

SYNTONIC PHOTOTHERAPY

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Syntonics phototherapy is one of the most powerful tools available in the armamentarium of the behavioral optometrist. Although light therapy is greatly underutilized in optometric treatment protocols, when used in conjunction with traditional behavioral optometry approaches, the efficiency, speed and success rates of vision therapy dramatically increase.^{1,2,3} Occasionally, syntonics phototherapy is used independently of other vision therapy techniques to remediate ocular pain, headaches and photosensitivity that may not be treatable with standard procedures.⁴

Optometrists are in a unique position to utilize this time-proven, ocularly transmitted light therapy that our profession has nurtured for nearly 70 years and literally has given us a monopoly on a specialized body of knowledge of light's effects on health and visual functions.

Energy medicine, which also includes different forms of light therapy, is rapidly becoming a global phenomenon utilized by a variety of health professionals from M.D.'s to chiropractors, acupuncturists, physical therapists and psychologists. In our view, there lies the future of medicine. As an example, psychiatric research has scientifically shown that it is light therapy through the eyes that is the most effective and accepted treatment for seasonal affective disorder. Psychiatrists are now investigating light therapy for other disorders such as subsyndromal SAD, nonseasonal depression, premenstrual depression, circadian sleep-phase disorders, sleep-maintenance insomnia, jet lag, and problems resulting from shift work. One psychiatrist, Kripke has carried out a systematic comparison of light and antidepressant drug studies in nonseasonal major depression. He argues that we should routinely prescribe light for nonseasonal depression, at least as a drug supplement.⁵

It is the responsibility of every optometrist involved in vision therapy to objectively investigate light therapy and specifically syntonics phototherapy in order not only to assist our patients to achieve higher levels of success but to put our profession in the forefront of energy medicine.

Syntonics therapy is non-invasive and can bring major improvements if patients are chosen carefully. The patients most likely to benefit have not just one or two but several

visual disabilities - weak in ocular motilities, accommodation, discrimination, binocularity, peripheral awareness, and visual information processing skills.

A typical treatment plan requires 20-minute sessions on at least three consecutive days each week for a total of 20 sessions. Therapy devices use white light directed through colored absorption filters (one device uses narrow band interference filters) onto a frosted collimating lens. The patient looks at a glowing dot of light 50mm in diameter from a distance of about 50cm in a darkened room. Perhaps the energy from the 'light field' generated by the instrument interacts with the eye's own magnetic field to produce therapeutic gains. This possible energy mechanism may complement the direct neurological and endocrinological effects of the light therapy.

Specific filters are prescribed for particular ocular conditions. Diagnosis is made on the basis of history, present symptoms and clinical measurements. Success of treatment is judged by changes in symptoms, behavior (mood/attitude, coping ability, and social/verbal skills), performance (academic, athletic and expressive) and changes in functional optometric test results. Of special importance in syntonics are measurements of pupil reactions and visual fields.

Optometrists look at pupil reactions. If they are conscientious they look for differences in pupil size, direct and consensual reflexes and Marcus-Gunn reactions. They are not aware of pupillary release caused by excess intracellular potassium due to adrenal insufficiency. When a patient looks at distance in a dim room and a penlight held at three inches is shined into the pupil of one eye, we expect the pupil to constrict and stay small for at least ten seconds. Pupillary release is when the pupil appears to give up and widens within a few seconds. Pupillary release is not uncommon, especially in children showing weakness in several areas of functional optometric testing or in emotionally stressed, toxic or post-trauma patients. The severity of release correlates with reduced visual fields and autonomic nervous system imbalance.

Constricted peripheral visual fields can be due to anatomical defects in the retina, visual pathway or cortex. Although optometrists are quite knowledgeable about

pathological fields due to glaucoma, tumor, retinal damage, stroke, and head trauma but they are not aware of "functional" field constrictions. This lack of knowledge does not preclude their existence. Fields can be constricted because of fatigue, emotional distress or swelling around the optic nerve. Measures of patients with Tourette syndrome shows specific, inconstant field defects.⁶

Functional field constrictions are not uncommon in children. Studies since 1927 report 9 - 20 per cent of unselected school children have fields of less than 15 degrees in diameter.^{7,8,9} Some children lose all but the central 1 or 2 degrees of vision. Generally, the smaller the field, the poorer the optometric findings and learning/performing success. Strabismic and amblyopes often have decreased fields in one or both eyes. It's harder to keep the binocular fusion if the fields are only 2, 3 or even 10 degrees in diameter. Sometimes blind spots plot two or three times normal. Because very few optometrists know about functional field loss, visual fields are rarely taken on children and color fields, sensitive indicators of underlying pathology and/or dysfunction, are almost never measured. Optometrists involved with schools or school vision screening programs should include visual field testing.

Syntonics optometrists have traditionally used campimeter (tangent screen-like) devices for plotting fields. They carefully measure the central 60 degrees using a 1 to 1.5 degree target moved from the periphery, non-seeing to seeing, while they monitor patient fixation on a central target. Threshold or flashed methods of taking fields may not pick up this functional field loss. Research indicates that simple kinetic measures correlate better with clinical symptoms and are a superior method to testing children.¹⁰ The frequency doubling field plotter, a recently introduced automated field instrument designed to measure magnocellular nerve loss in glaucoma patients, strongly correlates with syntonics kinetic fields taken on a campimeter.¹¹

Prescribing which color to use is an art. There are several approaches. There are several approaches to using color therapy in optometry. Some recent, experimental techniques attempt to achieve emotional clearing, others apply a sequence of various filters, and still others rely on feedback preference, body/mind techniques but the

most popular and most traditional diagnostic protocol organizes clinical data into patterns called the "Lazy Eye; "Acute;" "Emotional Fatigue;" and "Chronic" Syndromes.¹²

In the "Lazy Eye Syndrome," red/orange light is used to stimulate the sympathetic nervous system. These patients are parasympathetic dominant individuals exhibiting generalized over-flexion. Findings may include: esotropia (378.00), amblyopia (368.00), esophoria (378.41), suppression of binocular vision (368.31), field constrictions (368.45), abnormal retinal correspondence (368.34), or deficient vergence abilities (368.33).

"Acute Syndrome" individuals have history or symptoms relating to recent onset problems including infection, injury, head trauma, anoxia, stroke, or high fevers. They often suffer from headaches, hypersensitivity or pain. This syndrome requires palliation to alleviate the symptoms. Blue/green is used to reduce cortical and retinal swelling, redness and fluid, and to decrease pain by sensory depression. Symptoms include: diplopia (binocular or monocular 368.2), headache (784.0), transient blurred vision (368.12), asthenopia (368.3), orbital pain (379.91), abnormal posture (781.9), vertigo (780.4), motion sickness (994.6). Diagnostic factors include: high exophoria (378.42), exotropia (387.00), convergence insufficiency (398.83), enlarged blind spot (368.42), constriction of the visual field (368.45), visual field defects (368.4), accommodative insufficiency (367.5), deficiency of smooth pursuit movements (379.58), pupil release (794.14) are not uncommon. Pathology factors include: Acute trauma i.e., corneal abrasions (918.1); strokes and head trauma syndrome; conjunctivitis (372.30); iritis (364.3); cataract (senile) (366.9); corneal opacities; and wet macular degeneration (362.50).

In the "Emotional Fatigue Syndrome," individuals tend towards emotional exhaustion, mood swings, overt stress, negative emotional affect, visual stress. They may also exhibit extreme fatigue or hyper-irritability due to adrenal exhaustion. This syndrome is more frequently seen in children. Symptoms include: photophobia (368.13); transient blurred vision (368.120); asthenopia (368.13); abnormal fatigue (780.7); headache (784.0); dizziness (780.4); frustration; allergies; asthma; and fluid retention. Diagnostic factors include: pupil release; low breaks and recoveries in ductions; especially adductions (368.33); and fatigue exophoria (378.42). A combination of indigo and red filters is used for sympathetic/parasympathetic balance and to support the adrenals. Indigo/red can be used

for 20 minutes alone but is usually combined with yellow/green for 10 minutes each.

The "Chronic Syndrome" includes individuals with chronic health problems due to glandular, metabolic or organic imbalances, toxic conditions, or a past traumatic event. Yellow/green is used as a physiological stabilizer and detoxifier. Symptoms include-general fatigue (780.7); vision system loses stamina and speed; reduced peripheral vision; asthenopia (368.13); headache (784.0); orbital pain (379.91); photophobia; and transient blur. Patients who waken with morning headaches are suspects. Diagnostic factors include: constriction of the visual fields (368.45); pupil release; esophoria (378.41); low recoveries on ductions, especially abduction; esotropia (378.00); convergence excess (378.84); accommodative insufficiency (367.5), and excess (367.53); reduced ocular motor skills (794.14). acidity in aqueous; reduced red/green fields; interlacing fields; reduced blue field indicating liver involvement (toxemia); calcium deficiency; under-function - pale; flaccidity; and acid pH. Yellow/green is often combined with indigo/red for 10 minutes of each to incorporate emotional stability. The need for yellow/green increases with age.

Traditional syntonics therapy requires at least three consecutive days of treatment per week for a total of 20 sessions. Progress testing is done after 6-8 treatments. Visual fields, binocularity, ocular motility, visual acuity and accommodation are tested and symptom changes are recorded. Constricted field diameters will often double after just 6-8 treatments and will continue to expand to full by twenty sessions. If there are no improvements in field or other measures, different filters will be tried and the patient will be reevaluated after additional 6-8 treatments. Striking changes in quality of test results, symptom reductions, performance, behavior and mood to occur as a result of syntonics, especially when used in conjunction with other optometric vision therapy.

Three recent controlled studies by optometrists have attempted to measure syntonics phototherapy's impact on children's learning and vision. In 1983 Kaplan published "Changes in Form Visual Fields in Reading Disabled Children Produced by Syntonics Stimulation." using syntonics stimulation in a university setting for the treatment of learning disabled children.² Three years later,, Liberman published "The Effects of Syntonics Colored Light Stimulation in Certain Visual and Cognitive Functions."³ He studied syntonics therapy applied in an optometric office measuring its effects on children's

vision and cognition. Ingersol in 1998-9 investigated "Syntonics as Reading Enhancement Techniques at the Livingston Developmental Academy," studied syntonics effects when integrated into an elementary school curriculum and used in conjunction with vision therapy.¹

These studies show that this relatively short-term syntonics treatment significantly improves visual skills, peripheral vision, memory, behavior, mood, general performance and academic achievement. They confirm that children with learning problems have a reduction in the sensitivity of their peripheral vision. During and after phototherapy they demonstrated improvement of peripheral vision and visual skills. Control subjects who did not receive therapy showed no or little improvement in their peripheral vision, symptoms or performance. All these studies found profound improvements in the children who used syntonics phototherapy compared with controls.

Behavioral optometrists using syntonics successfully treat children and adults with learning, reading and attention disabilities, people suffering the effects of head trauma and stroke, retinal diseases, cross eyes, head aches and senility. Syntonics could supply thousands of examples of successful case histories. Included here are three dramatic cases. A 78-year old woman patient came for vision therapy because of double vision. Her eyes suddenly went crossed eight weeks earlier. In addition, she was mentally confused and emotionally distraught and had been since the death of her husband ten months before. Examination by her neurologist was inconclusive. After twelve 20-minute treatments, her eyes straightened and she regained mental/emotional balance and coherence. When asked what she thought had helped her get better, she said, "The green light. Every time I watched the green light I could feel waves and ripples inside my head finally during one light session I felt a kind of pop in my head and everything became clear."

Another patient, a 6-year old girl, was on the verge of being kicked out of public school because she could not learn and was disrupting class. Diagnosed as autistic and retarded from an early age, she was so hyperactive that even objective optometric testing was impossible. Her history included her mother's toxic pregnancy (pre-eclampsia), cord wrapped around her neck at birth, and her father was rundown and killed in a crosswalk a few feet in front of her when she was two. She started syntonics color therapy using yellow-green filters with the idea to eliminate any toxemia that might have

remained from the pregnancy. The results were astounding. In five treatments, for the first time in her life she had become a calm, cooperative and communicative little girl who could learn and participate in her normal first grade class.

Lisa was ten years old. Her mother brought her in for an examination because Lisa had suddenly stopped riding her bicycle complaining that she couldn't see well enough. Her history revealed a recent head injury. Three months earlier she had fallen down a flight of stairs and hit her head on the door jam at the bottom. She had suffered a bump and slight headache that was gone by the next morning. No doctor examined her at the time. Visual field plotting on a campimeter showed each eye was constricted to 15-degree fields with monocular doubling of the test target in the superior field. This acute problem required green/blue light and at the seven-day progress exam her field had enlarged to normal with no target doubling and her visual self-confidence had returned.

Syntonics has some of its most profound effects in the treatment of traumatic brain injury. One informal study of 46 patients with head trauma revealed all 46 had visual field loss. Seventy percent responded with field expansion after treatment with syntonics phototherapy.¹³

Not all patients have such severe problems and not every patient has such dramatic results in such a short time. An in-office, informal study of 100 successive syntonics patients showed that 20 per cent had dropped out of treatment, 40 per cent had dramatic success and 40 per cent had little or minor improvements. It's hard to believe these descriptions and that merely looking at color can produce such an impact on visual function and aid the healing of trauma. Sunlight, after all, contains every wavelength in the visible spectrum and it's around us all the time. Not quite all the time since most of us spend little time in natural light. Our modern lifestyle limits natural light exposure and we have become victims of malillumination; a syndrome of behavioral and medical conditions described by John Ott, a pioneer in the field.¹⁴ In the future the healthiest people may be the smokers because they spend time outdoors in the open air and sunlight. Most everyone else stays inside in artificial light and atmosphere. A recent California study showed students in classrooms with predominately natural lighting scored as much as 25 percent higher on standardized scholastic tests than did students in artificial lighting in the same districts.¹⁵

HISTORY OF SYNTONICS AND PHOTOTHERAPY

Throughout history there have been reports of using light to heal. Egyptians used precious gems, Greeks built solarium cities in high mountains to harness ultra-violet for healing tuberculosis, and red light was used to quell the effects of small-pox virus. Practitioners from the late 19th and early 20th centuries such as Babbitt, Pleasanton, Pancoast and Dinshah clinically found that color, applied to the skin, could have a non-intrusive, curative effect on bodily ailments. Similarly, the use of green or blue light on the skin is the currently preferred medical treatment for neonatal jaundice. At the turn of this century, it first became known that light entering the eyes not only served vision, but also traveled to other important brain regions.¹⁶

Clinical application of selected light frequencies in optometric practice began in the early 1920's. It was then that H. Riley Spittler theorized about the role of the eyes in phototransduction and light and color's role in biological function and development.¹¹ He developed the clinical science that he called Syntonics -- from "syntony", to bring into balance. Spittler concluded that many bodily, mental/emotional and visual ailments were caused primarily by imbalances in the autonomic nervous and endocrine systems. He was the first to elaborate the retinal-hypothalamic pathways. He also believed that applying certain frequencies of light by way of the eyes could restore balance within the body's regulatory centers thereby directly correcting visual dysfunctions at their source. His model suggests that red (low energy, long wavelength) at one end of the visible spectrum stimulates the sympathetic nervous system, green (middle wavelengths) was a physiological balance, and indigo - (high energy, short wavelength) activates the parasympathetic.

In 1933 Spittler established the College of Syntonics Optometry, dedicated to research in the therapeutic application of light to the visual system. In 1941 he published his thesis as The Syntonics Principle and included "Syntonics Effectivity: A Statistical Compilation of Ocular Anomalies Handled by Applying the Syntonics Principle," showing that of 3067 individuals, 2791 (90.7%) taking syntonics treatment responded positively.⁴ In the 1960's, Charles Butts, developed a diagnostic workup and treatment regimen which added a new dimension to vision therapy. Patients were diagnosed according to symptoms utilizing a specific case history, the O.E.P.21 points, pupillary responses, near point visual fields and other tests.

SCIENTIFIC FINDINGS ABOUT LIGHT'S IMPACT ON BIOLOGY

Measuring light's biological effects is a complex business. Outcomes are dependent on wavelength, intensity, time, timing and number of repetitions. There are short-term, measured a few seconds or minutes after irradiation, and long-term effects observed after hours and days. The effects also depend on the type of organism studied, its growth phase and the parameter being measured. For an interesting critique on criticism of light therapy see Tunér-Hode's Low Level Laser Therapy, Chapter 13 at: http://www.laser.nu/llt/LLLT_critic_on_critic_s.htm.

LIGHT ON THE SKIN

Only recently have scientists begun to pay attention to photobiology. The quantity of articles and quality of basic and clinical research is booming. Healing work with lasers started with Endre Mester in Budapest Hungary in 1966 as an investigation to determine whether ruby lasers could help cancer victims. He found that the laser did increase the growth of monocellular organisms and the growth of fur on a shaved rat. At a certain range of dose intensities the hair grew faster. At doses below and just above the laser had no effect but at even higher intensities a growth inhibitory effect occurred. The next experiment was conducted on rates of wound healing with the same range of results -- at a certain level the light increased wound healing. The finding was published in Hungarian in 1967. Since then nearly 2000 articles have been published about the effects of Low Level Laser Therapy (LLLT).¹⁷

Until recently most LLLT research has taken place in the former Soviet Union and Eastern Block countries. For twenty years Russian biophysicist Tiina Karu and her group at the Laser Technology Research Center in Troitzk, Russia, has been conducting a systematic study of LLLT. Their research shows that the light used for therapy does not have to be coherent (laser). Incoherent red light was as effective in healing peptic ulcers as coherent laser light of the same wavelength. Karu says that coherent sources are used only because lasers are easier to manage. Her data prove that comparatively low doses (102 -103 J/M2) and short periods (10 - 100 s) of irradiation stimulate lasting changes in cellular respiration chains as well as in RNA and DNA synthesis. Even seven days after stimulation, the number of cells, cell size, respiratory activity were increasing above non stimulated tissue. Research on various organisms and cell types consistently

showed light alters cell metabolism causing synthetic cell processes to dominate catabolic ones.¹⁸ In a recent paper Karu described it this way: The primary changes induced by light are followed by a cascade of biochemical reactions in the cell that do not need further light activation. These dark reactions are connected with changes in cellular homeostatis parameters due to an alternation of the cellular redox state. . .¹⁹

Which wavelengths of the spectrum stimulate these changes? She finds maximum effectiveness in almost every visible-light band. Cells stimulated first with red light, then with blue showed much greater increases than with just red or blue alone. Red followed by wide-band (white) visible light stimulated no acceleration of growth.¹⁸

Karu's research gives another phototherapy hint. How does light find the right places to work to heal the body? Normal tissue is much less effected by light than out-of-balance tissue. Starving cells are more sensitive than well-fed ones. Cells already reproducing at an exponential rate are least changed by light stimulation. In stagnant colonies, on the other hand, light triggered huge increases in rates of reproduction or cell mass growth. Wounded, chronically inflamed, and ischemic cells are characterized by their acidic, hypoxic and inhibited state. Light increases the pH and drives them toward oxidation, balance, vitality and healing.¹⁸

Karu's papers and books provide undeniable proof that light stimulates biological transformation and healing. Her work has encouraged clinicians worldwide to use low-intensity laser light therapy for healing a variety of human ailments. For an impressive experience of her research and influence visit her website at: <http://www.isan.troitsk.ru/dls/karu.htm> and books: Scientific of Low-Power Laser-Tharpy Dec. 1998, ISBN, 9056991086 and Photobiology of Low-Power Laser Therapy Laser Science and Technology, Vol 8 , Paperback (October 1989) Harwood Academic Pub; ISBN: 3718649705 visit amazon.com for a review.

Other Russian researchers are using red and far-red lasers to reduce eye strain in workers. In a controlled study of myopia and accommodation, myopic children stimulated for 12-minutes per day with a 2 mm spot of red or far-red light on the limbal sclera. After just ten consecutive sessions children receiving treatment had great increases in accommodation one month later and one-sixth the myopic increase of matched controls even three years after the light therapy.²⁰

A growing number of Western clinicians have gotten on the beam. One

organization, the North American Laser Therapy Association (NALTA), held The First NALTA Conference near Washington DC, in October, 1999. The meeting was convened collaboratively with the FDA to clarify regulations concerning laser photostimulation and laser acupuncture and to educate leaders of government organizations about clinical application of low-level laser therapy.

This approach to light and color therapy has been successfully applied in laboratory experiments and in clinics for relieving pain, resolving inflammation, enhancing tissue repair mechanisms, stimulating immune function, defeating infection, and improving damaged neurological tissue. Laser therapy has also been used for preventing dental caries and stress-related heart and cerebrovascular disease and for healing cancer, asthma, herpes simplex, rheumatoid arthritis, intractable wounds (ulcers), damaged nerves, tendons, muscles and bones, and for reducing infection, inflammation, and tenitis.

For a more complete list and details see these websites: <http://www.laser.nu/lllt/therapylink.htm> and, especially for cancer, <http://www.spie.org/web/abstracts/2700/2728.html>

LIGHT EFFECTS VIA BLOOD

Other research indicates that light sensitive blood constituents carry light information and energy to effect far-off places in the body. Blue light delivered to an area behind the knees, for example, resulted in significant alterations in human circadian rhythms.²¹ Oren and Therman postulate that the blood constituents hemoglobin and bilirubin in animals may be counterparts to chlorophyll and phytochrome the light-sensitive pigments in plants. Hemoglobin is similar to chlorophyll in structure. Both are reversibly altered by light.²²

Other research has found that the heme oxygenases are reversibly altered by specific wavelengths of visual light.²³ The heme oxygenases, HO-1 and HO-2, are enzymes controlling oxygen-carbon dioxide exchange and also regulate vasodilatation, neurotransmission, anti-oxidation, anti-inflammatory, anti-viral, gene expression and other basic physiological functions.²⁴ HO-1, like the sympathetic nervous system, acts to protect the organism from acute environmental stress while HO-2 acts more like the parasympathetic nervous system.

Nitric Oxide is another important blood constituent that works to control bodily stress reactions. Russian researchers

confirmed that low-power He-Cd (441.6 nm) and He-Ne (632.8 nm) lasers NO-hemoglobin can reversibly dissociate and release free NO. Relaxation of blood vessel walls due to NO is one of the physiological effects induced by visible radiation.²⁵

LIGHT DIRECTLY STIMULATING THE BRAIN

In another study, low levels of visible light directed onto slices of rat cerebral cortical tissue enhanced release of the neurotransmitter gamma-aminobutyric acid (GABA) from these brain slices. At higher light intensity this was suppressed. The effective amount of light for neurotransmitter release is approximately equal to the amount of light that can penetrate the head and reach the brain at the intensities of sunlight. This points to pathways of light transduction not considered in modern times.²⁶

Since the beginning of this century evidence has accumulated which demonstrates that nonmammalian vertebrates possess photoreceptors situated deep within the brain. These photoreceptors have been implicated in several different areas of physiology they play a critical role in the regulation of circadian and reproductive responses to light but in all species examined. Published data raise the possibility of several types of encephalic photoreceptor photopigments (cone-like, rod-like or different from both) and, depending on species, at least two types of photoreceptor cell: CSF-contacting neurons (larval lamprey, reptiles and birds) and classical neurosecretory neurons within the nucleus magnocellularis preopticus (fish and amphibians).²⁷

Expression of certain retinal and pineal opsins has been detected in selected regions of lower vertebrate brains but can this also exist in mammals? Until 1999 mammalian opsins have been described as specifically expressed only in the retina and the pineal. But now scientists at NIH have discovered what appears to be the first opsin, called encephalopsin expressed specifically in the mammalian brain. Because the major function of opsins involves light detection, we must consider the possibility that encephalopsin participates in such a process.²⁸

Other data suggest that low-energy infrared laser irradiation has certain neuroprotective activity in various types of oxidative stress including ischemia, reperfusion, and acute edema of the brain. Infrared laser irradiation lowered the increased levels of hydroperoxides and malonic dialdehyde and elevated superoxide dismutase activity in the brain during

ischemia, reperfusion, and acute edema of the brain. These findings have vast implications for the fields of immunology and rehabilitative medicine.²⁹

BIOPHOTONS

Other research has established a hitherto-overlooked information channel within living systems. All emit leak levels of visible and ultraviolet light. This biophoton emission has been correlated with many biological functions. Biophotons may trigger chemical reactivity in cells, growth control, differentiation and intercellular communication. Biophotonic communication may prove electromagnetic fields are more primary to biology than chemistry.³⁰

NEW INFORMATION ON CIRCADIAN CONTROL SYSTEMS

For billions of years, a dependable aspect of living on Earth has been the daily light-dark cycle. The circadian rhythmicity in organisms may have arisen directly as a response. Indeed, in free living cells and in tissues of multicellular organisms there is a correlation between photoresponsiveness and circadian rhythmicity. Even nonphotoreceptive tissues such as the mammalian suprachiasmatic nucleus have close connections to photoreceptors in the eye.³¹

“Circadian rhythms and the cellular oscillators that underlie them are ubiquitous--and for good reason. For most organisms, dawn means food, predation, and changes in all the geophysical variables that accompany the sun--warmth, winds, and so on. It's a big deal when the sun comes up, and most living things time their days with an internal clock that is synchronized by external cues. Given this common and ancient evolutionary pressure, circadian clocks probably evolved early, and common elements are present up and down the evolutionary tree. Circadian systems will almost certainly be made up of more than one interconnected feedback loop. Of these, one may be dominant and take the lead in determining phase (the time of day indicated by the clock) and others may be more like slaves. This interconnected ensemble will ultimately determine all the exact characteristics of classical circadian properties--period length, temperature compensation, and resetting by light or temperature...”(Jay Dunlap, Dartmouth Medical School)³²⁰

“In mammals the retina contains photoactive molecules responsible for both vision and circadian photoresponse systems. Opsins, which are located in rods and cones, are the pigments for vision but it is not known

whether they play a role in circadian regulation. A subset of retinal ganglion cells with direct projections to the suprachiasmatic nucleus (SCN) are at the origin of the retinohypothalamic tract that transmits the light signal to the master circadian clock in the SCN.³³ The SCN responds to light/dark neural signals which are converted in the pineal gland to hormonal secretions. Different wavelengths have varying entrainment abilities relative to hormone output. The pineal also responds to the earth's electromagnetic fields. Pineal secretions (primarily melatonin) regulate reproduction functions, growth, body temperature, blood pressure, motor activity, sleep, and immune function. Hormonal interactions with the pineal suggest it is the master gland. Pineal regulation plays a role in such conditions as diabetes, osteoporosis, heart disease, cancer, Parkinson's, Alzheimer's, and aging in general.³⁴ What latent abilities does the pineal possess that can be promoted by light activation?

Circadian clocks exist throughout the body. To understand the tissue clocks, chronobiologists will need to figure out how they sense light. For the brain clock this job is performed by the retina, although not by the light-sensitive cells responsible for vision. The optic nerve then transmits the information to the brain. But cells outside the retina lack the photosensitive pigments found in the eye. Instead, there are hints that these tissues may use recently discovered proteins that are sensitive to visible light. Human photoreceptor flavin molecules are not limited to the retina but are virtually in all tissues.³⁵

Research suggests that multiple biological clocks may exist throughout the body in the form of photosensitive proteins. Genetic research has already mapped sites expressing the potential for biological clocks in the heart, lung, liver, kidney, and testes. Each clock may be set individually by light and follow a schedule independent of the brain's master clock. Individual cells may undergo daily cycles of activity and rest just like whole organisms do. These cycles may be sensitive to direct light reception, to blood elements altered by specific frequency bands of visible light entering the eye or to light stimulation directly at the retina.

These examples of research included demonstrate the broad array of light pathways being investigated today. Applications in healing can be found in optometry, medicine, psychiatry, psychotherapy, color acupuncture (now termed colorpuncture), rehabilitative medicine, and a vast assortment of body centered therapies. Syntonic phototherapy is at the core of a

rapidly growing interest in and shift towards energy medicine in our quantum age. At this time energy medicine is not a final or unified model. There is a dynamic rhythmic matrix of energies including mechanical, electric, magnetic, gravitational, thermal, acoustic, and photonic. Different therapeutic approaches focus on one or more phenomena. Our living matrix can extract information needed to pilot our biological systems. There is not one but many pathways through which this may occur.

Syntonics may work through the retinal-hypothalamic-pituitary-pineal axis, by direct stimulation of the blood flowing through and behind the retina, by activating several acupuncture meridians around the eye, or by a yet undiscovered means. These applications are the future of medicine and healing. Syntonics is a time-honored and clinically proven modality of treatment. Optometry is in a unique position to further these applications and retain a special position in the light therapies of this new millennium.

Suggested Reading

Light, Medicine of the Future published by Bear and Co., Santa Fe, NM, 1991, by Jacob Liberman. This is the most current far ranging text on the subject of light as a therapeutic tool. It covers medical and psychological uses of light and contains an extensive bibliography. It is a must-read for anyone interested in the subject.

The Syntonic Principle by Harry Reily Spittler published by the College of Syntonic Optometry in 1941. The thesis from which the practice of phototherapy by way of the eyes known as syntonics was established, this is available through the College of Syntonic Optometry.

Spectrachrome Metricencyclopedia by Dinshah Ghadiali is published by the Spectrachrome Institute, Malaga, NJ, in 1933. This three-volume treatise on the systemic of application of lights on the body for healing and restorative purposes is a landmark in the application of color therapy in this century. This is available through the Dinshah Society.

Light Years Ahead, is a compilation of a conference during the 1990s in Santa Jose, California, of all the various light therapies being practiced around the world at that time. This compilation is edited by Brian Breiling and published by Celestial Press. It is one of the best texts to get an overview of all the different light therapies and light technologies now in current use.

References

1. Ingersoll, S., "Syntonics as Reading Enhancement Techniques at the Livingston Developmental Academy," presented at 66th Annual Conference Light and Vision, Vancouver, CN, 1998. Published in the Journal of Optometric Phototherapy, 1999

2. Kaplan, R., International Journal of Biosocial Research, 5, #1, 1983

3. Liberman, J., Journal of Optometric Vision Development, 7, 1986.

4. Harry Reily Spittler, M.D. O.D., The Syntonic Principle College of Syntonic Optometry, 1941.

5. Kripke DF. Light treatment for nonseasonal depression: speed, efficacy, and combined treatment. J Affect Disord. 1998;49:109-117; Terman M, et. al., controlled trial of timed bright light and negative air ionization for treatment of winter depression. Arch Gen Psychiatry. 1998;55:875-882; Lam RW, ed. Seasonal Affective Disorder and Beyond. Washington, DC: American Psychiatric Press; 1998; and see the whole issue of Arch Gen Psychiatry. 1998;55

6. Enoch, J.M., et. Al. (1988) Gilles de la Torette syndrome: Visual effects, Neuro-ophthalmology 5:251-257

7. Eames T.H. , The Relationships Of The Central Visual Field To The Speed Of Visual Perception, Am Jnl of Opth 1957 and Restrictions Of The Visual Fields As Handicaps To Learning Feb 1936 Jnl of Edu

8. Webb, H. F., Brombach, T.A., Visual Fields, O.E.P. Papers, Vol. 3, No. 11, pp. 35-36

9. Searfoss, J., & Garzia, R., Tunnel Vision, a Loss of Visual Sensitivity in School Age Children, in preparation for submission to JOVD

10. Clark BJ, et.al. Oculokinetic Perimetry for the Assessment of Visual Fields; Arch Dis Child 1990 Apr;65(4):432-434

11. Wallace, L., Proceedings of the Conference on Light and Color, April 30, 1999

12. The Blue Book, College of Syntonic Optometry Library, Bloomsberg P.A., 1995

13. Wallace, L., Syntonics and Head Trauma, Journal of Optometric Phototherapy, March, 1992

14. Ott,J, Health and Light, Old Greenwich CT., Devan-Adair, 1973

15. Reported in the Democrat and Chronicle (Rochester, NY), November, 26, 1999 Living, p. 1 via The Washington Post news service

16. Pesner, S.; Light Therapy: An Historical Overview, Light Years Ahead, Hartley, L.,

Breiling, B., (editors), Celestial Press , Berkeley C.A. 1996

17. Zeischegg, P, Laser: The Alladin's Lamp of the 20th Century? <http://www.DrZ.org/laser.htm#5>

18. Karu, T.I., Photobiological Fundamentals of Low-Power Laser Therapy; IEEE Journal of Quantum Electronics, Vol QE-23, No. 10, Oct 1987 p. 1703

19. Karu, T. I., Mechanisms of Interaction of Monochromatic Visible Light with Cells, Effects of Low-Power Light on Biological Systems, SPIE Proceedings Vol 2630, pp. 2-9, 1996

20. Avetinsov, E.S., et .al., Moscow Helmholtz Res Inst of Eye Dis., Laser Physics, Vol 5, No. 4, 1995, pp 917-921

21. Campbell, S. S. & Murphy, P. J., Extraocular Circadian Phototransduction in Humans Science, 1998 Jan 16, 279:396-399

22. Oren, D. A. & Terman M., Tweaking the Human Circadian Clock with Light Science 1998 Jan 16, 279: 333-334

23. Noguchi, M., et. al., Photo-Reversal by Monochromatic Light of the Carbon Monoxide-Inhibited Heme Degredation Catalyzed by the Reconstituted Heme Oxygenase System, J Biochem (Tokyo) 1981 Dec; 90(6):1671-1675

24. Maines, M.D., The Heme Oxygenase System, Annu. Rev. Pharmacol. Toxicol, 1997. 37:517-554.

25. Borisenko, G. G., et.al., Photochemical Reactions of Nitrosyl Hemoglobin during Exposure to Low-Power Laser Irradiation, (1997) Biochemistry (Moscow), 62(6), 661/774

26. Wade, P.D., et. al., Mammalian cerebral cortical tissue responds to low-intensity visible light. Proc Natl Acad Sci U S A 1988 Dec; 85 (23):9322-6

27. Foster R.G., et. al., Identification of Vertebrate Deep Brain Photoreceptors; Neurosci Biobehav Rev 1994 Winter;18(4):541-6

28. Jaffrey, S.R., & Snyder, S. Encephalopsin: A Novel Mammalian Extraretinal Opsin Discretely Localized in the Brain; Journal of Neuroscience, May 15, 1999, 19(10):3681-3690

29. Karageuzyan, K. G., Phospholipid Pool, Lipid Peroxidation, and Superoxide Dismutase Activity under Various Types of Oxidative Stress of the Brain and the Effect of Low-Energy Infrared Laser Irradiation; (1998) Biochemistry (Moscow), 63(10), 1226/1439

30. Chang, J., Fisch J., & Popp F-A. (Editors), Biophotons, Hardcover (July 1998) Kluwer Academic Publishers; ISBN: 0792350820

31. Susan K., Neurospora wc-1 and wc-2: Transcription, Photoresponses, and the

Origins of Circadian Rhythmicity; Science 1997 May 2; 276: 763-769.

32. Dunlap, J., Circadian Rhythms: An End in the Beginning; Science 1998 June 5; 280: 1548-1549

33. Robert J. Lucas, R. J., et. al. Regulation of the Mammalian Pineal by Non-rod, Non-cone, Ocular Photoreceptors, Science 1999 April 16; 284: 505-507

34. Swarthout, G., "The Pineal Gland and Aging," Complimentary Medicine, Nov/ Dec , 1986

35. O. Bergold, M.D., " The Effects of Light and Color on Human Physiology," Raum & Zeit, Vol 1, No. 4, 1989, pp 33-39.

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