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Handwriting and Visual Impairment: A Forensic Analysis of J. S. Bach's Signatures

Heidi H. HARRALSON^a, Clare KAUFMAN^b and Martin W. B. JARVIS^c

^a East Tennessee State University, Johnson City, Tennessee, USA

^b Institute of Optometry, London, United Kingdom

^c Charles Darwin University, Darwin, Australia

^a spectrum008@aol.com, ^b clarekaufman@gmail.com, ^c martin.jarvis@cdu.edu.au

Abstract. This paper examines the historical signatures of 18th century composer, J. S. Bach, to evaluate the effects of vision impairment on handwritten signatures. It is questioned whether Bach penned certain signatures as it is historically documented that he was virtually blind in the years just prior to his death in 1750. Applying information collected from published forensic studies about the effects of vision impairment on handwriting, handwriting indices of vision impairment are compared to Bach's signatures in the late 1740s.

1. Introduction

Forensic handwriting examination techniques have been previously utilized in the examination of music calligraphy associated with J. S. Bach (1685-1750) manuscripts. Notably, Jarvis (2007) postulated that the music calligraphy on some manuscripts historically associated with J. S. Bach were written by his wife, Anna Magdalena Bach. In furthering research concerning the authorship of Bach manuscripts and specifically signatures on manuscripts and letters, forensic handwriting examination techniques were applied in the analysis of purported J. S. Bach signatures written late in his life when he was suffering from severe eye strain and eye surgeries which eventually contributed to his death in 1750. This paper presents the results of an examination of J. S. Bach's signatures during the decade in his life associated with severe eye strain and eye surgeries. The observations of Bach's signatures from the 1740s are compared to information associated with visual impairment and its manifestation in handwriting as published in forensic literature.

2. Literature Review: Bach's Vision

Historically, it is believed by many scholars that the source of Bach's eyesight problems can be traced back to the period when in 1695 he went, at age ten, to live with his brother Johann Christoph Bach, following the death of his parents (EWB, 2015). During this period it is generally accepted that he was in the habit of copying manuscripts out by moonlight, thereby causing severe eye strain, that was then to be with him for the remainder of his life (NNDB, 2014; Gramophone, 2015). Evidence for this comes from his portrait "where Bach appears to squint, and the way his facial muscles are aligned has led analysts to believe that he suffered from shortsightedness [myopia].... Yet, according to his son [Carl Philipp Emanuel's Obituary of his father (David et al., 1999)], his eyesight was always weak; and according to his first biographer, Forkel (1802), he had a 'very painful disorder in the eyes'" (Ho, 2010).

It would seem that Bach had "naturally bad vision" and that "this was further weakened by a lot of studying, sometimes even all night long, especially during his youth" (Zegers, 2005, p. 1428). From his symptoms Zegers also suggests that he was myopic, although only moderately. He thinks that his possible level of refractive error was about -2.00 D; if it had been greater he would not have been able to play the organ in church. Zegers states that even recognising people's faces in the street would have been difficult with Bach's level of myopia, unless he wore his spectacles.

Refractive error is defined as "a defect in the ability of the lens of the eye to focus an image accurately, as occurs in nearsightedness [myopia] and farsightedness [hyperopia]" (Mosby's Medical Dictionary, 2009). Refractive error is important as, if it is left uncorrected, can cause avoidable visual impairment. There is some evidence to suggest that children who do a great deal of close work may either become myopic or make a pre-existing condition worse although a recent review notes that evidence for this is equivocal (Foster & Jiang, 2014). The review commented that greater time spent outdoors might be associated with reduced myopia.

It seems that Bach had a strong physical constitution throughout his life. However, he appears to be physically obese in the Hausmann portrait of 1748 and that "[a] striking feature is the narrowed eyelids. A closer look seems to give the impression of dermatochalasis ["sagging of the eyelid skin and underlying muscle that occurs commonly during the aging process" (dictionary.reference.com/medical)]; this has no serious clinical implications except that it can sometimes restrict the superior visual field" (Zegers, 2005, p. 1428). According to Bach's contemporaries his vision deteriorated as he aged. As his myopia was only mild, Zegers has concluded that the most likely cause of his visual difficulty was cataract. A cataract is defined as: "The development of an opacity within the lens. As we age, there is a disturbance in the structure of the lens and accumulation of pigment. The clarity of the normal lens is maintained through a precise structural arrangement of fibres and

balance of chemical constituents. This change to the microstructure results in opacification, which consequently alters the penetration and refraction of light...Clouding of the lens will cause a degree of scattering of light rather than focusing it to a point on the retina. The more opaque it becomes, the greater the scatter and the worse the vision. The majority of cataracts are age related" (Nash, 2013, p. 555).

The symptoms of age related cataract include: visual difficulty in dim light, needing more light to see things clearly, difficulty in reading small and fine print, alteration in colour perception and everything may have a yellow or brown tinge, spectacles become less effective, patients may see halos around bright lights and some experience double vision (NHS, 2015). Living in 18th century Germany, Bach would have worked by candle-light and, particularly during the autumn and winter months, he would have also experienced naturally lower levels of light. This would have had a greater impact on his vision as he aged, i.e. the developing cataract would have caused increasing difficulties seeing the lines on manuscript paper and writing on them accurately.

Up until about 1750, the only treatment for cataracts was an operation called couching (Blodi, 1996). This was a surgical procedure to displace the crystalline lens inside the eye which had become opacified, for varying reasons. The lens was usually pushed into the back of the eye and a person's vision was normally restored. This method of cataract treatment did not remove the lens from the eye, as with modern-day cataract extraction, but simply moved it into a place where it did not interfere with light hitting the retina, thereby allowing some restoration of vision. Couching itself was normally performed without anaesthetic and, according to Zegers (2005, p. 1429), in the 18th century patients were seated in an upright chair and held tightly by an assistant while the procedure was being performed.

Bach's treatment was performed by the travelling English eye surgeon, John Taylor (1703-1772). Although he had received training at St. Thomas' Hospital in London, he was "an oculist of note and notoriety" (Wade, 2008, p. 969). This was because he wrote detailed books about the eye whilst simultaneously causing a great deal of distress to his patients where his extremely expensive couching operations caused pain and also failed (Wade, 2008; Zegers, 2005). Indeed, he travelled throughout Europe performing these operations and instructed the patients that they were not to remove their bandages for a minimum of five days, by which time he had moved on to "the next town to operate on new victims" (Zegers, p. 1429). Zegers also reports that Taylor was right-handed and as such preferred to operate on the left eye, whether the patient needed it or not. His habit of covering the eye with bandages was also criticized because it increased the risk of post-operative infection. According to Tarkkanen (2013), "The Mayor of Leipzig had been asked for measures in case Bach would become unable to take care of his duties. After persuasion of his friends, Bach had both eyes operated by a travelling British eye 'surgeon' John Taylor" (p. 191).

Bach's first operation took place in Leipzig in March 1750. It was likely to have been Taylor's standard procedure to remove the cataract by couching. About one week later, Bach needed further surgery on that eye because the couching was followed by "anterior displacement of the lens, pupillary block and glaucoma" (Zegers, 2005, p. 1429). It must be remembered that this surgery took place in the pre-antiseptic era and many post-operative complications could have occurred as a result. Taylor decided to treat Bach with "bloodletting, laxatives and eye-drops of blood from slaughtered pigeons, pulverized sugar, or baked salt" (Zegers, p. 1429).

The newspaper *Vossische Zeitung* (1750, No. 4) stated that Bach's vision improved after the first operation; this would give some credence to the hypothesis that the cataract was successfully displaced. However, Taylor had significant influence with the newspapers of the time, because of the money he spent advertising his arrival in the towns that he visited, hence Zegers (2005) feels that this information is unreliable. He further dismisses Forkel's assertion that his eyes were painful before his surgery on the basis that his biography was written over a half a century after Bach's death and neither myopia nor cataract, on their own, are painful conditions. According to Tarkkanen (2013), Bach was extremely ill after the second procedure, suffering severe pain in his eyes and body; he was unable to play the organ and, indeed, was bedridden. It was at this point that Taylor "moved on and disappeared from Leipzig" (p. 192).

If Taylor operated on Bach's left eye first, as was his normal practice, and Bach had very little sight in his right eye, then if the first operation failed and on the second occasion he operated on the right, it is possible that "Taylor's interventions are compatible with most of the post-operative complications" (Zegers, 2005, p. 1430) described by his biographers. Hence Bach was left with very little sight and possibly died, according to Tarkkanen (2013), from "secondary phacoanaphylactic endophthalmitis" the following July (p. 191).

3. Forensic Literature Review

In the forensic handwriting examination literature, several features have been reported as characteristic of handwriting distortion caused by visual impairment. Features of handwriting written by those who are blind or visually-impaired reported by Beacom (1967) include: handprinting of the signature, poor alignment, preference for uppercase letters, square-shaped "r" forms, problems writing certain letters (e.g., j, b, d, k, h, f as the retraced movement of these letters creates difficulty for blind writers), difficulties with the letters "t" and "i" due to the

cross and dot formations in those letters, problems forming connectives between letters, lack of uniformity in size, illegibility, and incomplete signatures.

Lindblom (1983) reports that handwriting features associated with visual impairment include tremor, pen scratches, misalignment of words/letters, writing across or through other material, squared letters, overlapping of letters, ink errors, problems in writing certain letters, infrequent pen lifts, absence of “t” bars and “i” dots, inconsistent spacing, stunted letter designs, and flattened letter bases (due to use of visual aids).

In a forensic case study, Masson (1988) found that the handwriting was difficult to decipher because handwritten letters and words were written on top of another. Some of the primary effects of handwriting distortion included lack of baseline alignment, overwriting, entanglement, inconsistency in word and letter spacing, and erratic proportional relationships.

Komal et al. (1999) performed a statistical analysis of the writings of over 60 individuals who were blind and visually-impaired. The results showed that the writers exhibited overlapping/intermingling letters, unusual/distorted letter forms, ink failures (because the subjects could not see that the pen was not working), problems with certain letters (S, A, G, P, H, K), tremor, preference for capital letters, line quality problems, alignment, and inconsistent size.

4. Analysis

Three signatures dated in the late 1740s, which are attributed to J. S. Bach (Kobayashi, 1989; Pierpont Morgan Library, 1970) are the subject of question in this study as they are written during a time period when his vision is reported to have significantly deteriorated (reproduced in Figures 1, 2, and 3).

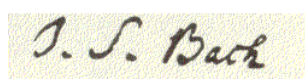


Figure 1. 1747

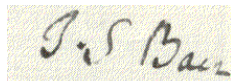


Figure 2. 1748



Figure 3. 1748

Table 1 summarizes the handwriting features associated with visual impairment from the four studies previously cited and discussed (Beacom (1967); Lindblom (1983); Masson (1988); and Komal et al. (1999)). In comparing the typical features of handwriting executed by those who are blind or have visual impairment to the Bach signatures in Figures 1, 2, and 3, there is limited support for the theory that someone who is blind (or severely visually impaired) wrote the Bach signatures in the 1740s. As reported in Table 1, some indices of visual impairment are observed in Figure 2, but the illegibility observed at the end of the signature could be caused by poor copy quality.

Examples of signatures attributed to J. S. Bach prior to the 1740s were included in the analysis (Kobayashi, 1989). It was observed that there were some notable variations amongst Bach signatures, which is partially evidenced by the three signatures used for comparison to represent pre 1740s signatures (Figures 4, 5, 6). Little evidence of handwriting indices of visual impairment were observed in the pre 1740s signatures (see Table 1). A comparison of the 1740s signatures to the pre 1740s signatures shows a high degree of similarity between Figures 1 through 3 (post 1740) and Figure 5 (pre 1740). No signs of deterioration were evident in the 1740s signatures although they were more simplistic in style than Figures 5 and 6 (notably the uppercase B).

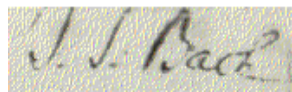


Figure 4. 1727/32

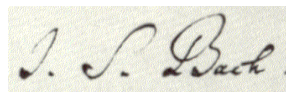


Figure 5. 1727/32



Figure 6. 1736

5. Discussion

Beacom (1967) reported that there can be a wide range of variation in handwriting performance by those who are blind. There can also be a difference between those who were blind at the time they learned to write in comparison to those who experienced severe visual impairment or blindness after they learned to write. J. S. Bach learned to write before he became severely visually impaired indicating that writing, such as his signature, would have been an overly-programmed skill in his motor memory. It was noted by Komal et al. (1999) that some subjects with partial visual impairment had “normal alignment, writing slant, writing pressure, line quality and connections” (p. 48). It was reported that J. S. Bach, as a youth, had strained vision and may have copied manuscripts with limited light (Zegers, 2005). He may have adopted visual strategies under such conditions and became accustomed to writing with dim light. There was no evidence among the signatures that Bach used signature aids or guides to assist with alignment of the signatures. It is not certain the level of severity of Bach’s visual impairment. However, if his vision was so poor that it required difficult and painful surgery, it is

reasonable to expect that his vision was impaired enough to affect his handwriting, especially since he was a composer and relied upon writing music as a primary source of income.

There is little to no evidence of visual impairment indices among the questioned Bach signatures from the late 1740s. The signatures were compared to earlier signatures and they were similar to at least one Bach signature from approximately 1730 (Figure 4). The lack of visual impairment indices in J. S. Bach's 1740s signatures lends some support to the theory postulated by Jarvis (2007) that more than one writer may have signed Bach's signatures and that another person may have signed on his behalf in the late 1740s.

Table 1		
<i>Handwriting Feature</i>	<i>Frequency in Bach signatures (late 1740s)</i>	<i>Frequency in Bach signatures (pre 1740s)</i>
Overwriting [2] [3]	None detected	None detected
Alignment [1] [2] [3] [4]	No internal alignment problems	No internal alignment problems
Entanglement, overlapping [2] [3] [4]	None detected	None detected
Inconsistent spacing [1] [2] [3]	Some compressed spacing in Figure 3	Some compressed spacing in Figure 6
Erratic proportions [3] [4]	None detected	None detected
Handprinting [1]	Fig. 3 has few disconnected, printed forms	None detected
Uppercase letters [1] [4]	No unusual uppercase letters	No unusual uppercase letters
Square-shaped letters [1] [2]	None detected	None
Difficulty writing letter forms [1][2][3]	None detected	None detected
Problems forming connectives between letters [1]	Some printed forms in Figure 3	None detected
Illegibility [1]	Figure 2 difficult to decipher at the end (probably due to poor quality copy)	None detected
Incomplete signatures [1]	Fully formed signature written with first and middle initials (typical of time period). Missing period after uppercase S (Fig. 2).	Fully formed signature written with first and middle initials (typical of time period)
Tremor [2] [4]	None detected	None detected
Pen scratches [2]	Possible scratches in Fig. 2 but may be due to poor quality copy	None detected
Ink errors/failures [2] [3]	None detected (possible in Fig. 2)	None detected
Infrequent pen lifts [2]	Consistent pen lifts	Consistent pen lifts
Stunted letter designs [2]	None detected	None detected
Flattened letter bases [2]	None detected	None detected
Distorted letter forms [3]	None detected	None detected
Line quality problems [4]	None detected	None detected

[1] Beacom (1967); [2] Lindblom (1983), [3] Masson (1988), and [4] Komal et al. (1999)

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