OMG ....he's green!

About lighting and how it can promote the wrong message.

Text: Deborah Burnett

Last September as I turned on the television to watch President Barack Obama address the United Nations for an important speech, I was horrified at the sickly appearance of the world leader staring back at me. Instead of watching a powerful message delivered by a youthful, vibrant and 'picture of health' world leader, I was transfixed by the green-faced, baggy-eyed features of someone who had the voice and energetic mannerisms of Obama but appeared considerably older, haggard and sickly. Talk about mixed perceptual signals!

As I listened to the strong voice of a charismatic world leader deliver an important speech, I became confused. What I was watching was not the same healthy and vibrant man I recognized as President Obama from a televised speech he delivered earlier that same day. Pictured before me was a ghastly green faced Mr. Obama standing in front of a dark green, highly reflective marble wall appearing to be a man in poor health as evidenced by his lackluster complexion and cloudy eyes; a universally accepted physical symptom of illness and distress.

In stunned disbelief I realized that my perceptual sensory disconnect was not the fault of my aging TV, but rather the failure of a hurried TV lighting crew. I couldn't believe that in this day of media savvy politicians and appearance-driven voting habits, I was witnessing an all too common failure by lighting designers to consider the consequences of artificial light on the human skin. By not taking into account the reflective and metameristic properties of the adjacent green marble wall when specifying the broadcast lighting levels, they failed in an 'evolutionary' way to provide an appropriate biological signal with which to judge the speaker's intent.

Examining how we use subtle shifts in the visual appearance of facial skin color for recognizing threats to our emotional and physical survival is the basis for recent scientific research. Cutting-edge evidence suggesting how and why visual photoreceptors are spectrally sensitive to underlying hemoglobin reflectivity beneath the skin's surface are now causing us to re-examine the distorting effects of artificial light on the visual appearance of human skin. Yet few lighting designers are aware of the evolutionary human need to utilize all forms of available environmental light to highlight subtle skin color changes brought about by a physiological reaction to our emotional state.

Emerging scientific studies are now supportive of the recognition of subtle facial coloration shifts as a means for identifying health conditions. Recently a Dutch research team supported the need for more yellow and red-based colorations to identify a healthy facial appearance (2), while another discovery delves into the visual interpretation of skin appearance and subsequent skin 'color shifts' due to physiological and emotional states.

In the past few years we have seen major investigative work giving rise to the evidence-based speculation of how and why we as a human species universally seek visual skin tone color shift cues as an evolutionary guidepost for recognizing important survival cues on the faces of our peers including signals for emotional intent, reproductive suitability and even as a visual signal for others to recognize our current health status.

And when it comes reading faces we've all done it. We are masters of recognizing subtle facial skin color signals to identify, clarify and discern such human traits as deceit, embarrassment and of course surprise. Characteristic skin color shift signals, known in the medical community as "Tell's", are innately offered and evolutionary recognized by one human to another as a uniquely human form of non-verbal communications. And the information imparted is powerful indeed: subtle but accurate insight into ones behavioral motives, physical condition of health, as well as reproduction status. A pale ash or gray skin color is a good indicator of a weakened cardiac or stroke condition, a growing pinkish-red flush to the facial cheeks is a universally recognized signal of embarrassment, and the sudden outburst of facial blue based red color is a good bet that the person approaching you is angry AND a direct threat to your survival! And when it comes to mate selection, Mother Nature also had a hand with subtle skin color shifts which enable our overall human species to thrive.

Recently recognized through scientific discovery, the subtle red shift of lip color in women as a signal for reproductive readiness and fertility is uniquely dependent on environmental light for the color shift to be innately recognized and appreciated.

Everyone can instinctively identify a person who is truly surprised as compared to a person only pretending to be surprised. But have you ever considered how we instinctively do this? To explain how this works is a matter of simply reading the language of the body. When a person is truly surprised the facial features of that person usually pale...
as breathing momentarily slows and the blood concentration of carbon dioxide increases. This metabolic and physiological reaction brings about a bluish cast to the skin. And when the surprise stimuli brings about a slight drop in blood pressure you experience and perceive a characteristic 'clean slate' pale bluish appearance to the facial skin tone irrespective of the racial melanin concentrations. For the observer, the visual signs are clear and unmistakable but only if the ambient lighting conditions do not obscure the subtleties of this facial color shift. And the consequences of misinterpreting these signals can sometimes be the difference between life and death. Real world examples of light failure are confrontational police actions where reading subtle facial shifts in emotional direction are prevented due to lack of well balanced lighting conditions.

In medical diagnostic situations, the recognition of subtle facial coloration changes is a powerful indicator of compromised health situations. But what happens when the lighting conditions in the exam room do not enable the observer to correctly identify the cues?

"I'll never forget the sheer panic I experienced when I saw my then four year old son fall to the ground as his facial features turned a subtle but deathly pale lavender-gray color," explained my friend Helen as she told of her son's struggle with severe migraine headaches. "I now know that it was not for natural lighting conditions flooding my kitchen that morning I would have never been able to notice his gray skin color and report this to the doctor". Without this vital clue, Helen says "my child would have suffered needlessly with invasive tests before getting properly diagnosed and the med stop his unbearable pain." For as is the case

in so many disease conditions, it is the subtle but classic skin color diagnostic cues normally associated with early onset disease conditions that are often overlooked and quite possibly obscured by poor environmental lighting conditions. The very lighting conditions that we, the architecture and design community, provide without fully understanding the evolutionary need to correctly read subtle skin color shifts.

Facial skin coloration changes are also playing a role in explaining our evolutionary past by looking at our lack of facial hairs as compared to other primates. Dr. Mark Changizi, assistant professor at Rensselaer Polytechnic Institute, is now exploring skin color changes unimpeded. Additionally, his position on the entire subject of color visual reception is based on the importance of recognizing subtle skin color shifts. He writes: "Color itself is about the perception of the complex distributions of light of all wavelengths (in the visible part of the spectrum) that emanate from each object. We have evolved to perceive the color not of photons but of certain objects and surfaces and especially the surface of skin".

Recently I had the opportunity to chat with Mark about his work. He graciously explained that "our eyes are optimized for noting small spectral changes in skin tone and color. This help explain that interestingly enough, our visual spectral sensitivity peaks at about 535 and 562 nm respectively, and our skin reflectance curve falls dead smack in the middle of the red and green cones at 550 nm. Check out the graph that shows the characteristic dip forming a 'W' shape at the point found to be the wavelength maximally sensitive to hemoglobin.

Figure 1

Reflectance of typical baseline skin

![Graph showing reflectance of typical baseline skin](image1)

Weavelength (nanometer)

400 500 600 700

Figure 2

Reflectance

Low concentration

High concentration

High oxygeration

Low oxygeration

Weavelength (nanometer)

400 500 600 700
Changizi’s work has also shown that human skin has a characteristic feature that forms a unique ‘W’ wave shape reflectance curve in the middle of the red and green cones also at 550 nm. Since this “W” shape occurs due to the iron rich oxygenated hemoglobin in the skin, the reflected skin appearance we perceive is a red shifted glow which happens to fall in the middle of the spectral sensitivities of our visual red and green cones thus giving us the innate human ability to read minute changes in skin color changes. And since our cone system has a “greater sensitivity for intermediate level color shifts in a field” says Changizi “we are optimized for noticing small spectral changes in skin tone.” That is the reason why we, as a species, are by large hairless on our faces.

Another graph from Mark’s book (Figure 2) also details how we are uniquely designed to both visually receive and bodily transmit the information of our life blood in a synchronized fashion, thus enabling us to visually display the status of our health to all onlookers. And it is the interpretation of these visual cues that could then be perceived by humans in evolutionary terms as representative of good health, a strong constitution, a clear visual picture of true emotional intent, and the very subtle, but extremely important visual color shift signals used for identifying mating opportunities (3). In fact, the first research to report this finding garnered so much attention that several labs are now actively perusing the topic of how men unconsciously seek out perspective female partners based on the color of their lips as a means of identifying suitable reproductive mate selection! No wonder red lipstick is the single best selling color worldwide!

As professional architects and designers we are trained to appreciate and understand how both natural and artificial light affects the surrounding surfaces. Without hesitation we capably use direct, indirect and diffuse lighting techniques in order to achieve the desired aesthetic results. However, most aesthetic lighting specifications do not always comply with what the body needs. The type of light needed by the body and brain to correctly display and read the subtle skin shifts are contrasting conditions with softly focused direct light within a well balanced spectral distribution in order to highlight the subtle skin changes needed for our humanness to prevail. And it is the need for a well balanced wavelength light to highlight our visible, emotional soul.

So the question is posed: with the ever increasing use of intense, blue rich light, what will be the yet unrecognized consequences on our light dependant skin surface? Will we lose the ability to discriminate the subtle skin details much in the same way we loose sight of sculptural details when viewed under too harsh a light?

An example of the powerful use of this questioning and understanding is viewed in these images from a thought provoking book by Henrik Clausen entitled “LIGHT and Communication”. In the book Clausen describes the power of how nature uses wavelength balanced direct, rather than diffused wavelength shifted environmental light as the optimal way of uncovering the subtle details found on any given surface. The photographs of the movement-filled bridge statuary located on Carl’s Bridge in Prague is a great place to examine this point. In the gray shifted overcast natural lighting conditions, the viewer immediately notices the female figure. Under the diffuse natural lighting conditions we fail to appreciate its true aesthetic quality and inherent sense of movement, symmetrical balance and textural composition. It is only when the natural lighting conditions change to a more direct burst of balanced wavelength sunlight which highlights the statue against the still darkened overcast sky that we notice the amazing genius of the sculptor. It is then that we fully appreciate the artistic detail, the emergence of the two additional figures and the apparent internal movement captured forever in stone.

This same observational technique can be made when viewing images of the rock walls (right-hand page). For without a wavelength balanced appropriate use of focused direct light, the subtle details of the rock wall or the graceful flowing skirt of the statue are lost. And as a result, we the observer, lose sight of the hidden messages contained within the objects much like when we fail to read the true intent of skin color shifts. Clausen goes on to explain that through the use of diffused lighting “our eyes seem to lose the ability to discriminate detail and focus rather on the larger overall view and it is only in the presence of direct focused lighting that we tend to notice the small details that comprise the whole”. When the rock wall is highlighted with direct lighting, we can easily observe the depth and texture of the individual rocks, the grainy surface of the mortar and the size relationship between each of the rocks. Thus the viewer is offered a clearer and more precise image of the rock wall.

The human need to forever seek this attention to detail in all human things seems to be inherently ingrained in our unconscious drive to view facial features in much the same way. In fact, ongoing brain research in the field of retinotopic mapping has shown that we are “hard wired” to specifically search
out faces for the purpose of reading the information encoded within. First identified several years ago by Dr. Christopher Tyler from Smith-Kettering Eye Research Institute (1), the brain has dedicated regions located along the higher-tier visual cortical area classified as V3A and V4d with the purpose to identify subtle facial inconsistencies as a means for non-verbal communication.

Additionally, the biological and evolutionary need for recognizing light-dependant subtle skin color shifts can best be understood from the perspective of the pocketbook. Most behavioral and consumer research will show that when it comes to food selection the recognition of subtle color shifts in vegetables, fruits and meats is a universally accepted means for determining the condition of food. Here's a true story of how the failure to recognize subtle skin and flesh color shifts can have monetary consequences. A designer attending one of my Epigenetic Design seminars related how his partner had been hired to redesign an Irish pub in Boston. This pub was well-known for its great food, fine cuts of meat and of course the displaying of the characteristic Irish Kelly-Green flag. In keeping with the Irish theme, the designer had specified a saturated monochromatic green color scheme throughout the entire facility including walls, tablecloths and window coverings. Unfortunately, the designer was unaware of the negative visual and monetary effects of reflected environmental light on flesh and skin. His specific rods and cones. Rod photoreceptor cells, numbering about 120 million per eye, are very light sensitive and operate optimally in dim illumination conditions. Cone photoreceptor cells number about six million per eye and are the work horses of our visual system. They are color-sensitive cells that function well in bright light conditions and consist of three types of highly specialized cells. They work in harmony while remaining spectrally sensitive to different wavelengths of light in order to create an endless array of color possibilities. But the most interesting job of the cones is to have the materials of these cells to discriminate environmental colors based on the available lighting conditions as well as detecting the subtle color shifts found within nature and displayed on our facial features. If only they would have taken a lunch break when Mr. Obama was standing in front of that green wall!

Without the right direct full spectrum light subtle details and the three-dimensional quality of the rock walls are lost.