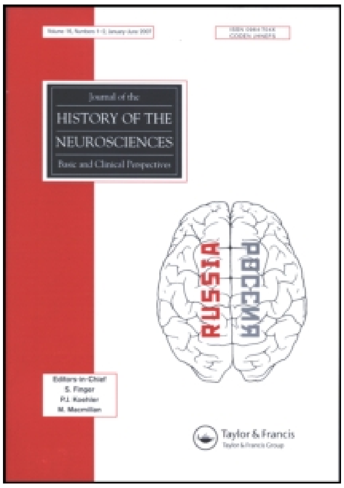


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Jörg Jewanski [a]; Sean A. Day [b]; Jamie Ward [c]
[a] Musicologist, Münster, Germany [b] Department of English and Journalism, Trident Technical College, Charleston, South Carolina, USA [c] Department of Psychology, University of Sussex, Brighton, UK

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# A Colorful Albino: The First Documented Case of Synaesthesia, by Georg Tobias Ludwig Sachs in 1812

JÖRG JEWANSKI,[1] SEAN A. DAY,[2] AND JAMIE WARD[3]

[1]Musicologist, Münster, Germany
[2]Department of English and Journalism, Trident Technical College, Charleston, South Carolina, USA
[3]Department of Psychology, University of Sussex, Brighton, UK



*In 1812, Georg Sachs published a medical dissertation concerning his own albinism and that of his sister. However, he also goes on to describe another phenomenon — namely synaesthesia involving colors for music and simple sequences (including numbers, days, and letters). Most contemporary researchers of synaesthesia fail to cite the case when offering a history of the subject and fewer still will have read it (the original was published in Latin). In this article, we argue that Sachs's case is the first convincing account of synaesthesia; we provide the first English translation of his description of it; we discuss the influence of the case in early theories about synaesthesia and its resonance with contemporary research findings.*

**Keywords** Synaesthesia/synesthesia, Sachs, 19th century, albinism, blindness, color

Georg Tobias Ludwig Sachs (1786–1814) provides what is probably the first ever medical account of synaesthesia, based upon observations of himself. His case was widely cited in the medical literature of the nineteenth century, but is not well known by contemporary researchers. Contemporary literature reviews of synaesthesia typically perpetuate an Anglo-centric view of the history of their subject that either begins with the philosopher John Locke (who almost certainly never encountered synaesthesia) or with Sir Francis Galton (who followed Sachs by around 70 years). Sachs's original medical dissertation, published in Erlangen, Germany in 1812, was written in Latin; although it was subsequently translated into German (Schlegel, 1824). There is no known English translation. The present paper aims to redress the balance by translating relevant parts of Sachs's dissertation and placing the case study into an historical context.

Synaesthesia is a rare condition in which a stimulus (e.g., a sound or a word) evokes an extra perceptual quality not normally associated with that stimulus (e.g., sound-color or word-taste; Cytowic, 1989; Day, 2005; Ward & Mattingley, 2006). It is reported to emerge early in development and persists throughout the lifetime and has likely a genetic component (Baron-Cohen, Burt, Smith-Laittan, Harrison, & Bolton, 1996; Ward & Simner, 2005). There is a wide variety of different types of synaesthesia (Day, 2005);

The historical research was conducted by JJ and translation of material was conducted by SD. The manuscript was primarily written by JW.

Address correspondence to Dr. Jamie Ward, Department of Psychology, University of Sussex, Falmer, Brighton, BN1 9QH, UK. Tel.: +44 (0)1273 876598; Fax: +44 (0)1273 678058. E-mail: jamiew@sussex.ac.uk

although different varieties tend to co-occur both within the same individual and within the same family (Barnett et al., 2008; Sagiv, Simner, Collins, Butterworth, & Ward, 2006). Functional imaging studies show that synaesthetes have a different physiological response to stimuli evoking synaesthesia (e.g., Hubbard & Ramachandran, 2005), thus providing corroborative evidence for their subjective reports. Structural brain imaging reveals differences in the organization of white matter (Rouw & Scholte, 2007). A recent prevalence study suggests that it occurs in a little over 4% of the adult population for types of synaesthesia involving one of the five classical senses (Simner et al., 2006). This relatively high prevalence contrasts with its largely hidden nature. We are all likely to know several synaesthetes amongst our personal acquaintances but most of us don't know who they are. Moreover, the high prevalence of synaesthesia, together with its postulated genetic contribution, suggests that it has been around for much of human history. However, it was not until 1812 that the first convincing description of synaesthesia appeared.

## Possible Documented Cases of Synaesthesia Prior to 1812

The case of Georg Sachs would be worth revisiting even if it turned out not to be the first ever documented case of synaesthesia. Indeed, there are several other pretenders to this claim and we shall consider them in chronological order. The three earliest candidate cases all experienced colors in spite of the fact that they were blind. The fourth case that we shall discuss probably invented a system of music-color correspondence.

Contemporary cases of synaesthesia have been documented who continued to experience colors after a noncongenital onset of blindness (Steven & Blakemore, 2004; Steven, Hansen, & Blakemore, 2006). Synaesthesia has also been reported to be acquired after the onset of blindness in people who were not previously synaesthetic (Jacobs, Karpik, Bozian, & Gothgen, 1981; Rao, Nobre, Alexander, & Cowey, 2007). But there is something very unusual about each of the three early blind "cases."

Larner (2006) discusses the case of John Vermassen from Maastricht, who could distinguish colors by the touch of his fingers. Vermassen was blinded by small pox at the age of 2. Although rare, touch-color synaesthesia has been noted in synaesthetes who later became blind (Steven & Blakemore, 2004; Wheeler & Cutsforth, 1921), in a blind person who subsequently acquired synaesthesia (Armel & Ramachandran, 1999), and in developmental cases of synaesthesia in sighted individuals (Smith, 1905; Ward, Banissy, & Jonas, 2008). Vermassen's case was reported by the scientist Robert Boyle (1627–1691) in 1664, having been relayed to him by a physician, John Finch (Hunter & Davis, 1999). However, Vermassen does not report "seeing" colors from touched objects, as would be expected of a synaesthete. He reports something far more remarkable. Namely, he can tell the true color of an object from touch alone. Thus, he can accurately name the color of differently dyed ribbons placed "betwixt the thumb and fore-finger (Larner, 2006, p. 247)." Contemporary cases of touch-color synaesthesia report colors from touch (e.g., Braille characters), but they do not see the true color of the text by touching it. Assuming the dyes have no tactile differences, we are aware of no scientific account of this — synaesthetic or otherwise. If the seventeenth-century dyes do have tactile differences (or if different dyes were used on different fabrics), then one need not evoke synaesthesia to explain the case. He may simply be relying on a more refined sense of touch than that possessed by sighted individuals (Heller, 1989).

In his 1690 *Essay on Human Understanding*, John Locke (1632–1704) noted the case of "a studious blind man who . . . bragged one day that he now understood what "scarlet" signified. . . . It was like the sound of a trumpet" (Locke, 1690/1997, p. 385). Others have interpreted this as a reference to synaesthesia (e.g., Mulvenna & Walsh, 2005). However, there is good reason to believe that this is philosophical rhetoric, not dissimilar to recent examples such as Jackson's (1982) "Mary, the color blind scientist," who knows everything about the science of color but has never seen colors herself. Locke believed that visual experiences could not be known via any other sense and this is clearly illustrated in his answer to "Molyneux's Question" (Morgan, 1977; Wade & Gregory, 2006). William Molyneux asked whether a blind man, on fully recovering his vision, would be able to know a globe and cube by sight alone (having previously only known such objects by touch)? Both Molyneux and Locke gave an emphatic "no" to this question. If someone is congenitally blind, they cannot learn the names of colors in the conventional way; i.e., by reference to shared visual experiences. Thus, although the blind man could use the word "scarlet," he could have no understanding of what this word commonly refers to, and Locke introduces the hypothetical example as a way of illustrating this point. Indeed, Locke introduces his "case" of synaesthesia in his section on language rather than in his section on sensation (O'Sullivan, 2007). One further claim is that Locke may have based this case on the famous blind mathematician, Nicholas Saunderson (1682–1739), who would have been a contemporary of Locke's in Oxford. O'Sullivan (2007) presents evidence that this cannot be so. Although the *Essay* was published whilst Saunderson was alive (although only a boy), Locke had first penned this "case" several years before Saunderson's birth.

A similar blind "case" was described by the English ophthalmologist, Thomas Woolhouse (1666–1734); although no first-hand accounts by Woolhouse are known to exist. This has been mooted as a case of synaesthesia by some (Cytowic, 1993; Marks, 1975). The mathematician, Rondet (1726) comments on Woolhouse's case in a letter written to endorse the building of a *clavecin oculaire,* a color organ, by Louis-Bertrand Castel (1725). One of the reasons to build it was that a deaf person could enjoy the beauty of music with his eyes, a blind person the beauty of colors with his ears (Castel 1725, p. 2553).

> M. de Woolhouse told me many times that he had seen in Maastricht a blind man who distinguished colors by touch. He was the son of a haberdasher who has lost his sight at the age of 6. When one gave to this man a red cloth, he said, upon touching it, that this color gives him the same effect as the sound of a trumpet or a drum. He recognized black because it was rough. As for white, or yellow, he only said that it was one or the other. It would be the same with green and blue, apparently because of the correspondence between these colors. (Rondet, 1726, pp. 654–655, translated from French)

A similar account is given by Castel (1735) himself some years later and is incorporated by Voltaire (1694–1778) in his famous *Eléments de la Philosophie de Newton* (Voltaire, 1738). Woolhouses's case clearly bears such close resemblance to the earlier descriptions of Vermassen and Locke's blind man that it is hard to imagine that it is indeed a new case.

The fourth case differs from the others in being sighted. Johann Leonhard Hoffmann (1740–1814) was a painter who developed a system of color harmony based on music, with seven colors for seven tones, and each color with seven octaves (Hoffmann, 1786). His very detailed system appears to be rationally constructed and is typical for this period (e.g., Junker, 1778; Lefébure, 1789). Hoffmann's connections between musical instruments and color could be synaesthetic (e.g., violin and viola are ultramarine, the human voice is green, trumpet is red, etc.). However, in the context of other descriptions in the book, even this is dubious. For example, he cites Aristotle as believing that green is the most pleasant of colors and so links this with the most pleasant instrument, the human voice. In considering the case, Bleuler and Lehmann (1881) spoke of "too much reflection" (p. 63) to be a synaesthete; although Marks (1975) lists Hoffmann as a potential synaesthete in his review.

In sum, there is significant doubt about the authenticity of these potential early cases. These cases are, in our view, a reflection of the late seventeenth- and eighteenth-century philosophical interest in whether it is possible to obtain knowledge without sensory experience (e.g., blind people knowing about vision) and the post-Newtonian interest in the science and art of music-color correspondences, rather than actual observations of synaesthesia (for comparisons between single musical tones and single colors in this period see Jewanski, 1999). Although others may choose to disagree, we believe that the case of Sachs is the first convincing account of synaesthesia as it is presently understood today.

## Sachs' Medical Dissertation and Description of Synaesthesia

From the information given in the dissertation (Sachs, 1812), its translation (Schlegel, 1824), an obituary (K., 1814) and a brief encyclopedia entry (Hamberger & Meusel, 1825), it is possible to construct a biographical sketch of Sachs. Georg Tobias Ludwig Sachs was born on April 22, 1786, in St. Ruprecht, Kärnthen, a small village in a mountainous area. His father was born in 1760 in Bayreuth, Bavaria, Germany; his mother, one year older, was born in Oberwürttemberg (today: Baden-Württemberg, Germany). He was the oldest of five children. Four of them (two sons and two girls) were born prior to 1795. The fifth child again was a girl, who was born January 4, 1797, in a small village, consisting of five houses at the river Drau, near Villach, Kärnten, Austria. Both he and his youngest sister were albinos. The other three children of the family and the parents were not. Sachs studied in Tübingen, Altdorf (the university was dissolved in 1809, so Sachs must have studied there before this date) and Erlangen. His obituary described him as a religious and modest man with a high educational level, interested in music and literature. The only published work is his doctoral thesis from 1812 about albinism, which included a small chapter about synesthesia. To preserve the scientific approach of his thesis, Sachs never wrote about "himself" as an albino, but about the "brother" and the "sister." It is only by the Latin title of the book it becomes clear that the brother is Sachs himself: "A Natural History of two Albinos, the Author and his Sister." In his brief career at the University of Erlangen, he gave lectures on pathology, physiology, physical anthropology, the application of mathematics to medical sciences, and astronomy. In addition, he practiced as a doctor and was engaged in chemical investigations of color theory. Two years after the publication of his thesis, he died of "nerve fever" on May 6, 1814, shortly after his 28th birthday.

Sachs's albinism provides an appropriate context in which his synaesthesia can be discussed, given that the topic of color is a recurring theme of the dissertation. In the early part of his dissertation, he describes his family history and various observations and studies into his and his sister's physical appearance (e.g., various chemical studies of samples of his own hair). He later goes on to describe his eyes, vision, and color preferences. Sachs placed his observations on vision within the theoretical framework of Goethe's recently published "Theory of Colors" or *Farbenlehre* (Goethe, 1810/1982). Goethe wished to challenge the dominant view of the time, namely, Newton's theory of optics. Although his account was never considered as scientifically credible, Goethe highlighted that many phenomena associated with color (e.g., afterimages) would be related to the biology of our sensory apparatus rather than laws of physics. In the chapter "Concerning the Connection of the Eyes to the Colors" (§ 149–162), Sachs shifts the focus away from a discussion on color preferences by himself and his sister to the topic to synaesthesia. His description is as follows (the numbers refer to the section numbering of the original text, and the italics are retained from the original text).

> §. 157. Although I am unwilling to speak anything about the *minds* of our albinos, yet I should nevertheless state some observations concerning *colors*, which I can attach in no other place, and want to communicate to the reader. I do not doubt at all that these features also express themselves and can be described in other humans; on the contrary, I recently found a trace of it in a very famous man; but I do not know anybody who would so certainly and exactly have noticed such a thing.
>
> There is much which either never comes before the eyes, or which cannot be reckoned with usual sight, that either does not belong to the sense of vision, or which is not perceptible to the senses, which, in the mind of the brother, inspires dark ideas of different colors, so intimate and recurring, that cannot be conceived of, or only scarcely and with difficulty, without a certain attention. I cannot express it better than to say that a colored idea appears to him. For some, however, this seems due more to a certain coincidence than to regulated impressions, whereby the color and the article in which the idea is connected, which affects the mind, seem to stand in harmony. Some ideas convey the colors by themselves, even if the feelings move all in heaven to differ.
>
> §. 158. Particularly those things which form a simple *series*; e.g., *numbers, the days of the week, the time periods of history and of human life, the letters of the alphabet, intervals of the musical scale*, and other such similar things, adopt those colors.
>
> These introduce themselves to the mind as if *a series of visible objects in dark space, formless and noticeably of different colors*. With some, the idea of the color is so dark that one can scarcely differentiate between the colors; with others, it is much more clear.
>
> Those individual members of such rows which show up outside of the row retain their own colors, but more *weakly*.
>
> In addition, others which refer back to no series have their own color; e.g., *cities* (even those never seen) *and the timbres of musical instruments.*
>
> §. 159. Not all colors occur with these ideas. The brightest — and probably therefore the most frequent — are *yellow, white* (which, however, is mostly more-or-less gray), *pale gray*, even also not rarely *bluish*. The darker (in regards to the ideas) are uncertain: *orange, red* (almost vermilion), *dark gray, bluish, dark green, dark blue.* Black occurs once with the letter U; the remaining colors, keeping the brother in mind, will never be observed, or at least never *recognized.*
>
> All these colors are only extremely faint and appear *faded*.
>
> §. 160. Thus I here present some examples concerning this, as I want to exhibit such to which the colors show themselves distinctly and clearly.
>
> In the *alphabet*, *A* and *E* are vermilion, *A* however is more cinnabar, *E* is more inclined to rose; *I* is white; *O* orange; *U* black; *Ue* (*ü*) gray; *C* pale-ash-colored;

> *D* yellow; *F* dark gray; *H* is bluish ash-colored; *K* nearly dark green (uncertain); *M* and *N* white, *S* dark-blue; *W* brown.
>
> The tones in the musical scale depend on the letter with which they are designated, and these relate also to the half-tones, which derive from them. Although the letters *g* and *b* actually do not carry a color trace, nevertheless the *fifth tone* (*g*) is recognized as green (uncertain) and the *first quarter tone* (*b*) is seen quite clearly by the ash gray color.
>
> With *numbers*: 0 is as if it were very light and bright in a pale-yellow color, uncertain. No. 1, indefinitely white; 2, of indistinct color; 3, almost ash-gray; 4, vermilion; 5, yellow; 6, indigo; 7, bluish gray; 8, brown; 9, nearly dark-green. The compound numbers of the simple numbers, from which they are composed, adopt the colors after themselves, but so that the color of the higher ordered numbers are prevailing. And herein the same colors do not really flow together in unity, but are to be recognized individually. The more digits possible in a number, the color is usually more indefinite and darker. Simple numbers composed with *zeros* retain the same color and usually cause a certain brightness. With compound numbers in which the same number is contained more times (e.g., 44, 661, 777), their color is as if very *enhanced*. Amongst the compound numbers, the following are characterised primarily as light and certainly colored: *whites*, 10, as if it were white glass; 11, milk-colored; 100, white, scarcely bright; 110 and 111, extremely shiny; *reds*, 14; 24; 40; 44; 400; 444; yellows, 15; 25; 50; 55; 500; 555; 1000; which is strange, is *not white*, except in the chronological numbers of years. It is plausible that the colors attach more to the ciphers, than to the numbers.
>
> *The periods of history and human life*, like certain other things, seek for colors for the numbers into which the years are divided. But there are many exceptions to this rule which, to me, do not seem worth the trouble to report.
>
> In regards to the *week*, *Sunday* is white, sometimes yellowish; *Monday* grey, *Tuesday* has a dark and uncertain color; *Wednesday* yellow, *Thursday* indefinite green, inclined more to yellowish than bluish, sometimes indefinite and dark orange; *Friday* dark gray, *Saturday* is bluish ash-colored. (translated from Latin and German).

Sachs did not apparently believe that there was a direct link between synaesthesia and his albinism, given that he notes that he had come across someone else ("a very famous man") who reported something similar. Although Sachs never ventured an explanation of synaesthesia, his opening sentence implies that he considered it a product of the mind.

Sachs leaves the topic as abruptly as he entered it, moving on to a paragraph concerning different kinds of color reception by different angles of view. The dissertation concludes with a discussion of the perception of scenes and distances (it is now well established that albinism is associated with certain difficulties in eyesight; Wildsoet, Oswald, & Clark, 2000).

## The Early Impact of Sachs' Case Study

Shortly after its publication, two reviews of Sachs's dissertation specifically commented on his synaesthesia. One reviewer wrote of "a curious connection of ideas, in which the strangest things are always placed into a relationship with light and color" (p. 236, Anonymous, 1813; translated from German). In the second review of the thesis, the reviewer praises Sachs' thesis, because it is the best he has read in recent times. In a small paragraph, the reviewer also dealt with Sachs' synaesthesia (Anonymous, 1814):

> It is strange that the author represents, in his own way, certain things as colored objects . . . a phenomenon of which the author also found traces in other people. [. . .] (This phenomenon speaks to an overall higher sense of vision in some humans. One could say that he is more reliant on the eyes than other people. Perhaps other people, for whom the sense of tones dominates the other senses, represent these objects as tones too . . . something similar probably takes place for blind people.) (p. 12, translated from German)

The reviewer accepted Sachs' synaesthesia as nonpathological, or as a positive ability, as Sachs did. This viewpoint, which was not given to it again until more than 100 years later in Germany in a kind of a *synaesthesia-euphoria* between 1925 and 1933 (Jewanski, 2002), is very near to our point of view today. The reviewer also offered a tentative first explanation of it: namely an overreliance on vision relative to the other senses. The reviewer was even open minded about the possibility of other types of synaesthesia occurring. For example, he speculated that individuals who are overreliant on hearing (such as the blind) may come to associate tones with nonauditory stimuli.

In 1824, a German translation of the dissertation was published (Schlegel, 1824). The dissertation had already been cited a number of times in the context of albinism (e.g., Mansfeld, 1822; Schnurrer, 1819) and the translator, Julius Heinrich Gottlieb Schlegel (1772–1839) recognized its importance. Schlegel was a doctor of medicine and, like Sachs, was a member of the *Physikalisch-medizinische Societät* of Erlangen. It was Schlegel who had first discovered Sachs in August 1795 at the age of nine and he, according to the introduction to his translation, wanted to receive credit. Sachs was the first known albino to describe himself in writing and the first to be successful in natural sciences. With this, he showed that an albino could write a doctoral thesis; although some people had said that albinos have a lack of intellect. After an introduction by Schlegel (pp. 1–6) and the translation of Sachs' thesis (pp. 7–142), the German edition of the thesis ends with the description of two more albinos, discovered by Schlegel in 1821 (pp. 142–148). Although about 95% of the book was based on Sachs' work, Sachs' name does not appear anywhere in the text; the title itself having been changed to "A Contribution to Deeper Knowledge of Albinos."

The first scientist who discussed in detail the sections on synaesthesia was the French physician (Charles-Auguste) Édouard Cornaz (1848), in his doctoral thesis "Congenital Abnormalities of the Eyes and their Appendices." Cornaz appears to consider it more as an abnormality; although his tentative account of it in terms of a heightened sensitivity to color is broadly consistent with the 1814 review. His suggestion that it could be the opposite of Daltonism or color-blindness is the first concrete proposal as to the origin of synaesthesia, and this influenced his choice of name for the condition: hyperchromatopsia. His account is as follows (square brackets indicate our insertions):

> Dr. Sachs, in his inaugural essay (* Hist. Natur. Duor. Leucæthiop. *Particulæ duæ. Erlangen*, 1812, p. 81 and following), reports on a complication of his state of albinism, which appears to me to deserve a place in this chapter: he offered the singular phenomenon of habitually binding the idea of colors to a great number of classes of things, mainly with those which form series, like numbers, the letters of the alphabet, the notes of music, the days of the week,

> the stages of life; it was the same for other objects, for example various cities. In this abnormal vision, the clear colors were most distinct, and those more dim were less; black was attached for him only to letters *i* and *u*. I draw from his work the following examples: *a* and *e* are red for him, but the first draws more on vermilion, the second on rose . . . [more examples of Sachs' colors] . . . This abnormality appears at opposite to me with dyschromatopsia [color-blindness]; it would be to some extent a hyperesthesia of the "direction of the colors," and I would propose to give it the name hyperchromatopsia (perception of too many colors). (Cornaz, 1848, pp. 149–150, translated from French)

Following Cornaz's publication, several new cases of synaesthesia came to light (see Krohn, 1892; Mahling, 1926). Sachs was referred to in some later nineteenth-century reviews (Krohn, 1892; Schirmer, 1884; Suarez de Mendoza, 1890) and in some twentieth-century German doctoral theses (Argelander, 1927; Mahling, 1923; Schrader, 1969; Wellek, 1928). A reference to Sachs resurfaced in the English-speaking literature in the review by Marks (1975) and was discussed more recently by Dann (1998) and Ione and Tyler (2004).



## Contemporary Resonances of Sachs' Account of Synaesthesia

Unlike the pre-1812 "cases," the description offered by Sachs has clear resonances with the contemporary literature on synaesthesia. Firstly, in terms of the experiences themselves, Sachs notes their consistent nature ("so intimate and recurring") and also the detailed specificity that seems almost impossible to put into words (e.g., "*Thursday* indefinite green, inclined more to yellowish than bluish"). The consistency and specificity of synaesthesia has become a hallmark of the contemporary literature (e.g., Baron-Cohen, Harrison, Goldstein, & Wyke, 1993; Cytowic, 2002). Sachs's colors themselves are said to appear in "dark space." Some synaesthetes report experiencing their colors on an "inner screen" (or mind's eye), whereas others see them externalized (Dixon, Smilek, & Merikle, 2004; Ward, Salih, Li, & Sagiv, 2007). Sachs's description is, in our view, more consistent with the former. Secondly, with regards to the nature of the inducing stimulus, Sachs's observation that the colors derive from "particularly those things that form a simple series" is true of most contemporary cases (Barnett et al., 2008; Rich, Bradshaw, & Mattingley, 2005; Simner et al., 2006) and is central to some neuroscientific theories of synaesthesia (e.g., Hubbard & Ramachandran, 2005). Similarly, his description of synaesthesia as "colored ideas" is consistent with contemporary studies suggesting that thought alone can induce synaesthesia, even without an externally presented stimulus (Dixon, Smilek, Cudahy, & Merikle, 2000; Simner & Ward, 2006).

Aside from linguistic sequences, the other inducer of synaesthesia in Sachs is music. The timbres of different musical instruments have their own color, as do the tones of the musical scale (although it is to be noted that, with regards to the latter, it is unclear whether he refers specifically to heard music, printed music, or both). What is perhaps particularly interesting is that the "tones in the musical scale depend on the letter with which they are designated," thus all notes designated by the letter "A" would be, to Sachs, vermilion. German, like English, uses letters of the alphabet to denote musical notes (although it does so slightly differently). For people with synaesthesia, these grapheme-color correspondences may migrate and become bound to printed musical notes (Ward, Tsakanikos, & Bray, 2006) and even heard musical notes (Carroll & Greenberg, 1961; Haack & Radocy, 1981; Langfeld, 1914; Riggs & Karwoski, 1934; Rogers, 1987). The latter appears to be particularly linked to perfect pitch (i.e., the ability to identify a given note without reference to another note), and one wonders whether Sachs may have possessed this too.

## Summary

The case of Sachs fell at an important historical crossroad that followed on from philosophical, artistic, and scientific musings about the connection between the senses (particularly sound and vision) and presaged the important biological and neuroscientific study of the senses that would follow in the nineteenth century. However, the earliest observations of synaesthesia are largely unknown to contemporary researchers and this article will hopefully redress the balance.

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