Synesthesia: The Sixth Sense

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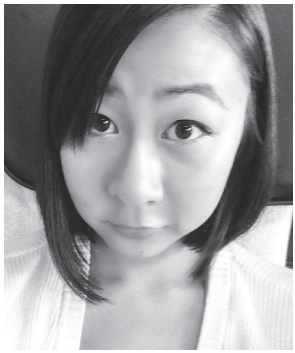

Writer's Comment: *As a biochemistry major with a love for literature, the restrictions of scientific writing seemed stifling. I filled the gaps in my schedule with creative writing classes to express myself where writing research papers could not, but I knew that if I ever wanted to have a successful career in science, I would have to master scientific and technical writing. With this in mind, I registered for Dr. Karma Waltonen's class, UWP104F: Writing in the Health Sciences. When asked to write a scientific article about a topic of my choice, I took it as my chance to have a little fun and, as odd as it may sound, to make amends to the boy I never believed.*

In middle school, I remember listening to one of my classmates talk about his cousin who could feel what others felt. It sounded bizarre and outlandish at the time, but he insisted that it was true. His cousin felt ticklish when other people were tickled in front of him. There was a name for it, he had said. He just couldn't remember. Needless to say, no one believed him. I certainly didn't. Years later, I realized how wrong I had been—synesthesia is very real and equal parts fascinating and promising in the field of neurology. In writing this article, I was reminded that science can be poetic and creative in its own way. I am grateful to Dr. Waltonen for keeping the class upbeat and enjoyable and for being an endless resource while writing this piece. I would like to give a special thank you to my parents for being unfailingly supportive.

Instructor's Comment: *At the beginning of each UWP 104F, I plead with my students to find an original topic for their science article—to either explore something new or to explore something more familiar in a new way. Sometimes my students will pick a rare disorder in an attempt for originality, not realizing that we have to read many essays on even the rarest of problems. The key, of course, is to choose something that one is actually interested in—interested enough to do the research necessary to find the actual original angle. As noted above, Demetria has a personal connection to the topic. This essay is written with grace and clarity for its lay audience. My favorite thing about*

this essay is that she doesn't just define the condition, but she also explains why this condition persists and what we can learn from it.

—Karma Waltonen, University Writing Program

For a majority of the population, the number eleven is nothing more than two straight lines drawn side by side, but for some, it can be so much more. Imagine that eleven is also the lightest shade of orange and pink, like the color of the sky just before the sun sets. Imagine that eleven is grainy and coarse, like sand slipping through cupped fingers. Imagine that eleven is the sound of silver bells and the smell of apple pie. Imagine that eleven is moody and sullen, thin with stringy hair, and not very talkative. For the subset of the population diagnosed with synesthesia, this is not imagination—it is reality. Synesthesia gives new meaning to the concept of perception, extending far beyond our typical understanding of how we interact with the world through our five senses. A largely understudied biological anomaly, synesthesia and its underlying causes offers valuable insight into the human mind, allowing for new ways to tackle the age old question: "What makes us tick?"

The meaning of the word synesthesia comes from the Greek roots *syn* (union) and *aesthesis* (sensation) (Cytowic 2). Put together, the two roots offer an idea of what synesthesia entails—the union of previously separated senses. Sight, sound, smell, touch, and taste are the five senses taught in most elementary schools. For the average individual, these senses remain distinct and divided, coming together as a sum rather than as an indefinite mixture. For synesthetes, sensory pathways have been jumbled (e.g. taste becomes sound and sight becomes touch). Each sensory shuffle leads to a different type of synesthesia. Richard E. Cytowic, in his book *Synesthesia: A Union of the Senses*, explains that synesthesia has existed in the form of metaphor for quite some time (1). People often say that red is a "warm" color, that a certain cheese tastes "sharp," that so-and-so is a "sweet" person" (Cytowic 1), but few have stopped to think about how these metaphors might translate literally. It is not hard to believe that certain metaphors are in literature as a result of synesthetic authors. In fact, the study of synesthesia dates back to the 17th century, with chromesthesia (the connection of color and sound) being one of the earliest recorded examples (Gage 231). Despite the recorded evidence of synesthesia-like descriptions for hundreds of years, synesthesia has proven elusive to the scientific community. Early scientists were quick to denounce synesthesia

as nothing more than an overactive imagination because "introspective accounts...[were] often found unreliable" (Cytowic 7). The main hurdle in verifying the existence of synesthesia has been reconciling "the first-person understanding of an experience with a third-person one that is supposedly objective" (Cytowic 8). It is not until recently that a solution has been found. Modern advances in neuropsychology and the ability to physically map brain activity have proven essential in establishing synesthesia's validity. Scientists can now use magnetic resonance imaging to show that there are significant spikes of brain activity in unexpected regions of the brain when sensory stimuli is administered, verifying the previously subjective first person testimony.

Current research efforts reveal that synesthesia affects approximately 2 - 4% of the population (Brang and Ramachandran). Though a specific genetic mechanism has not been outlined, synesthesia is believed to be hereditary. The condition "tends to run in families, as ~40% of synesthetes report a first-degree relative with the condition" (Brang and Ramachandran). Thus, it is highly likely that an individual with synesthesia will pass it on to his or her offspring. Even among families, the type of synesthesia differs, suggesting that genetics may play a role in the inheritance of the trait but not the variant that is expressed (Brang and Ramachandran). This inconsistency makes sense given synesthesia's biological explanation. One proposed hypothesis states that synesthesia is an incorrect cross-wiring of neurons in areas of the brain responsible for perception caused by "excessive proliferation (or defective pruning) of neural connections between adjacent brain maps" (Ramachandran and Hubbard 982). It is argued that synesthetic individuals have a genetic predisposition toward this unusual development of neurons. As a result, even related family members may experience different forms of synesthesia—different variations will occur depending on where the aberrant neural connection is made.

The possible sensory combinations are seemingly endless. For example, mirror-touch synesthesia mixes sight with touch so that affected individuals who see an action will feel that action as if it were happening to themselves. In an interview with *LiveScience*, Alice, a mirror touch synesthete, states that she has "never been able to understand how people can enjoy looking at bloodthirsty films, or laugh at the painful misfortunes of others when [she] can not only [look] but also feel it" (qtd. in Choi). For Alice, watching a horror movie becomes a truly 3D experience.

Grapheme-color synesthesia, one of the most frequently studied variants, is the attribution of colors to words, letters, and numbers. Ordinal-linguistic personification is a category of synesthesia where ordinal sequences are associated with actual personalities. One such synesthete writes that the letter H is "orange but toned down, (lighter than B); female; of a more formidable figure than A, but just as feminine" (qtd. in Cytowic 298). One can only imagine the far-reaching consequences of such altered perception, that there are people who experience the world through senses much differently than the average human being. As it stands, there are sixty different documented forms of synesthesia, and even more are being discovered (Brang and Ramachandran).

The diagnosis of synesthesia is only the first step. For years, efforts have been concentrated on proving that synesthesia exists, but very little has been done to investigate the role synesthesia can play in the larger picture of neurological study. The main reason for this is because synesthesia is not categorized as a disorder. For the most part, aside from viewing the world through a different lens, synesthesia is not fatal. With no immediate health risk, research and funding on the subject remain low. However, Joshua Paul Harvey suggests in "Sensory Perception: Lessons from Synesthesia" that the study of synesthesia may be the answer to other health conditions that are hot areas of interest (203). Synesthesia can help shed light on "how and where the different sensory modalities interact in the brain, how different sensory modalities can interact without confusion...as well as how sensory perception develops" (Harvey 203). This should be of particular interest to those in the medical field working on the rehabilitation of stroke victims because stroke victims find themselves unable to accurately perceive and interact with their surroundings after a stroke. Further digging reveals a plethora of other neurological conditions that occur because of abnormal neural connections—autism, schizophrenia, and Alzheimer's to name a few. The first step toward finding a cure for these debilitating disorders will require an understanding of the biological mechanism behind the perception deficit. Steffie Tomson, a neuroscientist at the Baylor College of Medicine in Houston, says that "Synesthesia is a perfect model because we have a healthy brain that has some kind of perceptual tweak that changes the relationship between various regions of the brain" (qtd. in Dayton). Thus, synesthesia becomes an opportunity to study conditions that pose serious health risks precisely because it is not a fatal disorder. Scientists

gain a healthy template off of which they can perform further research.

Additionally, synesthesia can help us understand human behavior on an emotional level. The reason we wince when we see someone trip and fall has synesthetic undertones. In fact, a study published in *Nature Neuroscience* by Michael Banissy and Jamie Ward shows that mirror-touch synesthesia is linked with empathy. Like mirror-touch synesthesia, "empathy relies on shared affective neural systems in which common brain areas are activated" (Banissy and Ward 815). On a smaller scale, we are simulating the fall and imagining the consequences. Perhaps for some, this simulation is grounded in firsthand experience that invokes a memory of the pain and discomfort that follows a brush with the ground. This unique ability to remember and mirror experiences connects empathy to mirror-touch synesthesia. The parts of the brain responsible for this mirroring ability are the "primary and secondary somatosensory cortex along with premotor and superior temporal regions" (Banissy and Ward 815). For those who have mirror-touch synesthesia, these regions of the brain experience irregular hyperactivity, lending to the conclusion that mirror-touch synesthesia may simply be empathy on steroids. This holds heavy implications for people who lack empathy or have insufficient amounts, such as those with Asperger syndrome. Understanding mirror-touch synesthesia can help those on the opposite end of the spectrum. Studying this specific variant of synesthesia can teach us not only how we interact with our external environment but, more importantly, how we interact and emotionally connect with each other.

As stated above, synesthesia can be used to understand and find cures for other disorders. This is helpful for those with these disorders but not necessarily for the synesthetic individual. The question remains: What benefit or evolutionary advantage does synesthesia provide to those who have it? In "Survival of the Synesthesia Gene: Why Do People Hear Color and Taste Words?", David Brang and Vilayanur Ramachandran discuss the possibility that synesthesia may be connected to higher creative and cognitive ability. Studies have shown that synesthetic test subjects have improved memories relative to control test subjects and, in extreme cases, "may exist as a foundation for savantism" (Brang and Ramachandran). The line of reasoning is not hard to follow. By entangling multiple senses, synesthetes can develop a greater network of mental points to enhance memorization. For example, memorizing a long chain of numbers may be daunting for the average individual, but, for someone with synesthesia,

the different senses serve as additional anchors. The number zero is no longer just an oblong shape but something associated with a particular color or a tactile sensation. Even if a synesthete were to forget the visual shape of the number, color and touch are additional reminders. Therefore, one hypothesis as to why synesthesia remains conserved in the population is that the trait offers memory benefits along with an increased ability to process multisensory information (Brang and Ramachandran).

The study of synesthesia is extremely promising. Though it is a fascinating subject, a condition that makes us stop to think about how limited our perception of the world may be, synesthesia is more than a rare condition to be marveled at. It is also a useful model for broadening social understanding and finding cures. A paradigm shift is required, a shift away from merely diagnosing synesthesia and a shift toward an exploration of its underlying causes. Only by asking the right question can we hope to find the right answer, and, in the advancing field of neurology, synesthesia is the right question. It is time that we ask it.

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