Barrow scientists discover ways to optimize light sources for vision

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Discovery could lead to billions of dollars in energy savings

(Phoenix, AZ Nov. 15, 2012) -- Vision researchers at Barrow Neurological Institute have made a groundbreaking discovery into the optimization of light sources to human vision. By tuning lighting devices to work more efficiently with the human brain the researchers believe billions of dollars in energy costs could be saved.

The research was conducted by Stephen Macknik, PhD, of Barrow's Laboratory of Behavioral Neurophysiology, and Susana Martinez-Conde, PhD, of Barrow's Laboratory of Visual Neuroscience. The study is published Proceedings of the National Academy of Sciences. The paper, titled "Optimizing the temporal dynamics of light to human perception," is believed to be the first attempt to tune light-emitting devices to the optimal temporal dynamics of the human visual system.

The discovery concerns the way humans perceive temporal modulations of light. For example, most light-emitting devices, such as light bulbs, video monitors and televisions, flicker. Faster flicker rates result in reduced perception of flicker, which is more comfortable to viewers. In studying this phenomenon in the brain, the researchers discovered that there is a range of flicker dynamics of light that optimizes the perceived brightness of the light without increasing power.

"We found a temporal sweet spot in visual perception that can be exploited to obtain significant savings by redesigning light emitting devices to flicker with optimal dynamics to activate visual system neurons in the human brain," says Dr. Macknik.

The researchers estimate that if every light-emitting device in the U.S. – from light bulbs to cell phones – operated at optimal efficiency for the human visual system, it could result in billions of dollars of savings in electricity and power.

To come to their conclusion, the researchers conducted experiments into two contradictory theories of temporal visual perception, or how bright a light appears. Bloch's Law states that the perceived contrast of a visual stimulus increases with its duration, but eventually plateaus at approximately 100 milliseconds. For example, a 5-millisecond flash will appear half as bright as a 10-millisecond flash, but a 200-millisecond flash will be just as bright as one of 400 milliseconds. The Broca-Sulzer Effect, on the other hand, states that perceived contrast increases with duration initially, but then peaks and falls again.

The researchers discovered that the discrepancy between Bloch's Law and the

Broca-Sulzer Effect is caused by an intrinsic bias among experiment subjects, leading to dramatically skewed data. By improving their experimental design to overcome this bias, something that has never been before reported or intentionally controlled for, the results demonstrated that temporal vision actually follows the Broca-Sulzer Effect.

"Researchers have been studying temporal vision for more than 125 years, but because ours is the first experiment of its kind to control for all known forms of criteria, it is the first to accurately measure the role of temporal dynamics in brightness perception," says Dr. Macknik. "Thus, the power savings are ripe for the picking because we can adjust our lighting to flicker to take advantage of this peak in perception."

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