Primary visual cortex

Training system designed to enhance quality of vision

Computer-based program focuses on initiating neural modifications for brain plasticity

Focus on Refractive Surgery

By George O. Waring IV, MD

Take-Home Message

A noninvasive treatment modality (RevitalVision) has been designed to enhance vision by modifying processes at the primary visual cortex.

Computer-based cortical vision training, also known as neural vision therapy (NVT), is a noninvasive treatment modality designed to enhance vision by modifying processes at the primary visual cortex.

Since the technology was developed in 1999, more than 1,500 patients have been treated in Europe, the United States, and Asia. The Singapore-based NVT company NeuroVision recently was purchased by RevitalVision, and operations were relocated to the United States.

Read a recent editorial by Peter J. McDonnell, MD, about trichromacy and how our brains perceive colors. Go to OphthalmologyTimes.com/plasticity

RevitalVision's launch primarily has been focused on improving quality of vision and contrast sensitivity in post-IOL and post-LASIK patients (NeuroLASIK), and clinical studies to date have been promising.[1] The company plans to release additional product offerings for the treatment of low myopia and early presbyopia as well as enhancement of night driving and sports vision.

Scientific background

Several studies have shown that the noise of individual cortical neurons can be modulated by appropriate choice of stimulus conditions and that contrast sensitivity can be increased through control of stimulus parameters.[2-5]

The interactive Web-based computer software program (RevitalVision) uses Gabor patches, a visual stimulus widely used in the field of visual neuroscience, to match and activate the shape of receptive fields in the visual cortex.

Lateral masking of the Gabor patches improves neuronal efficiency and improves contrast sensitivity function (CSF) by reducing the noise-to-signal ratio of neural activity in the primary visual cortex[5] (Figure 1 on Page 64).

This lateral masking technique is tailored to an individual computerized training regimen using various stimulus (Gabor) parameters such as spatial frequency, spa-

See **Vision therapy** on page 64

STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION

(Requester Publications Only) (Required by 39 USC 3685)

1. **Publication Title:** Ophthalmology Times
2. **Publication Number:** 0193-032X
3. **Filing Date:** 9/30/09
4. **Issue Frequency:** 24 issues, twice monthly
5. **Number of Issues Published Annually:** 24
6. **Annual Subscription Price (if any):** $200.00
7. **Complete Mailing Address of Known Office of Publication:** 131 West First Street, Duluth, St. Louis County, MN 55802-2065 **Contact Person:** Ryanne Battaglia **Telephone:** 218-740-6466
8. **Complete Mailing Address of Headquarters or General Business Office of Publisher:** 6200 Canoga Avenue, 2nd Floor, Woodland Hills, CA 91367
9. **Full Names and Complete Mailing Addresses of Group Publisher: Lauri B. Jorgensen, Woodbridge Corporate Plaza, 485 Route 1 South, Building F, First Floor, Iselin, NJ 08830**

   Group Editor: Mark L. Dlugoss, Great Northern Corporate Center II, 24950 Country Club Blvd., North Olmsted, OH 44070

   Managing Editor: Sheryl Stevenson, Great Northern Corporate Center II, 24950 Country Club Blvd., North Olmsted, OH 44070
10. **This publication is owned by:** Advanstar Communications Inc., 6200 Canoga Avenue, 2nd Floor, Woodland Hills, CA 91367. The sole shareholder of Advanstar Communications Inc. is: Advanstar, Inc., whose mailing address is 6200 Canoga Avenue, 2nd Floor, Woodland Hills, CA 91367.
11. **Advanstar Communications Inc. is a borrower under Credit Agreements dated May 31, 2007, with various lenders as named therein from time to time. As of June 30, 2009, the agent for the lenders is: Credit Suisse, Administrative Agent, Eleven Madison Avenue, New York, NY 10010. Advanstar Communications Inc is a borrower under an agreement with VSS-AHC Holdings, LLC, 350 Park Avenue, New York, NY 10022**
12. **Does Not Apply**
13. **Publication Title:** Ophthalmology Times
14. **Issue Date for Circulation Data Below:** August 15, 2009
15. **Extent and Nature of Circulation**

	Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
A. Total Number of Copies	22,820	22,006
B. Legitimate Paid and/or Requested Distribution		
1. Outside County Paid/ Requested Mail Subscriptions Stated on PS Form 3541	15,920	15,106
2. In-County Paid/Requested Mail Subscriptions Stated on PS Form 3541		
3. Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Paid or Requested Distribution Outside USPS	927	895
4. Requested Copies Distributed by Other Mail Classes Through the USPS		
C. Total Paid and/or Requested Circulation (Sum of 15b (1), (2), (3), and (4)	16,847	16,001
D. Non-requested Distribution		
1. Outside County Non-requested Copies as Stated on PS Form 3541	3,895	4,676
2. In-County Non-requested Copies Stated on PS Form 3541		
3. Non-requested Copies Distributed Through the USPS by Other Classes of Mail		
4. Non-requested Copies Distributed Outside the Mail	1,989	1,241
E. Total Non-requested Distribution (Sum of 15d (1), (2), (3), and (4)	5,884	5,917
F. Total Distribution (Sum of 15c and e)	22,731	21,918
G. Copies not Distributed	89	88
H. Total (Sum of 15f and g)	22,820	22,006
I. Percent Paid and/or Requested Circulation	74.11%	73.00%

16. **Publication for a Requester Publication is required. Will be printed in the October 15, 2009 issue of this publication**
17. **Name and Title of Editor, Publishers, Business Manager, or Owner: Christine Shappell, Audience Development Director**
    Signature:

Date: 9/10/09

I certify that the statements made by me above are correct and complete.

Vision therapy

Continued from page 63

tial arrangement, contrast level, orientation (local and global), task order, context, and exposure duration.[5]

This precise control of stimulus conditions leading to increased neuronal efficiency is fundamental in initiating the neural modifications that are the basis for brain plasticity.

Therapy details

The training system provides a series of individualized visual stimuli designed to "train" and enhance the neural interactions in the visual cortex.

Each training session lasts for approximately 20 minutes, during which time the patient responds to visual perception tasks (VPTs) displayed on the computer screen at home. Initially, the patient completes computerized evaluation sessions of individualized neural inefficiencies from which the training program begins.

The therapy typically is conducted at a pace of two to three training sessions a week over a course of 2 to 3 months and is completed after 20 sessions.

The patient is exposed to two consecutive laterally masked Gabor patch displays in random order on the computer monitor. The patient interactively communicates with the computer using a mouse and identifies the correct display as determined by the instructions for the specific task. If the patient answers correctly, the target contrast will be reduced and the task will become more difficult. Incorrect answers trigger the program to increase the contrast and the task becomes easier.

Focal Point

Computer-based cortical vision training may represent a new paradigm in vision correction treatment.

After each training session, the patient performance is recorded and sent via Internet to the company's servers. Subsequently, patient performance is analyzed by algorithms that generate the VPT parameters for the next training session. In this manner, patients receive training sessions that are individually tailored to their performance and neuronal inefficiencies.

Training sessions are individually tailored to each patient's performance and neuronal inefficiencies.

Clinical studies

Computer-based cortical vision training was originally used in Asia and Europe, where clinical studies showed efficacy in the treatment of amblyopia, low myopia, and early presbyopia.[6-7]

Tan and Fong reported mean improvement in uncorrected distance visual acuity of 2.1 logMAR lines after completion of the NVT training. The improvements were shown to be retained for at least 12 months.[7]

In collaboration with Daniel Durrie, MD, and Steven Slade, MD, the author conducted a prospective study comparing NVT after LASIK (NeuroLASIK) with sham treatment following LASIK in 98 eyes.

In the NeuroLASIK group that received NVT, the mean distance uncorrected visual acuity (UCVA) was 0.8 logMAR lines and 79% improvement in contrast sensitivity compared with a 0.28 logMAR line improvement and 52% improve-

Figure 1 Lateral masking technique

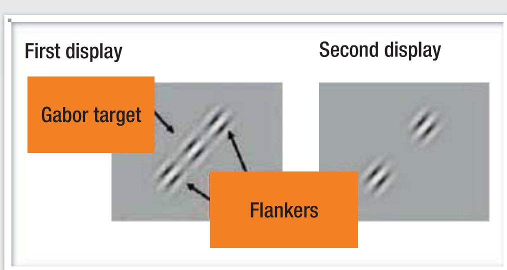

Figure 1 Lateral masking of the Gabor patches improves neuronal efficiency and improves contrast sensitivity function by reducing the noise-to-signal ratio of neural activity in the primary visual cortex. (Figure courtesy of RevitalVision)

ment in CSF in the control group. Eyes with vision worse than 20/20 after LASIK improved 1.56 logMar lines of distance UCVA and had a 90% improvement in CSF after NVT relative to 0.34 logMar lines and 47% CSF improvement in the control group.[1]

Although both groups had improvement to some degree (likely from normal tissue remodeling and healing), the NeuroLASIK group showed greater improvements. In addition, eyes with worse than 20/20 vision after LASIK benefited more with NVT than those who were better than 20/20, suggesting that a cortical limit may exist to how much improvement a patient may have.

Recent unpublished studies by John Hunkler, MD, and Richard Lindstrom, MD showed that patients who underwent this therapy after IOL implantation had decreased dependence on reading glasses, improvement in contrast sensitivity, and greater overall patient satisfaction.

New paradigm

Computer-based cortical vision training may represent a new paradigm in vision correction treatment. Analogous to rehabilitation after other forms of surgery, the therapy system may prove to be particularly useful for improving contrast sensitivity, quality of vision, and, therefore, patient satisfaction after refractive surgery. Stated another way, this novel technology may serve as another "tool in the toolbox" for improving vision where an additional surgical procedure is not clearly indicated or safe. Future studies may elucidate the role of computerized visual cortex training program for patients with low vision.**OT**

References

1. Waring GO IV, Durrie DS. NeuroLASIK: Can surgeons improve LASIK outcomes by training the visual cortex? *Cataract and Refractive Surgery Today*. Aug 2008;52–53.
2. Polat U. Functional architecture of long-range perceptual interactions. *Spat Vis*. 1999;12: 143–162.
3. Kasamatsu T, Polat U, Pettet MW, Norcia AM. Colinear facilitation promotes reliability of single-cell responses in cat striate cortex. *Exp Brain Res*. 2001;138:163–172.
4. Polat U, Mizobe K, Pettet MW, Kasamatsu T, Norcia AM. Collinear stimuli regulate visual responses depending on cell's contrast threshold. *Nature*. 1998;391:580–584.
5. Polat U, Sagi D. Lateral interactions between spatial channels: suppression and facilitation revealed by lateral masking experiments. *Vision Res*. 1993;33:993–999.
6. Polat U, Ma-Naim T, Belkin M, Sagi D. Improving vision in adult amblyopia by perceptual learning. *Proc Natl Acad Sci*. 2004;101:17:6692–6697.
7. Tan DT, Fong A. Efficacy of neural vision therapy to enhance contrast sensitivity function and visual acuity in low myopia. *J Cataract Refract Surg*. 2008;34:570–577.

author info

George O. Waring IV, MD, editor of *Focus on Refractive Surgery,* is in private practice and clinical assistant professor of ophthalmology, Emory University School of Medicine, Atlanta. He is a consultant for AcuFocus and RevitalVision.