**Purpose:** A wearable video camera based collision warning device for blind individuals in an obstacle course

**Methods:** A 45 m long indoor obstacle course was set up in the form of an ‘L’ shaped loop with 12 overhanging obstacles (> 1 m above the ground). Twelve subjects, 8 blindfolded normally sighted (NS) and 4 blind, walked with a long cane following the boundary of the obstacle course in two conditions: with (WD) and without device (WOD). In WD condition, the device was mounted on the chest and the task was to avoid collisions based on the warnings received from the device. Subjects walked the course in opposite directions WD and WOD. The device order was counterbalanced. Training was given prior to the task. NS were given additional cane usage training. Number of head-on collisions and task completion time in each condition were recorded by the experimenter. Video from the device camera with collision risk localization information was logged. Baseline walking speed was measured WOD along an unobstructed corridor and percent preferred walking speed (PPWS) was computed.

**Results:** Median values [25th – 75th percentiles] are reported for all quantities. The number of collisions reduced significantly with the device (WD: 4 [3 – 4.5], WOD: 11.5 [10.75 – 12]; p < 0.001). Except for 1 blind subject who had the same number of collisions in both conditions, all subjects experienced fewer collisions WD. Video recorded from the device showed that it failed to identify a median of 2 [2 – 3.5] collisions, which is lower than the observed collisions WD. This indicates that subjects might not have reacted to some of the collision warnings. There was a small but significant reduction in PPWS with the device (WD: 36 [31 – 41], WOD: 40.9 [39 – 45]; p = 0.04), possibly because the subjects attempted to navigate around the obstacles.

**Conclusions:** These results demonstrate significant improvements in real-world functional task performance immediately following training and retained after long-term use. The BrainPort® Vision Pro offers a non-surgical method for restoring functional abilities to persons blinded by trauma. In addition, the device can support the successful integration of blind Veterans and active duty Servicemembers into community life. With access to the BrainPort® Vision Pro, profoundly blind persons can regain or enhance independence, directly interact with their environments, and regain a sense of autonomy.
Using Sensory Augmentation to Optimize Training Outcomes with Vision Prostheses

Lauren N. Ayton1, 4, Lachlan Hamilton2, Chris D. McCarthy3, Matthew A. Petoe2, 3, 5
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Purpose: Retinal prostheses are currently the only regulatory-approved treatment option for patients with profound vision loss from retinitis pigmentosa. Whilst showing exciting results, user training can be challenging due to the non-intuitive nature of phosphene perception. The aim of this study was to investigate whether the addition of auditory cues, using the Seeing With Sound (SWS) software program, would improve the interpretability of simulated phosphene vision (SPV), similar to that provided by retinal prostheses.

Methods: Two computer algorithms were used to process the input camera image. In the first, the SWS program scanned the image from left to right, with brightness converted to loudness, vertical image position converted to frequency (or pitch), and horizontal position converted to stereo panning, presented audibly via stereo headphones. In the second, the SPV program converted the image to phosphene-like dots for display with head-mounted Virtual Reality goggles. This SPV program incorporated the retinotopic map of a patient implanted with the Bionic Vision Australia prototype suprachoroidal retinal implant between 2012 and 2014. Forty normally-sighted subjects completed two visual tasks: a light localization task from the Basic Assessment of Light and Motion (BaLM) and an optotype recognition task from the Freiburg Acuity and Contrast Test (FrACT) with 1) SPV alone, 2) SWS alone or 3) SPV + SWS, in random order.

Results: Subjects reported SPV to be more intuitive than SWS and were able to complete both tasks more quickly in conditions with SPV. Accuracy on the light localization task was highest in the combined SPV + SWS condition (94.7 ± 5.8%) compared to SPV alone (91.7 ± 9.0%, p = 0.002) and SWS alone (89.0 ± 13.0%, p = 0.001). Response times were significantly faster for both SPV (6.6 ± 3.4s, p < 0.001) and SWS + SPV (6.7 ± 3.1s, p < 0.001) when compared to SWS alone (9.3 ± 4.3s). Visual acuity was best in the SWS condition (1.95 ± 0.24 logMAR), followed by the SPV + SWS condition (2.04 ± 0.26 logMAR), and the SPV alone (2.54 ± 0.07 logMAR).

Conclusions: Results for the combined SPV (visual) + SWS (auditory) condition demonstrate that the addition of auditory cues improved performance with simulated prosthetic vision and did not significantly slow down response times. Hence, the use of auditory cues may be beneficial in training visual prosthetic recipients.

Commercial Relationships: Lauren N. Ayton, None; Lachlan Hamilton, None; Chris D. McCarthy, None; Matthew A. Petoe, None

Support: Australian Research Council Special Research Initiative (SRI) in Bionic Vision Science and Technology grant to Bionic Vision Australia (BVA)

Program Number: 4763
Presentation Time: 4:15 PM – 4:30 PM

Using Sensory Augmentation to Optimize Training Outcomes with Vision Prostheses

eQUEST: The eSight Quality of life and Efficacy Study

Walter Wittich1, 2, Marie-Celine Lorenzini1, Judith E. Goldstein1, Samuel N. Markowitz1, Beatriz E. Patino1, Kristen Lindeman1, Sonya Braudway2, Scott A. Gartner2, Lindsay Godsay3, Ashley Howson4, Michael Tolentino5, Thiran Jayasundera2, Sophia Reyes1, Gislin Dagnelie1, 1School of Optometry, University of Montreal, Montreal, QC, Canada; 2Centre de recherche interdisciplinaire en readaptation de Montreal metropolitain, Montreal, QC, Canada; 3School of Medicine, Johns Hopkins University, Baltimore, MD; 4Department of Ophthalmology, University of Toronto, Toronto, ON, Canada; 5Lighthouse for the Blind of the Palm Beaches, West Palm Beach, FL; 6University of Michigan, Ann Arbor, MI; 7Center for Retina and Macular Disease, Lakeland, FL.

Purpose: eSight Eyewear is a head-mounted magnification device intended to facilitate activities of daily living and improve quality of life for individuals with low vision. The present study aimed to evaluate the effect of training and experience in using eSight Eyewear on functional vision and vision-related quality of life.

Methods: In this prospective multicenter study, 60 participants (M/F = 36/24, age M = 47, range 13-75) with stable vision (acuity 20/60-20/400, visual field > 20°) were recruited across 6 sites (USA & Canada). Exclusion criteria were recent surgical/medical interventions or a score of < 26 on the Montreal Cognitive Assessment. Data were collected at baseline (no device), at device fitting (with device), and after three months of training with and use of the device. Dependent variables were visual ability on the Veteran Affairs Low Vision Functional Vision Questionnaire 48 (VA LV VFQ-48), letter acuity (ETDRS), critical reading print size (MNRead), contrast sensitivity (MARS), face recognition, and a modified version of the Melbourne Low Vision Activities of Daily Living (ADL) Index.

Results: To date, complete visual function data are available on 37 participants. Introduction of eSight Eyewear caused a significant improvement in acuity (0.73±0.24 logMAR), contrast sensitivity (0.60±0.25 log units), and critical print size (0.62±0.33 logMAR), p < .001. Practice and training did not result in further changes. A significant change in Melbourne ADL score (7.7±15.3) was observed immediately, p < .004, followed by a trend (p = 0.12) towards further improvement (4.1±15.5) at follow-up; a similar effect was observed for face recognition: immediate improvement (10.2±15.3; p < .001), followed by a further tendency (2.1±14.4; p = 0.38). Most VA LV VFQ-48 person measures improved: overall 1.04 logits, p < .001; reading: 2.95 logits, p < .001; mobility: 0.27 logits, p = .37; visual info: 1.34 logits, p < .001; visual motor: 0.67 logits, p < .01.

Conclusions: In our sample, the introduction of eSight Eyewear resulted in immediate improvements in all visual function measures, with face recognition and ADLs showing a benefit of further practice/training. Self-reported outcomes suggest that visual abilities, such as reading, are greatly improved when wearing the device. Further studies will examine benefits of practice and training and possible differential effects of underlying pathology or baseline vision.

Program Number: 4764
Presentation Time: 4:30 PM – 4:45 PM

eQUEST: The eSight Quality of life and Efficacy Study

Walter Wittich1, 2, Marie-Celine Lorenzini1, Judith E. Goldstein1, Samuel N. Markowitz1, Beatriz E. Patino1, Kristen Lindeman1, Sonya Braudway2, Scott A. Gartner2, Lindsay Godsay3, Ashley Howson4, Michael Tolentino5, Thiran Jayasundera2, Sophia Reyes1, Gislin Dagnelie1, 1School of Optometry, University of Montreal, Montreal, QC, Canada; 2Centre de recherche interdisciplinaire en readaptation de Montreal metropolitain, Montreal, QC, Canada; 3School of Medicine, Johns Hopkins University, Baltimore, MD; 4Department of Ophthalmology, University of Toronto, Toronto, ON, Canada; 5Lighthouse for the Blind of the Palm Beaches, West Palm Beach, FL; 6University of Michigan, Ann Arbor, MI; 7Center for Retina and Macular Disease, Lakeland, FL.

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Conclusions: In our sample, the introduction of eSight Eyewear resulted in immediate improvements in all visual function measures, with face recognition and ADLs showing a benefit of further practice/training. Self-reported outcomes suggest that visual abilities, such as reading, are greatly improved when wearing the device. Further studies will examine benefits of practice and training and possible differential effects of underlying pathology or baseline vision.
Commercial Relationships: Walter Wittich,
Marie-Celine Lorenzini, eSight (F), Judith E. Goldstein, eSight (F); Samuel N. Markowitz, eSight (F); Beatriz E. Patino, eSight (F); Kristen Lindeman, eSight (F); Sonya Braudway, eSight (F); Scott A. Gartner, eSight (F); Lindsay Godsay, eSight (F); Ashley Howson, eSight (F); Michael Tolentino, eSight (F); Thiran Jayasundera, eSight (F); Sophia Reyes, eSight (F); Gislin Dagnelie, eSight (F)
Support: eSight corporate funding

Program Number: 4765
Presentation Time: 4:45 PM–5:00 PM
Inpatient low vision rehabilitation has a long term positive effect on participation, vision-related quality of life and adaptation
Ruth M. Van Nispen, Hilde P. van der Aa, Ger van Rens. Ophthalmology, VU University Medical Center, Amsterdam, Netherlands.
Purpose: In the Netherlands, every year approximately 120 visually impaired adults with complex needs follow an inpatient multidisciplinary weekday rehabilitation program. The aim was to investigate its long term effectiveness on participation, vision-related quality of life (VRQOL) and mental health. Also, prognostic factors were studied as were the direct health care costs.
Methods: In a prospective longitudinal cohort, 74 adults (28% retnitis pigmentosa or Usher, 62% male, mean age 47 SD 15 years) were interviewed by telephone at baseline (Feb 2013-Jul 2014) and 10 and 18 months follow up (dropout 12%). The outcomes Participation and Activity Inventory, Low Vision Quality of Life subscales, Adaptation to Vision Loss, Center for Epidemiological Studies – Depression, Hospital Anxiety Depression Scale were fitted to item response theory models. Linear mixed models were used to analyze the effect of rehabilitation and prognostic factors. Costs of stay and of the interventions provided were calculated for each patient.
Results: Improvement was found on participation, the LVQOL mobility and acceptance subscales and on adaptation (p<0.001). Visual functioning, depression and anxiety symptoms did not change significantly over time. Comorbidity and severity of vision loss were negative predictors of participation and VRQOL; duration of the visual impairment was a positive predictor. Mean duration of stay was 137 SD 50 days. The most often followed interventions were computer training (mean 130 hrs SD 60), leisure courses (63 SD 49), Braille training (60 SD 55), orientation and mobility training (54 SD 56), psychosocial counselling (53 SD 31). Mean costs per patient of stay were €10,624 (range 3,089-21,873) and interventions €25,546 (range 6,270-73,631).
Conclusions: Although some mental health outcomes and visual functioning did not improve, there was a strong long term positive effect of inpatient rehabilitation on participation, mobility, acceptance and adaptation. Pinpointing vulnerable groups within the inpatient setting may increase awareness of professionals and may help to fine-tune rehabilitation trajectories. The variability in the tailor-made trajectories warrants future studies into dose-response relations of (combinations of) interventions to reduce costs of the program and to further increase effectiveness.
Commercial Relationships: Ruth M. Van Nispen, None; Hilde P. van der Aa, None; Ger van Rens, None
Support: Royal Dutch Visio

Program Number: 4766
Presentation Time: 5:00 PM–5:15 PM
First results from the EFFECT Trial, an RCT of eccentric viewing training for patients with AMD
Gary Rubin1, 2. 1Visual Neuroscience, University College London, London, United Kingdom; 2Biomedical Research Centre for Ophthalmology, NIHR, London, United Kingdom.
Purpose: Eccentric Viewing Training (EVT) aims to teach people who have lost their central vision from conditions such as AMD to use their peripheral vision to perform daily tasks like reading and recognizing faces. EVT is widely practiced in some European countries, especially Sweden, and at some low vision centers in the US and elsewhere. EVT is not generally available through the NHS in the UK. One reason it is not offered is the lack of evidence that EVT is effective. In 2011 we initiated the EFFECT Trial to help close the gap in the evidence.
Methods: EFFECT is a four parallel arm RCT. 50 patients were recruited into each of four groups. Group 1 is the control group that receives standard care (no EVT). Group 2 received the same amount of contact time as Group 1 but no EVT. Group 3 received 3 sessions of EVT at their self selected preferred retinal location (PRL) and Group 4 is given 3 sessions of EVT at a location chosen by the trainer that is meant to be optimal for daily tasks. All participants’ better eye had acuity worse than logMAR 0.3 and a dense central scotoma. EVT was administered by optometrists trained and certified by an experienced low vision trainer. The primary outcome was self-reported difficulty with daily activities measured with the Massof Activity Inventory,(MAI).
Results: 200 patients were recruited to the study. 178 participants completed the 6-month follow up and 168 12 months. After controlling for baseline MAI score and other covariates, MAI scores at the 6-month follow-up were highest for group 2 (equal contact time, no EVT) and lowest for group 3 (training at the PRL), but the difference, 0.23 logits was not statistically significant (p>0.1) or clinically meaningful. The results were the same at the 12-month follow-up.
Conclusions: We were not able to demonstrate a measurable benefit of EVT. There are several reasons why this may be so. We may have offered too little EVT, or used the wrong training methods. We may have selected the wrong patients or used the wrong outcome measure. But based on our prior work we believe the most likely explanation is that most people who develop a central scotoma from AMD discover eccentric viewing on their own; without any formal training. EVT may help the AMD patient discover eccentric viewing more quickly or adopt a better eccentric viewing strategy, but these must remain open questions for future studies to address.
Commercial Relationships: Gary Rubin, None
Support: Fight for Sight Programme Award
Clinical Trial: NCT01499628

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