THE SCIENCE BEHIND LIGHT & COLOR IMMERSION

The Color Immersion component of the Somadome combines the positive benefits of light with the stimulating effects of specific colors to support well-being. While color immersion for healthy individuals has not yet been scientifically validated, color has been used for thousands of years in traditional healing systems. Both Ayurvedic medicine and Traditional Chinese Medicine (TCM) offer well-developed systems of using color to both diagnose and treat illness. There is also a host of Western scientific research and clinical evidence that supports using both full spectrum light and specific colors of the spectrum to support health and wellness. This brief White Paper offers an overview of the science behind Somadome's light and color immersion and lists some of the most helpful books and articles available in English on this topic.

THE NATURE OF LIGHT AND COLOR

Light is vital to life and exposure to natural light has long been recognized as an important component of physical health.

Generally, when we talk about light, we are referring to sunlight and the narrow band of electromagnetic frequencies (EMFs) that our human eyes and brain have evolved to perceive. This light is often referred to as "full spectrum light" because this is the entire spectrum of light that our eyes can perceive, even though this represents only a small fraction of the total spectrum of electromagnetic frequencies (EMFs) we are exposed to on earth. Invisible frequencies of light that are close to the visible spectrum ,including ultra red (UR) and ultra violet (UV), are also used in healing.

Sunlight, or white light, is comprised of a number of colors, generally broken down into 3, 5 or 7 primary colors. Sir Isaac Newton, the founder of modern physics, published a treatise on light and optics in which he identified the seven primary colors that we in the west accept as representing the visible spectrum of white light. Those colours are red, orange, yellow, green, blue, indigo and violet.

As it happens, the seven colors that Newton named as primary match the seven colors identified as primary in the Indian Hindu and Ayurvedic tradition[1]. In the Indian tradition, a specific color is associated with each of the seven main chakras or energy centers of the body, which move from the base of the spine at the perineum (1st chakra, associated with the color red) up through the spine to the crown of the head (7th chakra, associated with the color violet). The progression of these colors mirrors the progression of energies and spiritual development of a human being posited by this tradition, with red representing the lowest frequency of vibration and the most materially grounded color while violet represents the most spiritually connected color vibrating at the highest frequency. The traditional Ayurvedic portrayals of these colors matches the measurements and characterizations of these colors by modern physics: red is a lower-frequency color that carries less energy than the "higher" colors of blue, indigo and violet.

LIGHT AND HUMAN HEALTH

Regular, patterned exposure to light regulates the physiological systems that keep us healthy and in homeostatic balance. Without regular exposure to natural light, our sleep rhythms are disrupted, our moods are negatively affected, our stress and pain levels increase, our social relations become strained, and our inflammatory response can develop unchecked. This is because regular exposure to light is necessary for proper production of melatonin, the hormone that regulates our sleep and waking; and cortisol, often referred to as the "stress" hormone, which regulates many bodily functions. Regular exposure to the sun is also necessary for normal vitamin D production, which is essential for healthy teeth and bones and also has an impact on mood. This is well established science.

AREAS FOR ILLUMINATION

Less clearly established are the physiological effects of specific colors of light – that is, specific wavelengths of light taken from the full spectrum. Many traditional medicine systems propose systems of understanding and using color in healing, and some historical and contemporary western medical practices also use color and give anecdotal reports of the efficacy of treatments with specific colors. However, we do not yet have laboratory research or verified mechanisms of action that scientifically validate what these systems say about healing and nurturing effects of colored light on the human body. Although our eyes are the primary route through which light enters our body, our skin is responsive to light to a certain depth – and some colors penetrate more deeply than others. There is also evidence that exposure to light through the skin can affect the body systemically. Vitamin D production is an

obvious example, but there is evidence for other effects as well. A 1998 study published in Science found that shining full spectrum light on the back of the knee could affect circadian rhythms; exposure to the light in this area also increased both the body temperature and circulating melatonin levels in the study's research participants.[ii] Daniel Oren, a neuroscientist from Yale, suggests that the mechanism for this effect is changes in the blood gas concentrations of carbon dioxide and nitric oxide, which then become photic cues for the nervous system.[iii] Physicians in Russia report applying specific frequencies of colored light to blood outside the body and then successfully treating patients with that blood to heal a variety of maladies, which suggests that Oren is on the right track.

EARLY INVESTIGATIONS IN LIGHT AND COLOR

Color was not used to heal in any systematic way in traditional western medicine. However, the discoveries of electromagnetism and the place that light plays in the spectrum of electromagnetic frequencies in 19th century Europe stimulated an explosion of clinical and scientific research on the uses of light and color as therapies. The first documented use of color in western medicine was Augustus Pleasonton's use of blue light in 1876 to stimulate secretory glands and the nervous system. He reported this treatment to be effective in treating a variety of diseases.[iv] His work is echoed by contemporary research, which has found that exposing premature infants with bilirubin processing deficiency to specific frequencies of blue light helps cure them of them of this disorder.

Three avenues of early modern exploration into the impacts of light and color on human health and functioning deserve mention here:

- The work of the Nobel-prize winning physician Niels Ryberg Finsen;
- The work of Dr. Harry Riley Spitler, an eye doctors who developed a form of ophthalmology in the 1920s and 1930s calls Syntonics, which used color light to treat eye problems and has evolved to treat nervous system and systemic disorders including trauma (which makes for an interesting comparison to the use of EMDR and rapid eye movements to treat PTSD).
- The work of doctor and scientist Dinshah Ghadiali, a naturalized American from India, who started using color to treat patients in 1897 and developed a sophisticated system of phototherapy that he called Spectro-Chrome.

NOBEL PRIZE WINNER NIELS RYBERT FINSEN AND USING LIGHT ON THE SKIN

Niels Ryberg Finsen from Iceland won the Nobel Prize in Medicine and Physiology in 1903 for his discoveries that concentrated exposures to light could contribute to healing[v]. Like many people who have become medical pioneers, he was motivated by his efforts to heal his own medical condition for which mainstream medicine had no treatments, Niemann-Pick Disease— a metabolic disorder that causes a specific type of fat to accumulate in cells, interfering with normal cell functioning. His experiments on himself led him to explore healing effects of light in his medical practice where he used light to treat tubercular skin lesions and other skin and metabolic disorders. He published two important papers on his research: *Finsen Om Lysets Indvirkninger paa Huden* ("On the effects of light on the skin"), published in 1893 and *Om Anvendelse i Medicinen af koncentrerede kemiske Lysstraaler* ("The use of concentrated chemical light rays in medicine"), published in 1896. Finsen's papers were rapidly translated and published in both German and French but have not yet been translated into English. This pattern reflects the general lack of interest in light and electromagnetic therapies shown by medical professionals in England and the United States.

HARRY RILEY SPITLER AND SYNTONICS – USING COLORS THROUGH THE EYES

Harry Riley Spitler was a medical doctor and ophthalmologist who conducted research into the use of light and color to treat vision disorders in the 1920s and 1930s. His studies resulted in a system called Syntonics that exposes patients to specific colors through the eyes to treat strabismus, amblyopia, accommodative/convergence problems, visual field constrictions, head trauma, and visually related learning problems. In recent years, practitioners report successfully expanding the use of color therapy to treat trauma, brain injuries and emotional disorders as well.

In a recent article published by Brainworld—a publication produced by the Brain Education Assocaition—Dr. Cari Solomon, the owner of Sol Optometry in New York City and a practitioner for over 20 years, explains that Syntonics posits that red (low energy, long wavelength) at one end of the visible spectrum stimulates the sympathetic nervous system (the "flight and fight" system); green (middle frequencies) yields physiological balance; while blue/indigo (high energy, fast frequencies) activates the parasympathetic nervous system (the "rest and digest" system). These clinical findings match the characterization of these colors in the Auryvedic system (which uses a total of twelve colors)[vii].

Dr. Solomon says regarding the specific application of colors:

I use deep purple for headaches, including migraines... This is also helpful for patients that have mental and emotional stress. Blue/green combinations are very helpful for eye strain or fatigue, night vision problems, blurred or fluctuating vision, poor concentration, reduced athletic performance, acute illness and allergies. Depending on the patient and their energy to start, I may use yellow/green combinations for these issues as well. Sometimes I change from one frequency to another during one treatment, depending on the patient's energy. Adrenal-gland function is greatly improved by a red/blue combination [viii].

DINSHAH GHADIALI AND SPETRO-CHROME – MATCHING COLOR TO SPECIFIC PHYSIOLOGICAL PROCESSES

Dinshah Ghadiali, Ph.d., MD, was a physician who was deeply influenced by the work of Dr. Edwin Babbitt, whose book *The Principles of Light and Color* (1878), is considered a classic work in light and color theory. Dr. Ghadiali conducted 23 years of clinical research and observation on the effects of colored light on health and developed a sophisticated system of treatment using colors called Spectro-Chrome. His system is based on the theory that specific colors relate to specific physiologic functions. When a patient has deficient functioning in an organ or process, treatment with the color specific to that tissue or process helps to restore the patient to health. Dr. Ghadiali's work was taken up by Dr. Kate Baldwin, a physician and chief surgeon of the Women's Hospital of Philadelphia, in the 1920s, who used Spectro-Chrome routinely in caring for her patients and published a number of articles about her clinical experiences using Spectro-Chrome.

RECENT DIRECTIONS IN LIGHT AND COLOR RESEARCH AND THERAPY

For a variety of reasons related to the development of medicine as a profession and of government regulatory oversight over medicine and medical devices, American allopathic medicine moved away from the study and use of light and color in healing. Studies of light and color in healing have continued in Europe, particularly in Finland, Germany and Russia. Presently, Russian medicine is the most advanced in using light and color in medical treatment. Many important scientific articles relating to light and color therapies have yet to be translated into English.

Nevertheless, scientists in the West have continued to study the effects of light and color because of their obvious centrality to healthy human functioning. Two of the most important arenas in which uses of light and color have been studied since the 1960s are in the multidisciplinary field of chronobiology; and in studies human physiology and health conducted by NASA and the US Military.

In 1960, a symposium was held at Cold Spring Harbor that laid the groundwork for what became known as chronobiology: the study of cyclic phenomena in living beings that relate to the solar and lunar cycles of times.[ix] Chronobiology studies human circadian rhythms and the effect of sunlight on maintaining normal and healthy human cycles. Research findings from the field of chronobiology have provided importance insight on how sunlight regulates sleep and stress levels. These findings ultimately led to Light Therapy— a medical treatment which uses bright full spectrum light to treat maladies including sleep disorders, mood disorders, Seasonal Affective Disorder (SAD), Parkinson's disease (PD), and Attention deficit/hyperactivity disorder (ADHD).[x] Light Therapy treatments are administered using standardized protocols regulating light brightness, time of exposure, and time of day for treatment. Although most Light Therapy currently does not break down visible light into specific colors for treatment, its use in the treatment of mood disorders and physiological dysregulation match the claims made by Syntonic practitioners about the effects of treatment Syntonic color therapy, where specific portions of visible light are used to treat eye and cognitive disorders. Daniel Oren, an NIMH and Yale neuroscientist cited earlier, is one of the few mainstream researchers to have conducted research on using specific colors of the spectrum to treat. He reported that green light is more effective than red light in treating Seasonal Affective Disorder.[xi]

NASA, driven by the imperative to understand the impacts of lack of regular sunlight on astronauts, has sponsored a variety of research on topics related to chronobiology and light's effect on human functioning, and on jet lag, a topic also of interest to the military. Both NASA and the military use near infrared light to stimulate wound healing and limit scarring, as well as using full spectrum light exposures to help regulate sleep and stress levels.

Light therapy of other kinds is routinely used in hospitals and clinics today in specialized settings without any theories of how and why light and color might impact health more generally. Dermatologists routinely use UV light to heal psoriasis and other autoimmune skin disorders. As mentioned earlier, blue light is used to treat premature and newborn infants born with bilirubin processing disorder (caused by an immature liver unable to break bilirubin down) and is the standard of care in neonatal intensive care units around the country.

LIGHT IMMERSION AND THE SOMADOME

With the option to select a single color of light for the whole session or cycle through the whole spectrum, the Somadome provides an environment in which to experience and explore the gentle and positive healing effects of being immersed in light and color.

Azeemi, Samina T. Yousuf, Syed Mohsin Raza, and Masoom Yasinzai **"Colors as Catalysts in Enzymatic Reactions"** *Journal of Acupuncture and Meridian Studies 1*, no. 2 (December 2008) : 139–42.

Baldwin, Kate, MD **"The Therapeutic Value of Light and Color"** *Atlantic Medical Journal* (April 1927).

Barber, C. F. **"The Use of Music and Colour Theory as a Behaviour Modifier"** *British Journal of Nursing (Mark Allen Publishing) 8*, no. 7 (April 8, 1999) : 443–48.

Bolotova, N. V., O. N. Voskresenskaia, and G. A. Slastukhina **"[Colour and rhythm therapy in the correction of psychoemotional disorders in children with obesity]"** *Zhurnal Nevrologii I Psikhiatrii Imeni S.S. Korsakova / Ministerstvo Zdravookhraneniia I Meditsinsko Promyshlennosti Rossisko Federatsii, Vserossiskoe Obshchestvo Nevrologov [i] Vserossiskoe Obshchestvo Psikhiatrov 107*, no. 9 (2007) : 73–75.

Campbell, Scott S. and Patricia J. Murphy **"Extraocular Circadian Phototransduction in Humans"** *Science, Vol. 279* (16 January 1998) : 396-398.

Cocilovo, A. **"Colored Light Therapy: Overview of Its History, Theory, Recent Developments and Clinical Applications Combined with Acupuncture"** *American Journal of Acupuncture 27*, no. 1–2 (1999) : 71–83.

Demarco, A., and N. Clarke **"An Interview with Alison Demarco and Nichol Clarke: Light and Colour Therapy Explained"** *Complementary Therapies in Nursing & Midwifery 7*, no. 2 (May 2001) : 95–103.

Dzulkifli, Mariam Adawiah, and Muhammad Faiz Mustafar **"The Influence of Colour on Memory Performance: A Review"** *The Malaysian Journal of Medical Sciences : MJMS 20*, no. 2 (March 2013) : 3–9.

Gest, Stephanie, Martin Holtmann, Sarah Bogen, Carina Schulz, Benjamin Pniewski, and Tanja Legenbauer **"Chronotherapeutic Treatments for Depression in Youth"** *European Child & Adolescent Psychiatry* (May 17, 2015).

Gruson, Lindsey **"COLOR HAS A POWERFUL EFFECT ON BEHAVIOR, RESEARCHERS ASSERT"** *The New York Times*, sec. Science. http://www.nytimes.com/1982/10/19/science/color-has-a-powerful-effect-on-behavior-researchers-assert.html (October 19, 1982)

Hankey, Alex, and Elena Ewing **"New Light on Chromotherapy: Grakov's 'Virtual Scanning' System of Medical Assessment and Treatment"** *Evidence-Based Complementary and Alternative Medicine : eCAM 4*, no. 2 (June 2007) : 139–44.

Hollfoth, K. **"[Effect of color therapy on health and wellbeing: colors are more than just physics]"** *Pflege Zeitschrift 53*, no. 2 (February 2000) : 111–12.

Kim, Mi Kyoung, and Sung Don Kang **"Effects of Art Therapy Using Color on Purpose in Life in Patients with Stroke and Their Caregivers"** *Yonsei Medical Journal 54*, no. 1 (January 1, 2013) : 15–20.

Kreitzman, Leon and Russell G. Foster **"Rhythms of life: the biological clocks that control the daily lives of every living thing"** *New Haven, Conn: Yale University Press.* (2004) ISBN 0-300-10969-5.

Moscovici, Lucian, and Moshe Kotler **"A Multistage Chronobiologic Intervention for the Treatment of Depression: A Pilot Study"** *Journal of Affective Disorders 116*, no. 3 (August 2009) : 201–7.

Newton, Sir Isaac **"Opticks, or, a Treatise of the Reflections, Refractions, Inflections and Colours of Light"** *William Innys*, London (1730)

Nowothy, L. **"Color Therapy"** *The Florida Nurse 48*, no. 1 (March 2000) : 9.

Oren, Daniel **"Humoral Phototransduction: Blood Is a Messenger"** *The Neuroscientist 2* (1996) : 207-210

Oren, Daniel A. and Michael Terman **"Biological Rhythms: Tweaking the Human Circadian Clock with Light"** *Science* Vol. 279. no. 5349 (16 January 1998) : 333-334.

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Weinzirl J., M. Wolf, P. Heusser, M. Nelle, and U. Wolf **"Effects of Changes in Colored Light on Brain and Calf Muscle Blood Concentration and Oxygenation"** *The Scientific World Journal* 11 (2011) : 1216–25.

[i] Newton noted that his decision about where to draw the boundaries of color was somewhat arbitrary; he fell upon seven because he wanted to have a color to match every note in the pentatonic scale. Given this, it is particularly notable that his system maps directly onto the Hindu system of chakra color associations.

[ii] Campbell, Scott S. and Patricia J. Murphy **"Extraocular Circadian Phototransduction in Humans"** *Science*, Vol. 279 (16 January 1998) : 396-398.

[iii] Oren, Daniel **"Humoral Phototransduction: Blood Is a Messenger"** *The Neuroscientist* 2 (1996) : 207-210

[iv] Demarco A. and Clarke N. 2001: 96.

[v] **"The Nobel Prize in Physiology or Medicine 1903"** Nobelprize.org. Nobel Media AB 2014. Web. (29 Jul 2015) http://www.nobelprize.org/nobel_prizes/medicine/laureates/1903/index.html

[vi] See, for example, Gottlieb, Ray, OD, PhD **"Mild Traumatic Brain Injury, Visual Fields and Light Therapy"** J. of Optometric Phototherapy, (April 2004) : 7-11. This journal is produced by the College of Syntonic Optometry and can be downloaded for free in PDF form at http://www.collegeofsyntonicoptometry.com/home.html

[vii] See http://www.ayurvedichealth.com/color-therapy/color-therapy for a chart that summarizes the functions of different colors for healing according to the Ayruvedic system, as well as the negative effects of overexposure to a color.

[viii] http://brainworldmagazine.com/syntonics-colored-light-therapy-for-balance/#sthash.GXgNAftl.dpuf

[ix] Leon Kreitzman; Russell G. Foster **"Rhythms of life: the biological clocks that control the daily lives of every living thing"** New Haven, Conn: Yale University Press (2004) ISBN 0-300-10969-5.

[x] For an excellent online source of information about scientific research on the health effects of full spectrum lighting, see http://www.lrc.rpi.edu/programs/nlpip/lightinganswers/fullspectrum/abstract.asp a site maintained by the Lighting Research Center at Rensselaer Polytechnic in New York State.

[xi] Breiling, B. (ed): **"Light Years Ahead: The Illustrated Guide to Full Spectrum and Colored Light in Mindbody Healing"** *Celestial Arts*, Berkeley, CA (1996) : 14, cited in (1999) : 4.