NeuroEyeCoach™ is the first commercially available eye movement-training program which is underpinned by a number of clinical and scientific studies. The program is specifically targeted at improving visual search efficiency in patients with visual field loss after brain injury. The underlying impact that has been established through extensive research is a significant improvement in the patient's visual performance leading to a better quality of life. Below are selected summaries of published literature that support the use of this technique.

Zihl J (1995). Visual scanning behaviour in patients with homonymous hemianopia. Neuropsychologia; 33: 287-303.

This study examined oculomotor scanning behavior in 60 patients suffering from homonymous hemianopia due to postgeniculate damage. Eye movements were recorded using an infra-red recording technique during performance of a visual searching task. In 24 patients (40%) scanning behavior was found to be normal; the remaining 60% showed significantly increased search times. Detailed analysis of patients' eye movements revealed that the pronounced slowing of visual scanning was mainly due to the disordered spatial organization of scanning not only in the affected, but also, to a lesser degree, in the intact hemifield. CT and NMR examination revealed that additional damage to the ipsilateral occipital white matter, posterior thalamus or the parieto-occipital cortex results in impaired spatial organization of visual scanning. A smaller group of patients ($n = 14$) with impaired visual scanning was treated to improve the spatial organization of visual exploration. After training, all patients showed a significant improvement in visual searching.

Conclusion

Study shows that successful oculomotor adaptation can substitute the lost visual hemifield. The reason behind its effectiveness is based on the findings that impaired visual scanning in hemianopic patients is mainly caused by visual spatial disorientation that also affects spatial integration of visual information.

Schuett S, Zihl J (2013). Does age matter? Age and rehabilitation of visual field disorders after brain injury. Cortex; 49: 1001-1012

Traditionally, it has been assumed that younger patients with brain injury are more likely to recover than the older adults. In this study Schuett & Zihl recruited 38 patients with homonymous visual field defects (HVFD). Patients undertook eye movement training as well as a reading therapy. The main finding was that older patients (mean: 77 years, range: 70-84 years) achieved the same treatment-induced improvements in reading and visual exploration with the same amount of treatment as younger patients (mean: 28 years, range: 20-35 years); severity of functional impairment also did not differ between older and younger patients, at least in reading.

Conclusion

Age does not seem to be a critical factor determining the functional and rehabilitation outcome in the compensatory treatment of HVFD. Older age per se is not necessarily associated with a decline in practice-dependent functional plasticity and adaptation. To the contrary, the effectiveness of compensatory treatment to reduce the functional impairments to a similar extent in younger and older patients with HVFD adds to the growing evidence for a life-long potential for adaptation to the adverse visual effects of brain injury.

Schuett S, Heywood CA, Kentridge RW, Dauner R, Zihl J (2012). Rehabilitation of reading and visual exploration in visual field disorders: transfer or specificity. Brain; 135: 912-921.

Compensatory therapies are aimed at improving eye movement and visual search efficiency after brain injury leading to unilateral homonymous visual field defects. These interventions allow patients to regain sufficient reading and visual exploration performance through systematic oculomotor training. In a cross-over rehabilitation study, the authors investigated whether the training-related performance improvements are task specific or whether there is a transfer of training related improvements between reading and visual exploration. They compared the therapeutic effects of compensatory oculomotor reading and saccadic eye movement training in 36 patients. In addition they investigated whether the training sequence determined the overall treatment outcome.

Conclusion

The findings demonstrated that the training-related improvements in reading and visual exploration were highly specific and task dependant and there was no effect of training sequence.

Aimola L, Lane AR, Smith DT, Kerkhoff G, Ford GA, Schenk T (2014). Efficacy and feasibility of home-based training for individuals with homonymous visual field defects. Neurorehabilitation and Neural Repair; 28: 207-218.

Authors have randomly allocated 70 patients into intervention and control groups. The intervention group undertook both a computer based visual search task as well as a reading task for 35 one hourly sessions. The control group undertook a fixation task of similar duration and attentional demand. Eighteen individuals failed to complete the training, but 28 in the intervention group and 24 controls completed the training. Individuals in the intervention group demonstrated significant improvements in the primary outcomes of saccadic exploration and reading which were significantly greater than those observed following the control intervention.

Conclusion

In conclusion, home-based compensatory training is an inexpensive accessible rehabilitation option for individuals with homonymous visual field defects, which can result in objective benefits in searching and reading, as well as improving quality of life.

Mannan SK, Pambakian ALM, Kennard C (2010). Compensatory strategies following visual search training in patients with homonymous hemianopia: an eye movement study. Journal of Neurology; 257: 1812-1821.

Using a visual search task, patients explored a computer screen, searching for a single randomly positioned target amongst distractors. 29 patients with homonymous visual field defect completed the 20 daily sessions over a period of 4 weeks. After training, patients demonstrated significantly shorter reaction times for search stimuli. Patients achieved improved search efficiency after training by altering their oculomotor behaviour in the following ways: (1) patients directed a higher proportion of fixations into the hemispace containing the target, (2) patients were quicker to saccade into the hemifield containing the target if the initial saccade had been made into the opposite hemifield, (3) patients made fewer transitions from one hemifield to another before locating the target, (4) patients made a larger initial saccade, although the direction of the initial saccade did not change as a result of training, (5) patients acquired a larger visual lobe in their blind hemifield after training. Patients also required fewer saccades to locate the target after training reflecting improved search efficiency. All these changes were maintained at follow-up one month after the completion of training.

Conclusion

Taken together these results suggest that computer based visual training facilitates the development of specific compensatory eye movement strategies in patients with homonymous visual field defects.

Kerkhoff G, Münßinger U, Haff E, Eberle-Strauss G, Stögerer E (1992). Rehabilitation of homonymous scotomata in patients with postgeniculate damage of the visual system: saccadic compensation training. Restorative Neurology and Neuroscience; 4: 245-254.

A systematic training procedure for patients with disturbed visual search was evaluated in 92 patients with postchiasmatic visual field disorders (VFD) and 30 VFD patients with additional left sided visual neglect (VFD +). Visual fields and areas of visual search via saccadic eye movements in the scotomatous field (search field) were mapped perimetrically in all patients before and after training and after a follow-up interval (mean follow-up interval: 22 months).

Conclusion

A significant increase of more than 20° of visual angle was found in visual search field in the scotomatous field during training. Search field remained stable at follow-up in both patient groups. In contrast, only minor, though significant increases in visual field size were obtained during search field training in some patients. Multiple baseline designs in 5 patients revealed that search field enlargements were training dependent and not related to spontaneous recovery, adaptation to test procedures or measurement variability.

Pambakian ALM, Mannan SK, Hodgson TL, Kennard C (2004). Saccadic visual search training: a treatment for patients with homonymous hemianopia. Journal of Neurology, Neurosurgery and Psychiatry; 75: 1443-1448.

Authors describe how the completion of 20 daily sessions of visual search task could lead to improved eye movement efficiency. They hypothesised that the improvement gained in training , would lead to reduction of patients' disability. Improvements were assessed by examining response time (RT), error rates in visual search, perimetric visual fields and visual search fields, before and after the intervention in patients with homonymous visual field defect (n=29). As a group the patients had significantly shorter mean RT in visual search after training. Improvements were confined to the training period and maintained at follow up. Three patients had significantly longer RT after training. They had high initial error rates which improved with training. Patients performed Activities of Daily Living (ADL) tasks significantly faster after training and reported significant subjective improvements.

Conclusion

Patients can improve in visual search with practice. This usually involves shorter RTs, but occasionally a longer RT in a complex speed–accuracy trade-off. These changes translate to improved overall visual function, assessed objectively and subjectively, suggesting that they represent robust training effects.