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Literature Review

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A regular feature of the Clinical Curriculum News Newsletter has been the Book Report. The Book Report will now be a separate feature, along with other reviews of literature, and will be sent out alternately with the Clinical Curriculum News Newsletter. Anyone wishing to submit a book report or article review for the new separate Clinical Curriculum News Literature Review, please email your report to Theresa at TheresaKrejciOEP@verizon.net.

Journal of Behavioral Optometry

A new feature of the updated OEP web site, www.ope.org, is the new tab entitled JOURNAL. Under this tab you will find abstracts of Journal of Behavioral Optometry articles as well as information on the Journal review board and instructions for authors. Check it out.

Article Reviews

By: Robert A. Hohendorf, O.D.

EXERCISE FOR THE BODY

Exercise For The Body Is Food For The Brain, Study Says
By Ronald Kotulak
Chicago Tribune
March 17, 2004 p. C1
Summarized from the Dana Foundation's
The Brain in the News - March 2004

"Brisk walking and other types of aerobic exercise not only strengthen muscles and improve cardiovascular capacity, they can also bulk up the brain and make it smarter, according to University of Illinois researchers."

"Six months of brisk walking produced significant physical changes in the brains of the exercise subjects, said psychologist Arthur F. Kramer of the university's Urbana-Champaign campus. They had increased connections between neurons in parts of the brain that make a person better able to pay attention compared with people who were physically inactive."

"When given tests that challenged their ability to pay attention, those in the exercise group were able to focus more clearly on goals while disregarding competing but irrelevant information," he said.

"Here's a demonstration where physical exercise in humans is something that produces not just a hedging against cognitive decline with age but actually shows that one can have improvement of cognitive function,"

said Molly Wagster, program director for neuropsychology of aging research for the National Institute on Aging.

"FMRI scans at the end of the experiment showed that when performing tests the brisk walkers had significantly increased activity in two areas of the brain: the middle frontal gyrus, which keeps a person goal-oriented, and the superior parietal area at the back of the brain, which focuses spatial attention."

From this same article, another reference for brain cell growth:

"Scientists used to believe that adults do not make new brain cells. That changed in 1999 when Fred Gage and Terrence Senjnowski—of the Salk Institute for Biological Studies in La Jolla, Calif.—discovered that exercise caused dramatic new brain cell growth in adult rats."

comments by: R. A. Hohendorf, O.D.

AS MAN LAY IN COMA-LIKE STATE HIS BRAIN WAS REBUILDING

By Karen Kaplan, Times Staff Writer
Reprinted in July 2006; *The Brain in the News*
From: The National Desk of The Los Angeles Times; July 4th, 2006; Pg 23

This article reports on following an Arkansas accident victim (Terri Wallis) who was in a "minimally conscious state" for 19 years before emerging at age 39 by speaking. "Although he showed little signs of consciousness, his brain was methodically rebuilding the white-matter infrastructure necessary for him to interact with the outside world." Using PET scans and new advanced technology DTI (Diffuser Tensor Imaging, which looks at water movement), it was found that cells in undamaged areas had formed new axons. "That Terri's brain may have been seeking out new pathways to re-establish functional connections to areas involved in speech and motor control to compensate for those lost due to damage."

This case opens the discussion of how doctors consider treatments for those languishing in minimally conscious and persistent vegetative states. They may have a way of knowing which patients are recovering and which are not. Original scans of Mr. Wallis showed excessive cerebral and sub-cortical atrophy, particularly affecting the brain stem and frontal cortex. The volume of the medial corpus callosum was one-third to two-thirds smaller than normal. "There was a marked reduction of volume and ventricular enlargement' typical of brain injuries. Once paralyzed from the neck down, he can now point with his left hand, move both legs and arch his back. He has quickly gone from single words to speaking in simple sentences.

The first scan was done 8 months after his "awakening", followed by another 18 months later. Changes were noted in the medial regions of the cerebellum that are consistent with the return of his motor function. The bilateral regions of white matter changed to become consistent with normal values at the 18 month measurement. Curiously they found no evidence of increased activity in the language centers of the brain.

Medical experts feel the drug Paxil (an anti-depressant) may be involved due to its use 2 years before the awakening occurred. Because of the lack of scans prior to the recovery, it only raises the possibility that reconnection among existing neurons in a slow structural way are the path to recovery. They stated that "sudden recoveries" only look that way externally. However, Mr. Wallis was the only one of 21 subjects to show these changes, but brains of car accident victims who were still minimally conscious showed this axonal re-growth.

I thought this was an interesting article because this is the regeneration of non myelinated tissue in the brain itself. It expanded my view on **nervous system plasticity** with an actual physical proof by measurement.

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Book Report

By: Paul A. Harris, O.D.

A Brief Tour of Human Consciousness – From Impostor Poodles to Purple Numbers V.S. Ramachandran, PI Press, New York ISBN 0-13-148686-1

Those of you who have read or had the good fortune to hear Rama, as he likes to be called, speak, as he did a few years ago at the COVD Annual Meeting have come to expect great insights into human behavior presented in an engaging style interlaced with humor that only Rama can produce. His latest, "A Brief Tour of Human Consciousness", will not disappoint. The following are some of the aspects that I found particularly relevant to my understanding of vision.

In the introduction Rama attacks head-on the critique that dogs us who provide optometric care from the behavioral perspective, namely the weakness of case studies. "The criticism is sometimes made that it is easy to be misled by single strange cases, but this is nonsense. Most of the syndromes in neurology that have stood the test of time – for example, the major aphasias (language disturbances), amnesia, cortical color blindness, neglect, blindsight, 'split brain' syndrome, etc. – were initially discovered by a careful study of single cases, and I don't now of even one that was discovered by averaging results from a large sample. The best strategy, in fact, is to begin by studying individual cases and then to make sure that the observations are reliably repeatable in other patients." One can almost feel Rama calling on us, the pioneers in our profession, to continue to follow the paths that each of our patients takes us, applying the underlying foundation principles that derive from our insights into the visual process and working to help our patients. We should then be taking the time to

document our “most interesting” patients in ways that our colleagues can know what we have done. Only over time may patterns emerge that could later lead to a large scale study.

He continues, “By studying neurological syndromes which have been largely ignored as curiosities or mere anomalies we can sometimes acquire novel insights into the functions of the normal brain -- how the normal brain works. Many of the functions of the brain are best understood from an evolutionary vantage point.” (Page 2) This statement really touched a nerve in me as I read it. For those interested in following this thread, understanding the evolution of our brain from a functional perspective, I highly recommend the book, “The Evolution of the Brain – Creation of the Self”, by John C. Eccles. (1989 Routledge ISBN 0-415-03224-5)

Cortical plasticity is one of the foundations on which stands much of what we do in vision therapy. “There is a tremendous amount of plasticity of malleability even in the adult brain, and this can be demonstrated in a five-minute experiment on a patient with phantom limb.” (Page 15) Much of Rama’s research has been in the area of phantom limbs and the lessons we learn from the way the architecture of the brain is reorganized and used differently following the loss of limb. These lessons apply to functional redistributions of the use of the brain following extensive practice in a particular domain and are the basis for change following vision therapy.

Rama brings in something that for me has been interesting and which has triggered a new way of understanding how yoked prisms may affect autism spectrum patients, namely synesthesia. “Synesthesia affects about one in two hundred people.” (page 19) This condition that I first learned so much about from the book, “The Man Who Tasted Shapes” by Richard Cytowic, MD (1993 Putmnam, ISBN 0-87477-738-0), is not just an odd curiosity but is functioning below levels of consciousness in all of us and helps us make the cross modal associations we do.

Rama touches briefly on the subject of laughter, where it fits in communication and why it evolved. I have been interested in this ever since reading the book, “Laughter – A Scientific Investigation”, by Robert Provine, (2000 Viking ISBN 0-670-89375-7). “Laughter is nature’s way of signaling that it’s a false alarm. Why is this useful from an evolutionary standpoint? I suggest that the rhythmic staccato sound of laughter evolved to inform our kin who share our genes: don’t waste your precious resources on this situation; it’s a false alarm. Laughter is nature’s OK signal.” (Page 22) In interpersonal communication the laughter is also a form of communication, particularly when tickling is occurring in play to let the tickler know that it’s OK to continue.

Rama speaks a bit on how much of the brain is involved in the visual process leading up to insights into blindsight. “We primates are highly visual creatures. We have not just one visual area, the visual cortex, but thirty areas in the back of our brains which enable us to see the world.” (Page 25)

The following section has changed forever how I view certain events that occur throughout my day. “In reference to Blindsight: Imagine you are driving your car and having an animated conversation with your friend sitting next to you. Your attention is entirely on the conversation, it’s what you’re conscious of. But in parallel you are negotiating traffic, avoiding the pavement, avoiding pedestrians, obeying red lights and performing all these very complex elaborate computations without being really conscious of any of it unless something strange happens, such as a leopard crossing the road. You have blindsight driving and negotiation traffic.” (Page 31) I often go to a certain food establishment to get my Caesar salad with chicken. In this place you first wait on a line to order and pay and then slide down to await the pick up of your food. Then I walk towards the tables to find a place to sit. While walking to find a table one of the ways is to walk back through where the first line is. I love watching how as I walk through people move forward or backward clearing a path for me, while never directly looking at me or altering for a second anything they are doing: talking with someone else on the line, talking on their cell phone, looking at the menu posted on the wall, etc. They are all functioning by using their blindsight pathways throughout all of that. I have found this a much easier way to explain what we are working with in vision therapy following a stroke to a family or a patient.

Here Rama addresses the subject of neglect. Interestingly, he still addresses neglect as occurring purely on the left side of space and the body only with right side hemisphere strokes. "A patient with a right hemisphere stroke (left side paralyzed) sending a command to move his arm receives a visual feedback signal saying it is not moving, so there is a discrepancy. His right hemisphere is damaged, but his intact left hemisphere goes about its job of denial and confabulation, smoothing over the discrepancy and saying, all is fine, don't worry. On the other hand, if the left hemisphere is damaged and the right side is paralyzed, the right hemisphere is functioning as it should, so it notices the discrepancy between the motor command and the lack of visual feedback and recognizes the paralysis." (Page 36) I recommend reviewing the article by Suchoff and Ciuffreda, "A primer for the optometric management of unilateral spatial inattention" (Optometry Vol 75/#5/May 2004).

Rama has a theory of rationalizing neglect as being a left-sided phenomena, based on his understanding of the spotlight of attention, which goes something like this. Because the left side of the brain is so involved in speech and language and speech and language evolved to use some of the correlate parts in the right brain that are used for global processing, the left brain's attention mechanisms only see the right side of the world internally and externally. The right sides of the brain's attention centers are global in function and view the whole world internally and externally. Thus, if left side of the brain is affected the right side of the brain can see the whole world and the entire person. If, however it is the right side of the brain that is affected, then the remaining attention mechanisms in the left side of the brain only see the right side of the world and the right side of the person. Suchoff and Ciuffreda's article call some of this into question or at least create a tension that may be resolved with further discoveries.

Rama now moves into areas in which he has particular interest such as how an artist can exploit aspects of how our visual processing occurs to stimulate our interest in what they produce. He first talks about how there is an economy in the use of our visual process. "The goal of vision is to do as little processing or computation as is necessary for the job on hand." (Page 46) I am surprised over and over about how in directing movement we seem to follow the *least action principle*, nearly always selecting from the infinite set of potential movement patterns that which bring about the expected results while using the least amount of effort and energy. Not only are we lazy in using our visual process but also in performing the myriad of tasks we do throughout the day. He continues, "Human artists through trial and error, through intuition, through genius, have discovered the figural primitives of our perceptual grammar." (Page 47) The following figure, known to many of us has a hidden figure that once seen, cannot go undetected, even if presented tachistoscopically.

Figure 1. Do you see the dog?

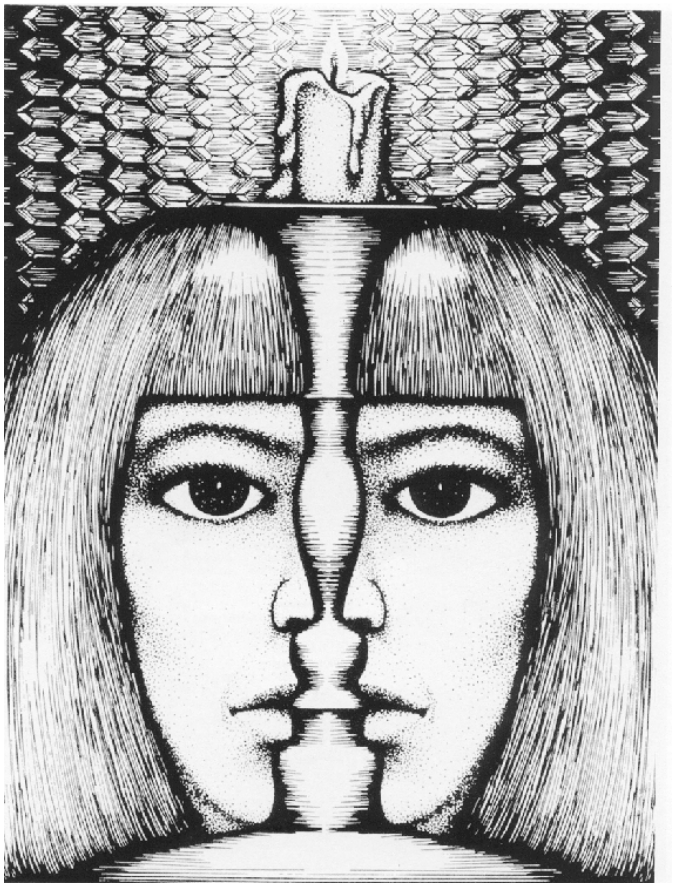
"Even looking at a simple scene involves a complex hierarchy, a stage-by-stage processing. At each stage in the hierarchy of processing, when a partial solution is achieved – when a part of the dog is identified – there is a reward signal "a-ha," a partial "a-ha," and a small bias is sent back to earlier stages to facilitate the further binding of the features of the dog. And through such progressive bootstrapping the final dog clicks in place to create the final big "A-HA!" Vision has much more in common with problem solving – like a twenty-questions game – than we usually realize." (Page 49) An interesting perspective as to the evolutionary advantage which

results from a visual process that possesses these abilities is, “Vision evolved mainly to discover objects and to defeat camouflage.” (Page 50)

What an artist tries to do is to generate as many of the “a-ha” signals in as many visual areas as possible. This is accomplished by more optimally exciting these areas with painting or sculpture as could be achieved with natural visual scenes or realistic images. What comes to mind here for me are the works of Escher. As I solve something in one part of a picture and then scan along my interpretation is challenged and the search for meaning and the “a-ha” continues, getting turned upside down each time my scan falls onto another part of the picture. I continue scanning, problem solving, getting “a-ha’s” but never final resolution. I can return over and over and continue to enjoy.

Why do some of us enjoy this searching so much? “The wiring of your visual centers to your emotional centers ensures that the very act of searching for the solution is pleasing, just as struggling with a jigsaw puzzle is pleasing long before the final “a-ha.” (Page 51) Think of optical illusions for a moment. “There cannot be two overlapping patterns of neural activity simultaneously. There is a bottle-neck of attention. Attention resources may be allocated to only on entity at a time.” (Page 52) I’m sure most of you already think me a bit strange but I have spent a good bit of time looking as some of the famous optical illusions attempting to see both perspectives at once, always failing. Imagine the one that is the two faces staring inwards OR the candelabra. I have tried seeing to people kissing the candelabra but it keeps shifting from one to the other. I can flip it one way or another if I want but as I try to see both, I lock in on one interpretation or the other, never both.

The following version of this is drawn in such a way to allow yet a third way of looking at the faces, namely a single face staring out off the page directly at you. Interestingly, when I switch from the two faces staring towards each other as opposed to a the face looking at me I feel a definite change in what feels like where I am posturing my convergence, though I never see any hint of Diplopia.



When I see the single face looking out at me the center of my attention goes to some area on the center of the face, which is actually hidden from view by the candelabra. So I feel centered, pulled inward, but at a single point on the face, that is actually hidden from view. So the pulling inward is not really closer to me along the Z-axis, but on the X-axis. When I see the two women staring at each other I seem to more into a soft type of looking, though I can study individual parts of their faces in detail. However, I feel that I am putting some visual attention now more dispersed along the X and Y axis as I hold both women rather than a single woman.

Fellow OEP Board member Greg Kitchener has emphasized analogy and metaphor in understanding the visual process. Douglas Hofstadter has explored this in his series of books most notably in his book, "Fluid Concepts and Creative Analogies – Computer Models of the Fundamental Mechanisms of Thought". (1995 Basic Books ISBN 0-465-05154-5): Rama comments, "On Synesthesia being the underlying basis of metaphors: I would conjecture that the TPO junction – especially the angular gyri – in the two hemispheres may have also evolved complementary roles in mediating somewhat different types of metaphor: the left one for cross-modal ones (e.g. "loud shirt," "sharp cheese") and the right for spatial metaphors (he "steeped down" from his post)." (Page 75)

In a later section Rama takes on the subject of free will asking the question, is there any such thing as free will? Subjects were instructed to wiggle a finger at any time of their own choosing within a ten-minute period. A full three-quarters of a second *before* the finger movement the researchers picked up a scalp EEG potential, which they called the "readiness potential," even though the subject's sensation of consciously willing the action coincided almost exactly with the actual onset of finger movement. "It's almost as though your brain is really in charge and your "free will" is just a post-hoc rationalization – a delusion." (Page 86)

Finally this comment from Rama: "Our brains are essentially model-making machines. We need to construct useful, virtual reality simulations of the world that we can act on. Within the simulation, we need also to construct models of other people's minds because we primates are intensely social creatures. We need to do this so we can predict their behavior. For this internal stimulation to be complete it needs to contain not only models of other people's minds but also a model of itself, of its own stable attributes, its personality traits and the limits of its abilities – what it can and cannot do." (Page 105)

This book is a fast read and I highly recommend adding it to your personal library.

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