The Mind's Eye
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pg. 67

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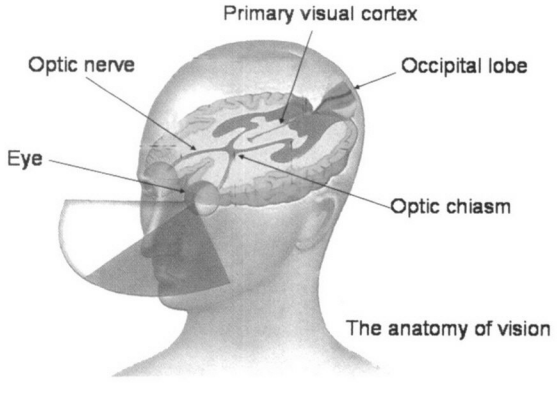
The science of optics and visual perception can fine-tune optical properties of actives, providing a key to making products with enhanced performance.

Cosmetics should please the senses. We see, touch and smell our creations, but how do our senses themselves affect the perception of visual, tactile and olfactory information? Understanding the workings of the human brain can open a world of possibilities for a new generation of products. It is obvious how our sense of smell informs our feelings for fragrance, and touch is the key to how our products feel. It is clear that the way we see is of vast importance for "the beauty biz."

Vision itself is divided into several distinct processes: the optical gathering of information in the eye, the decoding far back in our brain and the psychological reaction to the stimulus. The eyeball is a lens and its anatomy and functioning is well understood. The brain decoding is, by comparison, highly complex and resists final analysis.

It is vital to distinguish between sensation and perception. When light waves are received by your eyes, that is sensation—the phenomenon of stimuli being received by your sense organs. Perception is the organizing and interpreting of these sensations. Perception is the level where meaning is assigned to the sensations received from the world.

Along the basic path of the visual signal, indicated in Figure 1, each eyeball sends half its field of view to the opposite side of the brain, and the signals cross at a point called the optic chiasm. The optic pathway carries signals to the primary visual cortex, signals that contain information about color, luminance, motion, form, depth and other qualities. The ultimate destination of optical input is deep in the brain, a specialized region called the occipital lobe, where most of the real work of vision is done. The occipital lobe is a large and complex part of the brain, and the details of its functioning are still being unraveled. We do know that different types of information go to specialized areas, and the combined decoding becomes the final image in our brain. In a fraction of a second we see form, motion and color so that a rotating soccer ball always looks like a soccer ball while a tree bending in a strong wind always looks like the same tree.



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Seeing is Believing

Art produces beauty, or at least interesting visual stimulation, just as makeup, hair styles and Botox injections do. There is no space here for the detailed consideration of how the mechanisms of visual decoding can mold our sense of beauty, but a pioneering professor of neurobiology has given us such a book. Semir Zeki's *Inner Vision* is founded on the premise that our experience of art relates strongly to how the brain works. It seems logical that the same approach would explain a fundamental reason why we use cosmetics to refine our appearance, since the brain must respond to a beautiful face the same as a beautiful painting.

We see wrinkles because they create shadows, an optical effect. Getting rid of the wrinkles with the actives in treatment products is one solution, but usually is temporary and not totally successful. Filling in the hole with makeup reduces the visible impact, but leaves a dull appearance. Reflective particles like mica can create a more vibrant effect. Fluorescing materials are even better, since they actively provide light. An effective particle will significantly reduce the appearance of wrinkles without being at all invasive .

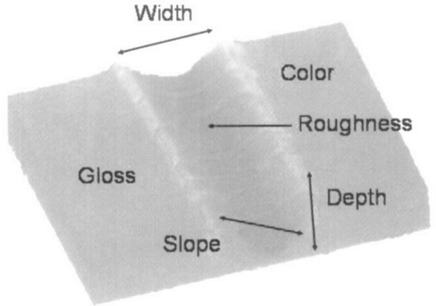
A non-pigmented lotion with 91% transmission diffuses reflected light without decreasing subsurface light, reducing the appearance of wrinkles.

A recent approach to wrinkles is to instrumentally quantify the human reaction to them. Some GE scientists , led by Moitreyee Sinha, applied the methodology developed for the auto industry to mathematically quantify scratches to understand how the process of vision interacts with the different properties of a wrinkle. Figure 2, derived from their work, depicts some of the varied optical properties of a wrinkle. They developed a methodology named Visual Quality to translate human perception into quantifiable parameters, combining optical and statistical measures. The formula is elaborate, but the result is that a higher Visual Quality number indicates higher visibility of the defect.

Tool of the Trade

The skin surface can be analyzed with a polarizing microscope. Lines viewed with cross polarizers show color contrast, while parallel polarizers show geometric features. When cosmetics are applied to skin, they affect the percentage of transmitted light. A non-pigmented lotion with 91% transmission was part of the test. It diffused reflected light without decreasing subsurface light, lowering the visibility of surface lines. Here is a tool for fine-tuning the optical properties of an emulsion to optimize its potential for reducing the appearance of wrinkles.

Skin color is another variable of aging. Everyone has green and red undertones in the skin, which create a youthful appearance when in proper balance. With age, there is less green than red coloration. Thus the addition of subtle green tint to treatment products can visually assist the creation of a younger appearance.



Critical visual parameters of a surface (after Sinha).

Age affects all the senses with declining capabilities. Some older people overdose with perfume or aftershave because of their lessened olfactory sensitivity. We know that sight changes significantly at the optical level as we grow older, and it is safe to assume that the acuity of the decoding process also changes. This makes it possible that an older person may see a wrinkle or other imperfection differently than a young person or apply excessive makeup and lipstick because it takes more color and contrast to give them the look they desire.

Vision, olfaction and touch are the means by which we gain most of our knowledge of the world. Moitreyee Sinha's team and Semir Zeki provide two approaches to using optics and visual perception to see the world in different ways, whether a work of art or a wrinkle. The science of optics and visual perception provide a key to making products with enhanced performance, even if it is only in the eye of the beholder. **GCI**

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Sinha, Moitreyee et al., *Seeing is Believing: The Science Behind Human Perception*, IFSCC 23rd Congress, Orlando Florida, Oct. 2004.

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