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2

Some Demographic and Socio-cultural Aspects of Synesthesia

Sean Day

To me, the taste of beef is dark blue. The smell of almonds is pale orange. And when tenor saxophones play, the music looks like a floating, suspended coiling snake-ball of lit-up purple neon tubes.

I am a synesthete, and I study synesthesia. Synesthesia is not a disease, nor is it a deficit in most cases. So, from a synesthete's point of view, why would the study of synesthesia be important? In this chapter, I address this question from both my own experience and from what I have learned from communicating with well over 800 other synesthetes, over the course of more than 25 years, via e-mail, telephone, handwritten letters, and face-to-face conversations.

Over the years that I have been investigating synesthesia, I have heard others frequently refer to what benefits the study of synesthesia might throw upon other, serious and life-threatening disorders. Synesthesia appears to have some aspects in common with—and thus helps us to understand—such conditions as phantom limbs (see, e.g., Ramachandran & Blakeslee, 1998; Ramachandran & Hubbard, 2001b; Ramachandran & Rogers-Ramachandran, 1996). Correspondences I have received over the past 10 years also indicate that synesthesia may have some possible connections or associations with some forms of autism (Temple Grandin, for example, asserted this in personal communication to me on December 9, 1998), some types of epilepsy (see Cytowic, 2002), and migraines (see, e.g., Podoll & Robinson, 2002). These are unquestionably worthwhile causes to pursue for further research. However, I feel that one major reason for studying synesthesia frequently and persistently seems to be overlooked: There are a lot of synesthetes out there in the world who live with synesthesia—and with being a synesthete—all of their lives. It is a real phenomenon to them, as much as hearing ringing in one's ears is a real phenomenon for those who have tinnitus or as much

as color vision is a real phenomenon for trichromats. The fact that a large number of individuals join sensations in a different way should not distract from its value as an area of scientific investigation.

Overview and Prevalence of Synesthesia

Synesthesia is the general name for two related sets (or "complexes") of cognitive states (see Baron-Cohen & Harrison, 1997; Cytowic, 1993, 2002; Day, 2001, 2003; Grossenbacher & Lovelace, 2001; Ramachandran & Hubbard, 2001a, 2001b). In the first set, "synesthesia proper," stimuli to one sense, such as smell, are involuntarily and simultaneously perceived as if by one or more other, additional senses, such as sight and/or hearing. For example, I have three types from this set of synesthesia: The sounds of musical instruments will make me see certain colors, each color specific and consistent with the particular instrument playing. I also have colored taste and smell sensations; for example, the taste of espresso coffee can make me see a pool of dark green, oily fluid about four feet away from me.

With the second form of synesthesia, which I call "cognitive" or "category synesthesia," certain sets of things which individual cultures teach us to put together and categorize in some specific way (like letters, numbers, or people's names) also get some kind of sensory addition, such as a smell, color, or flavor. The most common forms of cognitive synesthesia involve such things as colored written letter characters (graphemes), numbers, time units, and musical notes or keys. For example, the synesthete might see, about a foot or two before her (the majority of synesthetes, approximately 72%, are female), different colors for different spoken vowel and consonant sounds, or perceive numbers and letters, whether conceptualized or before her in print, as colored. A friend of mine always perceives the letter "a" as pink, "b" as blue, and "c" as green, no matter what color of ink they are printed with.

Synesthesia apparently has neurological aspects in regard to its causation, and it seems to be heritable, with one component (possibly a "trigger factor") perhaps passed down genetically as autosomal dominant. However, Bailey and Johnson (1997) propose X-linked dominance, with male lethality (see also Cytowic 2002, pp. 51–59, which lends support to this proposition). The percentage of the general human population which has synesthesia varies with the type involved; estimates run from 1 in 500 for basic types of cognitive synesthesia (colored graphemes or musical pitches), to 1 in 3,000 for more common forms of synesthesia proper (colored musical sounds or colored taste sensations), to 1 in 25,000 or more (1 in a couple million?) for people with rare (such as one synesthete I know of who synesthetically tastes things she touches) or multiple forms of synesthesia proper.

All forms of synesthesia are known for being quite idiosyncratic. No two people's sets of synesthetic associations are the same. However, there are a few trends among synesthetes; discovering such trends has been the focus of one of my major lines of research over the past 11 years. In 1991, I created an international e-mail forum for synesthetes, researchers of synesthesia, and all interested other parties, called The Synesthesia List (I have since come to regret the choice of name, but it has been around too long now to easily change). Over the past 10 years, I have studied cases of colored grapheme synesthesia in attempt to discern whether there are any trends. Approximately 27% of my current data comes from publications tracing all the way back to accounts such as that of Sachs (1812) and up to recent reports such as those mentioned by Cytowic (2002); the other 73% stems from my use of The Synesthesia List, personal letters and phone calls, and face-to-face interviews.

Establishing criteria for color selection was somewhat difficult. In the end, from trial and error with various methods attempted during interviews and correspondences, as well as from the influence of my background in anthropology and ethnography, I settled upon Kay's (see Berlin and Kay, 1969; Kay, 1975; Kay and McDaniel, 1978) designation of 11 basic irreducible color terms for English (black, white, red, green, yellow, blue, brown, gray, orange, pink, and purple), and Crayola Crayons (those crayons having the exact same prementioned names/designations) for best example or focus of each of these colors. Ready worldwide availability of the crayons, their ease in transport and use, and the fact that most subjects were very familiar with them, often proved extremely useful in facilitating matters. (Besides that, what crayons lack in scientific rigor, they more than make up for in being fun—which is usually far more essential to most subjects, particularly adolescents—and certainly helps in assuring future participation in additional interviews.)

For cases mentioned in the literature, most all listings of colors associated with letter graphemes given by the synesthetes used these 11 color designations. For those cases I gathered myself, I asked the synesthete to try to classify things within the 11 categories, usually suggesting (and often using, in face-to-face interviews) Crayola Crayons as a guide. When a different color designation was used, it was usually fairly easy to place it as a subtype of one of the 11 given: for example, "tangerine" is a type of orange; "mint green" a type of green; and "cherry" a type of red. I used my own judgment on this, but based my judgment heavily on what category the synesthetes I worked with felt was most proper (e.g., while many used the term "navy," virtually all who did so then allowed that this was a type of blue). Some synesthetes mentioned more than one color for a particular letter; if two colors were mentioned, I scored each as 1/2 (0.5); if more than two colors were mentioned, I listed this as "extended" and excluded such from appropriate later calculations.

With 11 colors, if things were evenly distributed, that means that any particular letter (A, for example) would have one of these colors (red, for example) about 9.1% of the time. In my study, of 172 "colored letter" synesthetes, 43% perceive the letter A as red ($\chi^2 = 134.93$); of 123 synesthetes, 57% perceive the letter O as white ($\chi^2 = 277.37$). The letter I holds interest: of 119, 38% perceive this letter as white, 28% as black, and 12% as gray; that is, 78% perceive it as non-hued; likewise, 75% perceive the letter O as non-hued. Of 93 synesthetes, 44% perceive Y as yellow. Actually, working with the assumption of even distribution across all 11 colors, only one letter, Q, falls within parameters ($\chi^2 = 14.38$), and this might just be serendipitous.

One could raise the argument, as per Kay's (1975) studies, that certain color names, such as black, white, red, and green, are more common than others, such as orange, pink, or purple. However, this would imply that, as samplings increase, all letter colors would progress towards black, white, red, or green being the mode. Such does not occur. In addition, the synesthete is attempting to describe specifically what color is seen or associated with each letter, not just rapidly picking out a random convenient color name. Plate 2.1 presents my findings for the most common synesthetic colors for each alphabet letter and numerical digit, based on my research sample of synesthetes—thus, a "typical" synesthete's set.

You might notice that the letters, as a whole, are not very colorful, and feature a fair amount of grays, browns, and dull tones, while the digits are far more colorful and brilliant. This is typical for the majority of colored grapheme synesthetes. We might instead investigate this phenomenon by asking whether certain synesthetic colors are more likely to be connected with certain geometric shapes (e.g., white with circles, such as with O and Q; red with triangles, such as with A, black with crosses, such as with X). Further, far more extensive research is needed to resolve such questions.

Table 2.1 lists which types of synesthesia are more frequent, less so, or yet unseen among 572 reported cases I have come across. As with the previous data, approximately 27% of the case studies come from previous publications. Of these published accounts, approximately 47% are of women, 36% of men, and 17% of undisclosed sex. Again, the remaining approximately 73% of the cases I looked at have come to me over the past 11 years via e-mail to The Synesthesia List, personal phone calls, handwritten letters, and face-to-face interviews. For this group, approximately 75% are female, 24% are male, and 1% has remained anonymous and of undisclosed sex.

Note that some of these cases are people with multiple synesthesiae. Table 2.1 is not meant to be an exhaustive list of every type of synesthesia there might possibly be. Messages on The Synesthesia List, for example, have led me and others to consider the possibility that some reports of "colored auras" being seen around people might be the results of synesthetic interactions between facial recognition (perhaps at that part [parts?] of the brain affected

Table 2.1. Types of synesthesia.

Type	No. synesthetes[a]	%
Colored graphemes	394	68.8
Colored time units	134	23.4
Colored musical sounds	106	18.5
Colored general sounds	82	14.3
Colored musical notes	62	10.8
Colored phonemes	60	10.5
Colored tastes	43	7.5
Colored odors	40	6.9
Colored pain	36	6.3
Colored personalities	26	4.5
Colored touch	25	4.0
Colored temperatures	15	2.6
Colored orgasms	7	1.2
Smell–synesthetic sound	4	0.6
Smell–synesthetic taste	1	0.1
Smell–synesthetic temperature	1	0.1
Smell–synesthetic touch	4	0.6
Sound–synesthetic smell	9	1.5
Sound–synesthetic taste	29	5.0
Sound–synesthetic temperature	4	0.6
Sound–synesthetic touch	25	4.3
Taste–synesthetic sound	1	0.1
Taste–synesthetic temperature	1	0.1
Taste–synesthetic touch	4	0.6
Temperature–synesthetic sound	1	0.1
Touch–synesthetic smell	2	0.3
Touch–synesthetic sound	2	0.3
Touch–synesthetic taste	3	0.5
Touch–synesthetic temperature	1	0.1
Vision–synesthetic smell	6	1.0
Vision–synesthetic sound	6	1.0
Vision–synesthetic taste	11	1.9
Vision–synesthetic temperature	2	0.3
Vision–synesthetic touch	5	0.8
Personality–synesthetic smell	1	0.1

[a] Total of 572 surveyed. Other possible combinations I have not yet found in 572 cases: taste–synesthetic smell ("smelling flavors"); temperature–synesthetic smell ("smelling temperature gradients"); temperature–synesthetic taste ("tasting temperature gradients"); temperature–synesthetic touch ("feeling temperature gradients").

in cases of prosopagnosia) and color processing centers of the brain, or perhaps between those portions of the brain that recognize overall human body form and those parts that see color.

In current literature (see, e.g., articles in Baron-Cohen & Harrison, 1997, but see also Cytowic, 2002), there is a claim that the current ratio of male to female synesthetes is about 1:6. My own studies indicate that, for those cases in published literature, 47% are female, 36% are male, and 17% are of undisclosed sex. Assuming a 1:6 M:F ratio, if we also divide the 17% into a 1:6

ratio, this results in $\chi^2 = 47.60$. Likewise, for my collection of nonpublished cases, I have rates of 75% female, 24% male, and 1% of undisclosed sex. Again, assuming a 1:6 male to female ratio and dividing the 1% accordingly, this results in $\chi^2 = 8.30$. However, there have also been proposals, put forth previously by myself and others, that the ratio of male to female synesthetes is more correctly approximately 1:3. If we assume this 1:3 ratio, the percentages of male and female cases in my total data collection results in $\chi^2 = 0.48 < 3.84$. If Baron-Cohen et al.'s 1:6 ratio is more accurate, this still leaves the question of how this ratio can easily be explained in terms of what many currently assume regarding the genetics of synesthesia based on various collections of case reports: to wit, that it has characteristics of being autosomal dominant, yet it also seems to be passed down solely or at least overwhelmingly only via the mother's side of the family, and has a significantly high rate of females to males. However, ratios just off of but approaching 1:3 can readily be explained with the proposal that the genetics of synesthesia involve an X-linked dominant gene and male lethality (a proposal previously suggested by Bailey & Johnson, 1997 and Cytowic, personal communication, May 18, 2002). As Bailey and Johnson, Cytowic, and others have pointed out, if the aspect of male lethality is involved, this would imply that, in families with synesthetes, we would see a higher than normal rate of spontaneous miscarriage. I can only offer anecdotal information at this time, but it does indeed seem to be the case that, over the past 10 years, female members of The Synesthesia List have reported a higher than normal rate of miscarriage for themselves; likewise, both male and female synesthete members have indicated the same regarding their mothers (I have little information regarding daughters in this regard). A joint project by researchers at the University of Waterloo (Ontario, Canada), the University of California–San Diego, the Laboratory of Human Neurogenetics at Rockefeller University, and other U.S. institutions is underway to more precisely pin down the genetics of colored grapheme synesthesia; additional institutes, such as University College London, the University of Melbourne (Australia), and the University of Hannover (Germany) may soon join in to broaden the scope.

It should be pointed out that synesthesia can also result from certain types of brain injury or seizures. Jacobs, Karpik, Bozian, and Gøthgen (1981) wrote about nine cases of visual synesthesia induced by auditory stimuli, resulting from lesions of the anterior portion of the optic nerve and/or chiasm. The synesthetic visions always appeared within a defective portion of the visual field; the sound stimuli producing the synesthesia were always heard in the ear ipsilateral to the eye in which the photisms were seen. Vike, Jabbari, and Maitland (1984) wrote of visual synesthesia to auditory stimuli resulting ipsilateral to a tumor in the left medial temporal lobe and adjacent midbrain. The synesthesia disappeared with removal of the tumor mass. One of the more recent subscribers to The Synesthesia List was a teenaged girl who was involved in a car accident when she was 14. It is uncertain as to whether she suffered a concussion in the accident; there was nerve damage, she lost her sense of taste and smell, but apparently there was no noticeable brain injury, from radiological evidence. However, since that time, she has also experienced synesthetic smell perceptions induced by auditory stimuli (that is, she "smells" music). I should add that it is not unusual for someone who is without a particular sensory input mechanism to nevertheless experience synesthesia in that sense. There are also other examples of anosmatic synesthetes who "smell" color, and blind synesthetes who "see" colors. These synesthetes, however, were not born with these conditions. To my knowledge, all of these cases of synesthesia induced through injury are of the "pure" synesthesia form. There are no such cases resulting in, for example, colored letters, numbers, or days of the week.

Sacks (1995) writes of the loss of developmental synesthesia due to injury, in the case of "Mr. I" (the colorblind painter), who suffered a concussion in an automobile accident. Before the accident, Mr. I experienced visual synesthesia to music stimuli (colored musical notes); after the accident, music was deadened. Mr. I suffered achromatopsia (loss of color perception) and temporary alexia (reading difficulty) as well. Unfortunately, the location of the brain damage in Mr. I remains unknown.

It appears that synesthesia is in no way limited by geography, nationality, or race. Over the past 10 years, I have interacted with Chinese, Brazilian, and Nigerian synesthetes, as well as synesthetes from Japan, Chile, and India, to name but a few. Odgaard, Flowers, and Bradman (1999) reported on a synesthete of Choctaw (Native American, USA) descent.

Although synesthesia is now generally considered to have genetic-based, biological causes, these are influenced by cultural factors. Synesthesia is, to some extent, also learned; or, rather, we might say that one learns how to be a synesthete. My research strongly suggests to me that most if not all correspondences which a given synesthete experiences are not via learned associations; however, I have encountered rare cases in which a handful of the correspondences (particularly the first four or five items in a sequence, such as the alphabet) are very evidently through childhood association.

Is Synesthesia a Problem?

Synesthesia is currently quite unknown among the general population of medical practitioners worldwide. It is recognized by the American Medical Association and the American Psychological Association, and an acknowledged American Synesthesia Association now exists. Nevertheless, an adolescent of, say, 13 years old, reporting aspects of synesthesia to her parents, teachers, and, perhaps eventually, her family doctor, is often greeted

with disbelief or outright scorn. In some of the most damaging cases, synesthetes have been sent to "specialists" who have sometimes misdiagnosed them as schizophrenic or just crazy. This has happened not just in non-Western countries, but also in the United States and Canada.

Knowing that they may be socially rebuked, many synesthetes keep their synesthesia a secret. This, in essence, basically means (perhaps especially in regard to the synesthesia "proper") denying how they have perceived the world all of their lives (or, from what my correspondence files and studies suggest, at least since about age four or five, when developmental synesthesia most frequently begins to firmly manifest itself) and pretending that one or more of their modes of perception work differently.

Let us put this into a kind of perspective: imagine being sighted, with "normal" visual abilities and perceptions of sensations, including typical full color vision, and being forced and pressured by those people and situations around you to deny all existence of colors and to try to pass for being wholly colorblind. Or having full, normal hearing and being pressured to pass as being profoundly deaf—including having to learn sign language in order to communicate. Some synesthetes use phrases derived from the gay and lesbian community, adopting such expressions as "closet synesthete" and "coming out to my family" in regard to their synesthesia. Although the rate of full-scale "coming out" is currently not increasing much, the rate of use of such phrases is growing quite rapidly and becoming common among synesthetes "still mostly in the closet." However, at least as many also describe their situation as being akin to being an extraterrestrial, nonhuman alien, or, perhaps, an animal such as a bat, trying to pass for human. Frequently, synesthetes fear ridicule by "normals." Far worse for some is the fear of being misdiagnosed and in one way or another trapped by professionals and parents who wish to attempt a diagnosis or cure.

One of my synesthete friends wrote to me the following:

> In his book *The Man Who Tasted Shapes* [Cytowic 1993], Dr. Cytowic talks about the tendency of the medical community (in the U.S., at least) to reject patients' claims related to synesthesia. I read it about 5 years ago, but as I recall it, the training that medical students receive (esp. since the 1940s or so) gives credence only to symptoms which can be objectively observed by the physician. Fundamentally subjective experiences (such as self-reporting of cross-sense experiences by synesthetes) tend to be discounted or rejected.
>
> I can say that almost no one in the psychology/psychiatry profession with whom I have spoken has ever heard of synesthesia—until recently, since synesthesia has received more attention in the press. One psychiatrist (quite young, I might add) had never heard of it before, and recommended that I have an MRI done to be sure there wasn't some kind of injury to my brain! I had to explain (emphatically) that synesthesia wasn't just some delusion I was experiencing, but rather a documented phenomenon.
>
> It's kind of ironic that, of all people, doctors (and psychiatrists and psychologists in particular) should be the most incredulous.

Another synesthete friend, whose adolescent daughter is also a synesthete, wrote to me,

> I've always been pretty open about sharing syn[esthesia] with others. Maybe because I find it so fascinating and feel it is a gift rather than a disorder. Most people have been interested and non-judgmental. Only two occasions have been met with hesitation and those were both by professionals who I assumed would be more open to variations from the norm than the general public. One was a professional counselor who gave me a look like I should be locked up and that ended the conversation. The second was my daughter's school teacher. My daughter is a syn[esthete] and I thought her teacher would find it interesting to learn about a different way that students may process information. She was open to the discussion but indicated she thought it was a very isolated instance and referred to it as a dysfunction rather than a gift. Even though my daughter is a gifted student. She told me later that she had spoken with her sister—a psychologist—who had heard of it but suggested that it would need to be "diagnosed." That word scares me. We haven't discussed it since.

Yet another synesthete, who works in a laboratory with researchers studying perception, wrote,

> Mostly, I am just curious, but I'm considering being a little more open about my synesthesia. For the record, I've told my immediate family (my mother is a synesthete), about 4 close friends, and my coworkers at my summer job, since I work in a perception lab and my synesthesia could impact how I perform on certain perceptual tests. I've told a couple of professors (in the fields of psychology and neurology) and have to admit that I've gotten the strangest reactions from them. One thought I was a savant, and the other tried to offer his condolences for "my condition." (I got a laugh out of that one later.) It's this type of reaction that keeps me silent.

In the past 6 years, I have also received urgent e-mail messages from synesthetes in Chile, Peru, and Italy. In each of these cases, the synesthete had sought out doctors to get more information about their synesthesia, only to get caught in a complex web where one or more doctors, plus various family members, wanted to institutionalize them, or at least perform a series of quite potentially harmful tests involving drugs. With the Peruvian and Italian cases, the synesthetes eventually got away from the doctors and

family members, and, last I heard, are no longer being pressured (or threatened) regarding institutionalization. I do not know what happened with the Chilean; I fear the worst.

Beginning about 3 years ago, I corresponded for almost a year via e-mail with a Canadian teenage girl, whose parents (I am assuming) had immigrated from India a few years prior to that time, and who was, at the time, a runaway living in the United States. Throughout the course of our correspondences, she kept herself anonymous, and moved from town to town about every three weeks. More than once, she told me that a main reason she had run away was that her father used to beat her severely every time she had mentioned any type of synesthetic experience (she only had the most common type, colored letters and numbers, but to an extremely strong degree). She claimed that her parents had taken her to numerous doctors in Canada and the United States, virtually all of whom had suggested major psychiatric treatment, and many of whom had suggested institutionalization. She also told me that she was strictly forbidden to mention her colored letters in any way to any other people besides doctors, and was often locked up in her room and denied contact with any other people besides her immediate family. When I last heard from her, she was still roaming the southern United States, had determined never to return to her parents, and had gotten a job (she would not reveal where) as an artist, she based her artwork on various things she "saw" synesthetically.

Is Synesthesia a Benefit?

This is not to say, however, that all or even most synesthetes have had severe problems with their conditions, nor that synesthesia is a drawback for everyone. Take, for example, the situation with Ian (a pseudonym), a 12-year-old synesthete I am currently assisting. Ian has colored-grapheme synesthesia, and is currently having trouble with algebra in school. Both he and his parents, as well as some of his teachers and administrators at his school, were worried that this form of synesthesia might, in itself, somehow create an insurmountable drawback for Ian in a number of academic areas. It gave them comfort to hear that not only did people use colored letters and numbers to advantage, but that Richard Feynman used his to memorize formulae that gained him a Nobel Prize (the fact that synesthete Vladimir Nabokov [figure 2.1] was the author of *Lolita* and *Ada* gave some of the teachers a little less comfort, but this can perhaps be countered by the amazingly strong piousness of Olivier Messiaen and Amy Beach [figure 2.2], both also synesthetes). Ian's problems in mathematics are similar to that of a couple of other young synesthetes whom I am also assisting. To give a basic example of these types of problems, see Plate 2.2.

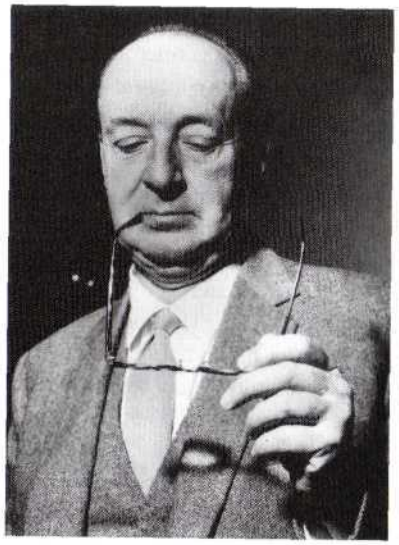

Figure 2.1. Vladimir Nabokov. (Reproduced with permission of Getty Images.)

Taking complications a step further, it is not infrequent that such colored-grapheme synesthetes will also perceive numbers (and, less often, letters) as having gender and personality, such as 2 being a shy, wimpy boy and 9 being a vain, elitist girl. Thus, extending our example from plate 2.2, Bob might really dislike certain things (such as 7×7, or office number 294) that result in putting 4 (a plain but decent, hard-working older woman) and 9 together,

Figure 2.2. Amy Beach. (Reproduced with permission from the Milne Special Collections, University of New Hampshire Library.)

as they greatly dislike each other and do not get along at all. Plate 2.3 is the set of letters and numbers, with their gender and personality descriptions, of one of my previous Synesthesia List members.

A recent subscriber to The Synesthesia List wrote,

> I have an intense association between colours and numbers. I migrated to Australia from the UK in the 1970s with my parents and remember having to do a maths test at primary school to determine what grade I should be put in. I think I was around 5 or 6 years old. I drew blocks of colour for my answers. Some of them just one colour—others two colours merging together. I remember the sum three plus five. Three is yellow for me and five is blue so I drew a merging of blue and yellow (a nice kind of green) as my answer. The teacher was appalled and held the sheet up in front of the class saying something like, "This might be how they do maths in England but it certainly isn't how we do it here." Much laughter and humiliation. At this point, I realised other people didn't see it this way and I tried to filter it out, which worked—to a degree.

However, I do not wish to convey that these types of synesthesia always present a problem for the synesthete, nor that they cannot be overcome—often in amusing and enjoyable manners. Plate 2.4 presents an example from one of my Synesthesia List members.

Then there is the story of a synesthete I know who replaced all of the keys on his laptop computer. Rather than displaying the graphemes, the new keys displayed only the colors which corresponded with each grapheme, creating a rainbow across the keyboard. After having done this, my friend reported that it was so much easier for him to recognize the various keys that his typing at least doubled in speed!

There have been many major figures who have not kept their synesthesia hidden, and have even used their synesthesia to advantage in their work. In the musical world, we have composers such as Franz Liszt (1811–1886): "When Liszt first began as Kapellmeister in Weimar (1842), it astonished the orchestra that he said: 'O please, gentlemen, a little bluer, if you please! This tone type requires it!' Or: 'That is a deep violet, please, depend on it! Not so rose!' First the orchestra believed Liszt just joked; later on, they got accustomed to the fact that the great musician seemed to see colors there, where there were only tones" (quoted from an anonymous article in the Neuen Berliner Musikzeitung, August 29, 1895; quoted in Mahling 1926, p. 230; trans. by author).

Nikolai Rimsky-Korsakov (1844–1908) had synesthetically colored musical keys:

C major	white
G major	brownish-gold, light
D major	daylight, yellowish, royal
A major	clear, pink
E major	blue, sapphire, bright
B major	gloomy, dark blue with steel shine
F♯ major	grayish-green
D♭ major	darkish, warm
A♭ major	grayish-violet
E♭ major	dark, gloomy, gray-bluish
B♭ major	darkish
F major	green, clear (color of greenery)

This is according to an article in the Russian press (Yastrebtsev, 1908).

Amy Beach (1867–1944) used her colored hearing as a basis for some of her compositions:

> Other interesting stories about Amy's musical personality and her astounding abilities as a prodigy are recounted in almost all previous biographical writings. One such story is Amy's association of certain colors with certain keys. For instance, Amy might ask her mother to play the 'purple music' or the 'green music'. The most popular story, however, seems to be the one about Amy's going on a trip to California and notating on staff paper the exact pitches of bird calls she heard. (Brown, 1994, p. 16; references are to letters in the Crawford Collection, Library of Congress)
>
> Amy's mother encouraged her to relate melodies to the colors blue, pink, or purple, but before long Amy had a wider range of colors, which she associated with certain major keys. Thus C was white, F-sharp black, E yellow, G red, A green, A-flat blue, D-flat violet or purple, and E-flat pink. Until the end of her life she associated these colors with those keys. (Jenkins, 1994, pp. 5–6; reference is an interview of Beach by George Y. Loveridge in the *Providence Journal*, December 4, 1937, p. 5)

Another synesthete composer and musician was Jean Sibelius (1865–1957; figure 2.3):

> For him there existed a strange, mysterious connection between sound and color, between the most secret perceptions of the eye and ear. Everything he saw produced a corresponding impression on his ear—every impression of sound was transferred and fixed as color on the retina of his eye and thence to his memory. And this he thought as natural, with as good reason as those who did not possess this faculty called him crazy or affectedly original.
>
> For this reason he only spoke of this in the strictest confidence and under a pledge of silence. "For otherwise they will make fun of me!" (Adolf Paul, 1890, as quoted in Ekman, 1938, pp. 41–42)

Figure 2.3. Jean Sibelius. (Reproduced with permission of Atelier Apollo, Helsinki [Music pic nr8879].)

Olivier Messiaen (1908–1992) was self-admittedly a synesthete, as is quite well detailed in his own writings and in interviews (see Samuel 1986/1994). Many of his compositions, such as "Oiseaux Exotiques," "L'ascension," and "Couleurs de la cite celeste," are directly based on trying to "produce pictures" via sound, writing specific notes to produce specific color sequences and blends.

Synesthete composers and musicians now living include the Hungarian György Ligeti (born 1923). Ligeti is probably best known to the wider world for his early works, some of which were used by Stanley Kubrick for the soundtrack of *2001*.

> I am inclined to synaesthetic perception. I associate sounds with colours and shapes. Like Rimbaud [Rimbaud was most likely not a true synesthete], I feel that all letters have a colour.
>
> Major chords are red or pink, minor chords are somewhere between green and brown. I do not have perfect pitch, so when I say that C minor has a rusty red-brown colour and D minor is brown this does not come from the pitch but from the letters C and D. I think it must go back to my childhood. I find, for instance, that numbers also have colours; 1 is steely grey, 2 is orange, 5 is green. At some point these associations must have got fixed, perhaps I saw the green number 5 on a stamp or on a shop sign. But there must be some collective associations too. For most people the sound of a trumpet is probably yellow although I find it red because of its shrillness. (Ligeti, 1978/1983, p. 58)

A strange twist: Ligeti studied and taught (1950–1956) at the Franz Liszt Academy in Budapest.

There is also the contemporary composer Michael Torke, definitely a synesthete, reporting that one of his types is colored time units (days of the week, years, and such). Torke has composed pieces with titles such as "Ecstatic Orange" and "Bright Blue Music." Other contemporaries include jazz-rock drummer Manu Katchè, jazz guitarist Tony de Caprio, the American composer Harley Gittleman, and violinist Itzhak Perlman.

In the realm of creative fiction writers, there have also been more than a few synesthetes. Perhaps the most famous was Vladimir Nabokov (1899–1977). In his autobiography, *Speak Memory* (1966), Nabokov tells us of his

> fine case of colored hearing. Perhaps "hearing" is not quite accurate, since the color sensation seems to be produced by the very act of my orally forming a given letter while I imagine its outline. The long a of the English alphabet (and it is this alphabet I have in mind farther on unless otherwise stated) has for me the tint of weathered wood, but a French a evokes polished ebony. This black group also includes hard g (vulcanized rubber) and r (a sooty rag bag being ripped). Oatmeal n, noodle-limp l, and the ivory-backed hand mirror of o take care of the whites. I am puzzled by my French on which I see as the brimming tension-surface of alcohol in a small glass. Passing on to the blue group, there is steely x, thundercloud z, and huckleberry k. Since a subtle interaction exists between sound and shape, I see q as browner than k, while s is not the light blue of c, but a curious mixture of azure and mother-of-pearl. Adjacent tints do not merge, and diphthongs do not have special colors of their own, unless represented by a single character in some other language (thus the fluffy-gray, three-stemmed Russian letter that stands for sh [S], a letter as old as the rushes of the Nile, influences its English representation).
>
> . . . In the green group, there are alder-leaf f, the unripe apple of p, and pistachio t. Dull green, combined somehow with violet, is the best I can do for w. The yellows comprise various e's and i's, creamy d, bright-golden y, and u, whose alphabetical value I can express only by "brassy with an olive sheen." In the brown group, there are the rich rubbery tone of soft g, paler j, and the drab shoelace of h. Finally, among the reds, b has the tone called burnt sienna by painters, m is a fold of pink flannel, and today I have at last perfectly matched v with "Rose Quartz" in Maerz and Paul's *Dictionary of Color*. The word for rainbow, a primary, but decidedly muddy, rainbow, is in my private language the hardly pronounceable: kzspygv. (pp. 34–35).

It should be mentioned that Nabokov's mother was a synesthete, as was his wife and his son Dmitri. Contemporary synesthete authors include Brits Julie Myerson and Jane Yardley.

As for other famous synesthetes, there is the artist David Hockney (see Cytowic, 2002). He sees synesthetic colors to musical stimuli. In general, this does not show up in his painting or photography artwork too much. However, it is a common underlying principle in his construction of stage sets for various ballets and operas, where he bases the background colors and lighting upon his own seen colors while listening to the music of the theater piece he is working on. Richard Feynman (1918–1988), winner of the 1965 Nobel Prize in Physics, was a synesthete. Feynman had colored letters and numbers: "When I see equations, I see the letters in colors—I don't know why. As I'm talking, I see vague pictures of Bessel functions from Jahnke and Emde's book, with light-tan j's, slightly violet-bluish n's, and dark brown x's flying around [see plate 2.5]. And I wonder what the hell it must look like to the students" (Feynman, 1988, p. 59). There are strong indications and good reasons for believing that the Serbian-born American physicist and inventor Nikola Tesla (1856–1943) was also a synesthete (see, e.g., Tesla, 1982).

I do not mention these famous synesthetes merely for curiosity's sake or to disperse trivia. These types of "heroes" can play essential roles both for young synesthetes and for their non-synesthete parents.

How then do we help students like Ian? This is a genuine concern; and I do not really have a good answer yet. However, one of the counselors at Ian's school points out to me that, whereas Ian has problems with math and also, upon occasion, with spelling, he seems to be coping quite fine. His parents, on the other hand, seem to be far more the problem at the moment. They want specific answers, in layman's terms that they can understand, as to whether something is wrong with their son, what the problem is, why he cannot do math the same as others, whether he will ever be able to do math at an adequate level, whether he needs medications or therapy, and so on. In other words, while Ian's synesthesia is a minor but still present problem for Ian, lack of information about synesthesia to give his parents is a major problem for Ian's school system.

Is Synesthesia a Special Gift?

One of the recurring themes on The Synesthesia List is the matter of whether synesthesia is, in some way, a "sixth sense" or a type of extrasensory perception (ESP), or a gift or blessing. I do not believe there is a synesthetic sixth sense. There is, rather, an atypical joining of the existing senses. Most normal perceivers have multiple senses within each of the traditional senses anyway. What we call touch might actually be broken down into at least five different senses (consider, for example, the difference between feeling a tickle on your arm and a sensation inside your stomach). Also, pain could probably be broken down into at least two if not three or more separate senses. And temperature could be broken down into two separate components—heat detection is separate from cold detection. And then there is also proprioception, balance, vomeronasal perception of pheromones, and others.

Beyond this, synesthesia does not add to the range of sensory perception. That is, for example, whereas a normal perceiver cannot see into the ultraviolet spectrum, neither can a synesthete. Whereas a normal person cannot hear ultra-high frequencies that a bat hears, neither can a synesthete. The ranges are not different, nor are they increased. Instead, synesthesia combines sensory experiences. Normal perceivers, for example, see colors; they also hear music. I see colors. I hear music. I also see colors when I hear music. There is no additional, sixth sense here. People with normal perception also taste things. I see colors when I taste things. Again, no sixth sense.

A question then emerges: What does the synesthete who is aware that, for example, the rest of the world does not see colors when hearing music think about the reality of synesthetic perceptions? Most synesthetes that I correspond with tell me that they basically work along lines of "two (simultaneous) realities": "other people's reality" and "my reality." The concept of having multiple realities does not seem to bother them. Similarly, Ramachandran and Blakeslee (1998) report that amputees with phantom limbs tend to eventually start operating with two simultaneous realities, "the phantom limb does exist and is still there," and "the limb does not exist and is not there." However, unlike with synesthetes, most amputees with phantom limbs cannot reconcile their two realities.

Humans take for granted that what each of us sees, hears, tastes, smells, and otherwise perceives is very much like that of the next person. Especially at a sensory level, most of us believe that our realities are pretty much the same. A person with synesthesia is, of course, no different in this sense. It might, however, be of interest to normal perceivers to hear that the quite larger majority of "colored-music" synesthetes I have corresponded with over the years were firmly convinced that everybody perceived music as colored; most of them were not shaken from this belief until well over the age of 20.

I personally do not feel that my own synesthesia is some kind of gift from someone or something. I am not somehow mystically blessed in that I somehow see a hidden truth that others do not. I believe I perceive music and flavors differently because my brain is sending signals to places different and/or in a different fashion than how it does in the average brain. To say that I "take in so much more of the world than normal people do" (to paraphrase a claim regarding synesthetes frequently expounded upon on The Synesthesia List and elsewhere) would imply that there is something actually out there to take in that others are not getting. I really do not think there is something extra out there. Rather, odd wiring and/or neuronal feedback is creating something in here—inside my head. It may be perceptually real in one way,

but it is not real (and I know very well it is not real) in another, more generally applicable, way.

Nevertheless, for the past few months, I have been dealing (fairly unsuccessfully) with trying to burst the bubbles of more than one non-synesthete colleague who seem quite seriously convinced that I have some form of mystic, spiritual connection to alternate dimensions or astral realms. From about October 2002 through February 2003, I served as a consultant to a commercial chemical laboratory which makes food additives, training and working as a taste-tester and "nose." Researchers at the company are interested in whether the synesthetic colors I "see" for various tastes and odors might help them in more accurately discerning fine-scale differences in products. However, these researchers have also frequently presented me with speculations regarding "auras," based, I deduce, on ideas extracted indirectly from Besant and Leadbeater's theosophy (see, e.g., Besant and Leadbeater, 1901/1978; Leadbeater, 1902/1925), with perhaps a touch of Kandinsky's interpretations. I have been hearing a lot about Zen philosophy and "astral seeing," too. During the course of various experiments and conversations, I have been asked, "Can you do this for us?" or "Can you do that?" and I am left once again trying to explain to them that synesthesia—not only mine but all that of all other synesthetes I have encountered and read about—does not work that way. Despite my presenting team members with scientific journal articles regarding synesthesia (such as those by Ramachandran and Hubbard), after 5 months, I am still basically considered by them as having "special insight" into "hidden truths" and that my "gift" is not via a neurological difference but from having a "more developed connection" with . . . something.

This is by no means the first time I have had to deal with such matters. Nor is it by any means a trivial concern: For example, recently, on an unmonitored synesthesia discussion chat-room web page, I noted one person who declared herself to be a synesthete explaining to another (self-declared) synesthete, who had come hoping for expert advice from trained medical professionals, how his touch–sound synesthesia perceptions were based upon "lines" and "vibrations" as per Californian variations on concepts of Buddhism, mysticism, and chakras. During the last year that I lived in Taiwan (2000–2001), I was interviewed by an associated group of television stations and newspapers for an evening news and newspaper feature regarding my synesthesia. When the features came out (all in Chinese), they were titled with a Chinese phrase which may be generally translated as "super-powers"; the same phrase is used in describing mythological demons, demigods, and cartoon and comic book superheroes. Rather than being informative pieces about a rare neurological condition, the features became an embarrassing joke that I then had to deal with for the next month.

I have been asked by various people over the years, "So what? Why should you care about other people's opinions and views regarding synesthesia? What difference does it make if they want to see synesthesia that way?" I am not really too concerned about the religious beliefs of others. I am far more concerned about those who distract synesthetes and other concerned parties (such as worried parents of synesthete children) from scientifically based information and conclusions, providing them instead with misinformation and concepts based upon belief and faith which have no scientific foundation or supporting solid evidence to back them up. Many subscribers to The Synesthesia List, for example, have come to me after having waded through numerous web sites providing gross misinformation and unfounded conclusions regarding synesthesia; these people are often extremely confused, but they also come holding incorrect assumptions, which it is then very difficult to dissuade them from. Pseudoscience, mysticism and such are not mere trivial concerns here; the spreading of misinformation, and lack of concern about the spread of misinformation, can directly hurt and impede synesthetes, just like it can hurt epileptics, autistic people, homosexuals, or others. As I write this paragraph, my most recent request for consultation on a project came from a person who hoped to find and employ synesthetes to help him detect ghosts.

After all of the horror stories I have mentioned about misdiagnosis, ridicule, scorn, and bad science, do I have anything positive to say regarding any doctors, psychiatrists, and other types of researchers? I most certainly do! There have been many who have definitely advanced our knowledge of synesthesia and thus lent a helping hand. A few of those recent workers are described below.

Baron-Cohen, Wyke, and Binnie (1987) established a set of tests that are now deemed to show that synesthesia is a real phenomenon, based upon its consistency; variants of this test are used to determine whether subjects may be shown to have certain forms of synesthesia before then proceeding to further experiments. In 1989, Cytowic produced his volume on synesthesia, reintroducing the topic to the neuroscience and medical community. He followed through in 1993 with a "pop reader" book on synesthesia which went on to gain international attention, including bestseller status, and was translated into additional languages. In 1995, Paulesu and his colleagues (1995) (which included Baron-Cohen) did positron emission tomography scan studies of colored-word synesthetes, revealing that there were sections of the brains of synesthetes that "lit up" differently than those of non-synesthetes performing the same word-recognition tasks, indicating that there were, indeed, neurological differences between synesthete and non-synesthete brains. Such studies have now been followed up using functional magnetic resonance imaging, magnetoencephalography, and event related potential technologies; Paulesu et al.'s basic findings hold up quite well, and are now supported by a rapidly growing body of data revealing neurological differences between synesthetes and non-synesthetes. Duffy, a

synesthete, has produced a volume that is a combination of autobiography, biography of other synesthetes, and general reader information regarding synesthesia (2001); this book has gone into paperback editions and is gaining widespread recognition, leading many to seek additional information regarding synesthesia. In separate, simultaneous studies, Mattingly, Rich, Yelland, and Bradshaw (2001) in Melbourne, Australia, Ramachandran and Hubbard (2001a, 2001b) in La Jolla, California, and Smilek, Dixon, Cudahy, and Merikle (2001a, 2001b, 2002) at Waterloo, Ontario, Canada, developed sets of tests to show conclusively that colored-grapheme synesthesia is a perceptual phenomenon, not a visual aberration, and, once again, to show that synesthetes could not possibly be making it up. And we now have these researchers and others joining together each year to share their work with each other and with synesthete and non-synesthete audience members at conventions such as those held by the American Synesthesia Association.

Revealing Synesthesia

On May 19, 2000, the first annual meeting of the American Synesthesia Association was held at Princeton University. Unfortunately, I was unable to attend. However, I received quite a lot of e-mail directly after the event. Perhaps not surprisingly, one of the things that most attendees mentioned was the coffee breaks between the paper and presentation sessions. Virtually every message I received, from synesthete and non-synesthete alike, mentioned how the synesthetes around the coffee and cookies were happily proclaiming, "Finally, I feel justified! After all these years, I finally feel like my way of seeing the world is just as good—is also real!"

One of the subscribers to The Synesthesia List wrote the following in 1997:

> About 3 days ago, I discovered that synesthesia is the name for the way I have been thinking my whole life. My mother clipped an article from the *Washington Jewish Week* about perfect pitch for me (I also have perfect pitch) and the article mentioned that an even smaller subset of people are "synesthetes" and see colors for every musical tone. Well, it was like a thousand Hallelujah choruses in my head at once. It has a name!
>
> Though I know that only one in so many people have synesthesia, I honestly can't imagine what it must be like NOT to see the world in a series of colors. Everything in my mind is color-coded. For me, what I now know to be synesthesia is not just a cute or freakish "talent," it is the manner in which I organize my thoughts and understand the world around me.
>
> I don't know why I see the colors that I do. I don't know why Biology is green, Chemistry is red, and Physics is yellow. They just are.

As mentioned above, synesthesia is not considered a problem in most cases. However, lack of knowledge about synesthesia—within the medical and scientific community, and, more broadly, among the general public—is considered a major problem by the synesthete community. Synesthetes do not need a cure for synesthesia. Rather, we need and want non-synesthete experts, family members, and concerned others to be informed about the occurrence and nature of our experiences so that it stops being thought of as an aberration, but rather as a normal variant of perception. Together, we all need to work at finding ways to get rid of biases, misconceptions, pseudoscientific misinformation, dogmatism, and intolerance, so that far many more synesthetes can finally feel a sense of relief and acceptance.

That is why I study synesthesia, and, for me, this is what this book is for. And that is why I sincerely applaud the other contributors to this book: You are of the small, but I hope growing, crowd of people who are making an extremely significant difference!

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