July 31, 2019
651 Dennison Ave
Columbus, OH 43215

Oculus

Dear Madam or Sir,

I am a Ph.D. applied mathematician and computer scientist, am now a senior level cognitive scientist with 20 years of research in vision and cognitive science, am founder and CEO of my own augmented reality optical device company, have consulted for companies like Yamaha Motors on augmented reality, am finishing up a book on affective computing and emotion-machine interfaces, and would like to be considered for the position of “Research Director FRL”.

I began as a student at the (then) new Thomas Jefferson High School for Science and Technology in Alexandria, Virginia, became a physics/math undergraduate at the University of Virginia, and then got my Ph.D. in applied math at the University of Maryland in 1997. My interests brought me toward the cognitive and brain sciences, and after my first professor job at the Department of Computer Science at University College Cork, Ireland, I went to Duke University as a postdoc in neuroscience where I began studying perception. In 2002 I won a prestigious Sloan-Swartz Fellowship in Theoretical Neurobiology at Caltech, where I collaborated with Professor Shinsuke Shimojo. I left to begin as an assistant professor at the Department of Cognitive Science at RPI in 2007, and in 2010 started my own research and incubator lab, 2ai. I have 20 years of experience leading teams of researchers.

On human cognition and perception, my specialty is understanding the evolutionary function and design of our biology, cognition or perception, reverse engineering it, and rigorously testing the hypothesis. Some of my research was included in my earlier book, *VISION rEVOLUTION* (2009), including, for example...

- The origin and function of color vision is for seeing emotions, health and state on the bare skin of others. (My 2006 paper.)
- Forward-facing eyes is designed for seeing within cluttered, forested habitats. (My 2008 paper.)
- Letter shapes across human writing systems are shaped like natural object junctions, thereby harnessing the visual object recognition system for reading. (My 2006 paper.)
- How illusions are due to the brain trying to correct for the neural delay from retina to perception. (My 2008 paper.)

My book was well received (e.g., “...one of the best works of theoretical vision science since Gibson," Dan Simons, author of *The Invisible Gorilla*), and has been translated into many languages, including going into its second round of printing in Japan.

A recurring theme in my research is making sense of how stimuli -- like writing, logos, speech, music, the arts -- have gotten shaped by cultural evolution to be well optimized for humans. This deep interest in how artificial stimuli can be designed to “harness” existing neural hardware was the topic of another book, *HARNESSED* (2011), also well received (e.g., “I’d be amazed if everything he says is right; but at this point I’d be even more surprised if his main ideas, which

crack open riddles that have annoyed me for years, aren't on the right track." Frank Wilczek Recipient, Nobel Prize in Physics, 2004). This was also printed in multiple languages.

I am invited worldwide for keynotes talking about these topics, such as companies (e.g., Microsoft, Samsung), art museums, ad agencies, consumer product placement conferences, and so on. For example, I was asked to curate my own exhibition at MONA museum on these "harnessed" topics in the context of the origin of art; the other curators were Steven Pinker, Geoffrey Miller, and Bryan Boyd, leading to a joint book, *ON THE ORIGIN OF ART* (2016). Really, though, my exhibition concerned the cultural evolution of human-technology interfaces.

In 2012 I founded a startup called VINO OPTICS (http://vinOOptics.com), an optical device company with technology that enhances perception of health and veins, sold to medical and tactical personnel. It emanates from a 2006 discovery of mine (mentioned earlier) that our primate red-green color vision evolved for sensing oxygenation modulations in the blood under the skin, so as to be able to see emotions, state and health. The technology is designed to leverage our natural human color perceptual capability, and enhance it to see oxygenation variations under the skin even better. In a sense, it is an augmented reality technology, but no battery or electricity required.

Although my personal web site has my publications and books and so on, my Human Factory site has many example applications coming from my research persective. See https://www.humanfactoryconsulting.com/

My most recent research concerns emotional ai and affective computing, and connects to my next book, *THE POKER ORIGINS OF EMOTIONAL EXPRESSIONS*. This research has led to a variety of new potential applications for emotion-machine interfaces, some which I discuss at my Human Factory site, https://www.humanfactoryconsulting.com/emotion.html

I can also communicate well, both in writing as evidenced by six books and many lay articles in magazines, and orally with a history of more than a hundred keynotes and talks, TEDs, and television appearances such as on Brain Games.

Sincerely,

Mark
Dr. Mark Changizi
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http://changizi.com/resume