is unknown. The aim of this study was to quantify the movement during VA testing for near and distance VA and relate the amount of movement to the VA score.

#### **Methods**

Clinical orthoptists were recruited to test VA in cooperative adults whilst being filmed. Both participants were told the purpose of the filming was to analyse test-retest values. VA measurements were repeated under controlled conditions, using a chin rest to maintain the precise test distance. Afterwards, the distance between the chart and subject were calculated by analysing the number of pixels and relating to the known size of a reference marker.

#### **Results**

16 orthoptists assessed a total of 51 subjects (measurement data available for n=86 eyes, missing data due to orthoptists obscuring the camera) with a mean age of 35 years. The range of movement towards or away from the chart was -0.1 to 0.18m for near VA and -0.19 to 0.35m for distance VA. In 7% (n=6) of eyes the movement towards the chart for near VA was =8cm, equivalent to at least one line logMAR improvement. However, only 2 of the 6 demonstrated an improvement in VA of =0.1 logMAR. Bland Altman plots demonstrated a mean bias ( $\pm$ SD) between the controlled VA measurement and orthoptist VA of -0.07 ( $\pm$ 0.1) logMAR for near VA and -0.04 ( $\pm$ 0.09) logMAR for distance VA.

#### **Discussion & Conclusions**

There was a significant deviation from the prescribed test distance, impacting on the VA result. Although the VA score did not improve as much as the movement would suggest, the analysis was based on the assumption that the best VA was achieved when the subject was closest to the chart. Further analysis will be undertaken to determine the variability in movement and impact of tilt of the near VA chart. As an equal or greater movement would be expected in children, a method of fixing the test distance to prevent movement of the patient and chart (for near VA) is recommended to ensure accurate measurements.

**Disclosure(s):** *None.*

**Keyword(s):** *visual acuity, visual development typical, visual function*

Monday 17<sup>th</sup> 4.05 pm

## **A Novel Colour Discrimination Test Suitable for Children with Low Vision**

**Presenting Author:** Sarah Kalwarowsky, *Institute of Ophthalmology, University College London, Great Britain*

**Co-Author(s):** M Nardini, *Institute of Ophthalmology, University College London, London, UK* ; C Ripamonti, *Institute of Ophthalmology, University College London, London, UK*

### **Purpose**

Normal colour vision relies on the absorption of light by the short-, medium-, and long-wavelength-sensitive cones. If one or more cone types are absent, or their function is compromised (*e.g.*, Leber Congenital Amaurosis), colour vision is affected. Most of the available colour vision tests can only assess the degree of colour vision in observers with visual acuity above 0.1 (6/60) (with some exceptions, *e.g.* Simunovic *et al.*, 1998; Arden & Wolf, 2004; Barbur, 2004). Also, few of the existing colour vision tests are suitable for young children (Neitz & Neitz, 2000).

### **Methods**

To measure the colour vision retained by children with low vision, we have developed a new computer-based test consisting of circles of random luminance. A small sub-set of circles delineate a 5-degree square that varies in saturation. Using a 2AFC paradigm, observers indicated whether the coloured square appeared on the left- or the right-hand side of the screen. The task is simple and easy for children to learn. During the test, the chromaticity of the square changed along several directions of the CIE (1976) *Luv* space. Using a staircase procedure, we measured the minimum saturation required for each observer to discriminate the square from the achromatic background. We tested adults and children as young as 7 years on this test, as well as the Cambridge Colour Test, the Ishihara plates, the Farnsworth-Munsell 100 Hue Test, and the Nigel Anomaloscope.

### **Results**

We found that chromatic discrimination thresholds were equidistant from the white point in all directions, for adults and children with normal colour vision. More importantly, affected observers, who were unable to perform the various standardised tests due to their low visual acuity, could successfully complete our test. However, their thresholds had overall larger departures from the white point and were better characterised by ellipses with axes of asymmetrical length, with the main axis being parallel to the protan, the deutan or the tritan confusion axes.

### **Discussion & Conclusions**

The test is a promising tool for measuring and monitoring changes in colour vision due to the progression of a disease or its improvement after treatment. Our future goals are to validate the test with larger numbers of observers and to extend it to younger ages by using gaze-contingent (eye tracking) methods.

**Acknowledgements:** *Fight For Sight NIHR Moorfields Biomedical Research Centre*

**Disclosure(s):** *None.*

**Web Page:** [www.ucl.ac.uk/ioo/cvl/](http://www.ucl.ac.uk/ioo/cvl/)

**Keyword(s):** *colour vision, visual development atypical, visual function*

Monday 17<sup>th</sup> 4.25 pm

## **Crowding, What's in a Name?**

**Presenting Author:** *Hélène Verbunt, Diagnostic Centre Grave, Royal Dutch Visio, The Netherlands*

**Co-Author(s):** *H.E.J.M. Lijnders, Royal Dutch Visio, Grave, The Netherlands ; C.J.A. Geldof, Royal Dutch Visio, Amsterdam, The Netherlands*

### **Purpose**

Crowding refers to impaired recognition caused by surrounding contours. In the rehabilitation of visually impaired children the term crowding is used by different professionals. But these professionals use different tools to establish crowding. This exploratory, practice based study aims to classify crowding at three levels: 1. sensory level, examined in visual acuity testing, 2. perceptual level, assessed using visual search and closure tasks, 3. behavioural level, as reported on an inventory list. In addition, associations between the three levels were explored.

### **Methods**

Children aged 5-7years with average mental development were examined at Visio in Grave between March 2012 and April 2013. Most children are already known with visual impairment, are in guidance of Visio and receive a regular multidisciplinary assessment before entering primary school. Exclusion criteria: visual acuity <0.1, hemianopia, visual field <30°, IQ <70. The assessment included visual acuity (Cambridge crowding cards); visual search (NEPSY visual attention (cats and faces), RAKIT hidden figures, DTVP-2 figure-ground); and visual closure (KABC-II gestalt-closure and DTVP-2 visual closure). Parents filled in three subsections of the Glasgow CVI Inventory (Dutton, et al.): 1. difficulty handling the complexity of a visual scene, 2. impaired visual attention, and 3. crowded environments. Associations are explored using correlation analysis.

### **Results**

Preliminary results of 16 children indicate that crowding ratio is strongly associated with RAKIT hidden figures, and NEPSY faces accuracy. Crowding ratio was moderately associated with visual closure tasks and behaviour in complex visual scenes. Behaviour in complex visual scenes was strongly associated with DTVP visual closure, whereas behavioural signs of impaired attention and crowded environments was moderately associated with accuracy in NEPSY faces and DTVP visual closure and strongly with RAKIT hidden figures.

### **Discussion & Conclusions**

The term crowding is used to address impaired performance on many of the tests we used. However, we did not find strong associations between most of the tasks used. Current results must be interpreted with caution, since our group is small and not representative for a general ophthalmic practice. To diminish ambiguity in multidisciplinary teams, we suggest restricted use of the term crowding in describing visual acuity results.

**Disclosure(s):** *None*

**Web Page:** *www.visio.org*

**Keyword(s):** *crowding, rehabilitation, visual function*

Tuesday 18<sup>th</sup> June 2013

Session E: Amblyopia 2

9.50 am

## **Declining Efficiency of Electronically Monitored Amblyopia Treatment Between Age 5 and 16 Years: Insight into Plasticity of the Visual System?**

**Presenting Author:** Maria Fronius, *Pediatric Ophthalmology, Child Vision Research Unit, Goethe University Frankfurt/M., Germany*

**Co-Author(s):** S. Kaemmerling, *Pediatric Ophthalmology, Child Vision Research Unit, Goethe University, Frankfurt/M., Germany* ; I. Bachert, *Pediatric Ophthalmology, Child Vision Research Unit, Goethe University, Frankfurt/M., Germany* ; CM Diehl, *Pediatric Ophthalmology, Child Vision Research Unit, Goethe University, Frankfurt/M., Germany*

### **Purpose**

Recent research has challenged the notion of a limited, early period of plasticity of the amblyopic visual system. In our prospective study applying the Occlusion Dose Monitor (ODM, Simonsz et al 1999) treatment efficiency was calculated to investigate to what extent the reduced effect of patching after early childhood is due to declining plasticity or lower adherence with prescribed treatment. The development of the depth of interocular suppression and its relation to acuity was explored.

### **Methods**

Occlusion was monitored electronically for 4 months in 25 patients aged 5 to 16 years with strabismic and/or anisometropic amblyopia undergoing patching treatment. Patching dose and acuity changes (logMAR gain or reduction of interocular difference IOD) were recorded, and data of patients younger and older than 7 years were compared. Treatment efficiency was calculated as: *acuity gain (or IOD reduction) [log units]\*1000/recorded occlusion [h]*. The depth of interocular suppression was quantified in 15 patients by means of a Bagolini red filter ladder.

### **Results**

Occlusion resulted in significant improvement in both age groups ( $p < 0.01$ ). Despite comparable patching dosages ( $p = 0.80$ ), the effects were significantly lower in patients older than 7 years. Treatment efficiency showed a nonlinear decline with age, and the difference between age groups was significant ( $p = 0.0367$ ). While mean IOD decreased steadily, the depth of suppression increased significantly during the first month of treatment and decreased later on.

### **Discussion & Conclusions**

Electronic recording allowed this first quantification of treatment efficiency within and beyond the "classical" treatment age. Though demonstrating improvement also in >7 year olds, it confirmed the importance of early treatment. Acuity and suppression did not change in parallel. Assessing treatment efficiency extends insight into age dependent plasticity of the visual system and provides a basis for comparison with emerging alternative amblyopia treatment.

**Acknowledgements:** *Funding: German Ophthalmological Soc., Bielschowsky Soc., "Augenstern"*

**Disclosure(s):** *none*

**Keyword(s):** *occlusion treatment, amblyopia, visual development atypical*

Tuesday 18<sup>th</sup> 10.10 am

## **Motion Perception Deficits and Occlusion Therapy for Amblyopia**

**Presenting Author:** Deborah Giaschi, *Ophthalmology and Visual Sciences, University of British Columbia, Canada*

**Co-Author(s):** C Chapman ; S Narasimhan ; C Ho ; C Lyons ; D Regan, *Psychology, York University, Canada*

### **Purpose**

Amblyopia is characterized by reduced visual acuity in a clinically normal, optimally refracted eye. Visual acuity and other aspects of form perception are usually normal in the fellow eye. We found that following treatment, many children also have deficits in motion perception in the amblyopic and the fellow eye. Bilateral motion deficits may reflect a visual system that is more compromised and more difficult to treat than one with only unilateral form perception deficits. Standard treatment - occlusion of the fellow eye - fails to restore visual acuity in up to 33%, and post-treatment slippage of visual acuity occurs in up to 25% of patients. Treatment failures may occur because occlusion treats only some of the problems in amblyopia. The purpose of this study was to determine the effect of occlusion therapy on motion deficits in children with amblyopia.

### **Methods**

We measured motion coherence thresholds for orientation discrimination of motion-defined rectangles, using standard psychophysical methods disguised as computer games. Children with strabismic or anisometropic amblyopia (4-8 years old) were tested at 3 time points during at least 1 year of part-time occlusion; age-matched controls were tested at the same intervals. Visual acuity was measured on each visit.

### **Results**

Initially, the amblyopic group showed elevated motion thresholds in each eye relative to the control group ( $p < 0.05$ ), despite an average improvement in amblyopic eye visual acuity of two lines. Children with poorer final visual acuity tended to have higher initial motion thresholds. No new fellow-eye deficits were induced by treatment.

### **Discussion & Conclusions**

These results suggest that deficits in motion-defined form perception are not caused by, and are somewhat resistant to, occlusion therapy. There are many negative effects associated with occlusion therapy; therefore it is important to identify children with visual deficits that are unlikely to be treated successfully. These children may benefit from recently successful alternative treatments, such as dichoptic antisuppression therapy.

**Acknowledgements:** *CIHR grant to D. Giaschi*

**Disclosure(s):** *None*

**Web Page:** *[www.giaschilab.ca](http://www.giaschilab.ca)*

**Keyword(s):** *amblyopia, visual development atypical*

Tuesday 18<sup>th</sup> 10.30 am

## **Aniso-Accommodation in Anisometropic Amblyopia**

**Presenting Author:** Sonia Toor, *School of Psychology and Clinical Language Sciences, University of Reading, United Kingdom*

**Co-Author(s):** AM Horwood, *School of Psychology and Clinical Language Sciences, University of Reading, Reading, UK* ; PM Riddell, *School of Psychology and Clinical Language Sciences, University of Reading, Reading, UK*

### **Purpose**

Accommodation in anisometropic amblyopia is thought to be a symmetrical process with the least ametropic eye determining the amount of accommodation and the more ametropic eye lagging behind. There is, however, some evidence from our laboratory that accommodation can be asymmetrical. This study aims to present the existence of aniso-accommodation in a sub-group of anisometropic amblyopes.

### **Methods**

Simultaneous convergence and accommodation responses of 22 anisometropic amblyopes aged between 5-7 years were measured using a PlusoptiXSO4 photorefractor set in a remote haploscopic device.

### **Results**

Preliminary results show that 32% of anisometropic amblyopes aniso-accommodate to some extent. In all cases the least ametropic eye accommodated more appropriately than the amblyopic eye, while vergence was unaffected. Those with symmetrical accommodation had an average uncorrected accommodative lag of 2D in the more ametropic eye at all distances. Those with asymmetrical accommodation had an average uncorrected accommodative lag of 2D in the distance but increasing to 5D at near. Anisometropic amblyopes with aniso-accommodation had a significantly poorer treatment outcome than those with symmetrical accommodation with an average final visual acuity of 0.51 logMAR in comparison to 0.10 logMAR.

### **Discussion & Conclusions**

This data provides evidence that accommodation is not always a symmetrical response. Approximately one in three children with anisometropic amblyopia aniso-accommodated. It is possible that the type of accommodation is a factor that influences the success or failure of anisometropic amblyopia treatment as those with aniso-accommodation had a poorer response to treatment.

**Disclosure(s):** *None.*

**Keyword(s):** *anisometropia, amblyopia, accommodation*

## Session F: Binocular vision

Tuesday 18<sup>th</sup> 12.00 pm

### The Role of Heterophoria and its Adaptation in Typically Hyperopic Infants and Children

**Presenting Author:** T. Rowan Candy, *School of Optometry, Indiana University, United States of America*

**Co-Author(s):** E. Babinsky, *Indiana University, Bloomington, USA* ; V. Sreenivasan, *Indiana University, Bloomington, USA*

#### Purpose

Visual experience during postnatal development is dependent on accommodation and vergence, in controlling retinal image quality and correspondence. Image correspondence requires motor fusion, which must overcome any dissociated heterophoria. Infants and young children are typically hyperopic and do not wear refractive correction. We wished to test the hypothesis that they would exhibit esophoria at near viewing distances as a result of their accommodative convergence, and to determine the range of their motor fusion and phoria adaptation responses for near targets in compensating for phoria.

#### Methods

Subjects were typically developing children aged 3months-7years and adults, who also underwent a clinical eye examination. Eye alignment was recorded using Purkinje image eye tracking at 25Hz, while subjects viewed naturalistic targets at near. The dissociated heterophoria was derived from these data from the difference between eye alignment in monocular and binocular viewing conditions. Motor fusion was measured objectively using base-in and base-out prisms (2-40pd). Adults also reported their subjective experience of diplopia. The monocular/binocular protocol was repeated to test adaptation after binocular viewing for 60s with 10 pd of base out prism to increase vergence demand.

#### Results

While uncorrected hyperopia in children implies they could have a convergent eye alignment in dissociated conditions, 74% had a divergent eye alignment (exophoria) at near, as compared to exophoria in 82% of adults. In the motor fusion condition, subjective measures of diplopia in adults were tightly associated with objective measures ( $R_{sq} = 0.95$ ,  $p = 8\text{pd}$  for infants and children and  $\geq 16\text{pd}$  for adults). BO responses were  $\geq 12\text{pd}$  for children and  $\geq 28\text{pd}$  for adults. At the end of the adaptation period, the children's mean heterophoria was 2.2pd ( $p = 0.002$ ) more convergent than their baseline phoria and took approx. 40s to return to baseline value.

#### Discussion & Conclusions

Despite typical levels of hyperopia, infants and children routinely exhibited exophoria and demonstrated substantial fusional reserves to overcome this phoria. Their apparent ability to adapt suggests that this exophoric misalignment may be desirable in protecting against refractive strabismus before emmetropization is complete.

**Acknowledgements:** NIH EY014460 (TRC), NIH LRP funding (EBB)

**Disclosure(s):** None

**Web Page:** [www.opt.indiana.edu/people/faculty/candy/index.html](http://www.opt.indiana.edu/people/faculty/candy/index.html)

**Keyword(s):** binocular vision, visual development typical

Tuesday 18<sup>th</sup> 12.20 pm

## **The Retinal Information Available to Drive Vergence Eye Movements During Early Development**

**Presenting Author:** Eric Seemiller, *School of Optometry, Indiana University, United States of America*

**Co-Author(s):** TR Candy, *School of Optometry, Indiana University, Bloomington, IN, USA*

### **Purpose**

High hyperopia or anisometropia are associated with abnormal visual development such as strabismus. Here we examine the information in the retinal image available to drive vergence eye movements in the presence of differing levels of defocus and anisometropia during development.

### **Methods**

Naturalistic images were filtered using a software simulation of the immature optics of the eye. Higher-order monochromatic aberrations of a typical 6-week-old, with a pupil size of 3mm, along with a variable defocus term (0, 3, 6D) were used to simulate retinal images. A sampling window of four degrees width was used to represent the central vision in each eye. The correlation between samples in the two eyes was determined systematically for a range of angular offsets between the eyes, to calculate the offsets with the higher correlations that would be appropriate to guide a vergence alignment.

### **Results**

As would be expected, the correlation between the images from the two eyes peaked when the samples from each eye were perfectly overlapped. However, the precision with which this alignment could be identified differed according to defocus condition. The introduction of 3D of defocus in both eyes increased the angular range of equivalent correlations by up to a factor of five, and the introduction of 6D by up to a factor of seven. Thus the potential for alignment of the eyes would depend significantly on the accommodative status of the hyperopic eye. When anisometropia was simulated (sampling with the right eye at 0D and the left eye at either 3 or 6D defocus), the correlations between the images were poorer and dependent on image content.

### **Discussion & Conclusions**

The retinal information available to drive vergence eye movements was determined for typical amounts of defocus during development. This information will be further limited by immature photoreceptor sampling and the effects of internal neural noise. Furthermore, the presence of inappropriate local correlation maxima provides another obstacle for a developing visual system.

**Acknowledgements:** *NIH EY014460*

**Disclosure(s):** *None.*

**Keyword(s):** *vergence, binocular vision, visual development typical*

Tuesday 18<sup>th</sup> 12.40 pm

## **Does – And How Does - Vision Therapy (Orthoptic Treatment) Work?**

**Presenting Author:** Anna Horwood, *Psychology, University of Reading, United Kingdom*

**Co-Author(s):** SS Toor, *School of Psychology & CLS, University of Reading, UK* ; PM Riddell, *School of Psychology & CLS, University of Reading, UK*

### **Purpose**

Many claims are made about orthoptic exercises/vision therapy, but how they act is unclear. Treatment, practice, placebo and effort effects are often confounded and their effect on normals is unknown. This study aimed to address these issues.

### **Methods**

In order to obtain normative data we studied 122 healthy young adults in a laboratory setting. Accommodation and convergence response gains were measured objectively with a PlusoptixSO4 PowerRefractor to targets moving in depth to a range of naturalistic and impoverished targets, manipulating blur, disparity and proximal/looming cues, both before and after two weeks of daily eye exercises. Participants were randomly allocated to six treatment groups specifically targeting blur resolution, binocular disparity resolution, near point exercises, attention (placebo), repetition and “encouragement” effects.

### **Results**

Only the exercises targeting disparity resolution produced significant improvements above no-treatment baseline, and only significantly for convergence ( $p=0.035$ ) and not significantly for accommodation ( $p=0.16$ ) which was more variable, although mean accommodation gain improved as much as vergence from these exercises. Blur, near point, or attention exercises produced insignificant improvements. Greatest improvement in responses was produced by “tester encouragement” on the re-test visit without any intervening exercises ( $p=0.004$  for vergence and  $p=0.006$  for accommodation). Greater improvements were seen in the more impoverished conditions and some participants performed at ceiling throughout, particularly for the vergence to the naturalistic target.

### **Discussion & Conclusions**

Effort and encouragement produced greater change than any exercises. Only treatment targeting disparity resolution produced any significant treatment effect and often improved accommodation as much as vergence.

While vergence exercises have some effect, effort and possibly voluntary influences are a major factor in effecting change, so influence the “success” of orthoptic exercises/and vision therapy. Very careful attention should be paid to these effects when studying eye exercises.

**Disclosure(s):** None

**Web Page:** [www.reading.ac.uk/pcls/people/a-m-horwood.aspx](http://www.reading.ac.uk/pcls/people/a-m-horwood.aspx)

**Keyword(s):** *vision therapy, binocular vision, reading and learning disabilities*

## Session G: Visual assessment 2

Tuesday 18<sup>th</sup> 2.00 pm

### Validation of Remote Gaze Tracking for Measuring Infant Visual Acuity

**Presenting Author:** Amithavikram Hathibelagal, *Optometry and Vision Science, University of Waterloo, Canada*

**Co-Author(s):** Moshe Eizenman, *Institute of Biomaterials and Biomedical Engineering, University of Toronto, Toronto, Canada* ; Elizabeth Irving, *School of Optometry and Vision Science, University of Waterloo, Waterloo, Canada* ; Krithika Nandakumar, *School of Optometry and Vision Science, University of Waterloo, Waterloo, Canada* ; Susan J Leat, *School of Optometry and Vision Science, University of Waterloo, Waterloo, Canada*

#### Purpose

Remote gaze-tracking (RGT), which utilizes the relative fixation time on a target, has potential for measuring visual acuity (VA) in infants. Our purpose was to validate objective grating acuity measured with RGT in adults and infants, against current clinical VA tests.

#### Methods

Visual scanning patterns were measured by a RGT system that requires minimal subject cooperation in adult and infant populations. Computer-generated gratings were judged as seen when the relative fixation time on the grating exceeded a pre-determined threshold. Experiment 1: In 15 uncorrected myopic adults, grating VA was measured for spatial frequency targets ranging from 2.3 to 37 cpd presented randomly in one of four positions on the screen. Objective RGT VA (in which VA was judged by fixations) was compared with VA measured with subjective responses using the same stimuli and with Teller Acuity Cards (TACs). Experiment 2: Binocular VA was measured in 14 typically-developing infants aged 3 to 12 months. Spatial frequency of the gratings ranged from 0.32 to 42 cpd and VA was measured on two visits with both the RGT and TACs.

#### Results

For adults there was no significant difference among the objective RGT VA, the subjective protocol and the TACs (repeated-measures ANOVA  $p > 0.05$ ). The objective RGT VA agreed with TACs as follows; 87% were within 0.5 octave and 100% were within 1 octave. The testability of both TACs and RGT was 100% in both visits for all infants. Infant RGT VA acuity estimates were within 1 octave of the TACs 93% and 79% of the time for the first and second visits respectively. Both the TACs and the RGT had repeatability of 86% within 1 octave between visits. Eighty-three percent of the RGT VAs were within the published 90% normal limits for age although on average the RGT gave significantly better acuity than the TACs (paired t-test,  $p = 0.011$ ). There was an increase in RGT VA with increasing age ( $r = 0.60$ ,  $p = 0.023$  for the first visit and  $r = 0.67$ ,  $p = 0.008$  for the second visit).

#### Discussion and Conclusions

In adults, the gaze tracker gave VA thresholds which were equivalent to the TACs and were not significantly different from subjectively determined grating VAs. The agreement between the TACs and RGT in infants and the correlation with age validates the measurements of the gaze tracker. The repeatability of the gaze tracker is similar to that of the TACs. These results demonstrate the potential for an automated test of infant visual acuity.

**Acknowledgements:** *Funded by NSERC (Collaborative Health Research Projects)*

**Disclosure(s):** *None.*

**Keyword(s):** *remote gaze tracking, eye movements, visual development typical*

Tuesday 18<sup>th</sup> 2.20 pm

## **Comparison of Acuity Measures Between Teller Acuity Cards, Lea Symbols, Lea Numbers Low Vision Book and Pacific Acuity Test in Children with Visual Impairment**

**Presenting Author:** John Lowery, *Optometry, Pacific University, United States of America*

**Co-Author(s):**

### **Purpose**

Acuity measures by different tests can vary widely within subjects, particularly in children with significant visual loss due to pathology. This study examines the relationship between acuity measures from three commonly used tests, Teller Acuity Cards (TAC), Lea Symbols Single Symbol Book (LS) and Lea Numbers Low Vision Book (LNB) compared with a new forced-choice vanishing optotype test, the Pacific Acuity Test (PAT).

### **Methods**

Threshold binocular acuities were measured during routine low vision exams on 139 individuals, age 4 to 18. PAT findings at 1 m test distance were compared to measurements from TAC at 50 cm or 67 cm (N=85), isolated LS at 10 feet (N=42) and LNB at 10 feet (N=43). Two measures of acuity were obtained for the majority of subjects. Three measures of acuity (PAT, TAC and LS) were obtained on a subset of the subjects (N=16). All acuity measures were converted to logMAR values for comparison. All tests were administered according to published test instructions.

### **Results**

Binocular acuities ranged from .2 to 1.32 with a mean of .7 logMAR (PAT) in the sample. The mean difference, 95% limits of agreement and correlation coefficient between PAT and the three other tests were as follows: PAT-TAC (+0.10, +0.37/-0.17, R=0.860), PAT-LS (-0.11, +0.20/-0.42, R=0.87) and PAT-LNB (-0.10, +0.23/-0.43, R=0.87). For the 16 subjects for whom PAT, TAC and LS acuities were measured, the mean differences, 95% limits of agreement and correlation coefficients were as follows: PAT-TAC (+0.07, +0.30/-0.17, R=0.89), PAT-LS (-0.13, +0.18/-0.45, R=0.86), TAC-LS (-0.20, +0.22/-0.61, R=0.74). A different relationship was observed in cases of retinal dystrophy with PAT and TAC yielding equal to or higher acuity thresholds than LS.

### **Discussion & Conclusions**

The data of this clinical sample demonstrate a clear trend in the relationship of acuities between the compared tests with measured acuity thresholds in the order LS/LNB>PAT>TAC. Considering high contrast optotypes (LS/LNB) are the gold standard for assessment of central visual function, PAT yields acuity thresholds that are significantly closer to the standard than TAC, albeit still with a clinically significant bias toward overestimation of acuity.

**Disclosure(s):** None.

**Keyword(s):** *pediatric acuity testing, low vision, visual function*

Tuesday 18<sup>th</sup> 2.40 pm

## **A Validation of iSight app in Pre-School Vision Screening**

**Presenting Author:** Nadia Northway, *Vision Sciences, Glasgow Caledonian University, United Kingdom*

**Co-Author(s):** G Panesar, *Dept of Vision Sciences, Glasgow Caledonian University, Glasgow, Uk* ; D McCulloch, *University of Waterloo, Waterloo, Canada* ; R McKay, *Dept of Vision Sciences, Glasgow Caledonian University, Glasgow, Uk*

### **Introduction**

Technologies such iPads are being used more and more in health care. There are many apps available that test vision however few have been validated. The aim of this study was to compare visual acuity measured with the Crowded Kay Picture test CKC (a LogMAR based crowded picture test widely used in the UK) and the iSight app (that includes an electronic version of the CKC) in pre-school children.

### **Method**

Monocular acuity was measured using both CKC and the CKC mode on the iSight iPad app in 35 preschool children aged between 3 years 8 months and 4 years and 7 months. Test order was randomised to minimise the effect of fatigue and loss of attention. iSight test was carried out by a student Optometrist and an Orthoptist used the CKC. Both tests were carried out at 3 metres. VA was recorded in LogMAR and timing in minutes and seconds was noted. Behaviour during each test was noted as 'good', 'average' or 'poor'. Each participant was tested in one single session. A staircase method was used when testing.

### **Results**

The range of acuities measured varied from -0.100 to 0.400 LogMAR for iSight, with a mean RE value of 0.045 LogMAR and LE 0.059 LogMAR. The range for CKC varied from -0.100 to 0.500 LogMAR, with a mean RE value of 0.073 LogMAR and LE 0.081 LogMAR. Mean visual acuity obtained with each test showed good agreement with correlation values of RE 79.6% and LE 82.6%. There was 100% agreement between the tests in terms of screening pass or fail criteria.

### **Discussion**

This study would suggest that the iSight app can be considered a reliable tool for visual acuity assessment in pre-school children. Any small differences found were not of clinical significance and the iSight test did not pass any children requiring onward referral making it a useful screening tool. Inter-tester differences may have influenced results. There was however generally good agreement between the conventional flip booklet method and the iPad and analysis showed that differences in acuity level were found mainly in the less co-operative children suggesting compliance in testing was a factor however fatigue effects were not.

### **Conclusion**

The iSight app available on iPad is a reliable alternative way to test crowded visual acuity in preschool children.

**Acknowledgements:** *The authors would like to thank Hazel Kay and Ian Livingstone who developed the app*

**Disclosure(s):** *No financial or commercial interests*

**Web Page:** <http://www.gcu.ac.uk/hls/aboutus/academicsubjects/visionosciences/>

**Keyword(s):** *visual development typical, visual function*

## Session H: Ocular disorders and Disease

Tuesday 18<sup>th</sup> 3.30 PM

### The Role of Visual Electrophysiology Testing in Pediatric Early Onset Horizontal Nystagmus (EOHN)

**Presenting Author:** Carol A. Westall, *Ophthalmology and Vision Science, The Hospital for Sick Children, Canada*

**Co-Author(s):** C.M. Panton, *Ophthalmology, The Hospital for Sick Children, Toronto, Canada.* ; M.A. Cotesta, *Ophthalmology, The Hospital for Sick Children, Toronto, Canada* ; J.E. Sutherland, *Ophthalmology, The Hospital for Sick Children, Toronto, Canada* ; M.A. Day, *Ophthalmology, The Hospital for Sick Children, Toronto, Canada* ;

#### **Purpose**

Each year >50 infants (< 6 months old) are referred with Early Onset Horizontal Nystagmus (EOHN) to our tertiary care pediatric hospital. Our purpose was to evaluate results from visual electrophysiology assessment used in the investigation of horizontal nystagmus manifesting in infancy.

#### **Methods**

Chart review of visual electrophysiology reports from children with EOHN. After obtaining REB approval, data were collected over a 10 year period from our departmental database. All visual electrophysiology assessments were conducted according to International Society for Clinical Electrophysiology of Vision Standards.

#### **Results**

Six hundred and nine probands referred with EOHN were evaluated. The term "proband" is used to identify the first patient from a family assessed in the Ophthalmology clinic. One hundred and two of these probands had the causative gene identified and were included in our study. The most common diagnoses presenting with an underlying cause of EOHN were: Leber Congenital Amaurosis (LCA) (n=19); Achromatopsia (n=17), Congenital Stationary Night Blindness (n=10) and Albinism (n=44). In 90% of the probands visual electrophysiological findings were consistent with the final ophthalmological diagnosis.

#### **Discussion & Conclusions**

Visual electrophysiology assessment provides important description of the phenotype of early pediatric onset eye disease. Results of visual electrophysiology investigations can help guide the Ocular Geneticist to identify which genes to investigate.

**Disclosure(s):** *No commercial interest*

#### **Web Page:**

<https://portal.sickkids.ca/uniqesig2c8556b78100c4856e57947106b204a6/uniqesig0/AboutSickKids/Directory/People/W/Carol-Westall-Staff-Profile.html>

**Keyword(s):** *electrophysiology, visual development atypical*

Tuesday 18<sup>th</sup> 3.50 pm

## **Association Between Vigabatrin Toxicity Identified by ERG and Subsequent Visual Field Reduction**

**Presenting Author:** Ananthavalli Kumarappah, *Institute of Medical Science, University of Toronto, Canada*

**Co-Author(s):** A.Y.Reginald, *Dept. Ophthalmology and Vision Sciences, Hospital For Sick Children, Toronto, Canada.* A.Bhan, *Dept. Ophthalmology and Vision Sciences, Hospital For Sick Children, Toronto, Canada.* R.J. Buncic, *Dept. Ophthalmology and Vision Sciences, Hospital For Sick Children, Toronto, Canada.* O.C. Snead, *Dept. Neurology, Hospital For Sick Children, Toronto, Canada.* C.A. Westall, *Dept. Ophthalmology and Vision Sciences, Hospital For Sick Children, Toronto, Canada.*

### **Purpose**

Vigabatrin is an antiepileptic drug approved for pediatric patients with infantile spasms (IS). Vigabatrin is known to be associated with visual field reductions in 30-50% of adults taking the drug (vigabatrin attributed field loss, VAFL). The amplitude of the 30-Hz flicker electroretinogram (ERG) is recommended for screening young children taking the drug. Vigabatrin ERG reduction (VAER) is reported if there has been significant reduction in age-corrected 30-Hz flicker amplitude from the baseline measurement on two consecutive visits. The purpose of this study is to determine if the VAER in a pediatric population is correlated with VAFL later in life.

### **Methods**

A prospective cross-sectional study assessing visual fields (Goldmann kinetic perimetry or confrontational methods) and retinal nerve fibre layer (RNFL) thickness (spectral domain optical coherence tomography, SD-OCT, Cirrus; Carl Zeiss Meditec) in participants older than 6 years.

### **Results**

8 participants (4 male, 4 female; age: 8-23 years; duration of vigabatrin treatment: 3 months-9 years) who developed VAER while on vigabatrin (toxicity identified 7-14 years ago) were examined. 3 participants (2 male, 1 female; age: 9-12 years) who did not develop VAER while on vigabatrin were also examined. For those with VAER, Goldmann perimetry was possible in 50% of the subjects; one subject showed severe restriction of the visual field, two had mild restriction of the visual fields and one had fields within normal limits. The RNFL was attenuated in all children who showed a reduction in the visual fields. Successful OCTs and visual fields were performed in all subjects without VAER, RNFL thickness and visual fields were within normal limits in all cases.

### **Discussion & Conclusions**

Visual field testing is difficult in this population due to developmental and cognitive delays, however successful testing can be performed in some patients. The light-adapted 3.0 flicker amplitude has a sensitivity of 75% and a specificity of 100% in predicting vigabatrin-associated visual field loss in a pediatric population. Retinal nerve fibre layer attenuation correlates strongly with reductions in visual fields suggesting that OCT imaging may be a potential alternative to ERG testing for monitoring vigabatrin toxicity.

**Acknowledgements:** *Visual Electrophysiology Unit, Sick Kids Ophthalmic Imaging Unit & Ophthalmic Assistants, Sick Kids*

**Disclosure(s):** *C.A. Westall, Financial support from Lunbeck Pharmaceutical.*

**Web Page:** <http://www.sickkids.ca/Research/VEU/index.html>

**Keyword(s):** *vigabatrin, electrophysiology, visual development atypical*

Tuesday 18<sup>th</sup> 4.10 pm

## **Spatial Findings of Neuro-Retinal Damage in Adolescents with Type 1 Diabetes**

**Presenting Author:** Wylie Tan, *Ophthalmology, The Hospital for Sick Children, Canada*

**Co-Author(s):** Y Garcia-Sanchez, *Ophthalmology, Hospital for Sick Children, Toronto, Canada* ; L Finkelberg, *Institute of Medical Science, University of Toronto, Toronto, Canada* ; T Wright, *Ophthalmology, Hospital for Sick Children* ; C Westall, *Ophthalmology, Hospital for Sick Children*

### **Purpose**

Adolescents with Type 1 Diabetes (T1D) and no clinically visible Diabetic Retinopathy (DR) have been shown to demonstrate localized neuro-retinal damage. It is unknown which retinal regions are most vulnerable to diabetes. We hypothesized that the standard and slow-flash (sf-) multifocal electroretinogram (mfERG) and adaptive optics (AO) imaging will localize regions of greatest vulnerability.

### **Methods**

Localized retinal function was examined in 55 adolescents, with T1D and no DR or mild non-proliferative DR, and 54 control subjects. The mfERG examined predominately retinal bipolar cell activity using a 103 hexagon stimulus and the sf-mfERG isolated three oscillatory potentials (OPs) from intraretinal amacrine and interplexiform cells using a 61 hexagon stimulus. Amplitude and implicit time (IT) of the first order responses were compared between groups using mixed model ANOVAs. Responses were compared by hexagons, quadrants and rings and p-values for pairwise comparisons were mapped using a linear colour gradient to illustrate patterns of dysfunction. Adaptive Optics imaging examined cone photoreceptor density in 20 adolescents with diabetes and 14 controls at four retinal quadrants located 7° eccentric from the fovea along the oblique meridians.

### **Results**

Amplitude was not significantly different between groups at the level of hexagons, quadrants, and rings for both mfERG and sf-mfERG tests. mfERG IT was delayed in adolescents with diabetes compared with controls at the level of hexagons ( $p < 0.0001$ ), quadrants ( $p < 0.0001$ ), and rings ( $p < 0.0001$ ). Mapping of p-values showed a global response delay across the retina. Quadrant and ring IT analyses revealed that the superior retina and rings 3 and 4 (approximately 5-10 degrees eccentricity) showed the greatest response delays, respectively. Greatest sf-mfERG delays were found at different eccentricities for each OP. No significant differences in cone density were found; however, adolescents with diabetes showed a trend towards reduced density in the nasal regions.

### **Conclusions**

Delays in both mfERG responses and OPs indicate dysfunction in the inner plexiform layer. Inner retinal structures may be more susceptible to damage by diabetes than outer retinal structures. These spatial findings will guide future studies in adaptive optics imaging to identify early structural damage caused by diabetes.

**Acknowledgements:** *Dr. Melanie Campbell and Ms. Marsha Kisilak, University of Waterloo*

**Disclosure(s):** *None.*

**Keyword(s):** *Diabetic Retinopathy, electrophysiology, visual function*

Tuesday 18<sup>th</sup> 4.30 pm

## **Cone Density in Nasal vs. Temporal Retina in Adolescents and Young Adults with Type 1 Diabetes**

**Presenting Author:** Laura Finkelberg, *Institute of Medical Science, University of Toronto, Canada*  
**Co-Author(s):** Y Garcia Sanchez, *Dept of Ophthalmology and Vision Sciences, Hospital for Sick Children, Toronto, Canada* ; W Tan, *School of Optometry and Vision Science, University of Waterloo, Waterloo, Canada* ; R Rajendran, *Institute of Medical Science, University of Toronto, Toronto, Canada* ; T Wright, *Dept of Ophthalmology and Vision Sciences, Hospital for Sick Children, Toronto, Canada* ; C Westall, *Institute of Medical Science, University of Toronto, Toronto, Canada*

### **Purpose**

For individuals with type 1 diabetes (T1D), the 25-year cumulative incidence of diabetic retinopathy (DR) is 97%. DR is the leading cause of blindness in Canadians under age 50. In the last two decades, mounting evidence has revealed that neuroretinal changes occur early in disease progression, preceding vascular changes visible on funduscopy. Moreover, recent work in electrophysiology (Holm and Lövestam-Adrian, 2012) has shown that the nasal retina is more susceptible to the effects of DR than is the temporal retina. We hypothesized that this nasal susceptibility would be reflected in structural neuroretinal changes in adolescents and young adults with T1D.

### **Methods**

Participants with T1D for 5 or more years, but without signs of DR visible on funduscopy (n = 21, mean age = 18.3), were recruited from the endocrinology clinic at SickKids Hospital, Toronto. Typically developing age-matched participants without T1D (controls, n = 20, mean age = 16.7) were also recruited. En-face 2x2 degree images of the photoreceptor layer of the retina were acquired with adaptive optics scanning laser ophthalmoscopy (AO-SLO), 7 degrees eccentric from the fovea along the four diagonal meridians: superior temporal, inferior temporal, superior nasal, and inferior nasal. Cone photoreceptor density was sampled in these four regions.

### **Results**

In typically developing adolescents and young adults, cone density is greater in nasal regions than in temporal regions ( $p < 0.05$ ). A difference in nasal vs. temporal cone density was not apparent in those with T1D ( $p = 0.89$ ). Furthermore, nasal regions in participants with T1D are less cone-dense than nasal regions in controls ( $p < 0.01$ ). Cone density in the temporal retina does not differ between T1D and control groups ( $p = 0.63$ ).

### **Discussion and Conclusions**

This is the first study to demonstrate a selective structural deterioration of the nasal retina, prior to the onset of DR resulting from T1D. These results may have direct implications for our understanding of the pathophysiological progression of sub-clinical DR.

**Acknowledgements:** *Banting and Best Diabetes Centre-Novo Nordisk Studentships, Vision Science Research Program Awards*

**Disclosure(s):** *None*

**Keyword(s):** *adaptive optics retinal imaging, electrophysiology, ocular disease*

Wednesday 19<sup>th</sup> June 2013

Session I: Amblyopia 3

11.20 am

## **A New Binocular Treatment for Amblyopia**

**Presenting Author:** Robert Hess, *Ophthalmology, McGill University, Canada*

**Co-Author(s):**

### **Purpose**

Current thinking puts the binocular deficit at the forefront of the amblyopic syndrome and, in terms of therapy, suppression-reduction along with improved binocular combination are considered the most important steps to promote improved monocular as well as binocular function.

### **Methods**

A new binocular treatment will be described involving dichoptic game play aimed at suppression-reduction along, improved binocular combination and improved monocular function

### **Results**

The results of a number of independent studies will be compared in terms of acuity and stereo improvements in adults with amblyopia, controlled comparison will be made between monocular and dichoptic video game play.

### **Discussion & Conclusions**

There is a **unique** advantage of dichoptic therapy that transcends that of monocular game play and supports a suppression-based explanation for amblyopia.

**Acknowledgements:** *This work was supported by a CIHR grant (#53346)*

**Disclosure(s):** *Patents for this treatment are held by McGill*

**Web Page:** [http://mvr.mcgill.ca/Robert/rhess\\_home.html](http://mvr.mcgill.ca/Robert/rhess_home.html)

**Keyword(s):** *treatment, amblyopia, binocular vision*

Wednesday 19<sup>th</sup> 11.40 am

## Use of Dichoptic Random Dot Kinematograms to Measure Suppression in Adult Amblyopes

**Presenting Author:** Benjamin T. Backus, *Graduate Center for Vision Research, SUNY College of Optometry, United States of America*

**Co-Author(s):** C Llerena Law, *Grad Ctr for Vis Res, SUNY College of Optometry, New York, USA* ; A Yuan, *Grad Ctr for Vis Res, SUNY College of Optometry, New York, USA* ; O Natanelova, *Grad Ctr for Vis Res, SUNY College of Optometry, New York, USA* ; L Steele, *Grad Ctr for Vis Res, SUNY College of Optometry, New York, USA* ; I Tseng, *Grad Ctr for Vis Res, SUNY College of Optometry, New York, USA* ; LT Cai, *Grad Ctr for Vis Res, SUNY College of Optometry, New York, USA*

### Purpose

Suppression is an important binocular mechanism that helps maintain amblyopia. Recently, Hess and colleagues (e.g. *Optom Vis Sci*, 2010) used dichoptic random dot kinematograms (RDK) to quantify suppression as the interocular contrast ratio (IOC). How does this RDK measure compare with other measures of IOC in amblyopes (e.g. Li et al. *IOVS* 2011)? Is it robust to overall changes in image size and percent coherence of the display? Does suppression as measured using RDK decrease in peripheral vision as one might expect?

### Methods

Coherently moving "signal" dots were presented to one eye while randomly moving "noise" dots were presented to the other. Display size was 5-10 deg, stimulus duration was 300 ms, and the total number of dots was 100, of which 18 to 36 (fixed) were presented moving coherently (18-36% coherence). The task was to judge direction of motion of the signal dots (up vs down) using a keypress. IOC was controlled by a three-down, one-up staircase procedure. 82%-correct threshold IOC was computed from the log likelihood fit of a cumulative normal curve to the logIOC values visited during the staircase procedure.

### Results

Across N=8 amblyopic adult participants and N=8 normally sighted adults, the measured value of IOC was highly consistent for a given individual across both display size and percent coherence, despite large differences between individuals. A contrast-based measure of IOC (similar to that used by Li et al.) correlated well ( $r=0.77$ ,  $p<0.001$ ).  $\log(\text{IOC})$  dropped systematically from 2.3 (i.e. a factor of more than 100) in central vision to 0.8 (a factor of less than 10) at 24 deg peripheral vision. An exception was an alternating strabismic participant who had much better-than-normal IOC no matter which eye received the signal dots, showing that this person was able to exclude (suppress) noise no matter which eye it was presented to.

### Discussion & Conclusions

IOC was robust to changes in stimulus size (and thus viewing distance from a display) and also to changes in percent coherence (and thus individual differences in percent coherence threshold). It correlated well with another measure of suppression, and decreased as expected away from central vision. It may be convenient to use for monitoring suppression during binocular approaches to the treatment of amblyopia.

**Acknowledgements:** *NIH R01 EY-013988, NIH K23 EY 022669-01, NIH T35, Martha Lain for laboratory assistance*

**Disclosure(s):** *None*

**Web Page:** *poseidon.sunyopt.edu/Backuslab/*

**Keyword(s):** *suppression, amblyopia, binocular vision*

Wednesday 19<sup>th</sup> 12.00 pm

## **Binocular iPad Treatment for Amblyopia**

**Presenting Author:** Eileen Birch, *Pediatric Vision Evaluation Center, Retina Foundation of the Southwest, United States of America*

**Co-Author(s):** S Li, *Pediatric Vision Evaluation Center, Retina Foundation of the Southwest, Dallas, TX, USA* ; RM Jost, *Pediatric Vision Evaluation Center, Retina Foundation of the Southwest, Dallas, TX, USA* ; V Subramanian, *Pediatric Vision Evaluation Center, Retina Foundation of the Southwest, Dallas, TX, USA*

### **Purpose**

The cornerstone of amblyopia treatment is patching the "fellow" eye to force use of the amblyopic eye. However, patching does not always achieve 20/20 visual acuity nor does it treat the binocular dysfunction that may underlie residual amblyopia. *Our objective was to evaluate a binocular treatment as an adjunct to patching therapy for 3- to 6-year old amblyopic children.*

### **Methods**

We developed anaglyphic iPad video games in which the contrast of game elements presented to the fellow eye is reduced to allow the child to overcome suppression and experience binocular vision. As the child achieves criterion game scores, fellow eye contrast is gradually incremented. Fifty-two 3- to 6-year-old amblyopic children were enrolled and assigned to the **Binocular** games (n=42) or **Placebo** games (n=10). In addition to 4 hrs/week of game play, children were prescribed 2 hrs daily patching. VA and Randot Preschool stereoacuity were assessed at baseline and after 4 weeks of treatment.

### **Results**

Based on intent-to-treat analysis, The Binocular group had  $0.13 \pm 0.10$  logMAR (1.3 lines) improvement in VA, compared with  $0.06 \pm 0.05$  logMAR (0.6 lines) for the Placebo group ( $t=2.14$ ;  $p=0.04$ ). Visual acuity improvement in the Binocular group was correlated with hours of game play ( $r=0.44$ ;  $p=0.004$ ) but was not significantly correlated with baseline or outcome stereoacuity, hours of patching, or baseline VA. Children who were compliant with both iPad and patching treatments (n=23) had more VA improvement than children who were only compliant with patching (n=9):  $0.18 \pm 0.09$  logMAR versus  $0.02 \pm 0.04$  logMAR;  $t=5.10$ ,  $p<0.0001$ ). Children who played the iPad games but were noncompliant with patching had significant VA improvement during the 4-week study period ( $0.18 \pm 0.05$  logMAR; 1.8 lines;  $t=8.05$ ,  $p<0.001$ ).

### **Discussion & Conclusions**

Binocular iPad treatment as an adjunct to patching therapy for amblyopia yields significantly better visual acuity outcomes after 4 weeks of treatment than patching alone. We are currently investigating whether additional binocular iPad treatment results in additional visual acuity improvement and whether the visual acuity improvement is maintained after discontinuation of treatment.

**Acknowledgements:** *Supported by grants from the National Eye Institute (EY022313), Knights Templar Foundation, BB Owens Foundation, Harold Simmons Foundation, and the Crystal Charity Ball.*

**Disclosure(s):** None

**Web Page:** <http://www.retinafoundation.org/research-pediatric.html>

**Keyword(s):** amblyopia, binocular vision

**Session J: Visual development**  
**Wednesday 19<sup>th</sup> 1.30 pm**

## **Development of Global Form, Motion and Biological Motion Processing in Patients with Congenital Achromatopsia**

**Presenting Author:** Eliza Burton, *Institute of Ophthalmology, University College London, United Kingdom*

**Co-Author(s):** J Wattam-Bell, *Psychology and Language Science, University College London, London, UK* ; M Michaelides, *Moorfields Eye Hospital, London, UK* ; KM Nishiguchi, *Moorfields Eye Hospital, London, UK* ; V Sundaram, *Moorfields Eye Hospital, London, UK* ; A Webster, *Moorfields Eye Hospital, London, UK* ; A Moore, *Moorfields Eye Hospital, London, UK* ; M Nardini, *Institute of Ophthalmology, University College London, London, UK*

### **Purpose**

Congenital achromatopsia is a condition affecting ~1 in 30,000 [Michaelides et al, *Br J Ophthalmol* 88 (2004) 291] and is characterised by an absence of functioning cone photoreceptors. This causes poor visual acuity, photophobia and an absence of colour vision from birth. While low-level vision is known to be impaired in achromatopsia, less is known about mid- and high-level vision and whether an absence of cones may impact on the development of these.

### **Methods**

Four patients with congenital achromatopsia (mean age 26.0 years) and six controls (mean age 25.5 years) completed tests of mid- and high-level visual function. 2AFC tests for discrimination of coherent motion, coherent form and biological motion were used to estimate participants' 75% coherence thresholds. Testing was done at photopic, mesopic and scotopic light levels in order to distinguish between rod and cone function.

### **Results**

Patients had higher coherence thresholds than controls on both coherent form and coherent motion tasks, with a greater deficit for motion than for form. This was true across all light conditions, including scotopic in which all participants relied on rod photoreceptors. Coherence thresholds for biological motion did not differ significantly between patients and controls. Additional tests of contrast sensitivity established that in 3 of the 4 patients the observed impairments were not explained by poor contrast sensitivity.

### **Discussion & Conclusions**

Congenital achromatopsia results in selective impairments in extra-striate vision, namely impaired coherent form and motion perception, with greater impairments in coherent motion. However, biological motion results are comparable between patients and controls suggesting that the pathways responsible are functioning despite impaired low- and mid-level vision. These results show a similar pattern to those seen in children with atypical visual development due to congenital cataracts [Ellemberg et al, *Vis Res* 42 (2002) 169; Lewis et al, *Vis Res* 42 (2002) 939; Bat-Sheva et al, *Dev Sci* 15 (2012) 474]. In order to establish whether these results are due to atypical visual development, we aim to carry out the same tests with patients of younger ages, and in those who have a form of progressive cone dystrophy in which there is normal early visual development followed by cone loss in early adulthood.

**Acknowledgements:** *Special Trustees of Moorfields Eye Hospital and the NIHR Biomedical Research Centre*

**Disclosure(s):** *None.*

**Keyword(s):** *cortical processing, visual development atypical*

Wednesday 19<sup>th</sup> 1.50 pm

## The Development of Sensitivity to the Direction of Motion

**Presenting Author:** Terri L. Lewis, *Psychology, Neuroscience & Behaviour, McMaster University, Canada*

**Co-Author(s):** LR Betts, *Department of Psychology, Neuroscience & Behaviour, McMaster University, Hamilton, Canada* ; D Maurer, *Department of Psychology, Neuroscience & Behaviour, McMaster University, Hamilton, Canada*

### Introduction

Little is known about the development of sensitivity to the direction of motion other than one study showing that 18-week-olds can discriminate a 17 deg difference in the direction of motion (Banton et al., 2001), a difference that is at least eight times worse than that of adults (Watamaniuk et al., 1989).

### Purpose

Here we investigated the development of sensitivity to small deviations in the direction of motion in five age-groups of children ranging in age from 5 –15 years and in adults (M = 18 yrs; n=20/group).

### Methods

Stimuli consisted of black dots (diameter = 2.5 or 10 arc min) moving coherently at 4.16 or 8.65 deg/s against a grey background. The task on each 1s trial was to indicate whether the dots moved to the left or right of a white vertical reference line. We used a 3-down, 1-up staircase to measure the minimum deviation discriminated from vertical for the smaller and larger dots moving at the slower or faster speed.

### Results

Sensitivity improved dramatically between 5 and 7 years of age and was better for faster than the slower speeds. For faster speeds, sensitivity was adult-like by age 7 for both larger and smaller dots (both  $p < 0.01$ ). For slower speeds, the developmental trajectory depended on dot size. For smaller dots, sensitivity was adult-like by age 7 ( $p < 0.01$ ). For larger dots, sensitivity *decreased* after 15 yrs of age ( $p < 0.01$ ).

### Discussion & Conclusions

Improved tuning between 5 and 7 years of age may reflect increased inhibition (Leventhal et al., 2003; Pinto et al. 2010). Decreased sensitivity after age 15 for larger dots moving at the slower speed may reflect the increased influence of suppressive mechanisms (Tadin et al., 2003).

**Acknowledgements:** *Supported by CIHR grant MOP 36430 and the James S. McDonnell Foundation*

**Disclosure(s):** *None*

**Web Page:** *baby.mcmaster.ca*

**Keyword(s):** *motion perception, visual development typical, visual function*

Wednesday 19<sup>th</sup> 2.10 pm

## **The Effect of Different Motion Paradigms on Smooth Pursuit Performance in Children**

**Presenting Author:** **Valdeflors Vinuela-Navarro**, *School of Optometry and Vision Sciences, Cardiff University, United Kingdom*

**Co-Author(s):** JM Woodhouse, *School of Optometry and Vision Sciences, Cardiff University, Cardiff, UK* ; JT Erichsen, *School of Optometry and Vision Sciences, Cardiff University, Cardiff, UK* ; CEM Williams, *School of Social and Community Medicine, University of Bristol, Bristol, UK*

### **Purpose**

Smooth pursuits are conjugate eye movements responsible for smooth tracking slow moving objects and maintaining their image at the fovea. In eye movement research, different stimuli motion paradigms can be used to study smooth pursuits: the ramp, the step-ramp and the sinusoidal motion paradigm. The aims of this study were to evaluate the effect of the different motion paradigms on smooth pursuit performance in children.

### **Methods**

Binocular eye movement recordings were obtained from 13 children between 2 and 15 years old, using an infrared eye tracker. A customized 2° animated stimulus was used to produce smooth pursuit eye movements following three different motions: a 6°/s ramp, a 6°/s step-ramp and a sinusoidal motion paradigm. In all three motions the stimulus moved horizontally back and forth with an extent of  $\pm 20^\circ$ . The number of saccades and microsaccades during the smooth pursuit task, the percentage time devoted to smooth pursuit and position gains were calculated for the three stimulus motion paradigms. Velocity gains for the constant velocity motions were also studied.

### **Results**

Non-parametric repeated measures ANOVA showed no statistically significant differences in the number of catch-up saccades, back-up saccades and microsaccades between the ramp, the step-ramp and the sinusoidal motions. Similarly, no differences were found in the percentage of time devoted to smooth pursuit within the three motions studied. Velocity gains assessed in the ramp and the step-ramp paradigm did not show statistically significant differences either. In contrast, some statistically significant differences were found within the motion paradigms in position gain ( $p = 0.046$ ) suggesting a reduced position gain when using the step-ramp motion.

### **Discussion & Conclusions**

The results found suggest that in general, the motion paradigm does not have an effect in the performance of smooth pursuit in children. Children perform similarly with any of the three motion paradigms and therefore any of the three are appropriate for eye movement research in children provided that a child-friendly stimulus and set up is used.

**Acknowledgements:** *This research is funded by The College of Optometrists.*

**Disclosure(s):** *No commercial and financial interests*

**Keyword(s):** *smooth pursuits, eye movements, visual function*

## Session K: Prematurity and vision

Wednesday 19<sup>th</sup> 3.10 pm

### Post-Natal Retinal Development in Very Low Birth Weight Infants Enrolled in a Randomised Controlled Trial of Early High Dose Vitamin

#### A

**Presenting Author:** Daphne L McCulloch, *Vision Sciences / Life Sciences, Glasgow Caledonian University, United Kingdom*

**Co-Author(s):** H Mactier, *Neonatal Unit, Princess Royal Maternity Hospital, Glasgow, UK* ; G Hanazono, *Vision Sciences, Glasgow Caledonian University, Glasgow, UK* ; L Farrell, *Neonatal Unit, Princess Royal Maternity Hospital, Glasgow, UK* ; R Hamilton, *Clinical Physics, University of Glasgow and the Royal Hospital for Sick Children, Glasgow, UK* ;

#### Purpose

Exposure of the retina to light may accelerate retinal maturation after premature birth. However, substantial risks are associated with immaturity of the respiratory, vascular and digestive systems.

#### Methods

In a double-blind, controlled, clinical trial, eligible infants born before 32 weeks' gestation and/or <1501 g birth-weight were randomised to receive additional intramuscular vitamin A, 10,000IU three times weekly from birth for two weeks or until oral feeding was established. ERGs were measured at 36 weeks postmenstrual age (PMA). Protocols included luminance-response (L-R) ERG series under dark-adapted and light-adapted conditions as well as standard ERGs. Parameters for saturated ERG amplitudes and sensitivity were calculated using non-linear regression. Infants who later required treatment for retinopathy of prematurity were excluded from the current data.

#### Results

ERGs recorded at 36 weeks PMA in 63 infants (32 supplemented, 30 controls) born between 25 and 32 weeks gestation showed marked immaturity of all parameters (>1.5 log units below adult values). Although all infants were tested at the same maturity, both a- and b-wave amplitudes of light adapted ERGs were reduced in the infants born earlier (i.e. with greater post natal ages at testing.  $p < 0.01$  and  $p < 0.03$  for standard and strong flashes, respectively). This association was independent of oxygen requirements and other health indicators. As previously reported<sup>1</sup>, cone-corrected, dark-adapted rod ERG sensitivity were improved in the supplemented group. We found no associations between supplementation group and light-adapted ERG parameters and none between the dark-adapted ERGs and post-natal age.

#### Discussion & Conclusions

The cone-dominated, light-adapted ERGs amplitudes are more mature in infants who spent more time in utero between 25 and 32 weeks gestation; dark-adapted ERGs were not significantly affected by the length of gestation. This suggests that any acceleration of retinal development associated with early light exposure may be outweighed by other disadvantages of very preterm birth.

1. Mactier et al. (2012) *J Paediatrics*, 160:954-959.

**Acknowledgements:** *Chief Scientist Office (Scotland): grant CZB/4/316*

**Disclosure(s):** *No financial or commercial interests*

**Keyword(s):** *electrophysiology, prematurity*

Wednesday 19<sup>th</sup> 3.30 PM

## Visual Sensory and Perceptive Functions in Very Low Birth Weight Children

**Presenting Author:** C.J.A. Geldof, *Clinical Neuropsychology, VU University, The Netherlands*

**Co-Author(s):** J Oosterlaan, *Dept of Clinical Neuropsychology, VU University Amsterdam, Amsterdam, The Netherlands* ; MJ de Vries, *Royal Dutch Visio, Dept of Rehabilitation and Advice, Amsterdam, The Netherlands* ; JH Kok, *Dept of Neonatology, Emma Children's Hospital Academic Medical Centre, Amsterdam, The Netherlands* ; AG van Wassenaer-Leemhuis, *Dept of Neonatology, Emma Children's Hospital Academic Medical Centre, Amsterdam, The Netherlands* ;

### Purpose

Visual dysfunction in very low birth weight (VLBW) children is shown using both visual sensory and visual perceptive tests. However, few studies investigate both domains simultaneously. We aimed to 1) establish a complete profile of visual functions, 2) explore the effects of visual sensory on visual perceptive deficits and 3) explore the effects of visual functions on intelligence.

### Methods

At 5.5 years corrected age, VLBW children (n=116) and age matched term controls (n=73) were assessed using tests for visual sensory functions (visual acuity, visual field, contrast sensitivity, color vision and stereovision), perceptive abilities (Static and Moving Coherence, Position in Space, Figure-Ground, Visual Closure, Form Constancy and Face Recognition) and IQ.

### Results

For visual sensory functions, VLBW children had lower single symbol visual acuity ( $p < 0.001$ ), more often reduced stereovision ( $p = 0.03$ ) and reduced lower visual field ( $p < 0.001$ ), as compared to term controls. For visual perceptive functions, VLBW children had worse perception of Static Coherence ( $p = 0.01$ ) and Position in Space ( $p = 0.006$ ), but not of Moving Coherence, Figure-Ground, Visual Closure, Form Constancy, and Face Recognition tasks (all  $p$ 's  $> 0.05$ ). Any visual sensory impairment was present in 28% and any perceptive impairment in 31% of VLBW children and in 14% and 25% of term controls, respectively. Performance on the Static Coherence and Position in Space tasks did not differ between VLBW children with and without visual sensory deficits. Static Coherence and Position in Space explained, in addition to VLBW-status, 29% variance in predicting performance IQ ( $R^2 = .40$ ;  $p < 0.001$ ). In addition to VLBW-status, Single Symbol Acuity and Position in Space added 10% explained variance in predicting verbal IQ ( $R^2 = .18$ ;  $p < 0.001$ ).

### Discussion & Conclusions

Visual abilities in both the sensory and perceptive domain are more frequently impaired in 5-year old VLBW, as compared to controls. Visual perceptive dysfunctions remain present in the absence of sensory deficits, suggesting that sensory and perceptive deficits occur independently. Visual perceptive functions are predominantly associated with performance IQ.

**Disclosure(s):** None

**Keyword(s):** prematurity, visual development atypical

Wednesday 19<sup>th</sup> 3.50 pm

## **Perceptual Visual Dysfunction in Children Born Prematurely: Common But Easily Missed**

**Presenting Author:** **Catriona Macintyre-Béon**, *Department of Paediatric Ophthalmology, Royal Hospital for Sick Children, Glasgow, United Kingdom*

**Co-Author(s):** R Bowman, *Dept of Ophthalmology, Great Ormond Street Hospital, London, UK* ; G Loffler, *Dept of Vision Science, Glasgow Caledonian University, Glasgow, UK*; D Young, *Dept of Mathematics & Statistics, Strathclyde University, Glasgow, UK*; GN Dutton, *Dept of Ophthalmology, Royal Hospital for Sick Children & Dept of Vision Science, Glasgow Caledonian University, Glasgow, UK* ; K Mitchell, *Dept of Ophthalmology, Royal Hospital for Sick Children, Glasgow, UK* ; J Simpson, *Dept of Child Health, Royal Hospital for Sick Children, Glasgow, UK* ; R Hamilton, *Dept of Clinical Physics, University of Glasgow & Royal Hospital for Sick Children, Glasgow, UK* ;

### **Objective**

Cerebral visual impairment (CVI), including perceptual visual dysfunction (PVD), is the commonest form of childhood visual impairment in the developed world. Although premature birth is recognised as a cause, the incidence and nature of PVD in prematurely-born children has not been studied in detail.

**Design:** A prospective, controlled investigation of a cohort of high functioning, prematurely-born school children.

### **Methods**

Forty-six mainstream primary-school children without identified neurodisability, aged 5.5–12.3 years, with gestations of 24.0 to 34.6 weeks, and 130 control (term-born) children. Assessment of IQ, visual function, visual perception, visual attention, and structured history-taking seeking evidence of behavioural features of CVI using a question inventory. Obstetric, neonatal and paediatric medical histories were documented from case-records.

### **Results:**

15/46 (33%) of the prematurely-born children - 'cluster A' - revealed behaviours corresponding to PVD on cluster analysis of the CVI inventory. Abnormalities of stereoacuity, contrast sensitivity and eye movements were more frequent in cluster A, and they were born 1½ weeks earlier and around 300g lighter on average than their unaffected peers. The whole prematurely-born group performed worse than controls on all visual perception tests and all four visual attention tests, but cluster A children performed worse than controls on all visual perception and attention tests except visual closure, while the remaining prematurely-born children performed no differently to controls. However, eight of the 15 children in cluster A had normal test results in all eight visual perception and attention tests.

### **Discussion and Conclusions**

The incidence of perceptual visual dysfunction in these prematurely-born children is between 21–47% (95% CI) with a pattern similar to 'dorsal stream dysfunction'. Currently available perceptual tests appear to be insufficiently sensitive to find the specific pattern of problems noted in this group. Many studies have provided evidence of cognitive and intellectual dysfunction in prematurely-born children, and it is possible that PVD is a contributor. The CVI inventory\* provides a potential means of identifying and characterising the condition.

**Acknowledgements:** *This study was funded by the Chief Scientist's Office, Scottish Government Health Directorate*

**Disclosure(s):** *None.*

**Keyword(s):** *perceptual visual dysfunction, prematurity, visual function*

## Poster Abstracts

### 1. Morphological Changes in Anterior Visual System Development Following the Loss of One Eye Early in Life

**Presenting Author:** Krista Kelly, *Centre for Vision Research and Department of Psychology, York University, Canada*

**Co-Author(s):** L McKetton, *Centre for Vision Research and Department of Biology, York University, Toronto, Canada* ; KA Schneider, *Centre for Vision Research and Department of Biology, York University, Toronto, Canada* ; BL Gallie, *The Hospital for Sick Children, Toronto, Canada* ; JKE Steeves, *Centre for Vision Research and Department of Psychology, York University, Toronto, Canada*

#### Purpose

The developing visual system is vulnerable to early monocular enucleation (ME; surgical eye removal) (Steeves et al., 2008; Spat Vis) and is related to anatomical hemisphere asymmetries in visual cortices later in life (Kelly et al., 2011; JOV). The following experiments sought to determine whether these anatomical asymmetries also occur in the more anterior parts of the visual system, including the optic tracts and chiasm (Experiment 1), and lateral geniculate nucleus (LGN) (Experiment 2). These data could help determine possible mechanisms of reorganization at the cortical level following early eye loss.

#### Methods

Experiment 1: Twelve ME adults who had their eye removed early in life due to cancer of the retina [mean age at enucleation (aae) = 27 months] were compared to 27 binocularly intact (BV) controls. T1-weighted anatomical images were acquired with a 3T MRI scanner. Images were reformatted to ensure the optic nerves, chiasm, and tracts were all in the same plane. Four raters blind to group membership measured the widths of the optic tracts and chiasm.

Experiment 2: LGN volume of 8 ME adults who had their eye removed early in life (mean aae = 15) was compared to that of 8 BV controls. A series of 40 high-resolution proton density-weighted images were acquired with a 3T MRI scanner. These images were then registered to each other and averaged. Three raters blind to group membership used these averaged scans to manually identify and trace LGN regions of interest (ROI) in each participant. LGN volumes for each rater were averaged together to obtain a mean LGN ROI.

#### Results

Experiment 1: The ME group exhibited overall decreases in optic chiasm and left/right optic tract widths compared to the BV group. Unlike the BV group, the ME group showed a hemisphere asymmetry where the decrease in width was less prominent in the hemisphere contralateral to the remaining eye.

Experiment 2: The ME group showed an overall decrease in LGN volume compared to the BV group. Similar to Experiment 1, this decrease was less prominent in the hemisphere contralateral to the remaining eye.

#### Discussion & Conclusions

Our data suggest that although cell degeneration occurs, the remaining eye is recruiting deafferented cells in the contralateral hemisphere. This may serve to compensate for the loss of one half of visual input. These data highlight the importance of early balanced binocular input for maturation of the anterior visual pathway.

**Acknowledgements:** NSERC and CNIB to JS, OGS to KK

**Disclosure(s):** There are no financial or commercial interests held by any of the authors.

**Keyword(s):** hemisphere asymmetries, cortical processing, visual development atypical

## **2. Audition Dominates Vision After Loss of One Eye Early in Life When the Systems Are in Competition but not When They Are Integrated**

**Presenting Author:** **Stefania Moro**, *Centre for Vision Research & Psychology, York University, Canada*

**Co-Author(s):** LR Harris, *Centre for Vision Research & Psychology, York University, Toronto, Canada*; JKE Steeves, *Centre for Vision Research & Psychology, York University, Toronto, Canada*

### **Purpose**

Previous research has shown that early blindness leads to better sound localization ability compared to sighted individuals, indicating compensation across the senses for the complete loss of vision (Lessard et al., 1998 Nature). We study individuals who have partially lost vision following unilateral eye enucleation (removal of one eye) early in life due to retinoblastoma (cancer of the retina). Despite the loss of half of the visual input to the brain, enucleated individuals have normal spatial form vision with the remaining intact eye (see Steeves et al., 2008 Spat Vis). As in congenitally blind individuals, people with one eye also have enhanced sound localization compared to controls (Hoover, Harris, Steeves, 2012 EBR). Binocular and monocularly viewing controls typically show a dominance of vision over audition when the systems are in competition whereas people with one eye do not (Moro & Steeves, 2012 EBR). These findings imply cross-sensory adaptation giving audition an advantage when vision is compromised.

We assessed whether the advantage given to audition in people with one eye when the auditory and visual systems were in competition might also be found when the systems were integrated together to make unified judgements.

### **Methods**

Participants were asked to spatially localize perceptually fused audiovisual events in which the auditory and visual components were spatially disparate. We were able to quantify the relative weightings assigned to each system when the systems were integrated.

### **Results**

There was no difference in the reliability assigned to localizing unimodal visual and auditory targets by people with one eye compared to controls. When localizing bimodal targets, the weightings assigned to each sensory modality in both people with one eye and controls were predictable from their unimodal performance in accordance with the Maximum Likelihood Estimation (MLE) model.

### **Discussion and Conclusions**

People with one eye appear to integrate the auditory and visual components of multisensory events optimally when determining spatial location despite the fact that they do not show the typical dominance of vision over audition when the two systems are in competition. It is possible that attentional modifications to the processing of each component when they are processed in parallel may represent an adaptive cross-sensory compensatory mechanism for the loss of binocular visual input that does not alter how these signals are integrated.

**Acknowledgements:** *This research is supported by NSERC, CFI, CNIB and Toronto Rehabilitation Institute.*

**Disclosure(s):** *None.*

**Keyword(s):** *audiovisual processing, cortical processing, visual development atypical*

### 3. The Effect of Convexity in the Biasing Children's Perception of Figures

**Presenting Author:** Michael Slugocki, *Department of Psychology, Neuroscience & Behaviour, McMaster University*

**Co-Author(s):** Daphne Maurer, *Department of Psychology, Neuroscience & Behaviour, McMaster University*; Mary A. Peterson, *Department of Psychology, University of Arizona*; Terri L. Lewis, *Department of Psychology, Neuroscience & Behaviour, McMaster University*

**Purpose:** Adults show a convexity bias: they are more likely to perceive as figures regions that are bound by convex rather than concave contours, a likelihood that increases with the number of regions displayed, revealing an effect of context (Peterson & Salvagio, 2008). The purpose of this study was to measure the development of the convexity bias and the effect thereon of context.

**Methods:** We tested 5-year-olds and adults ( $n=24/\text{age}$ ) with 2- and 8-region displays (Experiment 1). We then tested 3-year-olds, 5-year-olds, and adults ( $n=12/\text{age}$ ) with 4- and 8-region displays (Experiment 2). Displays consisted of alternating convex and concave regions that differed in luminance (black or white). The task on each trial was to identify the colour of the figure.

**Results:** In Experiment 1, both 5-year-olds and adults identified the convex regions more often as a figure for displays containing eight alternating regions (75%) than for displays containing only two regions (54%,  $p < .01$ ), suggesting an effect of context. No difference was observed between age groups ( $p > .70$ ). In Experiment 2, all age groups identified the convex regions as a figure more often for displays containing eight regions (90%) than for displays containing only four regions (81%,  $p < .01$ ). There was no significant difference in the proportion of trials on which the convex regions were identified as the figure across the three ages ( $p > .10$ ).

**Discussion & Conclusions:** Under the current testing conditions, the strength of convexity as a figural cue for figure-ground judgments appears to be adult-like by 3 years of age. Although the relationship between the effect of context and the strength of convexity still remains unclear for 3-year-olds, it appears to show an adult-like pattern at least by 5 years of age.

**Disclosure(s):** *Supported by Canadian Institutes of Health Research (CIHR) Grant MOP 36430*

**Web Page:** *baby.mcmaster.ca*

**Keyword(s):** visual development typical, visual function, figure-ground

## **4. Information is Not Communication: Meaningful Reporting of Visual Status**

**Presenting Author:** Kathryn Saunders, *Vision Science Research Group , University Of Ulster, United Kingdom*

**Co-Author(s):** J.A. Little, *Vision Science Research Group, University of Ulster, Northern Ireland, UK ;*

### **Purpose**

Many children with developmental disabilities have associated visual impairment. Families and others working with such children need to understand the child's visual abilities and limitations to ensure that the educational and recreational environment and materials provided are appropriate. The purpose of this work was to develop a web-based resource to support clinicians in writing meaningful, jargon-free reports for parents, teachers and other stakeholders.

### **Methods**

Using the authors' clinical experience examples and supporting material were designed and uploaded to <http://biomed.science.ulster.ac.uk/vision/-Vision-in-Childhood-.html>. Examples of reports reflecting the needs of children of different ages, with a variety of developmental disabilities and varying levels of visual impairment, were made available.

### **Results**

Dissemination regarding the availability of this support material is ongoing through regional and national stakeholder groups. Audit of families, education and health professionals receiving reports based on this information demonstrated that such reports were valued, understood and used in the care and education of the child.

### **Discussion & Conclusions**

The importance of vision in early learning is known. Children with developmental disability require early, thorough visual assessment. However, the impact of such intervention will be limited if outcomes are not communicated and disseminated in an appropriate format to family and other stakeholders. When this is done, parents, teachers and supporters of the child use and value the information. The availability of free downloadable examples and supporting information may be a useful tool for eye care practitioners working with children with special needs.

**Acknowledgements:** *Health and Social Care Research and Development Office, Public Health Agency, Northern Ireland*

**Disclosure(s):** *None.*

**Web Page:** *biomed.science.ulster.ac.uk/vision/-Vision-in-Childhood-.html*

**Keyword(s):** *children with special needs, rehabilitation, visual function*

## **5. The Representation of Visual Information on Educational Statements for children with Special Educational Needs**

**Presenting Author:** J-A Little, *Vision Science Research Group, University of Ulster, United Kingdom*

**Co-Author(s):** KJ Saunders, *Vision Science Research Group, University of Ulster, Coleraine, UK* ; L Wallace, *Orthoptic Department, Altnagelvin Hospital, Londonderry, UK*

### **Purpose**

Vision and visual processing are often impaired in children with neurological impairments (Gunn *et al.* 2002; Dutton *et al.* 2004; Ghasia *et al.* 2008; Saunders *et al.* 2010). In the UK, such children may undergo educational statementing for Special Educational Needs (SEN). This statement should include all information relevant to the child, to ensure appropriate education can be accessed and needs are met during school life. However, research has identified a lack of inter-professional communication, including between health and education, as a common problem for children with complex neurological impairment (O'Connor *et al.* 2008, Lundy *et al.* 2011). The current study reviewed SEN statements for children attending a Special School in Northern Ireland, UK, and compared this with clinical information from local hospital eye services.

### **Methods**

Parents of children at the Special School were informed about the study and access to their child's SEN educational records and clinical visual records requested. Once written consent was received, relevant information was reviewed.

### **Results**

Consent was obtained from 28 parents (27%) to access educational and clinical information about their child. Clinical visual records existed for 25 participants. Of these, 76% (n=19) had been assessed for refractive error, and 44% had glasses prescribed (n=11). A record of spectacle wear was only reflected in five SEN statements. 92% (n=23) had a measure of visual acuity recorded. Of those, 60% (n=14) of participants had best VA equal to or less than 0.3logMAR, which is classified as 'low vision' according to the World Health Organisation ICD-10. None of these was noted to have a visual impairment in their SEN statement. Two children were recorded as visually impaired in the SEN statement due to significant ocular/systemic pathology. Information regarding other aspects of vision and visual need was sparse within SEN statements. The SEN Medical Appendix 3 from the paediatrician sometimes noted a visual acuity measurement, frequently commented on visual history, but useful function information could not be derived from these reports.

### **Discussion and Conclusions**

SEN statements define the support needed for education and school life. Despite additional visual needs being common, and described in clinical visual records, SEN statement information accessed in the present study failed to highlight significant visual issues.

**Acknowledgements:** *Grant funding: HSC R&D Office, Northern Ireland, UK*

**Disclosure(s):** *None*

**Keyword(s):** *visual development atypical, visual function*

## **6. Withdrawn**

## **7. What Can Be Done to Help? A Scoping Review of Interventions Designed to Help Children with Both Visual and Neurodevelopmental Problems**

**Presenting Author:** *Cathy Williams, School of Social and Community Medicine, University of Bristol, United Kingdom*

**Co-Author(s):** *K Northstone, School of Social and Community Medicine, University of Bristol, Bristol, UK; C Borwick, School of Social and Community Medicine, University of Bristol, Bristol, UK ; M Gainsborough, Community Child Health Partnership, North Bristol NHS Trust, Bristol, UK ; J Roe, Education Dept, Bristol City Council, Bristol, UK ; S Rogers, Education Dept, Bristol City Council, Bristol, UK ; S Howard, Community Child Health Partnership, North Bristol NHS Trust, Bristol, UK ; J Amos, Community Child Health Partnership, North Bristol NHS Trust, Bristol, UK ; JM Woodhouse, School of Optometry and Vision Science, Cardiff University, Cardiff, UK ;*

### **Purpose**

Children with both visual impairment and a condition affecting their neurodevelopment (children with VND) may require extensive and specialized help but advice on the most effective strategies is lacking.

### **Methods**

We carried out a scoping review, following the PRISMA guidelines and systematic review methodology and we assessed the quality of included studies and of the overall body of evidence where appropriate. A structured database search produced 4450 abstracts that were each reviewed by 2 authors; 107 papers were selected for inclusion including 65 experimental studies.

### **Results**

We found 1 systematic review, 4 controlled trials, 13 before/after studies, 32 single-case design studies and 32 case reports. We found moderate quality evidence that supported the use of assistive communication devices and for the provision of glasses whilst the evidence for environmental modifications and for training/stimulation programmes was less strong.

### **Discussion & Conclusions**

The results of this review support current recommendations that children with neurodevelopmental problems receive an eye test and glasses if needed. Much of the evidence we found related to the efficacy of communication devices and further work is needed regarding whether assessment of visual function can help in device selection for individual children. The evidence we found regarding training/stimulation programmes and environmental modifications was less strong and further research into these potentially important interventions is needed.

**Acknowledgements:** *CW is supported by an NIHR CDF*

**Disclosure(s):** *None*

**Keyword(s):** *interventions, visual development atypical, visual function*

## **8. Corneal Hysteresis and its Potential Use for Diagnosing Keratoconus in Teenagers and Young People with Down's Syndrome - A Preliminary Study**

**Presenting Author:** *Stephanie Campbell, Optometry, Cardiff University, United Kingdom*

**Co-Author(s):** *JM Woodhouse, School of Optometry and Vision Sciences, Cardiff University, Cardiff, UK ; KM Meek, School of Optometry and Vision Sciences, Cardiff University, Cardiff, UK*

### **Purpose**

Keratoconus is a visually disabling condition of the cornea, preferentially affecting teenagers and young adults, and many times more prevalent in people with Down's syndrome (DS). Corneal hysteresis is a measurement of the eye's biomechanical response to pressure, and lower values are considered risk factors for ocular pathology including keratoconus. The study establishes hysteresis baseline norms for the paediatric population, and discusses the implications of these results for the risk of keratoconus.

### **Methods**

A slit lamp examination of all participants was carried out to exclude corneal or anterior chamber pathology. The Ocular Response Analyzer (Reichert Ophthalmic Instruments, Buffalo, NY) was used to measure corneal hysteresis and corneal rigidity factor for all paediatric participants.

### **Results**

The study is ongoing and we will present the results to date and discuss the implications of ORA results for the risk for keratoconus.

### **Discussion & Conclusions**

The advent of collagen cross linking provides brighter prospects for young people with DS and keratoconus, but also highlights the necessity of early detection before ectasia progresses in what is typically a thinner cornea than a non-DS patient. This study presents normative values for children in South Wales, and outlines the diagnostic principles for the early detection of keratoconus in young people with Down's syndrome.

**Acknowledgements:** *none*

**Disclosure(s):** *none*

**Web Page:** *[www.cardiff.ac.uk/optom/](http://www.cardiff.ac.uk/optom/)*

**Keyword(s):** *keratoconus, ocular disease, reading and learning disabilities*

## **9. Silicon-Hydrogel Contact Lenses in Multi-Disabled Visually Impaired Children: the Options and Indications for Use**

**Presenting Author:** Anna Zobanová, Paediatric Ophthalmologist, Low Vision Private Dept. of Ophthalmology, Czech Republic

**Co-Author(s):** Barbora Zobanová, Low Vision Private Dept. of Ophthalmology, Prague, Czech Republic

### **Purpose**

Correction of refractive errors is important and essential as a prevention of amblyopia. Adequate treatment during the first year of life is critical for development of vision. The aim of our care is to prevent the development of amblyopia in addition to principal impairment of visual system. Often it is necessary to resolve failure or loss of the ability to accommodate. We have compared the advantage of glasses and contact lenses use in these children.

### **Methods**

We care for a group of 256 visually impaired children (80% of them being multi-disabled visually impaired children) aged between 6 months and 10 years. All of them have the critical refractive error for development of amblyopia (Spherical error: Myopia > -2.0D, Hyperopia > +5.0D; Anisometropia > 2.0D; Astigmatism > 2.5D). All children were first managed with glasses. Absolute indications for optical correction or hypercorrection (using multifocal correction by glasses or contact lenses) are epilepsy including West syndrome, Down syndrome, optic disc atrophy, prematurity (without or with strabismus) and strabismus. Relative indications are microphthalmus, buphthalmus, megalocornea, coloboma of iris, lens, retina or optic nerve and status after uveal inflammation or vitreal hemorrhage. The indication for contact lens application were: intolerance of glasses at all, rehabilitation many times a day, spastic movements of the eyes or nystagmus, anisometropia or problems with frames in very low age.

### **Results**

The advantages of using glasses in MDVI children are not only functional - visual motivation of the children for better motoric development, prevention and treatment of disorders of monocular functions but also technical - simple care for parents or other assistant persons and lower price. On the contrary, the functional advantages of using silicon-hydrogel contact lenses (CL) are permanent sensoric stimulation of macula and improved development of binocular vision, whereas the technical advantage is CL application only once a week in the regime of continuous wearing.

### **Discussion & Conclusions**

The results of our 10-years care on MDVI children are encouraging because the optimal correction of visual acuity improves the integration of impaired vision into the total psychomotor development of the disabled child.

**Disclosure(s):** None.

**Keyword(s):** accommodation, refractive error

## **10. Low Vision Therapist as a Team Member in the Comprehensive Care of MDVI Children in Health Care in Czech Republic.**

**Presenting Author:** *Barbora Zobanová, Low Vision Therapist, Low Vision Private Dept. of Ophthalmology, Czech Republic*

### **Purpose**

Low Vision Therapist is a newly created profession working in health care in Czech Republic. Responsibilities of these specialists can be described as diagnostic, therapeutic, rehabilitative, preventive and dispensary care in the Low Vision Therapy. The specialist can work independently or in collaboration with an ophthalmologist. What is the content of Low Vision Therapy in our Health Care System? It is a set of diagnostic and therapeutical methods with exercises which encourage the patient to use compensation techniques and assistive devices to improve and utilize existing visual abilities. It's a long-term activity, we can say lifelong process of developing and maintaining visual options for obtaining information from the environment for communication, education and training, self-care, spatial orientation and independent movement and management of daily activities.

### **Methods**

What does it mean in practice?

- Low Vision therapist provides assessment of visual functions as visual acuity, contrast sensitivity, color vision, visual field and adaptation to light and dark.
- Functional vision examination which maps all vision abilities of the patient.
- Diagnosis and rehabilitation of visual skills, needed for every day functioning.
- Diagnosis and rehabilitation of CVI.
- Training of compensatory techniques for the use of special optical aids; suggestions and application of environment adaptation.

### **Results**

Our Low Vision Private Dept. of Ophthalmology care for more than 1200 MDVI children with refractive error, many kinds of syndromic defects, optic disc atrophy, prematurity (without or with strabismus), strabismus, microphthalmus, buphthalmus, megalocornea, coloboma of iris, lens, retina or optic nerve, disorders of retina, status after uveal inflammation or vitreal hemorrhage, nystagmus, ocularis albinismus, achromatopsia. These children need best vision. Their parents want to know how their child uses vision for every day functioning. All these children need glasses or contact lenses and we have to know visual function and functional vision examination.

### **Discussion & Conclusions**

The results of our 10 – years care on MDVI children need comprehensive care of ophthalmologist and low vision therapist for better sensorimotor development, prevention and treatment of disorders of visual functions and using vision.

**Disclosure(s):** *None.*

**Keyword(s):** *low vision, visual function*

## **11. Associations Between EEG Alpha Response to Emotional Vocalizations and Social Behaviour in Infants with Visual Impairment**

**Presenting Author:** Michelle O'Reilly, *Neurosciences Unit, UCL Institute of Child Health, United Kingdom*

**Co-Author(s):** E Sakkalou, *Neurosciences Unit, UCL Institute of Child Health, London, UK.* ; J Bathelt, *Developmental Cognitive Neurosciences Unit, UCL Institute of Child Health, London, UK.* ; M de Haan, *Developmental Cognitive Neurosciences Unit, UCL Institute of Child Health, London, UK.* ; A Salt, *Developmental Vision Clinic, Great Ormond Street Hospital NHS Trust, London, UK.* ; N Dale, *Developmental Vision Clinic, Great Ormond Street Hospital NHS Trust, London, UK.*

### **Purpose**

Visual impairment (VI) is associated with vulnerabilities in social development, with difficulties reported in early social interaction and emotional recognition (Dyck *et al.* 2004). The neural mechanisms underlying these social deficits remain unknown. We examined electrophysiological responses to emotional vocal stimuli, specifically alpha power, and how this relates to parental reports of social behaviour in infants with VI.

### **Methods**

21 infants (mean age  $13 \pm 2.4$  months) with 'potentially simple' disorders of the congenital visual system underwent EEG recording using a 128-channel EGI Sensor Net whilst being presented with happy, sad and neutral vocalizations from the Montreal Affective Voices set. Power spectral analysis was used to quantify the EEG, and absolute power within the Alpha frequency band (6-12 Hz) was extracted for frontal, lateral and posterior regions. The Near Detection Vision Scale (NDS, Sonksen *et al.* 1983) was used to grade the degree of visual impairment (profound/severe). Social behaviour was assessed using the Vineland Adaptive Behaviour Scales-II (Sparrow *et al.* 2005).

### **Results**

Half (53%) of our sample had Vineland Social Skills scores in the 'Low'/'Moderately Low' range according to norms, with the remainder in the 'Adequate' range. A partial correlation controlling for degree of vision revealed that the Social Skills score correlated negatively with the Alpha measure for the Sad condition ( $r = -0.53$ ,  $p = 0.04$ ) but not with the Happy or Neutral conditions ( $p > 0.05$ ). A significant negative correlation was observed for the 'Playing' subscale in particular ( $r = -0.6$ ,  $p = 0.01$ ). Items on this subscale include the response of the infant when the parent is playful with them and how much the infant shows interest in his/her surroundings.

### **Discussion & Conclusions**

The high incidence of social deficits in this sample is consistent with previous studies reporting impaired social behaviours in children with VI (Tadic *et al.* 2010). We report that higher Social Skills scores were associated with lower Alpha responses (reflects greater cortical activation) across all brain regions to sad vocalizations. These results are in line with those from a previous study reporting reduced alpha power associated with improved social behaviour in children with autism (Dawson *et al.* 2012). Our findings suggest an electrophysiological correlate of social functioning in infants with VI.

**Disclosure(s):** None.

**Keyword(s):** *electrophysiology, visual development atypical*

## **12. Optimum VI Project: Evaluation of Early Intervention and Development in Babies and Young Children with Visual Impairment (VI)**

**Presenting Author:** Naomi Dale, *Developmental Vision Clinic, Great Ormond Street Hospital NHS Trust, United Kingdom*

**Co-Author(s):** M O'Reilly, *Neurosciences Unit, UCL Institute of Child Health, London, UK* ; E Sakkalou, *Neurosciences Unit, UCL Institute of Child Health, London, UK* ; M de Haan, *Developmental Cognitive Neurosciences Unit, UCL Institute of Child Health, London, UK.* ; A Salt, *Developmental Vision Clinic, Great Ormond Street Hospital NHS Trust, London, UK.*

### **Purpose**

Our team has already established that infants and young children with severe visual impairment (VI) are vulnerable in all aspects of their development, including 'developmental setback' (Dale & Sonksen 2002). The aim of this unique national UK project is to investigate whether early intervention for children with severe VI is effective in reducing developmental vulnerability, including setback, and optimising outcome. It also aims to determine how additional factors such as children's vision level, brain integrity and interactions with parents and style of practitioner intervention impact on development and influence the effectiveness of early intervention.

### **Methods**

100 babies (aged 6-16 months at entry) with severe and profound VI, including approximately 75 with 'potentially simple' congenital disorders of the peripheral visual system (CDPVS) will be investigated. Infants with severe hearing and motor impairments will be excluded. The study design includes a 12 month longitudinal intervention trial with baseline pre and post-intervention measures including measures of brain electrical activity (EEG and Event-Related Potentials), functional vision, cognitive, social and language development, mother infant play, practitioner diary recordings and parent-professional relationships. MRI brain scans will also be analyzed to determine brain structural integrity. Multivariate regression and ANOVA statistical analyses will be undertaken to identify differing influences of the early intervention methods used and practitioner style on parent-child interactions and child outcome and to identify those aspects of early intervention and practitioner involvement which lead to the greatest effectiveness in child outcome and practice.

### **Results**

Data collection for this project is still ongoing.

### **Discussion & Conclusions**

We will present the full range of behavioural and neuroimaging measures being utilised, including new measures that have not previously been used with infants with VI. We will also present the background, aims and implications of the project in detail and clarify how the evidence base will be used for optimising early intervention and support for infants and young children with severe visual impairment. We anticipate that the results of this project will provide the evidence base for optimising the materials and practitioner delivery for early intervention and educational support for infants with VI.

**Disclosure(s):** *None.*

**Keyword(s):** *low vision, visual development atypical*

### **13. Retrospective and Longitudinal Study of Onset and Progression of Spherical Refractive Error in Albinism and Idiopathic Infantile Nystagmus (IIN)**

**Presenting Author:** Julie McClelland, *Vision Science Research Group, University of Ulster, United Kingdom*

**Co-Author(s):** KJ Saunders, *Vision Science Research Group, University of Ulster, United Kingdom.* ; N Healey, *Department of Optometry, Altnagelvin Area Hospital, Western Health and Social Care Trust, Londonderry, United Kingdom.* ; AJ Jackson, *Australian College of Optometry/ National Vision Research Institute, Melbourne, Australia & Royal Group of Hospitals, Belfast, United Kingdom & Dept of Optometry University of Melbourne, Australia.*

#### **Purpose**

The present study uses retrospective data to describe the onset and progression of spherical refractive errors in albinism and idiopathic nystagmus and compare the results between the two populations.

#### **Methods**

Refractive error data were obtained retrospectively from 146 (albinism n=93, IIN n=53) hospital records from the Low Vision Clinic at The Royal Group of Hospitals (RGH), Belfast. Data spanned a 24 year period (1986-2010). Data were recorded at each participant's initial visit, then after three months, six months and subsequently annually. Participants who attended for three or more visits (albinism n=83, IIN n=36) were included in the longitudinal analyses. Published normative data from children aged 6-7-year-old (n=399) and 12-13-year-old (n=669) were available for comparison from the Northern Ireland Childhood Errors of Refraction (NICER) Study (O'Donoghue et al 2010). Comparative data from a younger cohort (0-4 years) were available from Mayer et al (2001).

#### **Results**

A wider range of refractive errors and a higher mean most ametropic meridian was demonstrated by the albinism group (range: -13.50D to +10.25D; mean +3.16±4.07D) compared to the IIN group (range: -8.50D to +8.00D; mean +2.12±3.30D). Inspection of the longitudinal data revealed that the majority of participants in both clinical subgroups had spherical refractive errors that fell outside the normative limits in early infancy. These high levels of ametropia remained outside the normal limits with increasing age.

#### **Discussion and Conclusions**

Results demonstrated that refractive errors in both populations failed to emmetropise as would be expected with typically developing children. The higher spherical refractive errors in the albinism subgroup may be related to the additional structural anomalies present in albinism.

**Acknowledgements:** *The study was funded by The Department for Employment and Learning Northern Ireland (DELNI).*

**Disclosure(s):** *None*

**Keyword(s):** *albinism, low vision, refractive error*

## **14. Methodology for International Validation of Posterior Retinal Blood Vessel Diameter and Tortuosity in Retinopathy of Prematurity Clinical Trials - The Retinal Image Digital Analysis (RIDA) Study**

**Presenting Author:** *Catriona Macintyre-Beon, Ophthalmology, Royal Hospital for Sick Children, Glasgow, United Kingdom*

**Co-Author(s):** *B Fleck, Department of Ophthalmology, NHS Lothian, Edinburgh, United Kingdom ; C Wilson, University College London, London, United Kingdom ; KD Cocker, Phaethon.net*

**Purpose:** The Neonatal Oxygenation Prospective Meta-analysis (NeoPROM) collaboration is an international group of oxygen treatment trials for Retinopathy of Prematurity (ROP). One of these trials, the BOOST II UK trial, collected a large number of RetCam digital images from participating infants. A method was developed to allow international validation of diagnostic descriptions of posterior retinal blood vessel diameter and tortuosity ("Plus" disease) in this trial.

**Methods:** Wide-field digital fundus images of infants born preterm were captured using a RetCam system (Clarity Medical Systems, Pleasanton, CA, USA). Encrypted images were transferred via a secure study laptop using bespoke software (RetView, visionresearch.org) to extract, select and anonymise images for upload to a secure study web-server. The uploaded images were catalogued, quality assured and arranged for remote reading experiments. Methods for secure, remote access were used and methods for quantitative image analysis of blood vessel diameter and tortuosity were developed. Procedures to create anonymised links to clinical information from the BOOST II UK trial have been negotiated.

**Results:** Each component of the validation system has been tested and is operational. A series of experiments are now planned in order to compare clinical diagnostic decisions made by BOOST II UK participating ophthalmologists with assessments made remotely online.

**Discussion and Conclusions:** A methodology has been devised by which international validation of clinical diagnostic decisions in clinical trials of Retinopathy of Prematurity (ROP) may be achieved. All components are operational. It is anticipated that the use of this approach will lead to improved standardization of clinical diagnostic decisions in ROP treatment trials and in clinical practice.

**Disclosure(s):** *None.*

**Keyword(s):** *prematurity, visual development atypical*

## 15. Abnormal Visual System Development and Morphology in Human Albinism

**Presenting Author:** Larissa McKetton, *Department of Biology, Centre for Vision Research, York University, Canada*

**Co-Author(s):** K Schneider, *Department of Biology, Centre for Vision Research, York University, Toronto, Canada*

### **Purpose**

Albinism is a genetic condition of hypopigmentation in which defects in melanin pigment synthesis cause melanin and melanocyte depletion. The lack of melanin development has severe impacts associated with the development of the eye and visual system. The result includes a variety of ophthalmic deficits such as reduced visual acuity and an abnormal decussation pattern of the optic chiasm. Our experimental objective was to confirm and quantify morphological differences in the optic nerves, optic chiasm and optic tracts, and in the lateral geniculate nucleus (LGN) using high-resolution magnetic resonance imaging (MRI), with the aim of better understanding brain development and plasticity.

### **Methods**

Participants were scanned using a Siemens Trio 3T MRI scanner and 32-channel head coil. Ten patients with oculocutaneous albinism [OCA; mean age (SD) = 37(16) years; 5 women] were compared against ten age-matched controls. An anatomical T<sub>1</sub>-weighted three-dimensional MPRAGE sequence scan of the entire head (TR = 1900 ms, TE = 2.52 ms, 256 matrix) was reformatted so that the optic nerves, chiasm and tracts were in the same plane. Optic nerve, chiasm and tract widths were measured three times each by four raters blind to group membership. Anatomical regions of interest (ROIs) for each LGN were also traced by three raters blind to group membership from 40 proton density-weighted images that were registered and averaged together (TR = 3 s, TE = 26 ms, 256 matrix).

### **Results**

Significant reductions in the optic nerves, chiasm and tracts in albinism patients were observed compared to controls. The volumes of each LGN in patients with albinism were also found to be significantly reduced compared to controls, a novel finding.

### **Discussion & Conclusions**

Our findings of narrower optic nerves, tracts and chiasm in the albino compared to control group can be attributed to the abnormal crossing of optic fibres and the possible reduction of retinal ganglion cells (RGCs) in the central retina, consistent with albino primates. The volume of the LGN devoted to the center of the visual field could be reduced in albinism since they have fewer RGCs representing the center where the fovea would normally lie. This research helps address how genetic deficits can compromise proper visual system development that affect downstream visual structures and function.

**Disclosure(s):** *None.*

**Keyword(s):** *low vision, visual development atypical*

## **16. Blue Cone Monochromatism in a Female Due to Skewed X-Inactivation**

**Presenting Author:** Lotte Welinder, *Ophthalmology, University Hospital Aalborg, Denmark*

**Co-Author(s):** AL Frederiksen, *Dept of clinical genetics, Vejle Hospital, Vejle, Denmark* ; M Dunoe, *Dept of molecular biology, Rigshospital, Copenhagen, Denmark*

### **Purpose**

A case of a three year old girl with family history of blue cone monochromatism(BCM) presenting with nystagmus, low vision, colour vision defect and myopia

### **Methods**

Clinical investigation, genetic analysis of OPN1LW/MW genes and investigation of x-inactivation pattern using HUMARA-essay to investigate reasons for manifest BCM in an obligate carrier of an X-linked condition

### **Results**

The girl has clinically manifest BCM based on ERG, OCT and colour vision testing. We found mutations in well-known BCM genes in father and daughter and complete X-inactivation in buccal mucosa and leucocytes, explaining the clinical manifestation of X-linked disease in a female obligate carrier of the BCM gene

### **Discussion & Conclusions**

Girls in families with X-linked disease are traditionally informed that they will carry the gene expressed in their father, but will never express the disease themselves. Therefore it can be a shock to a family if a girl suddenly expresses manifest disease. Our case shows that in very rare cases a girl can manifest X-linked disease due to skewed X-inactivation.

**Acknowledgements:** *This case has been accepted for publication in Ophthalmic Genetics, and was accepted as a poster at WCPOS in Milan 2012*

**Disclosure(s):** None

**Keyword(s):** *low vision, ocular disease*

## 17. Interocular Difference of Foveal Thickness in Children with Unilateral Cataracts

**Presenting Author:** Jingyun Wang, *Ophthalmology, Glick Eye Institute, Indiana University School of Medicine, United States of America*

**Co-Author(s):** HA Smith, *Glick Eye Institute, Indiana University School of Medicine, Indianapolis, USA* ; KM Haider, *Glick Eye Institute, Indiana University School of Medicine, Indianapolis, USA* ; Y Sun, *Glick Eye Institute, Indiana University School of Medicine, Indianapolis, USA* ; GJ Roberts, *Glick Eye Institute, Indiana University School of Medicine, Indianapolis, USA* ; DT Sprunger, *Glick Eye Institute, Indiana University School of Medicine, Indianapolis, US* ; DE Neely, *Glick Eye Institute, Indiana University School of Medicine, Indianapolis, USA* ; DA Plager, *Glick Eye Institute, Indiana University School of Medicine, Indianapolis, USA*

### Purpose

Unilateral congenital cataract may be associated with abnormal retina as seen with some cases of persistent fetal vasculature (PFV). However, there are few reports of retinal imaging in this population. In this prospective study, in children with unilateral congenital and developmental cataracts, retinal structure was compared between the cataractous eye (CE) and the fellow eye (FE).

### Methods

Children with unilateral cataract surgery were recruited. Eyes diagnosed with microphthalmia were excluded. Criterion of gestational age is over 37 weeks. Unilateral cataracts during surgery were classified by surgeons into subtypes – posterior lenticonus (N=7), PFV (N=7), posterior subcapsular (N=1) and anterior polar (N=2). All patients had visual acuity (VA) better than 20/300. Age at imaging was  $9.6 \pm 3.9$  years old. Age at surgery was  $3.7 \pm 3.4$  years old. Pre-operative axial length (AL), spherical equivalent (SEQ) and VA at testing were recorded from medical records. Frequency domain optical coherence tomography (fdOCT) was used to image retinal structure. Retinal volume scans across the fovea were obtained from both eyes. Using a segmentation program of the software, foveal total thickness (FTT) and the thickness of inner and outer retinal layer regions were measured.

### Results

One child with PFV had unidentifiable retinal structure and was excluded from analysis. Although eyes of most (15/16) patients are in normal range (refer to Yanni et al, in press), FTT was significantly thicker in the CE than in the FE (paired t-test,  $p=0.004$ ). Superior, nasal, inferior and temporal sectors were all significantly thicker of FTT in the CE (paired t-test,  $p<0.01$ ). There was significant difference in foveal outer layer ( $p=0.03$ ), but not in inner layer ( $p=0.41$ ). The difference of FTT was not associated with the interocular difference of SEQ ( $r=0.06$ ,  $p=0.82$ ), nor interocular difference of VA ( $r=-0.05$ ,  $p=0.85$ ), nor age at surgery ( $r=-0.2$ ,  $p=0.46$ ). However, it is correlated to interocular difference of AL ( $r=0.54$ ,  $p=0.04$ ), which means that relatively shorter AL is associated with relatively thicker retina.

### Discussion and Conclusions

Most cataractous eyes have FTT within the normal range. However, there is a significant interocular difference of FTT between the CE and the FE, which is not associated with interocular difference of VA and SEQ, but was associated with AL. Further study is needed to understand the causes of interocular foveal difference in the unilateral cataract.

**Disclosure(s):** None.

**Keyword(s):** congenital cataract, visual development atypical, visual function

## 18. The Origins of Retinal Toxicity Attributed to the Anti-Epileptic Drug Vigabatrin in Infantile Spasms.

**Presenting Author:** Rachel Dragas, *Neurosciences and Mental Health, The Hospital for Sick Children, Canada*

**Co-Author(s):** T Wright, *Dept of Ophthalmology and Vision Sciences, The Hospital for Sick Children, Toronto, Canada.* ; A Kumarappah, *Institute of Medical Science, University of Toronto, Toronto, Canada.* ; CA Westall, *Dept of Ophthalmology and Vision Sciences, The Hospital for Sick Children, Toronto, Canada, and Institute of Medical Sciences, University of Toronto, Toronto, Canada.*

### **Purpose**

Vigabatrin, an anti-epileptic drug used to treat Infantile Spasms (IS), has been linked to retinal toxicity, in the form of visual field reduction. Visual field reductions have been observed in approximately 30% of adult patients treated with vigabatrin. Electroretinograms (ERGs) are used to monitor retinal function in pediatric patients. Vigabatrin-associated ERG reduction (VAER) is defined in our laboratory as a significant reduction in age-corrected 30-Hz flicker amplitude from the baseline measurement. The d-wave ERG response is the result of hyperpolarizing OFF bipolar cells and can be elicited by a long duration (150ms) flash stimulus. The purpose of this study was to evaluate if the long flash ERG response could be used as a marker for vigabatrin toxicity.

### **Methods**

A prospective cross sectional study was conducted to assess the cone-OFF response and 30 Hz flicker response to a 2.29 cd.s.m<sup>-2</sup> flash under light adapted (30 cd/ms<sup>2</sup>) conditions. 57 pediatric patients taking vigabatrin for IS (median age: 14 months, range: 2-46 months), were clinically monitored for VAER and received an additional long flash ERG test. Subsequently, 5 retinally normal controls (median age: 27 months, range: 9-60 months), underwent long flash testing. The resultant amplitude and implicit timing of the d-wave response were measured manually. 7 subjects taking vigabatrin were diagnosed with VAER at or prior to the time of testing. Vigabatrin dose information was identified by chart review.

### **Results**

Increased cumulative dosage of vigabatrin was significantly associated with a reduction in d-wave amplitude in subjects on vigabatrin ( $p = 0.01$ ). A relationship was also noted between d-wave amplitude and retinal toxicity ( $p$  value=0.08), with a mean amplitude of 36 and 50  $\mu$ V, in patients with and without toxicity, respectively.

### **Discussion and Conclusions**

Due to the high variability of the 30-Hz flicker response in this population, significant reduction is required on two consecutive visits for a diagnosis of VAER. Reduction in the cone OFF response may serve as a marker for vigabatrin induced retinal changes and potentially retinal toxicity. These results may aid in elucidating the biological mechanisms of vigabatrin associated visual field loss.

**Disclosure(s):** *Research funded by Lundbeck Pharmaceuticals.*

**Keyword(s):** *vigabatrin, electrophysiology, visual function*

## **19. Association Between Inner Retinal Layer Thickness and Neuroretinal Function in Adolescents with Type 1 Diabetes and no background Diabetic Retinopathy**

**Presenting Author:** Durgaa Rajendran, *Neurosciences and Mental Health, Hospital for Sick Children, Canada*

**Co-Author(s):** Y Garcia Sanchez, *Ophthalmology, Hospital for Sick Children, Toronto, Canada* ; W Tan, *School of Optometry and Vision Science, University of Waterloo, Waterloo, Canada* ; T Wright, *Ophthalmology, Hospital for Sick Children, Toronto, Canada* ; C Westall, *Ophthalmology, Hospital for Sick Children and University of Toronto, Toronto, Canada*

### **Introduction**

Diabetic retinopathy (DR) is the primary cause of severe vision loss in type 1 diabetes (T1D) and will develop in 95% of individuals with T1D over time. Puberty is associated with increased risk of DR; our lab investigates changes in retina structure and function in adolescents, prior to the clinical diagnosis of DR. We previously found delays in implicit time of multifocal oscillatory potentials (mfOPs) in adolescents with T1D compared with controls. OPs originate from cells in the inner retina; our purpose was to identify group differences and spatial associations between retinal areas and inner retinal thickness in adolescents with T1D.

### **Methods**

Cross-sectional pilot study including 7 adolescents with T1D for 5 years or more and no signs of DR ( $17.5 \pm 1.4$  yrs. old) and 7 age-similar participants without diabetes ( $16.3 \pm 1.5$  yrs. old). High-resolution adaptive optics-enhanced optical coherence tomography (OCT) images (Physical Sciences Inc.) were captured at 4 quadrants  $7^\circ$  eccentric from the fovea along the oblique meridians. Inner retinal thickness was measured from ganglion cell to the outer plexiform layer at each quadrant. mfOPs within the central retinal  $20^\circ$  were collected (VERIS EDI), and the implicit time of the mfOPs were measured for each quadrant. Participant group and quadrant differences for inner retinal thickness and mfOP implicit time were examined using repeated-measures ANOVA.

### **Results**

There was no quadrant effect observed in mfOP implicit time or inner retinal thickness. There was a delay in the implicit time of mfOPs in adolescents with T1D compared with control participants ( $p = 0.1$ ). Adolescents with T1D presented with a thinner inner retina ( $p = 0.04$ ) compared with control participants. Disruption in oscillatory potentials combined with thinner inner retinal layers point to localized damage of the inner plexiform layer in T1D.

### **Discussion & Conclusions**

This is the first study to quantitatively analyze spatial associations between localized neuroretinal function and the thickness of specific retinal layers in individuals with T1D prior to the onset of DR. This study provides evidence to warrant a full investigation; the results of which may provide insight into the biological mechanisms of early DR progression.

**Disclosure(s):** None

**Keyword(s):** *type 1 diabetes, electrophysiology, visual function*

## 20. Effect of Prenatal Exposure to Organochlorinated Pesticides on Visual Evoked Potentials in Inuit Children

**Presenting Author:** Chloé Cartier, *Département de Psychologie, Université du Québec à Montréal, Canada*

**Co-Author(s):** G Muckle, *Ecole de psychologie, Université Laval, Québec, Canada* ; E Dewailly, *Unité de Recherche en Santé Publique, CHUL, Québec, Canada* ; P Ayotte, *Unité de Recherche en Santé Publique, CHUL, Québec, Canada* ; JL Jacobson, *Département de psychiatrie et de neurosciences comportementales, Wayne State University, Detroit, USA* ; D Saint-Amour, *Département de psychologie, Université du Québec à Montréal, Montréal, Canada*

### **Purpose**

Due to their geographic location and their traditional diet rich in seafood and marine mammals, the Inuit from the Arctic Québec are exposed to high levels of persistent pollutants, including organochlorinated pesticides (OP). Whereas the adverse developmental effects of these pesticides on child cognitive function are well known, effects of developmental exposure to OP on sensory processes has not been evaluated. The aim of the present longitudinal study was to assess the effect of prenatal and current DDT and DDE exposures on visual processing in Inuit children.

### **Methods**

DDT and DDE levels were determined from umbilical cord samples and blood samples taken at 10 years of age. Visual evoked potentials (VEPs) were recorded in 170 children at 4 contrast levels (95%, 30%, 12% and 4%). Hierarchical multiple regressions were conducted to evaluate the association between prenatal or current pesticide exposure and VEPs, controlling for the effects of confounding factors (age, education, alcohol or tobacco uses during pregnancy, etc).

### **Results**

A significant positive association was found between DDE level measured in umbilical cord samples and N150 amplitude, at the lowest visual contrast level (4%).

### **Discussion & Conclusions**

Prenatal exposure to DDE impacts visual processing during childhood, as measured with VEPs. The underlying mechanism of action may rely on endocrine disruption and/or neuronal hyper-excitability, both of which are associated with exposure to this pesticide. Because current exposure to pesticides was controlled in our study, *in utero* exposure seems to entail greater vulnerability to neurotoxic effect of OP on the visual system, putatively via the magnocellular pathway.

**Disclosure(s):** None.

**Keyword(s):** Neurotoxicity, electrophysiology, visual development typical

## 21. Withdrawn

## **22. Disinvestment Study of Population-Based Preverbal Vision Screening in the Netherlands**

**Presenting Author:** *Frea Sloot, Ophthalmology, Erasmus Medical Center, The Netherlands*

**Co-Author(s):** *Sjoukje Loudon, Erasmus Medical Center, Rotterdam, The Netherlands ; Hein Raat, Erasmus Medical Center, Rotterdam, The Netherlands ; Huib Simonsz, Erasmus Medical Center, Rotterdam, The Netherlands*

### **Purpose**

In the Netherlands, Child Health Centers (CHC's) screen >99% of all Dutch children. Preverbal screening at 1, 3, 6-9 and 14-24 months includes cover test, Krimsky test, eye movements, cornea and pupillary reflexes. Preschool screening comprises measurement of visual acuity at 36 (pictures), 45 and 54 months. The RAMSES birth-cohort study showed that preverbal screening contributed little to the detection of refractive amblyopia and more than half of strabismus amblyopia was not detected through screening.

### **Methods**

In half of approximately 10,000 children in a large rural area of the Netherlands and the northern district of Amsterdam preverbal screening will be abolished. Children born in the second half of 2011 serve as controls. In children born in the first half of 2012 screening at 6-9 and 14-24 months will be omitted. The intervention group will be split by randomisation at the CHC level and in half visual acuity will not be measured at the age of 36 months. The endpoint is sensitivity and specificity of screening at 45 months, graded to severity of amblyopia and age at detection of amblyopia. Adherence to the study protocol is monitored through electronic screening records, anonymous questionnaires and on-site observations with stopwatch recording.

### **Results**

5205 children were included in the intervention group, against 5649 in the control group (6% of the Netherlands birth rate) complemented with 500 children from the northern district of Amsterdam. Extensive instruction was given to all participating CHC's. 27 anonymous questionnaires have been evaluated. On-site observations are currently started.

### **Conclusion**

In 2016 it will be clear whether continuation of preverbal screening and measurement of visual acuity with pictures at the age of 36 months is worthwhile.

**Acknowledgements:** *Foundation Lijf & Leven, Foundation Coolsingel CZ Health Insurance Tilburg*

**Disclosure(s):** *none*

**Keyword(s):** *screening, amblyopia, visual development typical*

## 23. The Use of Computer Generated Faces to Measure the Perception of Facial Expression

**Presenting Author:** Lisa Hamm, *Optometry and Vision Science, University of Auckland, New Zealand*

**Co-Author(s):** PM Corballis, *Dept of Psychology, University of Auckland, Auckland, New Zealand* ; JM Black, *Dept of Optometry and Vision Science, University of Auckland, Auckland, New Zealand* ; B Thompson, *Dept of Optometry and Vision Science, University of Auckland, Auckland, New Zealand*

### **Purpose**

We are interested in detecting subtle abnormalities in the perception of facial expression of emotion in children. FaceGen software provides a means of 3D facial avatar generation and easy manipulation of facial expression. The aim of this preliminary study was assess whether such images could be used to measure the perception of emotional expression.

### **Methods**

We imported a set of three photographs (front and side views) of a single model from which a 3D avatar was generated. The model was morphed to represent three emotions; happy, sad and angry. Five images with increasing intensity were rendered for each expression as well as a neutral face. Within a two-alternative-forced-choice paradigm, 7 adult participants judged the expression of upright or inverted faces in two tasks; one requiring a judgement of happy vs. sad and the other a judgement of happy vs. angry. Faces were presented for 1 second without feedback and each combination of expression and orientation (upright vs. inverted) was presented 30 times.

### **Results**

A within subjects ANOVA with factors of expression intensity (5 levels) and orientation (upright vs. inverted) revealed that task performance scaled with expression intensity for both the happy vs. sad ( $F = 24.2, p < 0.001$ ) and the happy vs. angry ( $F = 55.9, p < 0.001$ ) judgements. Task performance was poorer when faces were inverted for the happy vs. sad judgements ( $F = 17.9, p = 0.006$ ) but not the happy vs. angry judgements ( $F = 1.4, p = 0.28$ ). There was no interaction between expression intensity and orientation for either set of judgements. There was a significant bias towards "happy" for the neutral face across all conditions ( $t < 2.8, p < 0.05$  for all).

### **Discussion and Conclusion**

These initial results suggest that computer software such as FaceGen can be used to generate stimuli with graded levels of emotional expression that may be useful for psychophysical testing. The advantage of this approach is that a wide range of stimuli can be generated from a single set of photographs and that factors such as emotion expression can be manipulated in a parametric manner.

**Acknowledgements:** *The presenting author is funded through Education New Zealand.*

**Disclosure(s):** *None.*

**Keyword(s):** *face perception, cortical processing, visual function*

## 24. Novel Approaches to Automated, Real-Time Eye-Movement Classification in Infants and Adults

**Presenting Author:** Pete Jones, *Institute of Ophthalmology, UCL, United Kingdom*

**Co-Author(s):** E Burton, *Institute of Ophthalmology, UCL, London, UK* ; S Kalwarowsky, *Institute of Ophthalmology, UCL, London, UK* ; J Wattam-Bell, *Division of Psychology and Language Sciences, UCL, London, UK* ; M Nardini, *Institute of Ophthalmology, UCL, London, UK*

### **Purpose**

Eye-movements afford robust, non-invasive measures of visual function. They are also one of the few responses that can be elicited reliably in infants, making them vital indices of visual development and dysfunction. However, the classification of eye-looks predominantly occurs either offline, or via experimenter judgements. This hinders the design of efficient and flexible testing procedures in which stimuli are contingent on observer's performance. Here we present a number of automated approaches to classifying eye-looks in real-time, given a paradigmatic psychophysical task: sinusoidal contrast detection. Algorithms are compared in terms of their speed/accuracy/precision, and psychophysical detection limens derived autonomously are compared with those produced via current gold-standard procedures.

### **Methods**

Adults and infants were encouraged to discriminate fixed-contrast patterns of variable spatial frequency from regions of equivalent, uniform luminance. Spatial frequency was varied adaptively to track the observer's detection threshold. A simple quadrant-polling approach, in which visual fixations are classified based on the region of maximum interest, was compared with a Maximum Likelihood approach, in which the most likely fixation-object is determined probabilistically using a bounded drift-diffusion model. These automated approaches were further contrasted with measures derived manually, using Teller acuity cards.

### **Results**

Eye-tracker based measures of infant acuity using quadrant polling were consistent with those derived using Teller acuity cards, but less clearly showed age development and were less reproducible across sessions. The Maximum Likelihood approach (data collection ongoing) provides reliable measures with adults, and is a more powerful method that can be generalised to a wide range of infant-friendly paradigms. Work in progress is evaluating it against quadrant polling and Teller acuity.

### **Discussion & Conclusions**

Two methods of automated infant eye-movement classification for gaze-contingent testing of visual function are described. While one method does not yet show substantive improvements over manual testing with infants, work in progress is evaluating a promising alternative Maximum Likelihood approach. Automated eye-tracking methodologies are able to approximate manual approaches with adults, and provide a promising avenue for further development with infants.

**Disclosure(s):** *None.*

**Keyword(s):** *eye movements, visual development typical*

## 25. Visual Search and Attention in Very Low Birth Weight Children

**Presenting Author:** C.J.A. Geldof, *Clinical Neuropsychology, VU University, The Netherlands*

**Co-Author(s):** AG van Wassenaer-Leemhuis, *Dept of Neonatology, Emma Children's Hospital Academic Medical Centre, Amsterdam, The Netherlands* ; JH Kok, *Dept of Neonatology, Emma Children's Hospital Academic Medical Centre, Amsterdam, The Netherlands* ; J Oosterlaan, *Dept of Clinical Neuropsychology, VU University Amsterdam, Amsterdam, The Netherlands*

### **Purpose**

Very low birth weight (VLBW) is associated with visual perceptive and visual-motor dysfunctions (Geldof, et al., 2012). This study investigated the nature of the visual search problems in VLBW children and sought to test the hypothesis that visual search problems originate from deficits in attentional networks.

### **Methods**

Visual search and attentional network function was assessed in 108 VLBW children and 72 age matched term controls. Visual search performance was investigated with a newly developed paradigm that manipulated stimulus density and stimulus organization. Attention network function was measured using the Posner Attentional Network Test (ANT; Posner, et al., 2007). Data were analyzed using ANOVAs and multiple regression analyses.

### **Results**

Visual search was less efficient in VLBW children compared to controls, as indicated by increased reaction time ( $p = .04$ ) and lower accuracy in high stimulus density conditions ( $p = .03$ ). In addition, VLBW children demonstrated poor executive attention as indicated by lower accuracy levels on the executive attention measure of the ANT). No differences were found for the alerting ( $p = .45$ ) and orienting ( $p = .32$ ) attention measures. Preliminary analyses indicate no significant associations between the attention measures and visual search efficiency.

### **Discussion & Conclusions**

VLBW children were characterized by less efficient visual search ability and reduced executive attention. Deficits in executive attention did not explain the deficits in visual search, suggesting that both deficits occur independently of each other.

### **References:**

Geldof, et al. *Res Dev Disabil.* 2012;33: 726-736.  
Posner, et al. *Ann. Rev. Psychol.* 2007;58: 1-23.

**Disclosure(s):** *None*

**Keyword(s):** *visual attention, prematurity, visual development atypical*

## **26. Dorsal and Ventral Visual Stream Functioning in Very, Moderate and Late Preterm Born School-Aged Children**

**Presenting Author:** *Koen Van Braeckel, Pediatrics, Beatrix Children's Hospital, University Medical Center Groningen, The Netherlands*

**Co-Author(s):** *M Hitzert, Div of Neonatology, Dept of Pediatrics, University Medical Center Groningen, Groningen, The Netherlands ; JM Kerstjens, Div of Neonatology, Dept of Pediatrics, University Medical Center Groningen, Groningen, The Netherlands ; IFA Bocca-Tjeertes, Div of Neonatology, Dep of Pediatrics, University Medical Center Groningen, Groningen, The Netherlands ; SA Reijneveld, Dep. of Health Sciences, University Medical Center Groningen, Groningen, The Netherlands ; AF Bos, Div of Neonatology, Dept of Pediatrics, University Medical Center Groningen, Groningen, The Netherlands*

### **Purpose**

Currently, dorsal visual stream impairment in school-aged very preterm born children (GA<32 weeks) without major neurological disorders has generally been accepted. However, few studies investigated whether ventral visual stream functioning in this group of school-aged very preterm children is also affected. Furthermore, whether dorsal and ventral visual stream functioning is impaired in moderate and late preterm born children (33w>GA<37w) is still unknown. Finally, most visual-perceptual studies in preterm born children report only response accuracy, which is a measure of effectiveness, while little is known about the efficiency, taking response time and accuracy into account. Therefore, our goal was to investigate the efficiency of ventral and dorsal visual stream functioning in very and moderate preterm born children.

### **Methods**

Ten very preterm (GA 27w-32w) 10- to 11-year-olds without major neurological disorders and 19 full-term age mates, and 248 moderate and late preterm (GA 33w-36w) and 130 full-term 6-year-olds executed four visual-perceptual computerized tasks, which have been adapted from Chen et al. (2000) for use in children. In adults, Chen et al. reported that two of these tasks loaded high on one and low on a second factor, whereas the other two tasks loaded low on the one and high on the second factor. Given the nature of the tasks, the two factors were assumed to represent ventral and dorsal visual stream functioning. Response speed and accuracy were analyzed. A simple visual detection task was used as a control for visuomotor reaction time. Response times were analyzed using multi-level analysis. Accuracy data were analyzed using Mann-Whitney U.

### **Results**

The very preterm group performed significantly slower on each of the visual-perceptual tasks, while accuracy did not differ significantly on any task. On the detection task, response time did not differ significantly between the very preterm and control groups. Unfortunately, the data collection of the moderate and late preterm group is ongoing during the writing of this abstract. However, all data and results will be available at the time of the conference.

### **Discussion & Conclusions**

The results suggest a poorer efficiency of both ventral and dorsal visual stream functioning in very preterm school-aged children without major neurological disorders. Finally, the results suggest that future visual-perceptual studies should take both accuracy and response time into account.

**Acknowledgements:** *We acknowledge Dr. PR Butcher for her input in task selection*

**Disclosure(s):** *No disclosure.*

**Keyword(s):** *cortical processing, prematurity*

## 27. Visual Function in School-Age Children with a History of Prematurity

**Presenting Author:** Boram Hong, *Ophthalmology & Visual Sciences, Dalhousie University & IWK Health Centre, Canada*

**Co-Author(s):** JM Robitaille, *Ophthalmology & Visual Sciences, Dalhousie University, Halifax, Canada*; PH Artes, *Ophthalmology & Visual Sciences, Dalhousie University, Halifax, Canada*

### Purpose

To compare visual function in children with a history of prematurity, with or without retinopathy (ROP), to that of full-term children.

### Methods

We investigated 39 school-age children (24 girls, 15 boys, median age 10, IQR 9-12 years) born prematurely (gestational age <31 weeks) and 21 age-matched controls (13 girls, 8 boys). The premature participants were subdivided into those with mild ROP (stages 1 or 2 in zone 2), and those without ROP (stage 0). We investigated visual acuity (ETDRS chart), stereo-acuity (Frisby test), hyperacuity (Radial Deformation Acuity, Manchester RDA charts), and peripheral visual fields (Octopus 900).

### Results

Except for a clinically unimportant 2-letter difference in visual acuity, we did not observe statistically significant or clinically meaningful differences in any of the visual functions between the three groups (Table 1). Most children completed the fully-automated kinetic perimetry of three isopters with similar performance levels as are expected in adults.

**Table:** Median and IQR of visual acuity, stereoacuity, hyperacuity, and visual field (in mean radius degrees) in the three groups of children (sec arc = seconds of arc; VA=visual acuity; RDA=radial deformation acuity). \*Kruskal-Wallis rank-based comparison of groups test.

	VA	Stereo	RDA	Visual Fields		
	log MAR	sec arc	log units	I4e	I2e	I1e
<b>Mild ROP</b> n=15	0.00 -0.03, 0.04	35 35, 55	2.55 2.45, 2.63	60 58, 62	41 40, 43	26 23, 28
<b>No ROP</b> n=24	-0.01 -0.06, 0.03	35 35, 55	2.57 2.49, 2.69	59 57, 63	42 39, 45	26 22, 28
<b>Controls</b> n=21	-0.04 -0.07, -0.01	35 35, 55	2.59 2.49, 2.65	59 57, 60	40 37, 43	24 22, 26
<b>P-value*</b>	0.02	0.58	0.67	0.99	0.36	0.36

### Discussion & Conclusions

Mild ROP in pre-term children did not appear to cause visual problems in later childhood. Automated kinetic perimetry with the Octopus 900 may be a quantifiable and more accurate alternative to manual kinetic Goldmann perimetry and is feasible with school-age children.

**Acknowledgements:** *This research was supported by the grants from the NSHRF, IWK, Haag-Streit and the OPI Foundation.*

**Disclosure(s):** *I have no financial or commercial disclosures to acknowledge.*

**Keyword(s):** *prematurity, visual function*

## 28. The Development of Optic Flow Sensitivity

**Presenting Author:** Amanda Thomas, *Department of Psychology, The Pennsylvania State University, United States of America*

**Co-Author(s):** JD Fesi, *Department of Ophthalmology, McGill University, Montreal, Canada* ; RO Gilmore, *Department of Psychology, The Pennsylvania State University, State College, United States*

### **Purpose**

Optic flow provides an individual with information about her speed and direction of self-motion (Britten, 2008; Gibson, 1950). Radial (expansion/contraction) optic flow patterns elicit robust evoked potential responses in adults, while responses to rotation and translation (left/right) patterns are weaker. Comparatively, infants show the strongest evoked responses to lateral translation (Gilmore et al., 2007). Adult-like spatial and temporal tuning to global motion develops over a prolonged time period (Kiorpes & Movshon, 2004; Hou et al., 2009). Moreover, among adults, the responses vary extensively across the three patterns of flow (Fesi et al., 2011, VSS). In this study, we sought to investigate how these responses to optic flow develop, specifically when adultlike sensitivity emerges.

### **Methods**

We recorded steady-state visual evoked potential (SSVEP) responses from (n=23) 4-8 year-old children. Participants viewed coherence-modulating displays of three optic flow pattern types (lateral translation, rotation, and radial expansion/contraction) at 3 speeds (2, 4, and 8 deg/s). EEG was recorded using a 128 electrode net. Random dot displays (7 amin dots, 79.4 cd/m<sup>2</sup>, density = 10%) modulated in time from 0% (incoherent) to 100% coherent global motion at 1.2 Hz (F1). Phase-locked EEG at low order integer harmonics (1F1 and 2F1) was analyzed, as well as responses at the update rate of the dots (1F2: 24 Hz).

### **Results**

EEG amplitudes at 1F1 were shown across a distributed range of leads in the posterior scalp. Responses varied by pattern type and speed. First harmonic amplitudes to coherence modulation were largest for radial patterns, with responses to rotation and linear displays significantly lower. Fast speeds (8 deg/s) elicited the most robust responses across pattern type. The scalp distribution for slow (2 deg/s) radial patterns was more diffuse while the distribution for fast radial patterns was more medial and focal. Small amplitude, but significant responses at the dot update rate (1F2), reflecting a combination of local motion and luminance responses, were also observed.

### **Discussion & Conclusions**

The results suggest that adult-like sensitivity to coherence-modulating optic flow patterns emerges in middle childhood. Children show highest activity to fast radial flows and an emerging bilateral activation pattern for slow radial motion, broadly consistent with adults.

**Acknowledgements:** *Alice Mancino, Heidi Elnathan, Ken Hwang, NSF 1147440; Penn State SSRI*

**Disclosure(s):** *None.*

**Keyword(s):** *cortical processing, visual development typical*

## 29. Resolving Inconsistencies in Human Global Motion Maturation

**Presenting Author:** Kimberly M. Meier, *Psychology, University of British Columbia, Canada*

**Co-Author(s):** D Giaschi, *Ophthalmology and Visual Sciences, University of British Columbia*

### **Purpose**

The typical and atypical development of motion perception is commonly assessed with tests of global motion integration using random dot kinematograms. There are discrepancies, however, with respect to when typically-developing children reach adult-like performance on this task, ranging from as early as 3 years to as late as 12. We showed recently that differences in the density of the dots can partially account for some of the discrepancies (Narasimhan & Giaschi, 2012); here we search for additional parameters. While much research characterizes performance in terms of dot speed (as a ratio of distance over time), the distance that dots are displaced between animation frames, rather than frame duration or dot speed per se, determines performance in developing macaques (Kiorpes & Movshon, 2004). However, no studies have directly investigated whether psychophysical performance follows this pattern in children.

### **Methods**

Random dot kinematograms were presented to adults and to 5-7 year olds. Dot displacement ( $\Delta x$ ) varied from 1 to 38 min; frame duration ( $\Delta t$ ) was 17ms or 50ms with a total movie duration of 600ms; speed ranged from 0.3 to 38 deg/s. The proportion of coherently-moving dots was adjusted trial-by-trial according to a 2-down, 1-up staircase beginning at 100% coherence. Coherent motion thresholds for direction discrimination (left, right) were determined.

### **Results**

Adult performance was similar to that of young macaques, with worse performance at the smallest and largest  $\Delta x$  regardless of  $\Delta t$  (and thus, regardless of speed). The only effect of  $\Delta t$  in adults was at the smallest  $\Delta x$  where performance was better at the longer  $\Delta t$ . Child performance was dependent on  $\Delta t$  and  $\Delta x$ . It was adult-like at the longer  $\Delta t$  except at the slowest speed (smallest  $\Delta x$ ). At the shorter  $\Delta t$ , child performance was immature at speeds below 11 deg/s ( $\Delta x$  smaller than 11 min).

### **Discussion & Conclusions**

The effect of spatial displacement on motion coherence thresholds in adults and children is similar to that seen in monkeys. In addition, children have poorer sensitivity to motion at slow speeds, and this immaturity extends to moderate speeds when faster frame durations are used. These results help to explain previous discrepancies by showing that motion sensitivity to a given speed may be mature, or not, depending on the underlying spatial and temporal properties of the motion stimulus.

**Acknowledgements:** *Natural Sciences and Engineering Research Council of Canada (NSERC)*

**Disclosure(s):** *None.*

**Keyword(s):** *motion perception, visual development typical, visual function*

### **30. Normative Values for Smooth Pursuit Eye Movements in School-Age Children: A Preliminary Study.**

**Presenting Author:** *Valdeflors Vinuela Navarro, School of Optometry and Vision Sciences, Cardiff University, United Kingdom*

**Co-Author(s):** *JM Woodhouse, School of Optometry and Vision Sciences, Cardiff University, Cardiff, UK ; JT Erichsen, School of Optometry and Vision Sciences, Cardiff University, Cardiff, UK ; CEM Williams, School of Social and Community Medicine, Bristol University, Brsitol, UK*

#### **Purpose.**

The development of smooth pursuit in early infancy has been relatively well studied. In contrast, little information is available about the development of smooth pursuit in children before reaching adult-like values. The proposed study will use the latest non-invasive eye tracking techniques to establish normative values for smooth pursuit in primary school-age children.

#### **Methods.**

Children aged 4-11 will be recruited with no known eye movement problems from local Cardiff schools, and examined on their school premises. A 2° customized animated stimulus moving at 6°/s and following a ramp paradigm will be used to assess smooth pursuit performance. After data collection, we will evaluate the number of saccades and microsaccades performed during the smooth pursuit task as well as smooth pursuit performance parameters including position and velocity gains. The results obtained between children of different ages will be compared to assess smooth pursuit development in primary school-age children.

#### **Results.**

This study is ongoing but recently completed pilot studies evaluating smooth pursuits in 13 children aged from 2 to 15 have suggested an important smooth pursuit development during the ages studied. The number of saccades during the smooth pursuit tends to decrease with age, while the number of microsaccades shows a tendency to increase with age. The preliminary results also showed that position gains tend to increase with age, while velocity gains do not show important changes along the ages studied.

#### **Discussion & Conclusions.**

The results of this study will establish normative values and a full characterization of smooth pursuit eye movements in primary school-age children. These can then be used in future studies that aim to investigate the effectiveness of interventions provided to improve eye movements and educational achievements in children.

**Acknowledgements:** *The College of Optometrists*

**Disclosure(s):** *none*

**Keyword(s):** *normative values, eye movements, visual development typical*

**31. withdrawn**

**32. withdrawn**

### **33. Global Motion Detection is Related to Motor and Cognitive Development at Two Years of Age**

**Presenting Author:** Tzu-Ying (Sandy) Yu, *Optometry and Vision Science, The University of Auckland, New Zealand*

**Co-Author(s):** J Ansell, *Liggins Institute, The University of Auckland, Auckland, New Zealand* ; N Anstice, *Department of Optometry and Vision Science, The University of Auckland, Auckland, New Zealand* ; R Jacobs, *Department of Optometry and Vision Science, The University of Auckland, Auckland, New Zealand* ; N Paudel, *Department of Optometry and Vision Science, The University of Auckland, Auckland, New Zealand* ; T Wouldes, *Department of Psychological Medicine, The University of Auckland, Auckland, New Zealand* ; J Harding, *Liggins Institute, The University of Auckland, Auckland, New Zealand* ; B Thompson, *Department of Optometry and Vision Science, The University of Auckland, Auckland, New Zealand* ; on behalf of the CHYLD Study

#### **Purpose**

Specific deficits in global motion perception have been reported in groups of children with or at risk of abnormal neurodevelopment. This has led to the suggestion that the dorsal visual processing stream is particularly vulnerable during development. The purpose of this study was to assess the relationship between global motion detection and cognitive and motor function in a group of 2-year old children born at risk of abnormal neurological development.

#### **Methods**

Children born with risk factors for neonatal hypoglycaemia (n=366) were assessed at  $24 \pm 1$  months' corrected age. Global motion coherence thresholds (MCTs) were measured using the method of constant stimuli by presenting random dot kinematograms and recording the optokinetic reflex (OKR). Behavioural responses were also collected. Neurodevelopment was assessed using the Bayley Scales of Infant Development III (BSID-III) administered by trained examiners blinded to risk factors. Data were analysed using Pearson regression analysis or t-tests and are presented as mean  $\pm$  SD.

#### **Results**

MCTs were measured successfully using the OKR technique in 336 children (91.8%). Reliable behavioral responses were also provided by 31 children (8.5%). OKR MCTs correlated with BSID-III cognitive ( $r=-0.20$ ,  $p<0.001$ ) and motor ( $r=-0.24$ ,  $p<0.001$ ) composite scores, and with fine ( $r=-0.19$ ,  $p=0.001$ ) and gross ( $r=-0.20$ ,  $p<0.001$ ) motor scaled scores, with higher MCTs associated with poorer performance on the BSID-III scales. Children with BSID-III motor scores one or more SD below the standardised mean (n=22) had higher MCTs either as a composite score ( $47.8 \pm 15.7\%$  vs.  $41.3 \pm 13.6\%$ ,  $p=0.034$ ), or when assessed using fine ( $48.2 \pm 15.3\%$  vs.  $41.0 \pm 13.5\%$ ,  $p=0.007$ ) and gross ( $53.7 \pm 15.7\%$  vs.  $40.9 \pm 13.4\%$ ,  $p<0.001$ ) motor scales. Behavioural MCT correlated with the BSID-III cognitive composite score only ( $r=-0.34$ ,  $p=0.037$ ). Children with BSID-III cognitive scores one or more SD below the mean (n=84) gave fewer behavioural responses than other children ( $2.4 \pm 17.8$  vs.  $9.0 \pm 13.6$ ,  $p<0.001$ ).

#### **Discussion & Conclusions**

Global motion perception, as measured using reflex eye movements, is related to motor and cognitive function in 2-year old children. This suggests that assessment of dorsal stream function may provide an objective marker for neurodevelopment in young children.

**Disclosure(s):** None.

**Keyword(s):** *global motion coherence, cortical processing, visual development atypical*

## 34. Behavioural and Electrophysiological Measurement of Visual Acuity in Infants: Evidence of a Linear Relationship Only During Late Infancy

**Presenting Author:** *Claudia Polevoy, Psychology, Université du Québec à Montréal, Canada*

**Co-Author(s):** *M Simard, Research Center, CHU Sainte-Justine, Montreal, Canada. ; G Muckle, CHUQ Research Center, Laval University, Quebec, Canada. ; WD Fraser, Research Center, CHU Sainte-Justine & Montreal University, Montreal, Canada. ; T Arbuckle, Biostatistics and Epidemiology Division, Health Canada, Ottawa, Canada. ; B Lanphear, Faculty of Health Sciences, Simon Fraser University & BC Children's Hospital, Vancouver, Canada. ; JR Séguin, Research Center, CHU Sainte-Justine, Montreal, Canada. ; D Saint-Amour, Department of Psychology, Université du Québec à Montréal & CHU Sainte-Justine, Montréal, Canada.*

### **Purpose**

Visual acuity increases rapidly in the course of development. Behavioural forced-choice and electrophysiological approaches are favoured to identify neurovisual disorders among the preverbal population. While these methods correlate well in adults such a relationship is not clearly established in infants. Among studies that have addressed this issue, few have used sweep VEPs, which are yet often considered the "gold standard" method to determine acuity threshold. Moreover, fewer have looked visual acuity throughout the first year of life. The purpose of this study was to evaluate the relationship between acuity thresholds obtained by behavioural and electrophysiological methods among infants aged between 6-12 months.

### **Methods**

The estimation of acuity thresholds was conducted among 71 infants from 6-12 months ( $M=7.48$ ,  $SD=1.12$ ). Teller acuity cards (TAC) were used as the behavioural measure, from which acuity threshold was determined from the highest spatial frequency seen by the child. Sweep VEPs were used as the electrophysiological measure, from which acuity threshold was estimated using linear extrapolation to zero microvolts. The stimuli (vertical sinewave gratings) were presented at 80% of contrast ranged from 1-13.5 cpd and at a reversal rate of 12 reversals/sec.

### **Results**

A paired t-test analysis revealed that acuity thresholds obtained by the TAC ( $M=5.5$ ,  $SD=3.0$ ) were significantly lower ( $p < 0.001$ ) from those obtained using sweep VEPs ( $M=9.9$ ,  $SD=2.7$ ). Although our measurements of acuity from both techniques are very similar to those reported previously and they are consistent with the fact that sweep VEP acuity is generally higher than TAC acuity in infants, no correlation was observed between the two measures ( $r_p=0.21$ ,  $p=0.12$ ). However, when the sample was divided into three age groups (5-7; 7-8 and 8-12 months of age), a significant correlation between VEPs and TAC acuity thresholds was found only for the oldest age group ( $r_p=0.67$ ,  $p=0.005$ ).

### **Discussion**

The results of this study suggest that behavioural acuity may be underestimated during the first months of life. This can be explained, in part, by some inherent characteristics of the test and developmental capacities of infants (e.g. visuo-motor integration). It is likely that VEPs are a better metric to assess visual acuity maturation during infancy. Interestingly the relationship between the two measures is dependent of the age. This finding may explain, at least in part, the inconsistent results reported by previous studies.

**Disclosure(s):** *None.*

**Keyword(s):** *visual function, electrophysiology, visual development typical*

## **35. Scoping Exercise: The Assessment of "Tracking Difficulties" and Eye Movements in Children**

**Presenting Author:** *Valdeflors Vinuela-Navarro, School of Optometry and Vision Sciences, Cardiff University, United Kingdom*

**Co-Author(s):** *JM Woodhouse, School of Optometry and Vision Sciences, Cardiff University, Cardiff, UK ; JT Erichsen, School of Optometry and Vision Sciences, Cardiff University, Cardiff, UK ; CEM Williams, School of Social and Community Medicine, University of Bristol, UK*

### **Purpose**

The examination of eye movements in eye care practice is largely confined to identifying misalignments of gaze rather than assessing the quality of eye movements. Children are increasingly being referred to eye care professionals with suspected "tracking difficulties" and other eye movement disorders. The aims of this scoping exercise were to ascertain the current opinion with regard to "tracking difficulties" within groups of different professionals and evaluate the assessment of eye movements in eye care practice.

### **Methods**

Eleven professionals were interviewed: 3 Optometrists, 4 Orthoptists, 2 Teachers of the Visually Impaired, 1 Educational Psychologist and 1 Occupational Therapist. Interviewees were asked questions about the definition, signs and symptoms of "tracking difficulties", the methods used to assess eye movements and any therapies provided to children diagnosed with eye movement anomalies. After each interview, we reviewed the notes and created a report listing the statements and major issues found in the answers. Finally, a content analysis was performed by counting the frequency of the statements and identifying the major issues raised.

### **Results**

Four of 11 participants described "tracking difficulties" as reading and literacy difficulties, 5 as experiencing difficulties in following moving objects and 2 as poor oculomotor control. Nine of 11 participants stated that "tracking difficulties" interfere with reading skills and consequently impair the learning process, but 6 of those 9 reported that they also result in difficulties in general daily life activities. In terms of assessing eye movements, the 7 eye care professionals interviewed all assess smooth pursuit, while only 5 also assess saccadic eye movements. Moreover, eye movement assessments differed substantially between practitioners. Finally, only 4 of 11 professionals offer exercises to children diagnosed with eye movement disorders and most exercises only account for reading and ignore the issues with regard to daily life activities.

### **Discussion & Conclusions**

There is a lack of consensus within eye care and educational professionals as to the definition of "tracking difficulties", the use of terminology involving saccades, smooth pursuits and the assessment of eye movements. The results strongly suggest a need for a common terminology for professionals as well as a defined scheme in eye care practice.

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**Disclosure(s):** *No commercial and financial interests.*

**Keyword(s):** *eye movement assessment, eye movements, visual function*

## **36. Comparing M&S Smart System II with the Pelli-Robson Chart for Measuring Contrast Sensitivity Thresholds in a Clinical Setting**

**Presenting Author:** Manokaraanathan Chandrakumar, *Department of Ophthalmology and Vision Sciences, The Hospital for Sick Children and University of Toronto, Canada*

**Co-Author(s):** L Colpa, *Dept of Ophthalmology and Vision Sciences, The Hospital for Sick Children and University of Toronto, Toronto, Canada* ; YA Reginald, *Dept of Ophthalmology and Vision Sciences, The Hospital for Sick Children and University of Toronto, Toronto, Canada* ; H Goltz, *Dept of Ophthalmology and Vision Sciences, The Hospital for Sick Children and University of Toronto, Toronto, Canada* ; AMF Wong, *Dept of Ophthalmology and Vision Sciences, The Hospital for Sick Children and University of Toronto, Toronto, Canada*

### **Purpose**

The M&S Smart System II (MSSS-II; M&S Technologies Inc, Illinois) is a computer-based visual assessment system that now includes a contrast sensitivity testing module. The purpose of this study was to compare the utility of the MSSS-II as a clinical test for measuring contrast sensitivity threshold with the current clinical standard Pelli-Robson chart.

### **Methods**

134 participants aged 5 to 69 (33 visually normal participants and 101 patients) were tested. Participants were tested during monocular viewing using MSSS-II and the Pelli-Robson chart in random order. Agreement between MSSS-II and Pelli-Robson chart was assessed using the Bland-Altman test.

### **Results**

Bland-Altman test demonstrated that the two methods gave similar results. For visually normal participants, the mean contrast sensitivity ( $\pm$  standard deviation) was  $1.67 \pm 0.12$  log units with MSSS-II and  $1.64 \pm 0.04$  log units with the Pelli-Robson chart. For patients, the mean contrast sensitivity was  $1.44 \pm 0.29$  log units with MSSS-II, and  $1.48 \pm 0.28$  log units with the Pelli-Robson chart. Bland-Altman test showed that the mean difference of contrast sensitivity detected between the two methods was  $0.03 \pm 0.12$  log units for visually normal participants and  $-0.04 \pm 0.12$  log units for patients.

### **Discussion & Conclusions**

Contrast sensitivity thresholds measured by MSSS-II in both visually normal subjects and patients are in close agreement with those measured by the Pelli-Robson chart. The close agreement of contrast sensitivity thresholds suggests that the MSSS-II can be used as an alternative method to the Pelli-Robson chart in the measurement of contrast sensitivity in a clinical setting.

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**Disclosure(s):** *None*

**Keyword(s):** *contrast sensitivity , low vision, reading and learning disabilities*

## **37. Withdrawn**

## **38. Rat Ocular Medial Rectus Muscle Regeneration After Marcaine Degeneration**

**Presenting Author:** Branka Stirn Kranjc, *Pediatric Ophthalmology, University Eye Hospital, Slovenia*

**Co-Author(s):** J Sketelj, *Inst.of Pathophysiology, Medical Faculty Ljubljana, Slovenia* ; A D'Albis, *Lab.deBiologie Physicochimique, Univ. Paris, France* ; I Erzen, *Inst.of Anatomy, Medical Faculty, Ljubljana, Slovenia*

### **Purpose**

Strabismus can be treated by injecting the extraocular muscle with bupivacaine which has a known myotoxic effect.

### **Methods**

Regeneration of rat ocular medial rectus muscles (OMR) after 0.3 ml of 0.5 % bupivacaine (Marcaine) injection was studied.

The muscles were frozen in liquid nitrogen; serial cross sections were analyzed histochemically for myofibrillar ATPase at pH 9.4 and 4.4, for succinate dehydrogenase (SDH), and menadion linked  $\alpha$ -glycerophosphate dehydrogenase (GPDH) 6 weeks, 5 and 10 months after muscle degeneration. Myosin heavy chain (MyHC) isoforms in muscle fibers were demonstrated by specific monoclonal antibodies against b slow (BAD5), 2a (SC71), 2x/d (BF35), 2b (BFF3) and neonatal isoform. MyHC isoforms of whole muscle homo-genes were separated by SDS glycerol gel electrophoresis. Morphometric analysis was performed by own computer assisted analysis.

### **Results**

The response of OMR to the myotoxic agent manifested in complete myofibrillar dissolution three days after injection. Six weeks later the OMR muscles exhibited two layers, however, the histochemical fiber type differentiation was recognisable five months after injury with only fast, type 2 fibers. Slow, type 1 fibers could be distinguished after ten months. The metabolic activity of the muscle fibers became more glycolytic. Central nuclei were present even ten months after muscle degeneration. MyHC isoforms -2a, -2x/d, -2b and neonatal were detected already after 6 weeks of regeneration. Only individual slow, MyHC-1 positive fibers were identified at ten months of regeneration. SDS electrophoresis confirmed these results.

### **Conclusions**

Rat OMR muscle regeneration after Marcaine degeneration is slow and incomplete, especially in expressing the slowest MyHC-1 and fast MyHC-eom isoform which are specific for extraocular muscle structure and function.

**Disclosure(s):** None

**Keyword(s):** *rat extraocular muscle regeneration, binocular vision, eye movements*

## 39. Treatment of Anisometropic Amblyopia In Children with Refractive Correction

**Presenting Author:** Dinesh Kaphle, *Optometry, Malawi College of Health Sciences, Malawi*

**Co-Author(s):** P Paudel, *Brien Holden Vision Institute, Sydney, Australia* ; JB Shrestha, *Dept of Ophthalmology, Institute of Medicine, Kathmandu, Nepal*

### **Purpose**

To evaluate the visual acuity improvement in children with refractive correction in anisometropic amblyopia

To find out the outcome of treatment related to the amount of anisometropia

To find out outcome of treatment with regard to age and sex

### **Methods**

A hospital based prospective, non-comparative, non-interventional study was conducted at BP Koirala Lions Centre for Ophthalmic Studies, Nepal. Patients of age 3 to 15 years with a history of untreated anisometropic amblyopia were included. Anisometropia was defined as  $\geq 1.0D$  of spherical equivalent. Corrected amblyopic eye visual acuity was between 6/9 and 6/60. Cycloplegic refraction was done in every patient during the study. All patients were called for follow up after 3 weeks.

### **Results**

A total of 20 patients with mean age  $11.2 \pm 2.72$  years were included in the study. Among these, 14 had unilateral amblyopia and 6 had bilateral amblyopia. Altogether 26 eyes were reported to have amblyopia. The mean improvement in visual acuity after 3 weeks was  $0.85 \pm 0.65$  lines. The mean line improvement at the second follow up was  $0.8 \pm 0.70$  lines. There was a statistically significant ( $p=0.04$ ) decrease in interocular difference (IOD) for the range 1.0 to 2.0D of anisometropia and a borderline statistically significant ( $p=0.056$ ) decrease in IOD for the 2.0 to 3.0 D group. The IOD improvement (1.53 lines) at the first follow up was statistically significant ( $p<0.001$ ) in  $>8$  years' age group.

### **Discussion & Conclusions**

At the first follow-up more than 54% improved by one line and 11% improved by two lines, whereas there was  $\geq 2$  lines improvement in 77% of patients in the Cotter et al<sup>1</sup> study and two or more logMAR lines in the Chen et al<sup>2</sup> study. Improvement of visual acuity was related to lesser amount of anisometropia ( $p=0.04$ ) and nearly significant ( $p=0.056$ ) for 2.0 to 3.0D range. This is similar to the findings of Cotter et al and Chen et al but in contrast to the findings of Kutschke et al<sup>3</sup> and Hussein et al<sup>4</sup>. The treatment outcome (interocular difference) was related to age. Hussein et al study had reflected below 6 years had good improvement in acuity. But Studies by Susan et al and Cobb<sup>5</sup> found no relation to age.

### **Conclusion**

Nearly half (46%) of anisometropic amblyopia resolved to normal acuity within the first 3 weeks. Visual acuity improved and IOD decreased in the anisometropic group with low dioptres of refractive error. Improvement in acuity occurs in the higher age groups of children.

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**Disclosure(s):** No commercial interests

**Keyword(s):** amblyopia, refractive error

## 40. The Convergence Insufficiency Symptom Score Questionnaire in an Asymptomatic Undergraduate Sample

**Presenting Author:** Anna Horwood, *Psychology & CLS, University of Reading, United Kingdom*

**Co-Author(s):** SS Toor, *Psychology, University of Reading, UK* ; PM Riddell, *Psychology, University of Reading, UK*

### **Purpose**

The convergence insufficiency (CI) symptom score questionnaire (CISS) is a useful tool to assess severity and improvement in symptoms of patients with convergence insufficiency. However, some of the questionnaire items can tap into symptoms that are not only of ocular origin. We investigated the usefulness of the CISS in an asymptomatic population.

### **Methods**

110 psychology undergraduates who considered themselves visually normal and asymptomatic filled in the CISS questionnaire as part of the selection process for another study. For 5 questions where the symptom could have been due a non-ocular cause, such as general tiredness, poor memory (as in dyslexia), or disengagement with the reading content, an additional question was asked and the score adjusted down if the symptom was considered non-ocular. Orthoptic investigation measured convergence and accommodation near point and facility, prism fusion range and heterophoria.

### **Results**

Mean CISS score was 15.29 (95%CI  $\pm$  1.61, range 40-0) and 43.6% exceeded the CITT group diagnostic criterion of  $\geq 16$ . After adjustment for (participant-judged) non-ocular reason for the symptom the mean score reduced to 9.07 (95%CI  $\pm$  1.43 range 33-0) and those exceeding the diagnostic criterion reduced to 17.2%. The unadjusted CISS produced 37% false positives for any other sign of CI (PPV 12.5%), which reduced to 15% if adjusted (PPV 15%). 9 participants (8%) showed one other sign of mildly weak convergence or fusion, although all considered their eyes normal. Two (1.8%) had severe dyslexia. Unsurprisingly these participants showed significantly higher CISS scores ( $p < 0.000$ ) on both adjusted and unadjusted scores.

### **Discussion & Conclusions**

None of the participants felt they had an ocular problem and they were managing a heavy academic workload. Many reported some symptoms during close work – many of which they ascribed to non-ocular reasons.

Although the CISS questionnaire is very useful for monitoring severity and progress in clinically diagnosed CI, scores on some items can easily be inflated for non-ocular reasons. In our study group it had a very poor positive predictive value for any other sign of CI, even if adjusted. It should be used with caution as a stand-alone or screening tool in groups not presenting with a visual problem.

**Disclosure(s):** None

**Web Page:** [www.reading.ac.uk/pcls/people/a-m-horwood.aspx](http://www.reading.ac.uk/pcls/people/a-m-horwood.aspx)

**Keyword(s):** convergence insufficiency, reading and learning disabilities, rehabilitation



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