New research may lead to non-surgical cataract treatment

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The University of Massachusetts Amherst recently licensed a new technology to Janssen Pharmaceuticals, Inc. that holds promise of revolutionizing the treatment of cataracts and presbyopia, based on early phase discoveries by polymer physicist Murugappan Muthukumar and former graduate student Ben Mohr regarding the fundamental science of proteins in the lens of the human eye.

Muthukumar, the Wilmer D. Barrett Distinguished Professor in Polymer Science and Engineering, has a lifelong interest in understanding vision, the human eye and specifically the lens and how it functions. As he explains, the human lens is "a collection of proteins, of biopolymers, and one of my research areas is how light passes through the lens and how proteins and biopolymers in it scatter light. Characterizing light-scattering is a classic problem in polymer physics."

"If the molecules making up the lens aggregate or clump, it forms a cataract, which scatters light in an undesirable way," he adds. "Light must pass through the lens to reach the retina where the vision process is triggered. In a lens with cataract, light is scattered away from its path to the retina, disrupting vision. I wanted to understand how this aggregation takes place, because if I understand it I can come up with an approach to correct it."

In a related way, presbyopia is connected with the elasticity of the lens, which in turn depends on the extent of cataract. Understanding the origin and nature of cataract is expected to help in understanding the molecular basis of presbyopia as well.

In the company's announcement of this long-term collaboration with UMass Amherst, one of 15 new healthcare research partnerships it made public this month, Janssen said these age-related eye conditions represent "an area of high unmet need" that will benefit from the company's pursuit of cutting-edge science.

In their experiments, Muthukumar and colleagues shot light into protein solutions hundreds of times, measuring how much came out and at what angle. Using these measurements and a simplified model of how molecules are arranged in the human lens, they discovered the relationship between protein clumping and its molecular basis.

This work is all related to the lens, Muthukumar notes, but his lab is also working with Washington University researcher Nathan Ravi on a grant from the National Institutes of Health to develop a polymer hydrogel that could substitute for the vitreous part of the eyeball. Also, with support from the UMass Foundation, Muthukumar is collaborating with physician Dr. Hemant Khanna at the UMass Medical School on a project to address retinal blindness in children.

Recognized as one of the leading polymer physicists in the world, with numerous international awards, Muthukumar says he has been fascinated by vision and the physiology of the eye through his entire career. "One of the first papers I ever wrote as a theoretician was about the retina. My favorite books are all about the eye, its physiology and physics of light and perception," he adds.

"While I was growing up in India, I was deeply disturbed by the sight of too many blind people, unable to work and reduced to begging. It was heart-wrenching and still this feeling of distress is permanently etched in my memory. Every time I visit India, it strikes me again. Many times I have wondered what life would be like without sight, and I feel a terrible loss. All my professional life I have wanted to do something about it. This was my motivation. I hope this discovery will benefit those ill-positioned people and allow them to see the rest of the universe surrounding them."

The scientist adds, "I take satisfaction from being a

generalist, someone who is true to the spirit of the word 'university,' where our minds rove freely and we think constantly about helping the human condition."

Provided by University of Massachusetts Amherst