Binocular iPad game treatment for amblyopia is more successful than patching

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Purpose: Childhood amblyopia can be treated with binocular iPad games that rebalance contrast between the eyes, allowing the child to overcome suppression and experience binocular vision (Birch et al., 2015; Li et al., 2014). Yet, previous rudimentary games yielded low compliance, and no randomized clinical trials have compared binocular treatment to the standard monocular treatment of fellow eye patching. In this randomized clinical trial, we compared a more engaging, binocular iPad action game and patching as treatments for amblyopia.

Methods: Amblyopic children (4-9y) were randomly assigned to 2 weeks of at-home game play while wearing red/green anaglyph glasses (1 hr/day, 5 days/week) or patching (2hrs/day). At 2 weeks, children who patched crossed-over to the game, and all children played the game until the 4-week visit. Amblyopic eye best-corrected visual acuity (BCVA) was assessed at baseline, 2- and 4-week visits. Compliance was logged with the iPad (game) or calendar (patching).

Inclusion criteria: ≥8 weeks spectacle wear, aligned within 4PD, ≥0.3 logMAR interocular difference, fellow eye BCVA ≤0.1 logMAR.

Results: Interim results are presented. Baseline: Mean BCVA±SD was 0.48±0.13 (n=23). 2-weeks: Mean BCVA improved from baseline by 0.16±0.07 logMAR for game first (9.9±0.7 hrs, n=12, p=0.012) and 0.07±0.08 logMAR for patching first (27.4±2.8 hrs, n=11, p=0.001). Game treatment was more successful than patching (p=0.010). BCVA improved by 0.1-0.2 logMAR in 17 children [11(92%) game first, 6(55%) patching first]. 4-weeks: Mean BCVA improved from the 2-week visit by 0.08±0.09 logMAR for cross-over children (9.1±3.6 hrs, p=0.022), resulting in catching up to game first children (4-week improvement from baseline: game first, 0.18±0.10 logMAR, n=11, p<0.001; patch first, 0.15±0.10 logMAR n=10, p<0.001). Poor game play compliance (<50% of prescribed time) was found in 9% (n=2/22) of children, compared with 40% (n=18/45) of children previously reported for the rudimentary games.

Conclusions: Our highly-compliant binocular iPad game was successful at treating childhood amblyopia, and was more effective than the current standard monocular treatment of patching following 2 weeks of treatment. Dichoptic, contrast rebalancing games provide a promising additional option for treating amblyopia.

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Newly Developed Binocular Treatment of Amblyopia using Head-Mounted Display


Purpose: Amblyopia is the most common cause of visual impairment in children and most of current treatments are monocular patching or penalization. Recent studies report that abnormal binocular interactions play a key role in amblyopia. We developed a new binocular treatment of amblyopia.

Methods: The mechanism of dichoptic presentation is presenting the strong stimulus to the amblyopic eye and another weak stimulus to the normal fellow eye. The device which directly target the binocular function using dichoptic presentation is developed.

Results: The developed device and software program separate the 3D images and control the visual inputs into the both eyes using head-mounted display. It increases the contrast, size and intensity of the 3D target to the amblyopic eye and decreases those to the normal fellow eye. This separation of 3D images is expected to improve the monocular visual acuity of the amblyopic eye with the reduction of suppression and strengthen the binocular fusion including stereopsis.

Conclusions: The newly developed binocular therapy using head-mounted display is hand-held and convenient. Further investigation is needed to prove the effectiveness in improvement of both monocular and binocular vision in children and adults with amblyopia.
their individual cutoff frequency for 8 sessions, with 300 trials or 30 minutes per session. Contrast sensitivity function (CSF) and visual acuity in both the amblyopic and fellow eyes, and stereo acuity were assessed before and after training. CSF was measured using the qCSF procedure (Lesmes, et al 2010). Each qCSF assessment took less than five minutes.

**Results:** Training significantly improved visual acuity (2 lines) and contrast sensitivity (53.9%, from 13.01 to 20.02, p<0.0001) in the amblyopic eye, stereo acuity (80.8%, from 606” to 116.2”, p<0.0001), and contrast sensitivity (24.7%, from 28.4 to 35.4, p<0.01) in the fellow eye. The magnitudes of improvements were correlated with pre-training visual deficits: The worse the pre-training measure was, the greater the improvements. Interestingly, we found no significant correlation among the magnitudes of improvements in visual acuity, contrast sensitivity, and stereo acuity (all p > 0.39).

**Conclusions:** These results demonstrate the merit of perceptual learning in treating children with amblyopia. Consistent with results in adults with amblyopia (Xi, et al 2014), the lack of correlation among improvements in visual acuity, contrast sensitivity, and stereo acuity suggests that structured monocular and binocular treatments are necessary to fully restore deficient visual functions in amblyopia.

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**Program Number:** 3083 **Poster Board Number:** B0070 **Presentation Time:** 8:30 AM–10:15 AM **Baseline factors and visual acuity outcome following binocular amblyopia treatment**

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**Purpose:** Binocular treatment of childhood amblyopia rebalances contrast between the eyes, allowing the child to overcome suppression, experience binocular vision, and recover visual acuity (Birch et al., 2015; Li et al., 2014). For the first time, we evaluate baseline factors that may affect the success of binocular treatment for amblyopia.

**Methods:** Amblyopic children (3-12y) with hyperopic anisometropia (HA; n=11, 20/40-20/125) were enrolled. Children chose from 18 popular anisometropia + corrected esotropia (HA+ET; 20/800) and hyperopic anisometropia + corrected esotropia (HA+ET; 20/125) were enrolled. Children chose from 18 popular etiology, VA, stereoacuity, and prior patching treatment. Baseline factors examined were etiology, VA, stereoacuity, and prior patching treatment.

**Results:** VA improved significantly after treatment in amblyopic children with HA (DVA=0.13±0.03; p=0.002) and HA+ET (DVA=0.12±0.03 logMAR; p=0.003). VA did not significantly improve in amblyopic children with MA (DVA=0.02±0.03 logMAR, p=0.53). There was a trend for more improvement in children with baseline VA of 0.7 logMAR or worse (DVA=0.17±0.06) compared to children with baseline VA of 0.3-0.6 logMAR (DVA=0.08±0.02 logMAR; p=0.07). VA outcome was not correlated with baseline stereoacuity or prior patching treatment.

**Conclusions:** Amblyopia associated with hyperopic anisometropia, with or without corrected esotropia, improves with contrast-rebalanced binocular treatment while amblyopia associated with myopic anisometropia showed little response to treatment. Whether treatment failure is a result of early age of onset of amblyopia or structural changes in the eye associated with myopia is currently under investigation.

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**Program Number:** 3084 **Poster Board Number:** B0071 **Presentation Time:** 8:30 AM–10:15 AM **Do reminders on a smartphone increase compliance in amblyopia treatment?**

Aldo Vagge, Kammi Gunton, Bruce Schnall. Wills Eye Hospital, Philadelphia, PA.

**Purpose:** To determine if a smartphone medical adherence app (RxmindMe® Prescription/Medicine Reminder and Pill Tracker) can alter compliance in amblyopia therapy in patients 3-7 years of age who have not previously been treated for amblyopia.

**Methods:** This prospective, case-control study enrolled children under 8 years of age identified with refractive or strabismic amblyopia. The patients were randomized to receive electronic reminders programmed into the smartphone of the caretaker (reminders group) or educational information about amblyopia only (control group). Visual acuity was reassessed at follow up visit and compliance was evaluated through completion of the previously validated Amblyopia treatment Index Parental Questionnaire.

**Results:** Twenty-four patients completed enrollment. Thirteen patients in the reminder group (8 female, 5 male; mean age 4.7 ± 1.0) were compared with 11 subjects in the control group (5 female, 6 male; mean 5.3 ± 1.2). Socioeconomic characteristics such as education level of caregivers, marital status and age of parents were similar between the two groups. The compliance index rating in the questionnaire for both treatment and control groups was similar (p > 0.2).

**Conclusions:** This is the first report of the use of a smartphone medical adherence app to try to improve compliance to amblyopia therapy. Our findings indicate that universal recommendation of adherence apps may not influence compliance, yet this tool may be helpful when difficulty with compliance occurs. Future studies to evaluate particular characteristics of patients and larger sample size are recommended to further elucidate the use of this potential tool for compliance.

**Commercial Relationships:** Aldo Vagge, None; Kammi Gunton, None; Bruce Schnall, None
Results: The prevalence of amblyopia decreased from 1.3% in subjects born before the year 1985 to 0.9% among those born after 1985 \( (R^2=0.88, p<0.0001) \). This was mostly due to a decrease in unilateral amblyopia \( (R^2=0.92, p<0.0001) \). Bilateral amblyopia did not significantly change over the years \( (p>0.05) \). The severity of amblyopia did not change in a specific way across the birth years, with 57-63% of subjects having mild, 22-28% moderate, and 12-15% severe amblyopia. Anisometropia ranged between 16-25% among unilateral amblyopic teenagers across the different birth years, without a significant trend \( (p>0.05) \), while strabismus ranged between 6-13% across the different birth years, with no significant trend \( (p>0.05) \). Among bilateral amblyopes there was no significant trend in isoametropia (hyperopic, myopic, or astigmatic), ranging together between 52-58% \( (p>0.05) \). The incidence of strabismus in the entire cohort decreased over the years, ranging from 1.4% in subjects born in earlier years to 0.6% in those born in the later years \( (R^2=0.75, p<0.0001) \). Amblyopia occurred in 5-17% of strabismic subjects, and increased over the birth years \( (R^2=0.93, p<0.01) \). The increase over the last years was mostly attributed to higher proportion of mild amblyopia \( (1.5\%-11\%) \) in teenagers with strabismus \( (R^2=0.73, p<0.01) \). Moderate amblyopia \( (1.5\%-5\%) \) and severe amblyopia \( (0.8\%-5\%) \) did not have a consistent trend over the birth years.

Conclusions: The incidence of amblyopia and strabismus in Israel decreased among teenagers over a span of two decades. Among strabismic teenagers the incidence of amblyopia increased in later years.

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Presentation Time: 8:30 AM–10:15 AM

Quality of life and functional vision concerns of children with cataracts and their parents

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Purpose: To identify specific health-related quality of life (HRQOL) and functional vision concerns affecting children with cataracts as expressed by children or one of their parents (proxy), and concerns affecting the parents themselves.

Methods: Individual semi-structured interviews were conducted with parents of children with cataracts (N=31) and with the children themselves (ages 5-17 years; n=16). Transcripts of recorded interviews were evaluated using NVivo software. Specific concerns were identified and coded, and broad themes were identified. The frequency of each theme was calculated, along with the frequency of specific codes within each theme.

Results: Regarding the child’s experience 6 broad themes were identified: Visual Function (mentioned by 16 of 16 children (100%) and by 26 of 31 parents (84%), Social (94% and 65%), Treatment (81% and 90%), Worry (75% and 10%), Emotions (63% and 68%), and Physical (63% and 26%). For ages 5-17 years, there was good agreement between child and proxy concerns, with the exception of Worry: 12 of 16 (75%) children reported Worry but only 6% of proxies reported that their child experienced Worry \( (p=0.001) \). Children’s worries included worry that they might “damage or hurt my eye” or “hit my eye,” that “I may get blind” or “have to go into a surgery and be blind,” that “when I drive I could crash into someone because I can’t see out of this eye very well,” and that “as I get older, will my eyesight deteriorate.” Regarding the parents’ own experience, 5 broad themes were identified: Worry (100%), Compensation for Condition (100%), Treatment (94%), Emotions (90%), and Affects Family (52%).

Conclusions: A wide range of concerns were identified from interviews of children with cataracts and their parents. Concerns reflect the impact of cataracts in physical, emotional, and social domains, and specific concerns will be used for the development of questionnaires to quantify the quality of life and functional vision effects of pediatric cataracts.

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Intercocular contrast differences and the stability of fixational eye movements

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Purpose: The influence of binocular viewing on fixational eye movements is not well understood. This is important because abnormal fixational eye movements have been reported in disorders of binocular vision such as amblyopia. The objective of this study was to characterize the effect of interocular contrast differences on fixational eye movements in observers with normal binocular vision.

Methods: Adults with normal vision \( (n=8) \) viewed stimuli constructed from a central bright fixation cross \( (1.2^\circ) \) surrounded by a square \( (8.1^\circ) \) presented on mean luminance background. Stimuli were presented dichoptically using a haploscope. Eye movements were recorded separately for each eye using an infrared eye tracker sampling at 500Hz. There were three experimental conditions:

1. The contrast of the target presented to non-dominant eye was fixed at 100% and the contrast presented to the dominant eye was varied from 0-100% contrast in octave steps.
2. The contrast of the target presented to dominant eye was fixed and non-dominant eye contrast was varied.
3. Contrast was varied from 5-100% in both eyes simultaneously. Each trial involved 30 seconds of fixation and each contrast combination was repeated 4 times. The stability of fixation was quantified separately for each eye using the global bivariate contour ellipse area (BCEA) method. Ocular dominance was estimated using a sighting test.

Results: BCEA values were log transformed and subjected to repeated measures ANOVA. When the non-dominant eye contrast was fixed at 100% contrast, there was a significant interaction between Viewing Eye (non-dominant vs. dominant) and interocular contrast difference \( (7 \text{ levels}) \) \( [F(6,42)=3.78; p=0.004] \). This was characterized by significantly poorer fixation stability when the dominant eye had no central fixation cross \( (0\%) \) compared to the non-dominant eye \( [\text{BCEA}=1.02 \text{ deg}^2] \) \( (p=0.001) \). No differences between the two eyes were present for any other interocular contrast difference levels. Furthermore, no differences between the eyes were found when the dominant eye contrast was fixed at 100% contrast or when contrast was varied for both eyes.
Interocular contrast differences do not significantly influence fixational eye movements in normal observers. Contrast sensitivity differences alone may not underlie the poorer fixation stability observed in amblyopic eyes relative to fellow eyes.

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**Presentation Time:** 8:30 AM–10:15 AM

**Effects of amblyopia and strabismus on the performance of a manipulation task involving precision grasping, placement, and action sequencing**

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**Purpose:** Normal binocular vision provides important input for effective performance of manipulation tasks that involve reaching and grasping. Previous studies have shown that people with abnormal binocular vision experience difficulties with grasping; however, performance was examined using a single prehension movement. Because most daily activities consist of more complex movement sequences that require precise temporal linking between the gaze behaviour and manual actions, it is important to examine the consequences of abnormal binocular vision on the performance of sequential movements, which is the goal of this study.

**Methods:** Six adults with abnormal binocular vision due to amblyopia and strabismus, and 6 visually-normal adults were tested. Participants performed a sequential reaching, grasping and precision placement task while eye movements and limb movements were recorded with a video-based eyetracker and a motion capture camera. The task involved picking up a small bead, and placing it onto a vertical needle under binocular and monocular viewing conditions. Kinematic analysis focused on 4 phases of the movement: reach-to-bead, bead grasping, reach-to-needle, and bead placement on the needle. Kinematic outcome measures were analysed using mixed Analysis of Variance with 2 factors: Group and Viewing Condition.

**Results:** As expected, visually-normal participants had significantly shorter movement time (p<0.05) in comparison to the patient group for grasping and placement, while there was no difference for the reach duration to the bead or the needle. Bead placement on the needle showed the largest decrement during monocular in comparison to binocular viewing in the control group (binocular: 506±18ms; monocular: 780±26ms) and the patient group (binocular: 805±26ms; dominant eye: 960±33ms; non-dominant eye: 1021±30ms). In contrast, binocular advantage was not significant for grasping in the control group (binocular: 472±22ms; monocular: 487±20ms) or the patient group (binocular: 723±24ms; dominant eye: 812±27ms; non-dominant eye: 787±25ms).

**Conclusions:** Preliminary results indicate that the performance of a manipulation task that requires high precision and action sequencing is disrupted in people with abnormal binocular vision during all viewing conditions.

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and 2) a black square on white background (BoW) were adopted. For all presentations, one square was always presented at full contrast with a fixed size through a stereo shutter goggle in the amblyopic eye (non-dominant eye) (for both BoW and WoB), while its counter-half was presented in the fellow eye under various interocular contrast levels with adjustable size. An average of five measurements was adopted as the threshold.

**Results:** The matching size in the dominant /fellow eye increased monotonically with the decrease in interocular contrast ratio for both normal and amblyopes under both BoW and WoB conditions (ANOVA, P<0.05). Surprisingly, the matching size in the fellow eye of amblyopes differed drastically between the WoB and BoW conditions (P<0.05), while normal controls exhibited similar outcomes (P>0.05). This asymmetry could not be repeated in normal controls with one eye blunted with Bangertner filters.

**Conclusions:** Intercocular difference in contrast is related to the measurement of aniseikonia in both normal and amblyopic participants. Moreover, the discrepancy of aniseikonia under different backgrounds observed in amblyopes revealed a unique visual deficit. Any attempt to eliminate aniseikonia in amblyopes should consider their asymmetric responses under black and white backgrounds.

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Presentation Time: 8:30 AM–10:15 AM

**Sparing of coarse stereopsis in stereodeficient children depends on amblyogenic factors**

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**Purpose:** We have shown that children with amblyopia and/or strabismus who routinely fail clinical tests of stereopsis which assess fused disparities (fine stereopsis) can perform as well as controls on laboratory tests using large disparities that give rise to diplopia (coarse stereopsis). This finding is consistent with the view that coarse stereopsis develops early in life before amblyogenic factors exert their full effect. Because disrupted binocular vision is often more common in amblyopia caused by strabismus than by anisometropia, the current study examined fine and coarse stereopsis as a function of etiological subtype.

**Methods:** Accuracy on a depth order judgment task was assessed in 58 children with anisometropic, anisstroabicmic, or strabismic amblyopia; strabismus without amblyopia; and controls. All patients were stereodeficient on the Randot Preschool clinical test. On each trial, participants viewed a dichoptically-presented cartoon character with crossed or uncrossed disparity and reported the depth sign relative to a reference frame. Stimuli were adjusted to correct eye misalignment. Three disparity ranges were assessed: 1) small disparities (0.02-0.17 deg) within the range assessed by the clinical test, 2) disparities (0.33-1.0 deg) larger than those assessed in the clinical test but still fused, and 3) coarse disparities (2.0-3.5 deg) that give rise to diplopia.

**Results:** There was an effect of subtype in each of the three disparity ranges (p < .01). In the smallest range, controls performed better than all subtypes (p < .038). In the middle range, controls performed better than the strabismus subtypes (p < .001); the anisometropic group did not perform differently from other groups (p > .10). In the coarse range, only the anisstroabicmic group performed significantly worse than controls (p = .046). The latter subtype performed at chance on all three disparity ranges (p > .18), suggesting these children have no access to stereoscopic information at any scale. Performance in patients was not correlated with interocular acuity differences (p > .25).

**Conclusions:** The sparing of coarse stereopsis in stereodeficient children varies as a function of the etiological subtype. In particular, coarse stereopsis may be absent in children with anisstroabicmic amblyopia. This is not due to the depth of amblyopia, but may depend on other clinical variables such as age of onset of the amblyogenic factors.

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Presentation Time: 8:30 AM–10:15 AM

**Comparison of two angular eye charts for assessment of visual acuity in amblyopia : Thibaudet and Snellen tests**

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**Purpose:** Visual acuity is dependent on the eye discrimination power. Among existing tests, Thibaudet and Snellen tests are two angular eye charts, validated for distance visual acuity evaluation. Amblyopic patients suffer from a weakening of their visual acuity and largely from a perturbation of their overall visual experience. The main objective of this study is to determine if Thibaudet and Snellen are equivalent in evaluating visual acuity in those amblyopic patients.

**Methods:** All amblyopic patients under 40 years who consulted at Amiens University Hospital between August 2014 and March 2015 were included prospectively. They presented a difference between two eyes of two lines or more on morphoscopic projected tests. The minimum age depended on the feasibility of the tests. The best corrected visual acuity (BCV A) was determined for each eye in a randomly chosen order, using a Thibaudet test and a Snellen test. The evaluation began with the same test for both eyes, under standardized conditions of room management, light and the presenting distance. For each included eye, the BCVA obtained with one test was compared to the BCVA obtained with the other.

**Results:** The study included 140 eyes of 70 patients, from 2 years and 11 months to 37 years and 6 months. 34 were female. 20% had bilateral amblyopia, 16% suffered of organic amblyopia and 53% of functional amblyopia, while 31% had a mixed amblyopia. For a presenting distance of less than 5 meters, the mean BCVA was not different between two tests (0.27 lines weaker with Thibaudet compared to Snellen test). Conversely, for a presenting distance of more than 5 meters, the mean BCVA was 4.1 lines better with Thibaudet compared to Snellen test.

**Conclusions:** The Thibaudet test seems to overestimate visual acuity compared to Snellen Test. The presentation distance is a major factor of reliability of those tests in the assessment of visual acuity. With
a mean variability of 4 lines in the measured BCVA. Thibaudet test might ignore a mild to moderate relative amblyopia, so it should not be used to detect amblyopia. This easy-to-use test can prove useful in evaluation of children while in addition to others available tests.

Figure 1: Thibaudet test

In this first-reported application of IRIS-7, our outcomes leave room for improvement; less than half of our patients were successfully treated for amblyopia using IRIS-7 criteria. Further subgroup analysis, including cycloplegic refraction, physician practice patterns, comparison with results of other centers, and focused, prospective interventions may help to uncover factors that are amenable to intervention when managing this patient population.

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New Pediatric Vision Screener – Data Analysis and Validation

Purpose: We have developed and described an improved pediatric vision screener (PVS) that can reliably detect central fixation (CF), eye alignment and focus. It uses the birefringence of the human fovea and identifies risk factors for amblyopia, namely eye misalignment and defocus. An early version of the PVS from our lab was tested at Children’s Hospital, Boston. It is being commercialized as an instrument that detects eye alignment but not defocus (REBIScan, Boston, MA). Meanwhile, development of retinal birefringence scanning (RBS) continued in our lab, resulting ultimately in an improved PVS that combines polarization-modulated RBS (PMRBS) for detecting strabismus, with technology for assessing proper focus of both eyes simultaneously. PMRBS is an optimized upgrade of RBS, based upon our theoretical and experimental research and computer modeling, to yield high signals across the entire population. In addition, using phase-shift-subtraction, the new PVS eliminated the need for initial background measurement.

Methods: We studied 18 patients with known vision abnormalities, and 19 controls with proven lack of vision issues. Calibration for CF. RBS in the foveal region results in the generation of five distinct frequencies in the signal obtained from the returned light. Calibration for CF was performed in a preliminary study, based on data from five normal volunteers. Two algorithms were developed for classification into one of the two classes – CF vs para-CF, using the available signal power measurements: a crawling threshold and discriminant analysis.

Calibration for focus detection (FD) was based on a normalized focus signal and determining monocular focus curves: the normalized logMAR 12-18 months after first diagnosis. We report our amblyopia treatment outcomes using IRIS-7.

Methods: Electronic health records (EHR) of all new amblyopia patients age 3-7 years in a hospital-based pediatric ophthalmology practice and evaluated during 2013 were reviewed. Multiple logistic regression analysis was used to assess factors affecting successful and unsuccessful treatment.

Results: Of the 477 new patients diagnosed with amblyopia, 199 met IRIS-7 inclusion criteria. Of these, 91 (46%) had IOD entry ≤ 0.23 less than 18 months after initial diagnosis, including 65 with IOD exit ≤ 0.23 at 12-18 months (IRIS-7-defined “Performance Met”). IOD exit, number of attended visits, atropine prescription, and average days between visits correlated with successful outcome (backward elimination technique, ROC=0.83). Age, race, ethnicity, payer, and number of missed visits were not associated with successful treatment outcome. The EHR did not record an easily extractable assessment of patching hours recommended or compliance with treatment, so dosing or compliance effect could not be assessed.

Conclusions: In this first-reported application of IRIS-7, our outcomes leave room for improvement; less than half of our patients were successfully treated for amblyopia using IRIS-7 criteria. Further subgroup analysis, including cycloplegic refraction, physician practice patterns, comparison with results of other centers, and focused, prospective interventions may help to uncover factors that are amenable to intervention when managing this patient population.

Commercial Relationships: Constence E. West1, 2, Patricia Cobb1, Denise L. White3

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Purpose: The American Academy of Ophthalmology (AAO) recently announced Center for Medicare and Medicaid Services’ inclusion of “IRIS-7: Amblyopia: Intercocular visual acuity”(www.aoa.org/assets/d881e07d-238e-4940-ad0a-0ce2ce61157c/635676621663200000/iris-7-amblyopia-interocular-visual-acuity-pdf) as an outcome measure of effective clinical care. Treatment was defined as “successful” if corrected interocular visual acuity difference (IOD) was < 0.23
focus signal is plotted while ophthalmic trial lenses are placed in front of the eye, simulating refractive errors. This enables us to find a threshold signal level under which the subject fails the focus screen (within ±1D), thus identifying those subjects where the amount of optical blur is abnormal.

**Results:** Both CF and FD detection criteria worked robustly and allowed reliable separation between normal test subjects and symptomatic subjects. The sensitivity of the instrument was 100% for both CF and FD. The specificity was 100% for CF and 89.5% for FD. The overall sensitivity was 100% and the overall specificity was 94.7%.

**Conclusions:** We believe that the PVS design and the analysis methods employed will prove valuable for mass screening of children.

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**Support:** The Hartwell Foundation

**Program Number:** 3095 **Poster Board Number:** B0082

**Presentation Time:** 8:30 AM–10:15 AM

**Dilated Eye Examination among Multi-ethnic Preschool Children**

Xuejuan Jiang, Kristina Tarczy-Hornoch, Susan A. Cotter, Mina Torres, Rohit Varma.

**Methods:** Data were obtained from the Multiethnic Pediatric Eye Disease Study, a population-based cross-sectional study of 9,197 African-American (AA), Hispanic (HW), Asian American (AS), and non-Hispanic white (NHW) children 6-72 months of age identified in Los Angeles. A parental interview and a detailed ocular exam were performed. Logistic regression was used to evaluate independent associations between dilated eye exam and demographic, behavioral, and clinical factors identified in the parental interview.

**Results:** The prevalence of dilated eye exam was 6.3% among preschool children overall, ranging from 2.8% in 6-12 month-old children to 11.6% in 61-72 month-old children. In children with strabismus, only 38% had a previous dilated eye exam. The prevalence of dilated eye exam in strabismic children varied significantly by subtype of strabismus (p<0.001): 54% for esotropia and 23% for exotropia. In 4+ year-old children with amblyopia, only 29% had a previous dilated eye exam. The prevalence of dilated eye exam seemed to vary by race/ethnicity: 8.1% for NHW children, 4.9% for HWs, 6.3% for AAAs, and 7.9% for ASs. However, in multivariate analysis of demographic, behavioral and clinical factors obtained from parental interview, a higher prevalence of dilated eye exam was not associated with race/ethnicity, and was independently associated with older age, having a gestational age of <33 weeks, having Down syndrome, having cerebral palsy, a family history of strabismus, and having vision insurance coverage. In children with strabismus, dilated eye exam prevalence was 74% for NHW children, 36% for HWs, 25% for AAAs, and 37% for ASs. This variation remained significant after adjusting for strabismus subtype and the risk factors identified in the overall analysis. There was no racial/ethnic disparity after adjustment for other predictors in 4+ year-old children with amblyopia.

**Conclusions:** Dilated eye exam was relatively rare among preschool children, even among those with ocular disorders such as amblyopia and strabismus, and was limited to a small subset of children with unique characteristics. Interventions are needed to provide broad access to preventive eye care and treatment for preschool children, including evidence-based vision screening/examinations.

**Commercial Relationships:** Xuejuan Jiang, None; Kristina Tarczy-Hornoch, None; Susan A. Cotter, None; Mina Torres, None; Rohit Varma, None

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**Program Number:** 3096 **Poster Board Number:** B0083

**Presentation Time:** 8:30 AM–10:15 AM

**Comparison of the Amblyopia Preferred Practice Patterns of the American Academy of Ophthalmology with the Practices of an Academic Pediatric Ophthalmology Division**

Tehilla Steiner, Ilana Friedman, Jamie Rosenberg.

**Purpose:** Amblyopia is a main cause of visual impairment in children. The Preferred Practice Patterns (PPP) were developed by the American Academy of Ophthalmology to “identify characteristics and components of quality eye care.” This project compares our practice to the PPP in order to examine our compliance with the guidelines.

**Methods:** A retrospective chart review was performed on new patients diagnosed with amblyopia between August 2014 and January 2015.

**Results:** 102 children were diagnosed with amblyopia. Of these, 62(60.8%) had isometropic ambylopia, 40(39.2%) anisometropic ambylopia, 17(16.7%) strabismic ambylopia, and 2(1.9%) deprivational ambylopia, with 17(16.7%) having more than one etiology. Tests performed in 100% of patients include visual acuity and fixation pattern, binocular alignment and motility, pupillary exam, external exam, and dilated fundus exam. Stereocuity was done in 90.8% and cycloplegic refraction was done in 97.1% of visits. Bruckner testing, which had a rating in the summary benchmarks of A III, indicating a “most important” recommendation that is supported by “evidence from one of the following: descriptive studies, case reports, reports of expert committees/organizations,” was not documented in any patient at their initial visit.

**Conclusions:** Our practice followed the guidelines set by the PPP except for the Bruckner test. Further study is required to determine the additive value of the Bruckner test if a complete examination is performed.

**Commercial Relationships:** Tehilla Steiner, Ilana Friedman, None; Jamie Rosenberg, None

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**Presentation Time:** 8:30 AM–10:15 AM

**Assessment of the plusoptix A12 photoscreener to detect amblyogenic risk factors in Nebraska**

Thomas Williams, Donny Suh.

**Purpose:** To determine the accuracy of the plusoptix A12 photoscreener (PPS) in detecting amblyopia or amblyogenic risk factors in pediatric patients of Nebraska.

**Methods:** Using the PPS, we collected data from children seen at a single pediatric ophthalmology practice over the course of a 3-month period. Each patient was screened using the device and received a comprehensive ophthalmic examination. The results of the PPS...
were compared to the gold standard, comprehensive ophthalmic examination findings. The assessment of amblyopia or amblyogenic risk factors in our patients were based on the updated American Association for Pediatric Ophthalmology and Strabismus (AAPOS) referral criteria guidelines.

Results: Data was collected from 219 children (438 eyes) during the 3-month study period. Among these, 87 children (40%) were determined to have amblyopia or amblyogenic risk factors after the comprehensive pediatric ophthalmology examination on the basis of the AAPOS guidelines. We found the plusoptiX A12 to have a sensitivity of 93.02%, specificity of 84.96%, false positive rate of 9.13%, false negative rate of 2.74%, positive predictive value of 80.00%, and negative predictive value of 94.96%.

Conclusions: PPS is a viable option and is comparable to various commercially available devices to detect refractive amblyogenic risk factors based on Nebraska pediatric patient population. While the results of this outpatient clinic are promising, our sample had a higher incidence of amblyopia than the general population due to partial selection bias. Future studies may show increased sensitivity by combining the use of the plusoptiX A12 with an alternate cover test.

Commercial Relationships: Thomas Williams, None; Donny Suh, None

Program Number: 3098 Poster Board Number: B0085
Presentation Time: 8:30 AM–10:15 AM
Assessment of the OPTEC vision screener in the detection of amblyopia in the pediatric population

Mary Haschke, Hannah Kinberg, Donny W. Suh. U of Nebraska Medical Center, Omaha, NE.

Purpose: Amblyopia, defined as a functional reduction in the visual acuity of an eye caused by disuse or misuse during the critical period of visual development, is the most common visual deficit in children with a prevalence of 4%. OPTEC 5500 Vision Tester (OVT) is widely available in pediatric medical practices for visual screening, due to inexpensiveness and ease of use. No studies have been conducted to ascertain the validity of this device in the pediatric population for the detection of amblyopic risk factors. The aim of this cross-sectional study was to determine the validity of the OPTEC Vision Screener in detecting refractive errors and amblyopia in pediatric patients age 3-17 years, by comparing it to the gold standard comprehensive ophthalmic examinations.

Methods: A cross-sectional study of sixty-four subjects, ages 3-17 underwent a vision-screening test using the OPTEC vision screener, followed by the traditional visual acuity testing via the Snellen or Lea optotypes. After data was collected the results of the OPTEC were compared to the Snellen and Lea visual acuity tests (gold standard), and then statistical analysis was performed for the right and left eyes separately. Patients were considered to have amblyopic risk factors based on the American Association of Pediatric Ophthalmology and Strabismus (AAPOS) referral criteria guidelines.

Results: The overall results of the OPTEC study for participants of all ages were as follows: Right Eye- sensitivity: 77.4%, specificity: 100.0%, positive predictive value: 100.0%, negative predictive value: 50.0%, and accuracy: 81.5%. Left Eye- sensitivity: 81.0%, specificity: 87.0%, positive predictive value: 91.9%, negative predictive value: 71.4%, and accuracy: 83.1%.

Conclusions: The OPTEC 5500 is a vision screening device that employs “E” or Snellen optotypes projected to simulate distance visual acuity inside a self-contained housing. While specificity was acceptable, sensitivity of OVT were below average of other available devices; and exhibited some of the weakness the device. We need to continue to explore better options for pediatric vision screening devices.

Commercial Relationships: Mary Haschke; Hannah Kinberg, None; Donny W. Suh, None

Program Number: 3099 Poster Board Number: B0086
Presentation Time: 8:30 AM–10:15 AM
Referral basis for infantile cataracts

Priyanka Kumar, Phoebe Lenhart, Scott R. Lambert. Emory Eye Clinic, Atlanta, GA.

Purpose: The American Academy of Pediatrics recommends all newborns undergo a red reflex evaluation at birth and 6-8 weeks. We conducted a retrospective, observational study to determine the referral basis for infantile cataracts in a busy US pediatric ophthalmology practice.

Methods: A retrospective consecutive case series between January 2010 and September 2015 at one tertiary-care center of children less than 1 year of age diagnosed with infantile cataract. Referral indications were categorized into four groups: 1) referral initiated by pediatric healthcare provider because of suspected cataract, 2) referral initiated by parent/caregiver because of concerning ocular signs or symptoms, 3) referral initiated because of a positive family history of infantile cataracts, or 4) routine eye exam.

Results: A total of 50 patients and 74 eyes were included in the study. Twenty-one of the 50 children were male (42%), 29 were female (58%). Twenty-four had bilateral cataracts (48%), while the remainder had unilateral cataracts (52%), with 15 affecting the left eye. Cataract types were anterior polar (11), cortical (2), lamellar (7), nuclear (15), mature (29), and posterior polar (10). Thirty-one patients were referred by their primary care provider, 11 were brought in by concerned parents or caregivers, 5 were identified during retinopathy of prematurity screening, and 3 were referred because of a strong family history. The age at diagnosis ranged from 1 week to 10 months of age. Twenty-six children had seen an average of at least one other eye care provider prior to their referral to the tertiary care center. Twenty-one were diagnosed before 8 weeks of age (42%), and 41 children (92%) were advised to undergo surgical removal of the cataract(s) to improve visual potential of the affected eye.

Conclusions: This study demonstrates that less than half of all patients diagnosed with infantile cataracts are identified within 6-8 weeks of birth, which can delay the institution of critical vision-saving interventions. However, pediatric providers initiate the referral to an eye care provider in almost two-thirds of cases. We hope that the results of this study stimulate discussion about the utility of current practice and referral guidelines regarding infantile cataracts.

Commercial Relationships: Priyanka Kumar, None; Phoebe Lenhart, Scott R. Lambert, None

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Presentation Time: 8:30 AM–10:15 AM
Visual Profile of Children Passing/Failing a UK School Vision Screening Protocol

Kathryn Saunders, Lisa O’Donoghue, Sara McCullough. BIOMEDICAL SCIENCES RESEARCH INSTITUTE, ULSTER UNIVERSITY, Coleraine, United Kingdom.

Purpose: The UK National Screening Committee recommends screening for reduced vision at school entry (4-5 yrs). The recommended protocol tests monocular acuities with a pass criterion of 0.2LogMAR or better in both eyes. The guidance states “amblyopia is the most likely condition to be detected” but that “refractive error and strabismus” are also detected. The present study investigated the visual profile of children who passed/failed vision
assessments using this criterion. The aim is to determine how well the protocol detects strabismus and refractive error, how many children with significant visual issues pass and to describe the visual profile of those who fail.

**Methods:** Participants were 295 children (5.2±0.4 yrs; 55% female) recruited and tested in local schools. In addition to the vision screening protocol (crowded LogMAR monocular acuity @3m), ocular posture (cover test), refractive error (cycloplegic autorefraction), stereopsis (random-dot stereogram), and accommodation (dynamic ret) were assessed. These metrics were used to identify children who passed/failed the vision screening protocol, had manifest strabismus and/or significant refractive error (hyperopia SER≥+3.50DS, myopia SER≤-0.50DS; astigmatism ≤-1.50DC; anisometropia diff SER≥+1.50DS). All data were used to identify children with a visual deficit requiring clinical intervention.

**Results:** Of 284 children who completed all tests 79(27.8%) failed to achieve 0.2LogMAR or better in both eyes, 10(3.5%), 55(19.4%) and 60(21.1%) had strabismus, significant refractive error and/or required clinical intervention respectively. The pass/fail criterion for vision screening identified 8 children with strabismus (sensitivity 80% specificity 74.4%), 40 with significant refractive error (sensitivity 71.4% specificity 82.5%) and 42 judged as needing clinical intervention (sensitivity 70% specificity 83.5%). Half (49.4%) of those failing the screening protocol had significant refractive error of which 82% were non-strabismic. The visual profile of almost half (46.8%) of those failing vision screening did not indicate a need for clinical intervention.

**Conclusions:** Vision screening with monocular acuity is reasonably sensitive and specific for detecting refractive error and strabismus. Half of those failing vision screening primarily need refractive intervention and the majority of the remainder are likely to be ‘false positives’ for clinically significant visual deficits.

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**Presentation Time:** 8:30 AM–10:15 AM

**Preschool Vision Screening by Parents Using an iPad in Saudi Arabia**

*Noura A. Aldossary1, 2, Ali M. AlSaqr2, Elise B. Ciner1, Noura Aldohayan1*

1Salus University, Riyadh, Saudi Arabia; 2Optometry Department, King Saud University, Riyadh, Saudi Arabia; 1Ophthalmology, Prince Sultan Military Medical City, Riyadh, Saudi Arabia.

**Purpose:** Use of iPads is widespread in Saudi Arabia and present in most households. Early vision screening before 6 years of age is not common. The aim of this pilot study is to evaluate the ability of parents to administer an iPad-based preschool vision screening and to compare criteria for referral.

**Methods:** Children ages 3 to <6 years presenting for an eye examination with a parent at Prince Sultan Military Medical City, Riyadh were invited to participate. Parents were required to have prior experience using an iPad to participate. Children underwent screening (SC) with an iPad based visual acuity (VA) test (iSight, Kay Pictures Limited, UK) followed by an eye exam with cycloplegia (EE). The SC began with parent administration of the iSight on their child. An optometrist (O) who was masked to the parental results then performed the iSight on the child. The EE by a pediatric ophthalmologist included: monocular VA, distance and near cover test, cycloplegic refraction and ophthalmoscopy. Outcomes were testability (T) along with, sensitivity (SN) and specificity (SP) (95% Confidence Interval [CI]) with criteria by iSight (<20/25) or the American Association for Pediatric Ophthalmology and Strabismus (AAPOS) age based screening criteria.

**Results:** 40 children (21 female,18 male, average age 52.35 months SD±10.4) and 38 parents (22 female,16 male) participated (2 parents came with 2 children each). Most parents were Saudis (97.4%) and living in Riyadh (89.5%). 26(65%) of children failed the EE; 6(23.1%) had >3 diopters (D) hyperopia, 8(30.8%) had bilateral astigmatism >1.5D, 1(3.8%) had ≥1D anisometropia, 8(30.8%) were amblyopia suspects and 3(11.5%) were strabismic. The T of iSight was 90% for parents and O. With iSight criteria, the SPs by the parents and O were 76.92% [46.19, 94.96] and 84.62% [54.55,98.08], while SNs were both 100% [85.18, 100.00]. With AAPOS criteria, SNs by parents and O were reduced to 60.87% [38.54, 80.29] and 56.52% [34.49, 76.81], while the SPs were improved to 100% [75.29,100].

**Conclusions:** Parents performed similarly to an O on the iSight. Although the iSight provides parents in Saudi Arabia the ability to screen their children for vision disorders at home, findings from this pilot show low sensitivities or specificities. These results are consistent with previous studies of VA screening tests. Further investigation may help to determine iSight applicability for screening in Saudi Arabia.

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