

## ***When People See a Sound and Hear a Color***

***By ERICA GOODE***

Most people, when not under the influence of hallucinogenic drugs, experience the sensory world as a place of orderly segregation.

Sight, sound, smell, taste and touch live in different neighborhoods and commute on separate freeways: A Beethoven symphony is not pink and azure; the name Angela does not taste like creamed spinach.

Yet there are those for whom these basic rules of the sensorium do not seem to apply. They have a rare condition called synesthesia, in which the customary boundaries between the senses appear to break down, sight mingling with sound, or taste with touch.

Thus, the composer Olivier Messiaen, speaking of the union of color and tone in his music, explained to an interviewer: "When I hear music, I see inwardly, in the mind's eye, colors which move with the music. This is not imagination, nor is it a psychic phenomenon. It is an inward reality." A 21-year-old woman, participating in an continuing synesthesia study at the National Institute of Mental Health, told researchers that when she ate buttered toast, "it is rough, but not pointy; and if it has jelly on it the rough texture is rounded." And Carol Steen, a New York artist who, like most synesthetes, has had synesthetic experiences from an early age and who uses her perceptions in her work, says she distinguishes different types of headaches by their colors. "If it's a sinus headache, it's green," Ms. Steen said.

Synesthesia received a flurry of attention from artists and psychologists at the turn of the century. But until relatively recently, modern science largely ignored it. Those who experienced synesthesia rarely complained ("It's the most wonderful thing in the world!" exclaimed one synesthetic woman). And the private nature of the perceptions made investigation difficult -- there was no objective way to tell what, if anything, unusual was taking place.

In the past 10 years, however, the arrival of imaging techniques and other new technologies for studying the brain at work has revived interest in synesthesia, capturing the interest of a small core of researchers in a variety of countries and disciplines. PET scanners, electrophysiological recording, DNA analysis and other techniques are increasingly being used.

In the current issue of *The Journal of Neuropsychiatry and Clinical Neurosciences*, for example, German researchers from the University of Hanover Medical School report electrophysiological findings from a group of synesthetic subjects.

An understanding of synesthesia as a perceptual anomaly, researchers hope, may eventually help elucidate normal perception, or even shed light on consciousness itself.

Meanwhile, much more remains unknown about the comingling of the senses than is known. Even basic facts about synesthesia -- its prevalence, for example -- are still less than certain. One newspaper and magazine survey, however, by Dr. Simon Baron-Cohen, a psychologist, and his research group at Cambridge University in England, found that 1 out of 2,000 people reported synesthetic experiences.

Scientists offer differing theories of synesthesia's cause: Some argue that it represents an innate difference in neurophysiology, others that it is a result of associations learned at an early age. And researchers disagree about how exactly the condition should be defined, with some viewing it as a

perceptual framework entirely distinct from normal perception, while others envision a continuum of synesthetic experience, with normal sensory perception at one end. Dr. Lawrence Marks, a psychologist at Yale University, for instance, has found that normal subjects show "implicit" associations that may be milder versions of the links found in synesthesia: Most people, for instance, associate brighter colors with higher pitched sounds.

Also mysterious is why the extent and form of synesthetic perceptions differ so widely from person to person. Seeing letters of the alphabet in different colors is a common synesthetic phenomenon. But, Dr. Baron-Cohen said: "Even within families, people argue about the colors of different letters. It seems to be highly individual and idiosyncratic."

And while the majority of synesthetes, who are about six times as likely to be female as male, find their unusual sensory abilities enjoyable, in some cases synesthesia can be disruptive. One woman, Dr. Baron-Cohen said, not only saw colors when she heard sounds, but heard sounds whenever she saw colors. "For her it was very unpleasant, and her reaction was to try to control the environment and keep everything very low key," he said.

Amid all this uncertainty, a growing body of evidence supports the notion that whatever synesthesia is, it represents more than the clever use of metaphor by creative individuals. Hallucinogenic drugs like mescaline and LSD, as well as some organic diseases, can produce synesthesia, suggesting a physiological basis. And people who report synesthetic experiences -- seeing particular colors evoked by particular sounds, for example -- demonstrate a remarkable consistency in their associations over time. In a 1989 study, Dr. Baron-Cohen and his colleagues found that synesthetic subjects showed a 92 percent consistency in their color-sound associations after a full year, in contrast to only 37 percent consistency after one week in control subjects.

Synesthesia also appears to run in families, leading some researchers to believe it has a genetic basis. Certainly, many synesthetes report that a family member shared their ability. The writer Vladimir Nabokov, for example, wrote that as a young child, he informed his mother that the painted colors on his wooden alphabet blocks were "all wrong." She understood immediately, Nabokov recalled, because she, too, saw each letter in a distinctive hue.

For her part, Ms. Steen remembers a family visit 30 years ago, when she was in college: Sitting at the dinner table, she mentioned casually that the numeral "5" was yellow, but her father corrected her. "No, it's yellow-ocher," he said. Her mother and brother, Ms. Steen said, sat in silent perplexity.

Perhaps most intriguing as arguments for the "realness" of synesthetic phenomena, however, are the handful of brain studies that show differences in brain functioning of subjects who have synesthesia. In 1982, Dr. Richard Cytowic, a Washington neurologist and the author of "The Man Who Tasted Shapes" (Putnam, 1993), led the way by measuring brain metabolism in a single synesthetic subject -- a man who at a dinner party announced that the meal would be late because "there are not enough points on the chicken." Dr. Cytowic found that during synesthetic experiences, the man showed decreased blood flow in brain areas of the cortex responsible for language and abstract thought -- findings the neurologist argued were indications that synesthetes were not simply using their imaginations or playing with language.

A more sophisticated PET scanning study, published in 1996 in the journal *Brain* by Dr. Eraldo Paulesu, Dr. Baron-Cohen and colleagues, compared brain functioning in six synesthetes to that in six members of a control group. The subjects, all women, were blindfolded and listened to sound cues delivered

through headphones. Synesthetes, the researchers found, showed increased activation in some areas of the visual cortex when responding to sounds; control subjects did not.

The areas showing increased activity are not the same as those activated when someone is imagining images, said Dr. Baron-Cohen. He said an M.R.I. study, as yet unpublished, by researchers at the Institute of Psychiatry in London had replicated these results.

Most recently, the team of German researchers compared recordings of electrophysiological activity in the brains of 17 synesthetic subjects, who experienced color images upon reading letters or numbers, with recordings from 17 control subjects.

The results, said Dr. Thomas Munte, a neurology professor at Hanover who took part in the study, suggest that during synesthetic experiences, regions of the frontal cortex of the brain that control attention and also play a role in processing sensory information are inhibited. "But this paper is just the starting point," said Dr. Munte.

Murkiness in science is not without its rewards, and one benefit of the absence of conclusive data about synesthesia is that it has left ample room for the construction of titillating theories. Dr. Cytowic, for example, argues on the basis of his own research and the subsequent brain study findings that synesthesia is a kind of "cognitive fossil," left over from a time before the separation of sensory pathways evolved. In this sense, synesthesia may be "closer to the essence of what it is to perceive," Dr. Cytowic has said, and may be tied to phylogenetically older, subcortical brain structures involved in emotion and other primal functions.

Dr. Peter Grossenbacher, a senior staff fellow at the National Institute of Mental Health, who with Christopher T. Lovelace and Carol Crane has interviewed more than two dozen synesthetic subjects as part of a current study, has a different theory. He suggests that in synesthetic experiences, neural pathways that normally act to suppress irrelevant sensory input and allow focused perception in a single sensory mode, may be selectively disinhibited, resulting in multimodal perception.

For Patricia Duffy, a 46-year-old instructor in the United Nations' language and communication training program, the cause of her perceptions is less important than the richness they have brought to her life. She sees the words she speaks fly by in a rainbow of colors. She sees a year as an oblong circle, a week as a sidewalk with seven colored squares of pavement. The month of January is garnet red; December is dark brown. "I don't really know where it comes from," she said. "I just know it's always been that way."

## **'George Bush is like crusty potato'**

**James Wannerton, president of the UK Synaesthesia Association, explains how the condition which "mixes the senses" affects his life.**

He is speaking at a conference in Edinburgh where scientists and others with the condition are discussing the phenomenon.

For as long as I can remember, words, word sounds, musical instruments and certain ambient noises have produced involuntary bursts of taste on my tongue.

Texture and temperature also feature in this experience which is with me 24 hours a day. My dreams also contain tastes, and I am unable to turn it off.

Although predominant during my formative years, I never considered these invasive sensations to be abnormal. Tasting words seemed as natural as breathing.

As I got older and more involved in the wider world, I found my word/taste associations having an increasing effect in my everyday life, subtly dictating the nature and course of my friendships, personal relationships, my education, my career, where I live, what I wear, what I read, the make and colour of car that I drive. The list is endless.

As a teenager, my developing interest in girls was heavily influenced by the tastes of their names, something which has led me up some disastrous paths over the years.

A girl's name was just as important as her looks and in some extreme cases, even her personality.

How shallow is that? I've constantly asked myself why girls with the sweetest tasting names quite often come with the sourest of temperaments.

### **'Surreal experience'**

Everyday tasks such as meeting people, general conversation, driving, shopping, or reading a newspaper, often pose an extra challenge.

I have concentration issues if a person I am listening to speaks slowly and has clear diction.

At university, some lectures were a total waste of time.

I vividly remember once sitting through a two-hour economics lecture, having learnt very little about the Money Supply but having an intense craving for apples.

Negotiating the taste of road sign information at the same time as processing the multifarious flavours of my surroundings often causes confusion and usually ends with me feeling hot and bothered in Burnley when I should have been in a cake shop in Eccles.

Eating out can be a surreal experience, especially if the menus are in a language other than English.

Thankfully, there is a plus side to all of this.

Music has a very pleasant added dimension and my taste sensations most certainly aid my memory recall.

If I see a face I can't immediately identify my mind goes through a process of using taste recollections to effectively apply a name to the face.

Whenever I see a picture of Tony Blair I instantly get the taste of desiccated coconut.

Gordon Brown leaves me with a very strong taste of dirt and Marmite, so he shouldn't count on getting my vote.

George Bush gives me a taste similar to the crusty potato bit on top of a cottage pie.

What is beyond doubt is that I would never consider the option of being cured, if ever such a thing were offered, although it would interest me to find out how my perceptions would be altered if I "lost" it for a day.

It is a fundamental part of who I am and has most certainly helped shape my concepts and personality.

**3 Paragraphs:**

What is synesthesia? Give some specific examples.

Is synesthesia a good thing, a bad thing, or both? Explain your answer with examples.

Have you ever experienced synesthesia? Would you like to? Why or why not?

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